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Teaching Matching-to-Sample to Low-Performing Children with Autism

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TEACHING MATCHING-TO-SAMPLE TO LOW-PERFORMING CHILDREN WITH AUTISM

by

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Matching-to-sample is a basic procedure used in most programs for pre-school children with autism. However, a few children fail to acquire this skill with standard matching-to-sample procedures. Therefore, the purpose of this study was to evaluate an alternative method for teaching matching-to-sample to those children when the traditional methods are likely to fail. First, simple discriminations with the matching materials were taught, then the discriminations were made more complex across successive sessions. Initially, all discriminations were taught using bins to separate the comparison stimuli. All three children acquired matching-to-sample, which generalized to matching novel two-dimensional stimuli, not placed in bins.

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Blaire E. Michelin

TABLE OF CONTENTS

Table of Contents—Continued

LIST OF TABLES

LIST OF FIGURES

Teaching Matching-to-Sample to Children with Autism

Matching-to-sample procedures are used frequently in discrete-trial training to help children with developmental delays acquire visual discriminations. A strong visual discrimination repertoire is crucial for children with developmental delays to be successful in their everyday lives (Green, 2001). Even though extensive research has been done on visual discriminations, there are still students who struggle to acquire those skills (Graff & Green, 2004; Green, 2001; Saunders & Spradlin, 1990; Serna, Dube, & McIlvane, 1997). However, there are several alternative methods to help teach visual discriminations to those students who struggle to acquire them.

It has been suggested by Graff and Green (2004) that conditional discriminations may be too complex for some students. We can make the discrimination easier to learn by teaching the necessary prerequisite skills, like simple discriminations. Simple discriminations require the student to differentiate between a target stimulus and a distractor stimulus. In these simple discriminations, the target stimulus remains the same throughout the entire session, whereas in conditional discriminations, which stimulus is the target stimulus is conditional based on which specific sample stimulus is presented. By first training on simple discriminations, it can potentially help to facilitate the acquisition of conditional discriminations (Dube & Serna, 1998; Graff & Green, 2004).

Another alternative approach to help facilitate the acquisition of matching-to-sample is to separate the comparison stimuli into individual bins. Serna, Dube, and McIlvane (1997) stated that this sort-to-match method might be a good place to start for individuals who were unable to learn through the traditional matching-to-sample procedures. Their sort-to-match procedure is different from typical matching procedures, because they allow the stimuli to accumulate in the bins, instead of removing the sample stimulus from the array after the response was made. In their study, they began with a sort-to-match procedure, then progressed to a table-top matching procedure (without the bins), and the final step was a computerized matching-to-sample task. All of their participants were successful with each procedure and were able to match three-dimensional objects, two-dimensional pictures that ranged from familiar items to arbitrary items, and other complex two-dimensional stimuli that involved patterns. Farber, Dube, and Dickson (2016) also used a sort-to-match procedure to help facilitate acquisition with compound matching. Like the previous study, they started with the sort-to-match procedure, progressed to a table-top matching procedure, and the final step was a computerized compound matching task. All of their participants were successful with all steps and they also displayed generalized matching. For those students who struggle with typical matching-to-sample procedures, the sort-to-match procedure may be a good alternative to help facilitate the acquisition of these matching skills.

The purpose of this study was to expand on the previous research on alternative matching-to-sample procedures when the typical procedures are not successful. Instead of using one procedure at a time, we combined simple visual discrimination and bin matching to help students who were unable to match. Unlike the previous sort-to-match procedures, we did not allow the sample stimuli to accumulate in the bins and would remove them from the bins after the response was made.

General Methods

Participants

Prior to the start of this study, Devin was in our discrete-trial classroom for six months and Otto[1] and Landon for five weeks. These children were selected to participate in this study due to their inability to match-to-sample. Each child was assessed using the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) (Sundberg, 2008) to determine their skill levels after they started in our classroom (see Table 1).

Table 1

Participant's Demographic Information

Name	Age	Gender	Diagnosis	Intake VB-MAPP score	Score on VP-MTS on VB-MAPP
Devin	3 years 7 months	Male	ASD	10.5	3
Otto	3 years 2 months	Male	ECDD*	22.5	4
Landon	3 years 2 months	Male	ASD	14.5	2.5

Note. *Early Childhood Developmental Delay

Devin's initial VB-MAPP score was 10.5 and he only displayed a few skills in level 1. He would engage with toys and movement play independently, spontaneously emit some speech sounds, and could indicate that he wanted to be held or played with. In

[1] Pseudonym used to protect privacy of the participant

the Visual Perceptual/Matching to Sample (VP/MTS) section, he was able to visually track objects and would attend to a toy for 30 seconds.

Otto's initial VB-MAPP score was 22.5 and he displayed several skills in level 1 and a few skills in level 2. He engaged in some spontaneous speech sounds, would appropriately play with toys that had multiple parts, would initiate interactions with a peer, and was able to mand independently for a few items with the assistance of an icon exchange communication system. In the VP/MTS section, he would visually track objects, attend to toys or books, and could place items into a container on the table.

Landon's initial VB-MAPP score was 14.5 and he only displayed a few skills in level 1. He was able to spontaneously mand a few times with the assistance of an icon exchange communication system, would engage in movement play, independently interact with some toys, and would emit some speech sounds spontaneously. In the VP/MTS section, he would attend to a toy or book and would place items in a container.

When we assessed Devin, Otto, and Landon's matching skills, none of them were able to match identical objects or pictures. They were all included in this study due to their performance in baseline. The two participants who started to show an increase in correct responses throughout the initial baseline sessions were excluded from this study.

Settings and Materials

We conducted sessions in an early childhood special education classroom in a public school in Kalamazoo, Michigan. All children received one-on-one discrete-trial instruction for three hours a day, five days a week. We conducted sessions once or twice a day, four days a week. If multiple sessions were run throughout the day, there would be at least a ten- to fifteen-minute break between each session. Stimuli used in this study were arranged on a white, rectangular foam board, which was split into sections by three rectangular black bins that were approximately 6”x4”. Three different stimulus sets were used for training: A) three-dimensional objects, B) two-dimensional simple pictures, and C) two-dimensional complex pictures. For stimulus set B, the simple pictures contained one cartoon image of a common object on a white background. For stimulus set B, the complex pictures contained an image of an animal or object with a detailed background (e.g., landscape) or it contained three images of common objects or animals on a white background. Table 2 describes what objects and images were used in each phase.

Table 2

Stimulus Set Details

Stimulus set	**Baseline**	**Intervention**	**Generalization Probes**
A (Objects)	Horse, bus, hat, fork	Sphere, cone, star, frog, sheep, boat, flower, baby, shoe, duck	Horse, bus, hat, fork, orange, turtle, octopus, orange fish, plate, pink fish
B (Simple pics)	Tree, carrot, daffodil, horseshoe, balloon, car, cat, apple, frog, dog	Tree, carrot, daffodil, horseshoe, balloon, car, cat, apple, frog, dog	Minion, truck, owl, flower, milk, mickey, duck, cupcake, cat, tree
C (Complex pics)	Giraffe, butterfly, frog, elephant, bear, spider, snake, penguin, whale, rhino	Three cartoon characters on each card	Three common objects on each card

A counterbalanced data sheet (see Appendix A) was used to predetermine the location of the stimuli. We wanted to ensure each stimulus was randomly rotated, that all stimuli were presented in each bin position (left, middle, or right), and that each stimulus was not in the same position for more than two consecutive trials throughout the sessions.

Interobserver Agreement

Undergraduate and graduate student research assistants were trained to collect interobserver agreement data. These data were collected for 36% of sessions and agreement never fell below 100% accuracy.

