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Matching-to-Sample Using a Tablet

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Table of Contents

Abstract

Kids with autism tend to have a difficult time with one-to-one correspondence matching. Matching-to-sample is the process of pairing an identical stimulus to its corresponding stimulus, for example, matching a physical object to its corresponding picture. This is an important skill because it is the first step in teaching individuals with developmental delays visual discrimination skills and generalization of matching. The use of technology is beneficial because it helps with attending in instructional learning. Technology is also becoming more advanced and is being used more in classrooms. The purpose of this study was to teach matching-to-sample using a tablet. There were two participants for this study. Both participants were 3 years of age and were selected due to their difficulty with matching using the typical classroom procedure. Researchers taught the skill a different way, using a tablet and using individualized prompting specific to each participant to test whether using a tablet was a more effective way to teach matching than typical procedures. The intervention consisted of placing a tablet screen in front of the participant. The tablet displayed an array of items with the target item above the array by itself as well as in the array. Researchers probed generalized matching for one of the participants. Overall the intervention was successful. One participant mastered the procedure, and unfortunately, the other participant left in the middle of the study.

Key words: Autism, matching, technology, picture-to-picture matching, prompting

Introduction

Kids with autism tend to have a difficult time with one-to-one correspondence matching. Matching-to-sample is the process of pairing a comparison stimulus to the sample stimulus. For example, matching a picture of an object to a corresponding picture or matching a physical object to a corresponding picture (Gaisford & Malott, 2010). Matching is important because children can acquire a generalized identity matching-to-sample repertoire and use that skill in a variety of new educational and practical contexts where the matching task involves novel and untrained stimuli. In addition, matching is the first step in teaching individuals with developmental delays visual discrimination and generalization of matching novel stimuli. It is beneficial to have this skill and be able to generalize because it helps children in the academic environment. According to Dube & Serna (1998), "Some instructional programs require matching skills as part of their curricula."

In a study by Dube and Serna (2018), they began with simple discriminations and then had their participants eventually progress through a "systematic elaboration of performances" to build a strong and generalized matching repertoire. When working with individuals with developmental disabilities, matching-to-sample is especially valuable when language skills are limited, and instructors cannot rely on verbal instructions. In teaching communication skills, matching is a critical prerequisite that can help with more complex matching such as the Picture-Exchange Communication System. This is important because matching-to-sample is the first step in teaching individuals with developmental disabilities who have limited language a way to communicate.

The study by Larah et al. (2015) demonstrates how using new technologies, such as an iPad, is a fun and different way to teaching functional skills to children with autism spectrum disorder. It's important because an iPad can present both a visual and an auditory instruction and may enable such students to participate in instructional learning. Kagohara et al. (2013), suggest that technology is important because one can teach individuals with developmental disabilities matching-to-sample and other academic skills using alternative procedures. Using technology is beneficial because technology is being used more in classrooms today.

Physical prompting combined with visual prompting can increase the efficiency of skill acquisition, reduce the number of errors, and reduce the likelihood of a child becoming prompt dependent. Sabielny & Cannella-Malone (2014) found that both least-to-most and most-to-least prompting strategies were equally effective when teaching daily living skills, but that using a most-to-least prompting hierarchy results in fewer errors as compared to a least-to-most prompting hierarchy (Demchak, 1990). The purpose of this study was to implement an intervention to teach matching-to-sample using a tablet and used physical prompts specific to each participant, as well as visual prompts. Another purpose was to examine whether using a tablet to teach matching-to-sample is an effective alternative way to teach the skill.

Methods

Participants

In this study there were two participants, Sammy and Danny. Both were 3-year-old boys and enrolled in an early special education classroom. Sammy was diagnosed with early childhood developmental delay and Danny was diagnosed with autism spectrum disorder. Sammy had a matching and scanning repertoire but lost both skills over time. He may have lost

the skill due to the lack of consistent technicians over the summer. He had trouble matching picture to picture. First, the Master's student in charge of his case tried using a positional prompt. They placed the picture in a bin and moved to target stimulus closer to the student. This type of prompting helped the student regain the skill. After matching the similar pictures independently, the child moved on to complex pictures. Over time matching became aversive and there was a decrease in performance with an increase in problem behavior. In addition, the participant started swiping the pictures and materials off the desk. Danny struggled with matching simple pictures and had difficulty with attending. The inclusionary criteria were for those who had difficulty matching. Sammy had problem behavior that consisted of whining and Danny had no problem behavior.