Procedure

General Procedure. In typical discrete-trial matching-to-sample, an instruction is given (e.g., tutor says “match same”). We did not include a vocal instruction because we wanted to ensure the response was under the stimulus control of the visual stimuli and not under the stimulus control of the vocal instruction. The comparison stimuli were placed in front of the child, either on the table or in individual bins, depending on the phase. Once the child looked at the comparison stimuli, we held up the sample stimulus (S+) so that the child had to turn his head, thus making a clear observing response to see the S+. Once they looked at the sample stimulus, we allowed them to take the stimulus to make a matching response. If the child placed the sample stimulus with the corresponding comparison stimulus, the response was reinforced with a highly preferred edible and also access to a preferred toy or a video for 10 s. During this time, we removed the stimuli and prepared for the next trial. If the child placed the sample stimulus with any of the distractor stimuli (S-) or into an empty bin, a least-to-most prompting hierarchy (gestural, partial physical, full physical) was used until the child made the correct response. After they engaged in the prompted response, they did not receive any reinforcers, and the stimuli were removed from the table and prepared for the next trial.

Baseline. For stimulus set A (objects), three objects were placed on the table in front of the child as the comparison stimuli. We randomly rotated between four different objects (a horse, bus, hat, and fork) as the S+ for twelve trials. For stimulus sets B and C (simple and complex pictures), three pictures were set on the table as comparison stimuli and we randomly rotated among ten different pictures as the S+ for twelve trials.

Pretraining. A pretraining phase was included to ensure that the children would be able to visually discriminate the placement of the bin and could place an item into the bin. The bin was randomly rotated between three positions on the table (left, middle, and right) for twelve trials. If the child placed the block in the bin, the response was reinforced with an edible. If the child placed the block anywhere other than the bin, a least-to-most prompting hierarchy was used until they made the correct response. After the child was able to place the block in the bin with 100% accuracy for one session, we continued to the next phase.

Intervention. The purpose of Phase 1 was to teach a discrimination between the presence or absence of the correct stimulus. We presented the foam board with one S+ comparison stimulus, a blue sphere, which rotated among the three bins for twelve trials (see Table 3). The phase change criteria for Phases 1 through 8 were three sessions at 80% or greater, or two at 90% or greater.

Table 3

Bin Matching with Stimulus Set A

Phase	Phase Details
1	Sphere S+, no other stimuli
2	Sphere S+, cone S-
3	Cone S+, star S-
4	Random rotation between sphere and cone as S+
5	Random rotation between sphere, cone, and star as S+
6	Random rotation between sphere, cone, star, and two additional objects as S+
7	Random rotation between sphere, cone, star, and four additional objects as S+
8	Random rotation between sphere, cone, star, and seven additional objects as S+
9	Random rotation between the 10 previously trained objects without bins
Gen. test	Random rotation between 10 novel objects

In Phase 2, the discrimination was made slightly more difficult by adding a distractor stimulus (S-). The two comparison stimuli in the bins (sphere S+ and cone S-) were presented, and the sphere remained as the only S+ for all twelve trials. Phase 3 was identical to Phase 2 with the exception that the S+ sample stimulus was changed to the cone, and the S- was the star. In Phase 4, we randomly rotated between the sphere and the cone as the S+. The purpose of these initial phases was to ensure the children could make simple discriminations and that they were scanning the array. Once they were displaying these skills, it was deemed unnecessary to return to train Phases 1 through 4 with stimulus sets B and C (see Table 4).

Table 4

Bin Matching with Stimulus Sets B & C

Phase	Phase Details
1	N/A
2	N/A
3	N/A
4	N/A
5	Random rotation between 3 pictures
6	Random rotation between 5 pictures
7	Random rotation between 7 pictures
8	Random rotation between 10 pictures
9	Random rotation between the 10 previously trained pictures without bins
Generalization test	Random rotation between 10 novel pictures

In Phase 5, all stimulus sets were randomly rotated between three stimuli as the S+. For Phases 6, 7, and 8 we continued to add more stimuli until 10 stimuli were used throughout the session. Once the child met a phase change criterion for Phase 8, we continued to Phase 9, where we randomly rotated through the previously trained stimuli in an array of three on the table, not in the bins. If the child did so with an accuracy of 90% or greater, we tested novel stimuli without bins as part of the generalization test phase. If the child failed to match the previously trained stimuli without the bins, we then used the bins for testing generalization. The generalization tests randomly rotated through 10 novel stimuli in an array of three. If the child was able to match the novel stimuli with an accuracy of 90% or greater, they moved on to the next stimulus set, otherwise, they continued to train on that stimulus set until they reached the 90% criterion. Once they met the criterion again with one set of stimuli, we tested for generalization of matching to sample with another set of novel stimuli and would repeat this process until they were able to demonstrate generalized matching by reaching the 90% criterion in the first session with a new novel stimulus set.

Results

Devin

Devin spent three sessions in baseline (see Figure 1) and he did not make any correct responses in any of those sessions. When we held up the sample stimulus for him, he would grab the stimulus and set it on the table in front of him or play with it. He continued to respond in this manner throughout all the baseline sessions, despite the error correction.

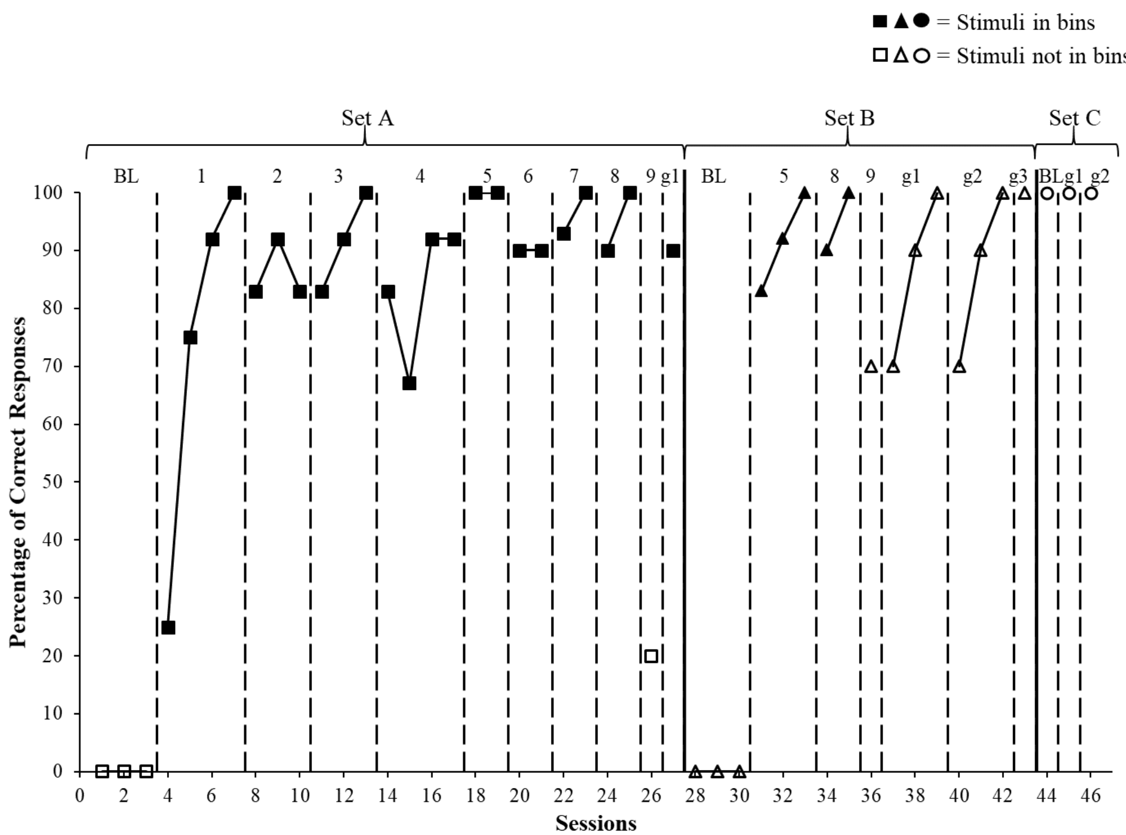

Figure 1. Devin's matching-to-sample data with stimulus sets A (objects), B (simple pictures), and C (complex pictures).

Devin required two sessions in pretraining and the first two trials of the first session were the only errors he made.

Despite only making three correct responses in the first session of Phase 1 (see Figure 1), the number of correct responses he made in the subsequent session rapidly increased and he met the phase change criterion within the next two sessions. He quickly progressed through Phases 2 and 3, and throughout those six sessions his performance never fell below 80% correct. In session 15 (Phase 4), we ran out of his highly preferred edible reinforcer (mini M&Ms) and thought that regular sized M&Ms cut into ¼ pieces would suffice. We handed him the M&M piece after he made a correct response and he put the M&M into his mouth, made a disgusted face, and refused to accept any M&Ms for the rest of the session. We resorted to preferred tangible reinforcers for the rest of the session, which may have contributed to his low performance in session 15. We continued to run sessions after we purchased several bags of mini M&Ms to ensure we would not run out of them again. He met a phase change criterion for Phase 4 within the next two sessions and continued to perform extremely well throughout Phases 5 through 8; he only required two sessions in each phase and his performance never fell below 90% correct. In Phase 9 (where the bins had been removed), he did not continue to match the objects. Instead, for the majority of the trials in this session, he only placed the sample stimulus on the table in front of him and did not place it near any of the corresponding stimuli. Therefore, we ran the generalization test with the bins, and he demonstrated generalized matching to sample at 90% accuracy.

Devin's performance in baseline for stimulus set B (simple pictures) was similar to his performance in baseline with stimulus set A. For all the sessions we ran, he would place the sample stimulus on the table in front of him or he would play with it. After three sessions in baseline with no correct responses, we moved on to Phase 5 with the bins, and his performance immediately increased to 80% accuracy. He quickly met the phase change criterion within the next two sessions. Since he performed so well in Phase 5, we skipped Phases 6 and 7 as those two phases only add a few new stimuli. Phase 8 added seven novel stimuli along with the three stimuli from Phase 5, for a total of 10 stimuli. Despite the addition of the seven novel stimuli, his performance remained high and he met the phase change criterion within two sessions. In Phase 9, where the bins were removed, his performance decreased to 70% accuracy; however, if he made an incorrect response he would immediately self-correct and place it with the correct corresponding stimulus. This is in contrast with the first time he had done Phase 9, with the three-dimensional stimuli, where he simply placed the sample stimuli in front of himself, not near the comparison stimuli. Although he did not meet the criterion for the generalization tests without the bins, because we saw his responses change in Phase 9, we continued to run the generalization tests without the bins. In the first sessions of generalization tests 1 and 2, he only performed with 70% accuracy but quickly met the phase change criterion within the next two sessions. In generalization test 3, he performed with 100% accuracy in the one session we ran. Stimulus set B was considered mastered and we moved on to stimulus set C (complex pictures) which he mastered after only three sessions. Each session involved a set of novel stimuli, and he performed at 100% accuracy with each set.

Otto

We only ran one baseline session with Otto because of his aggressive problem behavior that occurred whenever demands were placed, or when highly preferred items were removed (see Figure 2). Since physical prompts also increased the intensity of the problem behavior, we did not use our typical error correction procedure. Instead, we modeled the response we wanted him to make for the baseline and pretraining phases, and in the intervention phases we used a gestural prompt. He did display some spontaneous imitation, but it was not under our instructional stimulus control. Throughout the procedure, we took additional data on rates of problem behavior and the duration of the session (see Figure 3). To determine the rate of problem behavior we used partial interval recording in 30 s intervals. Intervals were marked as containing problem behavior if there was any instance of screaming, crying, or whining that lasted more than 3 s or any instance of him getting out of his chair, throwing items, or laying on the ground. Data for rates of problem behavior that occurred during baseline were not included in Figure 3, because our camera malfunctioned and stopped recording four minutes in to the session.

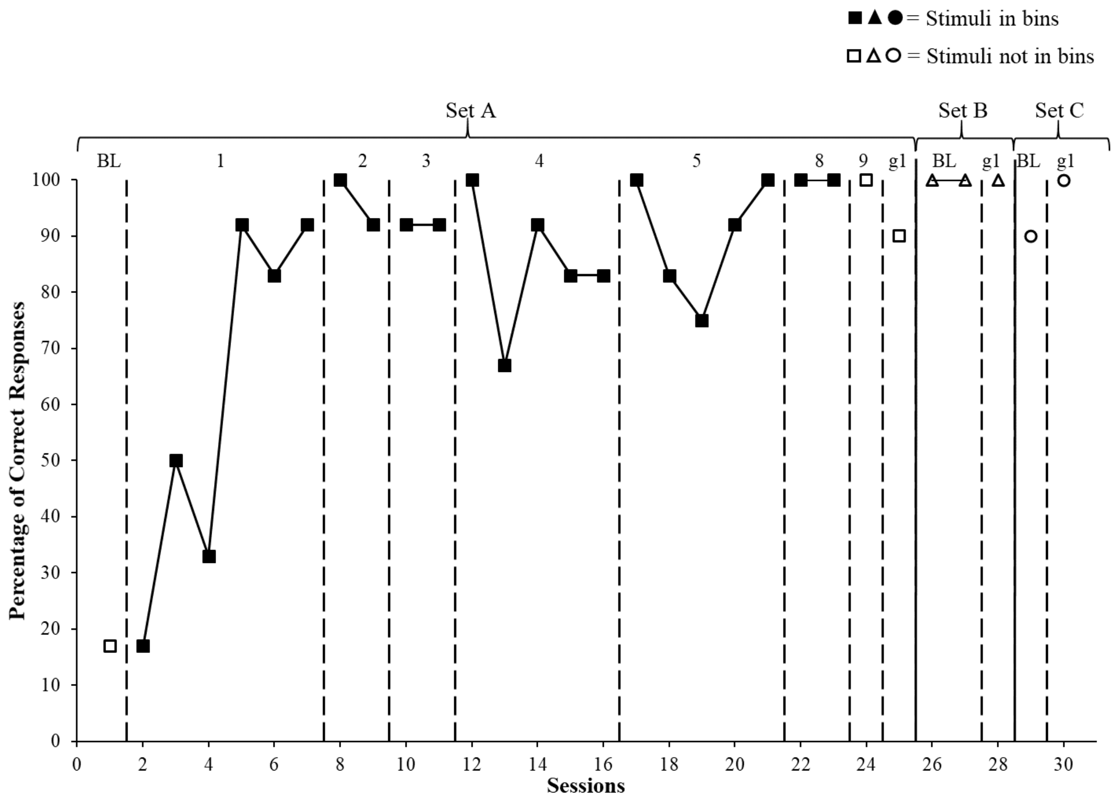

Figure 2. Otto's matching-to-sample data with stimulus sets A (objects), B (simple pictures), and C (complex pictures).