Setting

All sessions were conducted in the child's private work area called booths that were inside the classroom. The classroom consisted of booths set up throughout the classroom. Each booth contained 2 small chairs and a small table in a corner with the researcher sitting perpendicular to the child when running sessions. The booth also had a bin of the child's reinforcers/toys and a bin of their procedure materials.

Materials

On the tablet, researchers used the PowerPoint Slide Software for the intervention to display the targets and arrays. Nine targets that both participants had never been exposed to were selected to teach the matching skill (see Appendix A). Each session consisted of nine trials instead of 10 since researchers wanted all 3 of the stimuli in the array to be a target an equal number of times, meaning 3 target trials for each stimulus. The participants' preferred edibles

and tangibles were used to reinforce correct responses. A PowerPoint presentation clicker was used to move onto the next trial. Data were collected on paper data sheets (see Appendix B).

Research Design

We used an AB research design which is composed of a baseline phase and a treatment phase. The dependent variable was the percentage of correct responses, and the independent variable was the intervention. We ran one session of baseline for both participants where no prompts were provided for correct responses. 0% for the baseline session were collected for both participants.

Procedure

A tablet with the PowerPoint Slides Software was used to present the procedure material. Each trial consisted of two slides; the first slide displayed the target stimulus by itself and the following slide displayed the array with the target stimuli above an array as well as in the array (see Appendix C). Because there were 9 trials per session, there was a total of 18 PowerPoint slides being used per session. The researcher used the PowerPoint presentation clicker to move on to the next slide. Phase 1 started off with 3 targets in the array. After each phase change, 2 new stimuli were added to the array until all 9 novel stimuli were in the array. To avoid a bias from the participants, researchers counterbalanced the arrays, which is having each target stimuli in every position possible per trial. Data were collected for correct responses on paper data sheets and the set-up of the data sheets corresponded to the PowerPoint Slides (see Appendix B).

A tablet was placed standing in front of the participant on the table and the child would then have to select by pointing to the corresponding image in an array on the tablet screen. There was one baseline session with no intervention/treatment for both participants, and both participants performed at a 0% correct. Because there were 9 trials per session, the mastery

criteria were 78% or greater for 3 consecutive sessions or 89% or greater for 2 consecutive sessions. The PowerPoint Slides Software was used to display the matching targets while using differential reinforcement. Sessions were conducted every day, Monday through Friday, and each session took about 10-15 minutes. The procedure consisted of teaching picture-to-picture matching with a tablet while using prompting specific to each child.

With Sammy, most-to-least physical prompting and visual prompts were used. The visual prompts were a black full circle around the comparison stimulus that was in the array on a white background (see Appendix C). Correct responses for Sammy looked like him not resisting the physical prompts and/or not engaging in problem behavior or selecting the correct corresponding picture/object by touching it on the screen with his hand or finger. Incorrect responses were the child resisting prompts and/or engaging in problem behavior or selecting an incorrect image. For error correction, researchers went up the prompting hierarchy. Because Sammy was prompt dependent, 6 subphases were added to phase 1. Those subphases were different levels of physical prompting to fade out physical prompts as quickly as possible and reduce prompt dependency. Phase 1a was full physical prompting and phase 1b was partial physical prompting at the forearm bringing the forearm directly in front of the target stimuli on the screen. Phase 1c was partial physical prompting at the forearm with less of a directional prompt. Phase 1d and 1e were partial physical prompting at the hand. Phase 1e, however, had the top target removed in the second slide and the array was made bigger. In phase 1.1e physical cut-out pictures were added to increase chances for correct responding. Unfortunately, Sammy moved schools in the middle of the study and researchers were unable to continue teaching the matching skill.