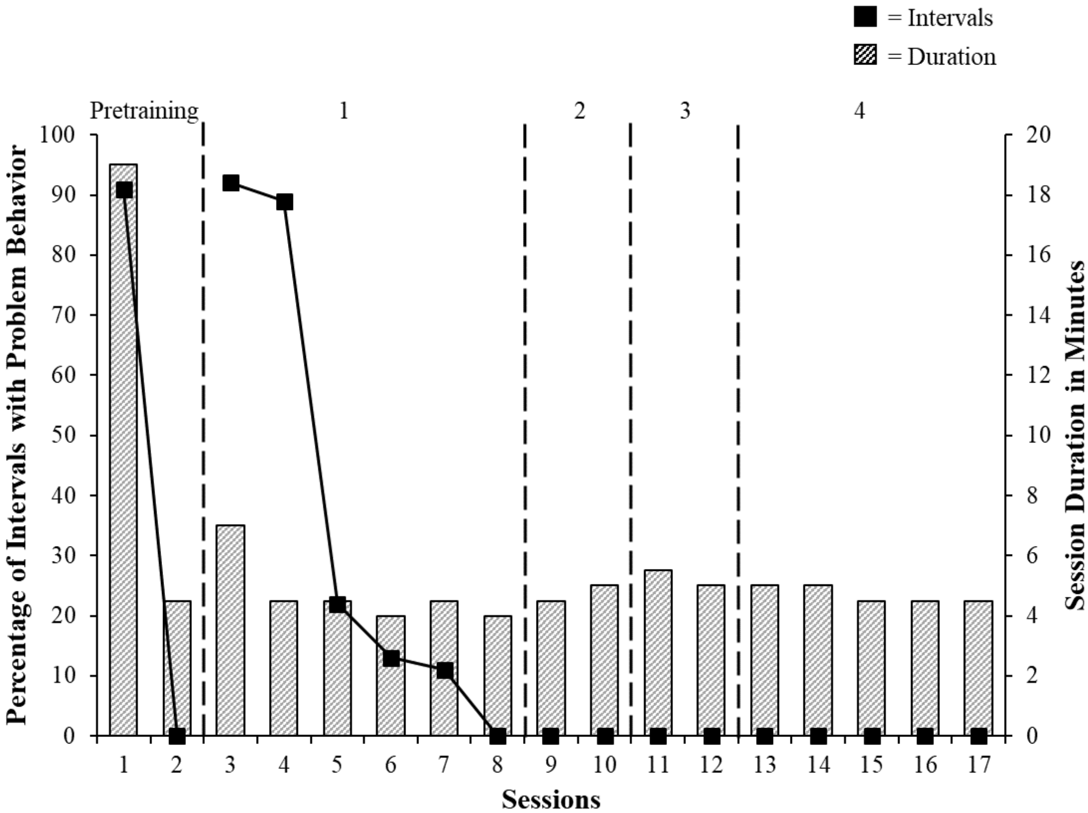

Figure 3. Otto's occurrence and duration of problem behavior throughout the sessions. After Phase 4, occurance of problem behavior was at 0% for the remainder of the intervention.

Otto only required two sessions in the pretraining phase. Despite performing with 100% accuracy on the first pretraining session, problem behavior occurred for 90% of the intervals and the session duration lasted 19 minutes. The first eight trials of the session took the longest, and he started to respond more quickly during the last four trials. Because he started to respond more quickly and displayed less problem behavior during those last four trials of session 1, we immediately continued to session 2, where his problem behavior dropped to 0% of the intervals for the entire session which lasted four minutes.

In the first two sessions of Phase 1, Otto's problem behavior occurred in ~90% of the intervals, but the session duration decreased significantly. In those sessions, the severity and intensity of his problem behavior decreased from what we observed in pretraining, which contributed to the decrease in the duration of the sessions. In the first three sessions of Phase 1, he never performed above 50% accuracy; he usually placed the sample stimulus into one of the empty bins instead of the bin that contained the comparison stimulus. In the 5th session, his performance increased from 35% to 92% accuracy and he was able to meet the phase change criterion within the next two sessions. As the accuracy in his performance increased in Phase 1, his problem behavior continued to decrease. In Phases 2 and 3, the accuracy of his performance remained high and he met the phase change criterion in the minimal number of sessions required. Also, in these phases, rates of problem behavior decreased to 0% and remained at 0% for the entirety of the intervention. In the first session of Phase 4, he performed with 100% accuracy but in the second session, his accuracy dropped to 67%. Session 13 was run five minutes after session 12; he displayed signs of satiation with the IPad (e.g., not watching the screen, engaged in other behaviors) which may have contributed to the low performance. In session 14, his performance increased to 92% accuracy and he was able to meet the phase change criterion within the next two sessions. His performance remained high throughout Phase 5 and he was able to meet the phase change criterion within five sessions. Instead of slowly introducing more novel stimuli (Phases 6 and 7), we moved forward to Phase 8, which introduced 7 novel stimuli. He continued to do well in Phase 8 and we moved on to Phase 9 after two sessions. When we removed the bins for Phase 9, he continued to match the objects with 100% accuracy. Because he performed well without the bins, we ran the generalization test without the bins. He performed with 90% accuracy in the generalization test, so we continued to stimulus set B.

Otto continued to perform well in baseline sessions for stimulus set B (simple pictures) with 100% accuracy for both sessions. Because he already performed to the mastery criterion in the baseline sessions, we did not run any of the intervention phases, and continued to the generalization test. After 100% accuracy in the generalization test, we continued to stimulus set C. His performance continued with high accuracy in the baseline and generalization test sessions for stimulus set C. In other words, he completed the testing with the simple and complex two-dimensional stimuli, in only 5 sessions, with no explicit training required.

Landon

Landon spent two sessions in baseline for stimulus set A (see Figure 4). In the first session of baseline, he would only match the forks and would only play with the other sample stimuli presented to him. Before the second session of baseline, the forks were placed on the floor, and he constantly tried to retrieve them. He displayed problem behavior (e.g., screaming, hitting, biting, flopping to floor) when access to the forks was blocked, so the forks were removed from the booth. The forks were replaced with cups for the second session of baseline, and he performed with 0% accuracy. Throughout the baseline sessions, he would play with the sample stimuli and consistently engaged in problem behavior, so we continued to the pretraining phase. He spent two sessions in pretraining and the only incorrect responses he made were on the first two trials in session one.

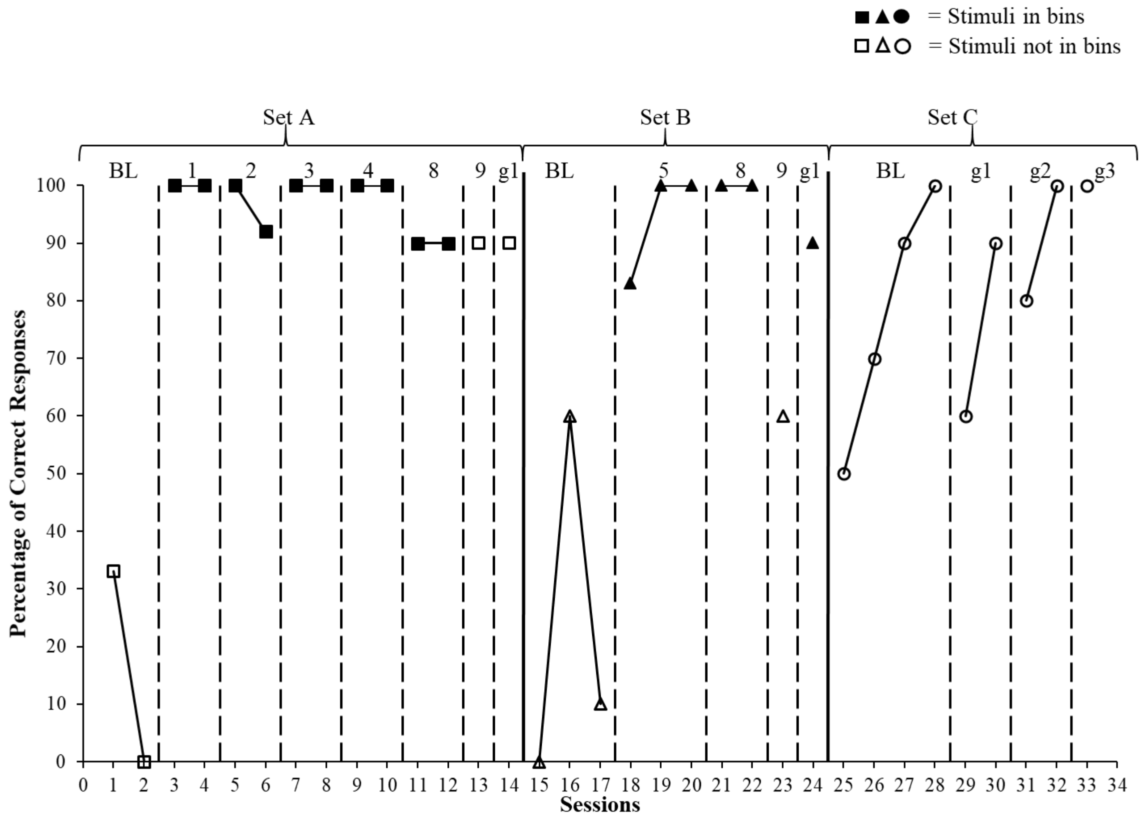

Figure 4. Landon's matching-to-sample data with stimulus sets A (objects), B (simple pictures), and C (complex pictures).

Landon performed with 100% accuracy in both sessions in Phase 1, unlike the other two children who spent four to five sessions in Phase 1. His high performance continued throughout Phases 2, 3, and 4, where his accuracy never fell below 90%. Similarly to Otto, we went directly from Phase 4 to Phase 8, from three stimuli to ten stimuli. He continued to perform well throughout Phases 8, 9, and the generalization test, where his accuracy did not fall below 90% correct.

In the first session of baseline with stimulus set B, Landon performed with 0% accuracy. He would place the card on the table in front of him, slide it in front of every card in the array, or he would play with it. In the second session, his performance increased to 60% accuracy, but then decreased to 10% accuracy in the third session. In the third session, when we would gesture to the correct stimulus in the array, he would imitate the gesture to the sample stimulus. Because his response topography changed so quickly in the third session of baseline, we did not run additional baseline sessions, but continued directly to Phase 5. His accuracy quickly increased in Phase 5 with the stimulus set in the bins, and he met the phase change criterion within three sessions. Once again, we moved directly to Phase 8, with all 10 stimuli, where he performed with 100% accuracy during the first two sessions. In Phase 9, he performed with only 60% accuracy with the stimuli not in the bins; for the incorrect responses throughout the session, he placed the sample stimulus on the table, would look at us, and moved it around to different places in the array, without looking at those stimuli. Due to this, the generalization test was conducted in the bins. After he performed with 90% accuracy in the generalization test, we continued to baseline with stimulus set C (complex pictures). While he only performed with 50% accuracy in the first session of baseline with stimulus set C, he watched us place each card on the table and scanned the array more than what was previously seen in baseline and Phase 9 with stimulus set B. His performance continued to increase throughout baseline and met the phase change criterion within the next three sessions. Therefore, we bypassed Phases 1 through 8 and went directly to the generalization tests. In generalization test 1, he only performed with 60% accuracy in the first session. Three of the four incorrect trials in that session were when the S+ stimulus was on the left side of the array, so there was a slight position bias towards the stimuli in the middle or right side of the array throughout that session. Despite the slight position bias in the previous session, his performance increased to 90% accuracy in the second session of generalization test 1. In generalization test 2, his performance remained high throughout the two sessions, where he performed with 80% and 100% accuracy, respectively. In the final generalization test with the 3rd set of novel complex pictures, he performed with 100% accuracy.

Discussion

All three children in this study were able to match-to-sample with several sets of stimuli after exposure to our intervention. All three spent most of the procedure in stimulus set A (objects), which was the only stimulus set that used Phases 1-4. The purpose of those phases was to teach the simple discriminations before we moved to conditional discriminations, which is one of the reasons that there were more trials in that stimulus set. Devin was the only child exposed to Phases 6 and 7 in stimulus set A, which gradually added more target stimuli; however, the other two children continued to perform with high accuracy without those two phases. While those two phases may not have been crucial to the success in the procedure, they could potentially be beneficial for other children who struggle to acquire conditional discriminations.

Devin and Landon were the only two who were exposed to Phases 5 (three target stimuli) and 8 (ten target stimuli) with stimulus set B (simple pictures), while Otto mastered that stimulus set in baseline. Devin progressed through three different novel stimulus sets without the bins for the generalization tests, in contrast to Landon, who still needed the bins for the generalization test. Devin and Otto mastered stimulus set C (complex pictures) in baseline, while Landon was the only participant who required several sessions of baseline and three sets of novel stimuli to reach the mastery criterion.

Based on Otto's intake VB-MAPP score and the skills he started to display throughout the study, he may have been able to do well with our classroom matching-to-sample procedure. He was the only participant who showed generalization from 3D objects to 2D simple pictures without any additional training. The problem behavior he exhibited in the initial phases of the study was a barrier to his skill acquisition. Once the frequency and intensity of his problem behavior decreased, we saw new skills emerge. In Phase 3, he started independently handing over the iPad when we requested, compared to previous sessions when we had to physically prompt him to hand it over. In the first baseline session of simple pictures, he started tacting "puppy" when the dog was in the stimulus array, though tacting was not a part of any explicit programming from our classroom. In the first generalization test for complex pictures, on the only trial where he made an incorrect response, he shook his head from side to side, said "no", and then placed the picture on top of the correct stimulus. While he might have done well with our classroom procedure, the current procedure with its modified error correction (no physical prompts) may have been an easier way for us to gain instructional control.

We compared the number of trials it took our students to master each stimulus set to the average number of trials it took with the standard classroom matching procedures (see Table 5). Although the classroom matching procedures did contain different stimuli than were used in this study, all the stimuli had the same characteristics (e.g., simple pictures contained one cartoon image on a white background, complex pictures with three images on a white background on each card).

Table 5

Number of Trials to Master Each Stimulus Set

Stimulus set	Classroom Average	Devin		Otto		Landon	
		1-8	Gen*	1-8	Gen	1-8	Gen
Objects	259	260	10	260	10	116	10
Simple pics	353	56	70	20	10	56	10
Complex pics	307	10	20	10	10	40	50
Total Trials	919	326	100	290	30	212	70

Note. Data for classroom average for number of trials were taken from current and previous students. Simple-objects procedure had n=18 and a range of 79-1029 trials. Simple pictures had n=19 and a range of 100-1121 trials. Complex pictures had n=12 and a range of 110-664 trials. *Generalization tests.

One crucial difference between the classroom 3D object procedure and this procedure was that the classroom procedure only involved four different stimuli, whereas this procedure involved ten. Yet, our participants mastered more than twice as many stimuli in the same or fewer trials than the classroom average. With the classroom procedure, the average number of trials to master 2D simple pictures increased over the initial acquisition of matching with the 3D objects; however, with this procedure, the number of trials to mastery decreased considerably. While Devin and Landon did not perform well with the simple pictures (stimulus set B) without the bins in baseline, once the bins were introduced they were able to match all ten simple pictures and generalize to novel simple pictures within 126 and 66 trials, respectively. Complex pictures (stimulus set C) took Devin, Otto, and Landon significantly fewer trials than the classroom average. Another difference from the classroom procedures was that they did not test for generalization with novel stimuli after the mastery of each stimulus set. The generalization tests (which included reinforcement) in this procedure may have helped to establish a generalized matching repertoire, which may have contributed to the decrease in trials required for the complex pictures stimulus set when compared to the classroom average. Overall, our procedure might help to facilitate the acquisition and generalization of matching skills when compared to the procedures typically used in the classroom.