Before the intervention, researchers tested to see if Danny would attend to the tablet and the duration he would attend. Least-to-most physical prompting and visual prompts were used

with Danny. Researchers changed the original procedure and changed the white background into a black background and had a white full circle around the comparison stimulus serve as the visual prompt (see Appendix D). Other changes consisted of one slide per trial, meaning there were a total of 9 slides per session. Each trial slide only displayed the array. Physical cut-out pictures were used in every phase. Correct responses looked like him selecting the correct corresponding picture by touching it on the screen with his hand or finger or bringing the physical cut-out picture to the corresponding picture on the tablet. After each phase change, two new stimuli were added to the array; phase 2 consisted of 5 targets in the array and so on. Researchers added a probe phase after the intervention was mastered to test whether he would match using physical pictures. Researchers conducted a probe for identical, similar and complex pictures (see Appendix E). Mastery Criteria was 90% or above for 1 session.

Results

Both participants struggled with matching at the beginning of the intervention. There was an increasing rate of responding during the last phase of the procedure for Sammy before he left. Danny mastered the procedure as well as generalized the matching skill.

Sammy

Sammy did not have the matching or scanning skills at the beginning of the study. This could have been due to not having a consistent technician over the summer, and therefore, he met our inclusionary criteria. Because the rate of responding was low, subphases were added to reduce physical prompting as quickly as possible. Afterwards, there was a variable rate of

responding and right before he left, there is a start to an increasing trend in phase 1.1e (see figure 1). In addition to seeing this increasing trend, there was a slight decrease in problem behavior.

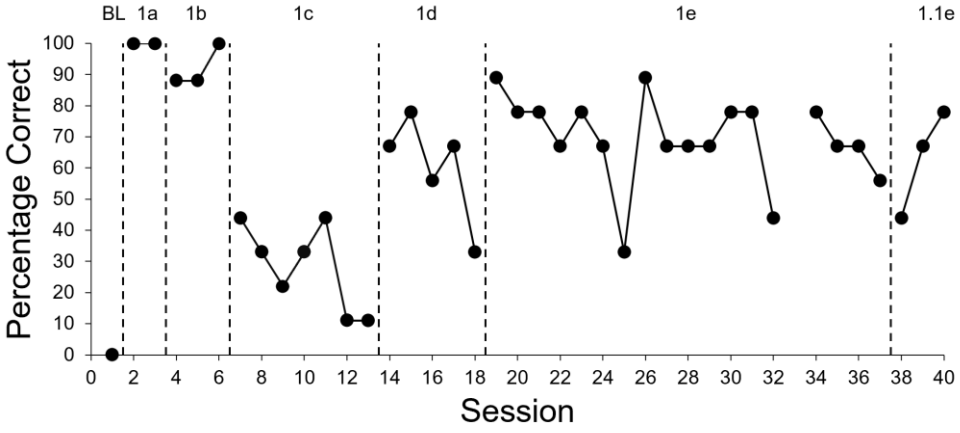

Figure 1. Intervention performance for Sammy while using most-to-least prompting. Visual prompts were used in all of phase 1. A physical picture cut-out was added in phase 1.1e.

Danny

Because researchers changed the original procedure for Danny, an updated procedure, procedure 2 (see appendix F), was used along with least-to-most prompting and visual prompts. He mastered phase 1f, which was independent responding, in 10 sessions. After he mastered phase 1, a probe session was conducted without the visual prompts due to time constraints. Danny responded with a 67% and 78% accuracy and visual prompts were removed. Danny was then moved on to the next phase which added 2 new stimuli to the array. Danny mastered phase 2 in 10 sessions, phase 3 in 3 sessions, and phase 4 in 2 sessions. Not only did he master the intervention, researchers also saw an increase in his duration for attending and scanning. In addition, there was an increase in echoics; he would repeat the name of the target stimulus as

well as his reinforcers. After he mastered the whole procedure, researchers probed in real life matching with simple, similar, and complex pictures, where mastery criteria were 90% for 1 session. He mastered and performed at 100% for simple pictures and 90% for similar pictures but did not meet mastery criterion for complex pictures, where he performed at 40%. Unfortunately, researchers were unable to continue teaching matching with complex pictures because of the world pandemic.