While all three participants were able to acquire matching-to-sample, future studies should evaluate the crucial components of the procedure. We were unsure if the simple discriminations (Phases 1-4) were critical; could the use of the bins be all that was needed to facilitate the acquisition of matching and the simple discrimination training was unnecessary. We are also unsure what it is about the bins that help to facilitate acquisition of matching. It could have been that the bins gave the children an exact place to put the sample stimulus or that it made it easier to scan the stimuli. Future studies could evaluate what exact component of the bins are crucial for success. For example, could a stimulus board work in the same way or would squares taped onto the table exert the same stimulus control that the bins did? Many of the children in the classroom can acquire matching without the use of the bins, but the bins probably would not hinder their progress and might help in at least some cases.

One limitation to this study was the number of participants. Because we only had three participants, future studies could consider replicating with more participants with a variety of skill levels. Otto and Landon were also in our classroom for a month and a half before they started our study. They could have potentially been able to acquire matching with our classroom procedure after more exposure to discrete-trial training.

Summary

This study demonstrates that using bins for the matching stimuli greatly decreases the number of trials to mastering matching-to-sample and generalized matching, with a variety of different stimuli, with children of different skill levels and interfering behaviors. Future research could study the value of training simple discriminations before training matching-to-sample and also the crucial characteristics of the bins.

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Appendix A

Counterbalanced Data Sheets

Participant #: _________ **PHASE 1** Page #: ___________

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Circle**			
2			**Circle**	
3		**Circle**		
4	**Circle**			
5		**Circle**		
6			**Circle**	
7			**Circle**	
8	**Circle**			
9		**Circle**		
10	**Circle**			
11			**Circle**	
12		**Circle**		

Session: _____ Phase: _____

	L	M	R	Resp.
1		**Circle**		
2	**Circle**			
3		**Circle**		
4			**Circle**	
5		**Circle**		
6			**Circle**	
7	**Circle**			
8			**Circle**	
9	**Circle**			
10		**Circle**		
11	**Circle**			
12			**Circle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1			**Circle**	
2	**Circle**			
3	**Circle**			
4		**Circle**		
5	**Circle**			
6		**Circle**		
7			**Circle**	
8		**Circle**		
9	**Circle**			
10			**Circle**	
11			**Circle**	
12		**Circle**		

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Circle**			
2			**Circle**	
3			**Circle**	
4		**Circle**		
5		**Circle**		
6	**Circle**			
7			**Circle**	
8		**Circle**		
9	**Circle**			
10	**Circle**			
11			**Circle**	
12		**Circle**		

Session: _____ Phase: _____

	L	M	R	Resp.
1			**Circle**	
2	**Circle**			
3			**Circle**	
4		**Circle**		
5	**Circle**			
6		**Circle**		
7	**Circle**			
8			**Circle**	
9	**Circle**			
10		**Circle**		
11		**Circle**		
12			**Circle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1		**Circle**		
2			**Circle**	
3	**Circle**			
4			**Circle**	
5	**Circle**			
6		**Circle**		
7			**Circle**	
8		**Circle**		
9	**Circle**			
10			**Circle**	
11		**Circle**		
12	**Circle**			

Session: _____ Phase: _____

	L	M	R	Resp.
1		**Circle**		
2	**Circle**			
3			**Circle**	
4		**Circle**		
5			**Circle**	
6		**Circle**		
7	**Circle**			
8	**Circle**			
9			**Circle**	
10		**Circle**		
11	**Circle**			
12			**Circle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Circle**			
2		**Circle**		
3			**Circle**	
4	**Circle**			
5		**Circle**		
6			**Circle**	
7		**Circle**		
8		**Circle**		
9	**Circle**			
10			**Circle**	
11	**Circle**			
12			**Circle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1			**Circle**	
2		**Circle**		
3	**Circle**			
4			**Circle**	
5	**Circle**			
6		**Circle**		
7			**Circle**	
8		**Circle**		
9			**Circle**	
10	**Circle**			
11		**Circle**		
12	**Circle**			

Participant #: _________ **PHASE 2** Page #: ___________

Session: ______ Phase: ______

	L	M	R	Resp.
1	**Circle**		Triangle	
2		Triangle	**Circle**	
3	Triangle	**Circle**		
4	**Circle**		Triangle	
5	Triangle	**Circle**		
6		Triangle	**Circle**	
7	Triangle		**Circle**	
8	**Circle**	Triangle		
9		**Circle**	Triangle	
10	**Circle**	Triangle		
11	Triangle		**Circle**	
12		**Circle**	Triangle	

Session: ______ Phase: ______

	L	M	R	Resp.
1	Triangle	**Circle**		
2	**Circle**		Triangle	
3	Triangle	**Circle**		
4		Triangle	**Circle**	
5		**Circle**	Triangle	
6	Triangle		**Circle**	
7	**Circle**	Triangle		
8	Triangle		**Circle**	
9	**Circle**		Triangle	
10	Triangle	**Circle**		
11	**Circle**	Triangle		
12		Triangle	**Circle**	

Session: ______ Phase: ______

	L	M	R	Resp.
1		Triangle	**Circle**	
2	**Circle**		Triangle	
3	**Circle**	Triangle		
4		**Circle**	Triangle	
5	**Circle**	Triangle		
6		**Circle**	Triangle	
7	Triangle		**Circle**	
8	Triangle	**Circle**		
9	**Circle**		Triangle	
10		Triangle	**Circle**	
11	Triangle		**Circle**	
12	Triangle	**Circle**		

Session: ______ Phase: ______

	L	M	R	Resp.
1	**Circle**	Triangle		
2	Triangle		**Circle**	
3		Triangle	**Circle**	
4		**Circle**	Triangle	
5	Triangle	**Circle**		
6	**Circle**		Triangle	
7	Triangle		**Circle**	
8		**Circle**	Triangle	
9	**Circle**	Triangle		
10	**Circle**		Triangle	
11		Triangle	**Circle**	
12	Triangle	**Circle**		

Session: ______ Phase: ______

	L	M	R	Resp.
1	Triangle		**Circle**	
2	**Circle**	Triangle		
3		Triangle	**Circle**	
4	Triangle	**Circle**		
5	**Circle**		Triangle	
6		**Circle**	Triangle	
7	**Circle**	Triangle		
8	Triangle		**Circle**	
9	**Circle**		Triangle	
10	Triangle	**Circle**		
11		**Circle**	Triangle	
12		Triangle	**Circle**	

Session: ______ Phase: ______

	L	M	R	Resp.
1		**Circle**	Triangle	
2		Triangle	**Circle**	
3	**Circle**		Triangle	
4	Triangle		**Circle**	
5	**Circle**	Triangle		
6		**Circle**	Triangle	
7		Triangle	**Circle**	
8	Triangle	**Circle**		
9	**Circle**		Triangle	
10	Triangle		**Circle**	
11		**Circle**	Triangle	
12	**Circle**	Triangle		

Session: ______ Phase: ______

	L	M	R	Resp.
1		**Circle**	Triangle	
2	**Circle**	Triangle		
3	Triangle		**Circle**	
4	Triangle	**Circle**		
5		Triangle	**Circle**	
6	Triangle	**Circle**		
7	**Circle**		Triangle	
8	**Circle**	Triangle		
9	Triangle		**Circle**	
10		**Circle**	Triangle	
11	**Circle**		Triangle	
12		Triangle	**Circle**	

Session: ______ Phase: ______

	L	M	R	Resp.
1	**Circle**		Triangle	
2	Triangle	**Circle**		
3		Triangle	**Circle**	
4	**Circle**	Triangle		
5		**Circle**	Triangle	
6	Triangle		**Circle**	
7		**Circle**	Triangle	
8	Triangle	**Circle**		
9	**Circle**		Triangle	
10		Triangle	**Circle**	
11	**Circle**	Triangle		
12	Triangle		**Circle**	

Session: ______ Phase: ______

	L	M	R	Resp.
1	Triangle		**Circle**	
2	Triangle	**Circle**		
3	**Circle**		Triangle	
4		Triangle	**Circle**	
5	**Circle**	Triangle		
6		**Circle**	Triangle	
7	Triangle		**Circle**	
8		**Circle**	Triangle	
9		Triangle	**Circle**	
10	**Circle**		Triangle	
11	Triangle	**Circle**		
12	**Circle**	Triangle		

Participant #: ________ **PHASE 3** Page #: ___________

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Triangle**		Star	
2		Star	**Triangle**	
3	Star	**Triangle**		
4	**Triangle**		Star	
5	Star	**Triangle**		
6		Star	**Triangle**	
7	Star		**Triangle**	
8	**Triangle**	Star		
9		**Triangle**	Star	
10	**Triangle**	Star		
11	Star		**Triangle**	
12		**Triangle**	Star	

Session: _____ Phase: _____

	L	M	R	Resp.
1	Star	**Triangle**		
2	**Triangle**		Star	
3	Star	**Triangle**		
4		Star	**Triangle**	
5		**Triangle**	Star	
6	Star		**Triangle**	
7	**Triangle**	Star		
8	Star		**Triangle**	
9	**Triangle**		Star	
10	Star	**Triangle**		
11	**Triangle**	Star		
12		Star	**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1		Star	**Triangle**	
2	**Triangle**		Star	
3	**Triangle**	Star		
4		**Triangle**	Star	
5	**Triangle**	Star		
6		**Triangle**	Star	
7	Star		**Triangle**	
8	Star	**Triangle**		
9	**Triangle**		Star	
10		Star	**Triangle**	
11	Star		**Triangle**	
12	Star	**Triangle**		

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Triangle**	Star		
2	Star		**Triangle**	
3		Star	**Triangle**	
4		**Triangle**	Star	
5	Star	**Triangle**		
6	**Triangle**		Star	
7	Star		**Triangle**	
8		**Triangle**	Star	
9	**Triangle**	Star		
10	**Triangle**		Star	
11		Star	**Triangle**	
12	Star	**Triangle**		

Session: _____ Phase: _____

	L	M	R	Resp.
1	Star		**Triangle**	
2	**Triangle**	Star		
3		Star	**Triangle**	
4	Star	**Triangle**		
5	**Triangle**		Star	
6		**Triangle**	Star	
7	**Triangle**	Star		
8	Star		**Triangle**	
9	**Triangle**		Star	
10	Star	**Triangle**		
11		**Triangle**	Star	
12		Star	**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1		**Triangle**	Star	
2		Star	**Triangle**	
3	**Triangle**		Star	
4	Star		**Triangle**	
5	**Triangle**	Star		
6		**Triangle**	Star	
7		Star	**Triangle**	
8	Star	**Triangle**		
9	**Triangle**		Star	
10	Star		**Triangle**	
11		**Triangle**	Star	
12	**Triangle**	Star		

Session: _____ Phase: _____

	L	M	R	Resp.
1		**Triangle**	Star	
2	**Triangle**	Star		
3	Star		**Triangle**	
4	Star	**Triangle**		
5		Star	**Triangle**	
6	Star	**Triangle**		
7	**Triangle**		Star	
8	**Triangle**	Star		
9	Star		**Triangle**	
10		**Triangle**	Star	
11	**Triangle**		Star	
12		Star	**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Triangle**		Star	
2	Star	**Triangle**		
3		Star	**Triangle**	
4	**Triangle**	Star		
5		**Triangle**	Star	
6	Star		**Triangle**	
7		**Triangle**	Star	
8	Star	**Triangle**		
9	**Triangle**		Star	
10		Star	**Triangle**	
11	**Triangle**	Star		
12	Star		**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	Star		**Triangle**	
2	Star	**Triangle**		
3	**Triangle**		Star	
4		Star	**Triangle**	
5	**Triangle**	Star		
6		**Triangle**	Star	
7	Star		**Triangle**	
8		**Triangle**	Star	
9		Star	**Triangle**	
10	**Triangle**		Star	
11	Star	**Triangle**		
12	**Triangle**	Star		

Participant #: _________ **PHASE 4** Page #: ___________

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Triangle**	Circle		
2		Triangle	**Circle**	
3		**Triangle**	Circle	
4	**Circle**		Triangle	
5	Circle	**Triangle**		
6	Triangle		**Circle**	
7		Circle	**Triangle**	
8	**Circle**	Triangle		
9		**Circle**	Triangle	
10	**Triangle**		Circle	
11	Circle		**Triangle**	
12	Triangle	**Circle**		

Session: _____ Phase: _____

	L	M	R	Resp.
1		**Circle**	Triangle	
2	**Triangle**		Circle	
3	Circle	**Triangle**		
4		Triangle	**Circle**	
5	Triangle	**Circle**		
6		Circle	**Triangle**	
7	**Circle**	Triangle		
8	Triangle		**Circle**	
9	**Triangle**	Circle		
10		**Triangle**	Circle	
11	**Circle**		Triangle	
12	Circle		**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1		Triangle	**Circle**	
2	**Triangle**	Circle		
3	**Circle**		Triangle	
4		**Triangle**	Circle	
5	**Triangle**		Circle	
6	Circle	**Triangle**		
7	Circle		**Triangle**	
8	Triangle	**Circle**		
9	**Circle**	Triangle		
10	Triangle		**Circle**	
11		Circle	**Triangle**	
12		**Circle**	Triangle	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Triangle**	Circle		
2		Triangle	**Circle**	
3	Circle		**Triangle**	
4	Triangle	**Circle**		
5		**Triangle**	Circle	
6	**Circle**	Triangle		
7		Circle	**Triangle**	
8		**Circle**	Triangle	
9	**Triangle**		Circle	
10	**Circle**		Triangle	
11	Triangle		**Circle**	
12	Circle	**Triangle**		

Session: _____ Phase: _____

	L	M	R	Resp.
1		Triangle	**Circle**	
2	**Triangle**	Circle		
3	Triangle		**Circle**	
4	Circle	**Triangle**		
5	**Circle**	Triangle		
6		**Circle**	Triangle	
7	**Triangle**		Circle	
8		Circle	**Triangle**	
9	**Circle**		Triangle	
10		**Triangle**	Circle	
11	Triangle	**Circle**		
12	Circle		**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	Circle	**Triangle**		
2	Triangle		**Circle**	
3	**Circle**	Triangle		
4		Circle	**Triangle**	
5	**Circle**		Triangle	
6		**Triangle**	Circle	
7		Triangle	**Circle**	
8	Triangle	**Circle**		
9	**Triangle**		Circle	
10	Circle		**Triangle**	
11		**Circle**	Triangle	
12	**Triangle**	Circle		