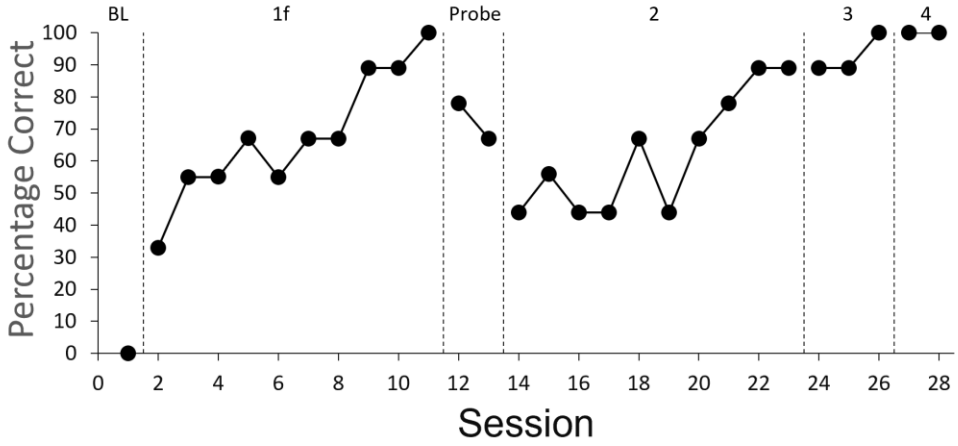

Figure 2. Intervention performance for Danny while using least-to-most prompting. Physical cut-out pictures were used in all phases. Visual prompts were only used in phase 1 and a probe session without the visual prompts was conducted after to remove said prompts.

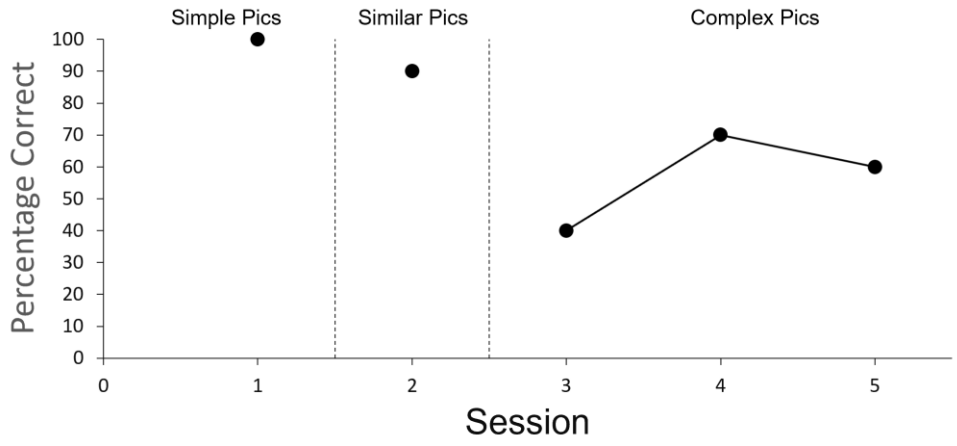

Figure 3. Probe performance for Danny after intervention was mastered.

Discussion

Overall, the intervention was successful. Researchers found that using a tablet to teach matching was effective. Although Sammy left early in the study, there was an increasing trend in the last phase. Danny mastered the procedure and was able to generalize matching with physical pictures.

There were many changes to the original procedure. When running the procedure with Sammy, some of the changes included changes to the visual prompts as well as changes to the physical prompts (see Appendix F). In phase 1c when the rate of responding decreased, a visual prompt was added on the tablet, which was a black circle around the comparison stimuli on a white background. In phases 1d, 1e, and 1.1e, prompting at the forearm was changed into prompting at the hand. In phase 1e, the slide that consisted of the target stimuli above the array was removed and the array was made bigger. In phase 1.1e, the slide with the single target

stimuli was also removed and a physical cut-out picture was also added. With Danny, researchers tested whether he would respond without physical prompts. He started the procedure at phase 1f, which was independent responding. When running the procedure with Sammy, the tablet was in a vertical position, but with Danny the tablet was flat on the table to increase his attending and scanning responses.