Session: _____ Phase: _____

	L	M	R	Resp.
1		**Circle**	Triangle	
2	**Triangle**	Circle		
3	Circle		**Triangle**	
4	Circle	**Triangle**		
5		Triangle	**Circle**	
6	Triangle	**Circle**		
7	**Triangle**		Circle	
8	**Circle**	Triangle		
9	Triangle		**Circle**	
10		**Triangle**	Circle	
11	**Circle**		Triangle	
12		Circle	**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**Triangle**		Circle	
2		**Circle**	Triangle	
3	Circle		**Triangle**	
4	**Circle**	Triangle		
5		**Triangle**	Circle	
6	Triangle		**Circle**	
7	Triangle	**Circle**		
8	Circle	**Triangle**		
9	**Triangle**	Circle		
10		Triangle	**Circle**	
11	**Circle**		Triangle	
12		Circle	**Triangle**	

Session: _____ Phase: _____

	L	M	R	Resp.
1		Circle	**Triangle**	
2		**Triangle**	Circle	
3	**Circle**	Triangle		
4		Triangle	**Circle**	
5	**Triangle**		Circle	
6		**Circle**	Triangle	
7		Circle	**Triangle**	
8	Triangle	**Circle**		
9	Triangle		**Circle**	
10	**Triangle**	Circle		
11	Circle	**Triangle**		
12	**Circle**		Triangle	

Participant #: _________ **PHASE 5** Page #: ___________

Session: _____ Phase: _____

	L	M	R	Resp.
1	B	**A**	C	
2	A	C	**B**	
3	A	**B**	C	
4	**C**	A	B	
5	A	**B**	C	
6	B	C	**A**	
7	A	B	**C**	
8	**B**	A	C	
9	B	**C**	A	
10	**A**	B	C	
11	B	C	**A**	
12	**C**	A	B	

Session: _____ Phase: _____

	L	M	R	Resp.
1	A	**C**	B	
2	**B**	A	C	
3	A	**B**	C	
4	B	C	**A**	
5	B	**A**	C	
6	A	C	**B**	
7	**C**	B	A	
8	B	A	**C**	
9	**A**	B	C	
10	B	**C**	A	
11	**A**	B	C	
12	C	A	**B**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	A	C	**B**	
2	**C**	B	A	
3	**A**	B	C	
4	A	**C**	B	
5	**B**	C	A	
6	B	**A**	C	
7	C	B	**A**	
8	A	**C**	B	
9	**B**	C	A	
10	A	B	**C**	
11	B	C	**A**	
12	A	**B**	C	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**C**	A	B	
2	B	C	**A**	
3	A	C	**B**	
4	B	**A**	C	
5	B	**C**	A	
6	**A**	B	C	
7	C	A	**B**	
8	A	**B**	C	
9	**C**	A	B	
10	**B**	C	A	
11	A	B	**C**	
12	C	**A**	B	

Session: _____ Phase: _____

	L	M	R	Resp.
1	C	B	**A**	
2	**B**	C	A	
3	B	A	**C**	
4	C	**B**	A	
5	**A**	B	C	
6	A	**C**	B	
7	**B**	A	C	
8	B	C	**A**	
9	**C**	B	A	
10	B	**A**	C	
11	B	**C**	A	
12	C	A	**B**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**B**	C	A	
2	B	A	**C**	
3	A	**B**	C	
4	B	C	**A**	
5	**A**	B	C	
6	B	**C**	A	
7	C	A	**B**	
8	C	**B**	A	
9	**A**	C	B	
10	A	B	**C**	
11	B	**A**	C	
12	**C**	B	A	

Session: _____ Phase: _____

	L	M	R	Resp.
1	C	**B**	A	
2	**A**	C	B	
3	B	A	**C**	
4	B	**C**	A	
5	C	A	**B**	
6	A	**C**	B	
7	**B**	A	C	
8	**A**	B	C	
9	B	C	**B**	
10	B	**A**	C	
11	**C**	A	B	
12	B	C	**A**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**A**	C	B	
2	C	**B**	A	
3	A	B	**C**	
4	**B**	C	A	
5	C	**A**	B	
6	A	B	**C**	
7	C	**A**	B	
8	A	**C**	B	
9	**B**	A	C	
10	B	C	**A**	
11	**C**	B	A	
12	A	C	**B**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	B	A	**C**	
2	C	**B**	A	
3	**B**	A	C	
4	B	C	**A**	
5	**C**	B	A	
6	B	**A**	C	
7	C	A	**B**	
8	A	**C**	B	
9	C	B	**A**	
10	**A**	C	B	
11	A	**B**	C	
12	**C**	A	B	

Participant #: ________ **PHASE 8, 9, & GENERALIZATION** Page #: ___________

Session: _____ Phase: _____

	L	M	R	Resp.
1	G	**A**	J	
2	H	**B**	D	
3	E	D	**C**	
4	**D**	I	A	
5	A	**E**	I	
6	B	J	**F**	
7	C	**G**	B	
8	F	C	**H**	
9	**I**	H	E	
10	**J**	F	G	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**C**	A	J	
2	F	**E**	H	
3	**I**	B	D	
4	A	I	**B**	
5	**G**	J	I	
6	D	C	**A**	
7	H	**D**	G	
8	**J**	F	C	
9	E	G	**F**	
10	B	**H**	E	

Session: _____ Phase: _____

	L	M	R	Resp.
1	E	A	**I**	
2	B	**F**	A	
3	G	**J**	B	
4	D	I	**G**	
5	**C**	E	F	
6	J	**B**	C	
7	F	G	**E**	
8	**A**	C	H	
9	**H**	D	J	
10	I	H	**D**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**F**	I	B	
2	D	**J**	F	
3	C	**A**	E	
4	**E**	C	D	
5	J	B	**H**	
6	H	D	**C**	
7	**B**	F	A	
8	G	**D**	I	
9	A	E	**G**	
10	**I**	G	J	

Session: _____ Phase: _____

	L	M	R	Resp.
1	E	**B**	H	
2	**D**	G	I	
3	B	D	**J**	
4	H	**C**	B	
5	**G**	F	E	
6	F	I	**A**	
7	C	**E**	G	
8	**I**	A	C	
9	A	J	**F**	
10	J	**H**	D	

Session: _____ Phase: _____

	L	M	R	Resp.
1	C	**F**	D	
2	**A**	I	F	
3	G	C	**B**	
4	**H**	J	A	
5	F	A	**E**	
6	B	**D**	H	
7	**I**	H	G	
8	D	**G**	J	
9	**J**	E	I	
10	E	B	**C**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	**C**	I	H	
2	H	B	**G**	
3	**I**	C	F	
4	D	**F**	E	
5	A	G	**D**	
6	G	**E**	J	
7	F	**J**	C	
8	**B**	A	I	
9	E	**H**	B	
10	J	D	**A**	

Session: _____ Phase: _____

	L	M	R	Resp.
1	H	**B**	E	
2	I	F	**J**	
3	**D**	H	B	
4	A	E	**C**	
5	**F**	G	D	
6	J	**A**	F	
7	C	D	**H**	
8	**E**	C	A	
9	B	**I**	G	
10	**G**	J	I	

Session: _____ Phase: _____

	L	M	R	Resp.
1	B	A	**I**	
2	E	**D**	J	
3	**J**	I	H	
4	F	**G**	A	
5	D	E	**B**	
6	I	**C**	D	
7	G	F	**E**	
8	**A**	H	C	
9	C	B	**F**	
10	**H**	J	G	

APPENDIX B

HSIRB Approval Letter

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Date: March 23, 2017

To: Richard Malott, Principal Investigator
Blaire Michelin, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair Amy Naugle

Re: HSIRB Project Number 17-03-19

This letter will serve as confirmation that your research project titled "Teaching Matching-to-Sample to Low Performing Children with Autism" has been **approved** under the **exempt** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., ***you must request a post approval change to enroll subjects beyond the number stated in your application under "Number of subjects you want to complete the study***)." Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: **March 22, 2018**

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