Issues that researchers came across when running the procedure with Sammy was the delayed time between delivery of reinforcers and not having effective reinforcers. His motivation changed frequently, and preference assessments were conducted every 2 to 3 trials. Having low motivation made it difficult to find am effective reinforcer. Sammy also had a side bias; he would respond more towards the middle and left targets. Another issue was inconsistent prompters, which may be one of the reasons we see variability in performance. The prompter changed from master students to different first year technicians. An issue when running the procedure with Danny was that he had started taking new medication. Danny had difficulty attending but researchers later discovered the iPad to be an effective reinforcer. Possible limitations were Sammy leaving in the middle of the study and the world pandemic.

Future research ideas would be to start off the procedure with 1 slide per trial where the array is made bigger and displayed by itself as well as having a physical picture cut-out. Other future research ideas consist of looking more into using technology to teach skill acquisition; possibly creating an app where targets and arrays are predetermined and provide some type of immediate visual reinforcer. That same app could have an auditory or visual prompt that makes the comparison stimuli as salient as possible. Future researchers could also try this procedure with more participants.

The purpose of this study was to see if using a different way to teach matching from those typical classroom matching procedures was also effective. The intervention was found to be effective. Unfortunately, Sammy was unable to complete the rest of the study. Danny mastered the procedure as well as generalized to real life matching.

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Appendix A:

Targets:

1- Toothbrush

2- Chair

3- Lamp

4- Table

5- Shoe

6- Coat

7- Car

8- Flower

9- Cup

Appendix B:

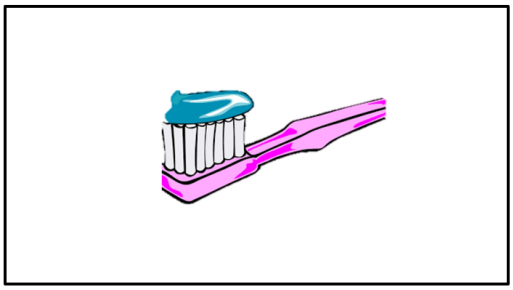
Instructor _____ Phase _____ Date _____

trial		Target		Data	Notes
1	Chair	Toothbrush	Lamp		
2	Lamp	Toothbrush	Chair		
3	Chair	Lamp	Toothbrush		
4	Toothbrush	Chair	Lamp		
5	Lamp	Chair	Toothbrush		
6	Chair	Lamp	Toothbrush		
7	Toothbrush	Chair	Lamp		
8	Lamp	Toothbrush	Chair		
9	Chair	Toothbrush	Lamp		
	PowerPoint 1			%	

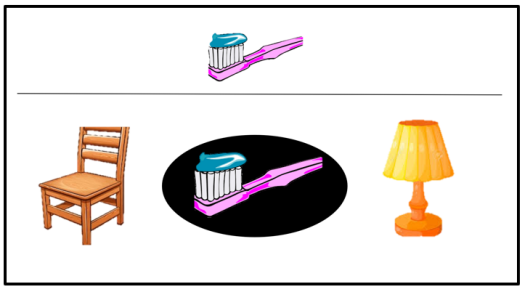
Initials:				**Date:**		
Trial	**Target**					**Phase:**
Stimuli:	**A**	**B**	**C**	**D**	**E**	**Data**
1	shoe	toothbrush	table	chair	lamp	
2	lamp	shoe	toothbrush	table	chair	
3	chair	lamp	shoe	toothbrush	table	
4	table	chair	lamp	shoe	toothbrush	
5	toothbrush	table	chair	lamp	shoe	
6	shoe	toothbrush	table	chair	lamp	
7	lamp	shoe	toothbrush	table	chair	
8	chair	lamp	shoe	toothbrush	table	
9	table	chair	lamp	shoe	toothbrush	
	PowerPoint 2					**%**

Appendix C:

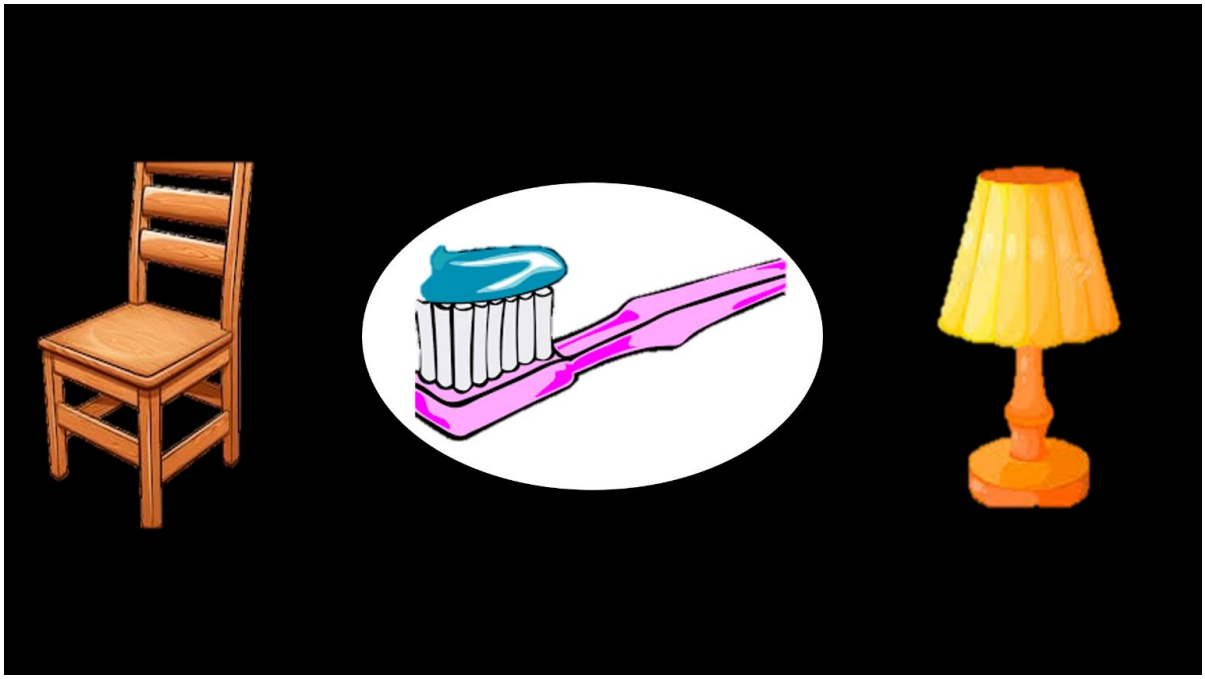
Slide 1



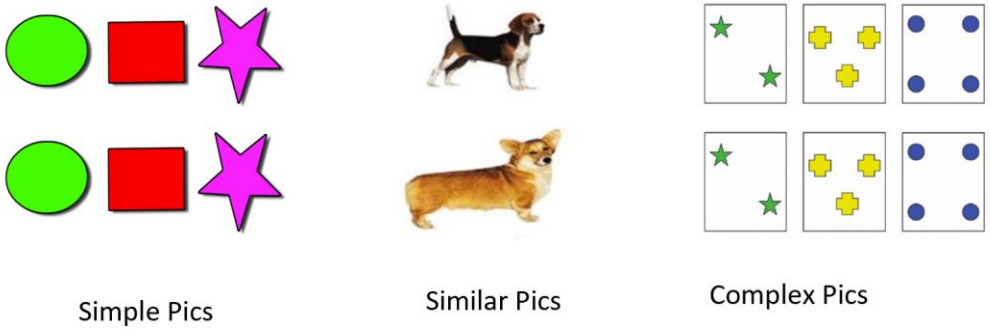
Slide 2



Appendix D:



Appendix E:



Simple Pics

Similar Pics

Complex Pics

Appendix F:

Matching With iPad Updated Procedure

Objective: Child will select the corresponding image in an array on the tablet screen

Materials: Childs most preferred reinforcer, tablet-computer, PowerPoint, data sheet (corresponds to PowerPoint slides), writing utensil

Trials: 9

Procedure:

1. Making sure child is attending to the tablet screen, present PowerPoint slide with only the target stimuli on display and state target name, wait **2 seconds** before moving on to the next slide that displays the target stimuli above the array (number of stimuli in the array depends on phase) and state target stimuli name
    a. If the child engages in PB block and redirect or follow through with demand
    b. If the child does not engage in problem behavior, deliver preferred reinforcer immediately after correct response/selection has been made
2. Conduct frequent preference assessments (every 2-3 trials) (MO changes rather quickly)
3. Mix trialing/ELO's (high fives, Nesting Cups, Simple Directions) make it as natural as possible
4. Different PowerPoint Slides (different order of arrays & target stimuli)
5. Error Correction

Data Collection: + Correct, - Incorrect

Phases:

Phase 1a - Array of 3 (Stimuli 1-3) - **Criteria of 90% or greater for 2 consecutive session**

- Full Physical prompt (At wrist)

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 1b - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Partial Physical Prompt (Prompt at the Forearm; bring in front of target and child should independently touch it

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 1c - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Partial Physical Prompt (Prompt Lifting Forearm in front of screen. He should independently touch it)

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 1d - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Partial Physical Prompt (Hand prompt)

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 1e - *Stimuli on top was removed* - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Partial Physical Prompt at hand

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 1.1e - *Single slide taken out and physical card cut out* - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Partial Physical Prompt at hand

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 1f - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - child independently selects the corresponding picture

  Incorrect Response - child doesn't select the correct the corresponding picture

  Gestural - White Circle Prompt on Black Screen Around Target

Phase 2 - Array of 5 (Stimuli 1-5) - Array of 5 (Stimuli 1-5) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - Selects correct/corresponding stimuli

  Incorrect response - Selects incorrect stimuli or engages in PB

Phase 3 - Array of 7 (Stimuli 1-7) - Array of 7 (Stimuli 1-7) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - Selects correct/corresponding stimuli

  Incorrect response - Selects incorrect stimuli or engages in PB

Phase 4 - Array of 9 (Stimuli 1-9) - Array of 9 (Stimuli 1-9) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - Selects correct/corresponding stimuli

  Incorrect response - Selects incorrect stimuli or engages in PB

Appendix G:

Matching With iPad Original Procedure

Objective: Child will select the corresponding image in an array on the tablet screen

Materials: Childs most preferred reinforcer, tablet-computer, PowerPoint, data sheet (corresponds to PowerPoint slides), writing utensil

Trials: 9

Procedure:

1. Making sure child is attending to the tablet screen, present PowerPoint slide with only the target stimuli on display and state target name, wait **2 seconds** before moving on to the next slide that displays the target stimuli above the array (number of stimuli in the array depends on phase) and state target stimuli name
    a. If the child engages in PB block and redirect or follow through with demand
    b. If the child does not engage in problem behavior, deliver preferred reinforcer immediately after correct response/selection has been made
2. Conduct frequent preference assessments (every 2-3 trials) (MO changes rather quickly)
3. Mix trialing/ELO's (high fives, Nesting Cups, Simple Directions) make it as natural as possible
4. Different PowerPoint Slides (different order of arrays & target stimuli)
5. Error Correction

Data Collection: + Correct, - Incorrect

Phases:

Phase 1 - Array of 3 (Stimuli 1-3) - **Criteria of 90% or greater for 2 consecutive session**

- Full Physical prompt (At wrist)

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 2 - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Partial Physical Prompt (Prompt at the Forearm; bring in front of screen and child should independently touch it

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 3 - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Gestural

  Correct Response - child doesn't resist prompt or engage in PB

  Incorrect response - child resists prompt or engages in PB

Phase 4 - Array of 3 (Stimuli 1-3) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - child independently selects the correct/corresponding picture

  Incorrect Response - child doesn't select the correct the corresponding picture

Phase 5 - Array of 5 (Stimuli 1-5) - Array of 5 (Stimuli 1-5) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - Selects correct/corresponding stimuli

  Incorrect response - Selects incorrect stimuli or engages in PB

Phase 6 - Array of 7 (Stimuli 1-7) - Array of 7 (Stimuli 1-7) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - Selects correct/corresponding stimuli

  Incorrect response - Selects incorrect stimuli or engages in PB

Phase 7 - Array of 9 (Stimuli 1-9) - Array of 9 (Stimuli 1-9) - **Criteria 80% or greater for 3 consecutive sessions, 90% or greater for 2 consecutive sessions**

- Independent

  Correct Response - Selects correct/corresponding stimuli

  Incorrect response - Selects incorrect stimuli or engages in PB