EVALUATING THE IMPACT OF REINFORCER MAGNITUDE ON RESPONSE ALLOCATION ACROSS TWO COMMUNICATION MODALITIES UNDER A CONCURRENT SCHEDULE ARRANGEMENT

by

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(Under the Direction of Joel Ringdahl)

ABSTRACT

The purpose of this study was to evaluate the impact of reinforcer magnitude on response allocation across two different communication modalities (vocalizations and picture exchange). A single-subject reversal design was used to evaluate the effects of altering the magnitude of requested items with one male participant who engaged in limited and inconsistent vocalizations. This study took place in a classroom that served students with intellectual disabilities and autism for kindergarten to second grade students, as well as in a teachers' workroom. Before each intervention, the researcher conducted forced trials to ensure the participant contacted the different reinforcement magnitudes assigned to the responses. In the first intervention, the participant received high magnitude reinforcement for vocalizations and low magnitude reinforcement for picture exchange. In the second intervention, the participant received low magnitude reinforcement for vocalizations and high magnitude reinforcement for picture exchange. The results showed that the participant allocated responding to the communication modality that received higher magnitude of the requested item.

INDEX WORDS: reinforcer magnitude, response allocation, concurrent schedule, vocalizations, picture exchange, communication modalities

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TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

According to the Center for Disease Control (2011), the prevalence of any developmental disability increased 17% between the years 1997 and 2008. Children with significant developmental delays (SDD) often reach developmental milestones later than typically-developing children (Boyle et al., 2011). Practitioners give the diagnosis of SDD to children ranging in age from 3 to 9 years old, when appropriate. These children with SDD diagnoses often develop speech and communication skills later than typically-developing children (Schwartz, Garfinkle, & Bauer, 1998).

Communication Modalities

According to the American Speech-Language-Hearing Association (ASHA, 2005; Fosset & Mirenda, 2007), augmentative and alternative communication (AAC) addressed deficits with spoken and written modes of communication. Two types of AAC that were recognized include aided communication (through the use of pictures, book, or speech-generating devices) and unaided communication (through the use of signs, gestures, and facial expressions; Fosset & Miranda, 2007). Picture Exchange Communication System (PECS; Bondy & Frost, 1994) was a type of AAC that promotes communication through the use of picture cards and had successfully been used to increase independent communication exhibited by children who are initially acquiring the ability to communicate in a social context. According to Bondy and Frost (1994), the Delaware Autism Program (DAP) was the first to teach children to exchange a picture card with an item that the child wanted in the moment with a communication partner. The communication partner will then give the child the item they have requested. Prior to training, which is done through phases that slowly build on each other, the researcher presents an array of

items for the child to pick from. It is important to use an item that the student will persistently pick, and has a high preference for (Bondy & Frost, 1994). Instead of using verbal cues, such as the question, "What do you want?", PECS solely relies on the child initiating the request (Bondy & Frost, 1994, 2002; Sulzer-Azaroff, Hoffman, Horton, Bondy, & Frost, 2009). PECS requires some ability of fine motor skills, since it requires a child to pick up a picture off a Velcro strip with his or her fingers (Bondy & Frost, 1994; Ganz, Simpson, & Lund, 2012).

Although PECS is a widely used form of communication, it cannot be used with everyone. For example, people with visual impairments or people with limited fine or gross motor skills may not be able to use PECS (Mirenda, 2001; Ganz et al, 2012). Those who are able to communicate through speech do not necessarily need this form of communication, because vocalizations and approximations can be shaped into intelligible speech. Children who are not able to correspond the picture with objects (one-to-one correspondence) may not benefit from PECS training (Bondy & Frost, 1994; Ganz et al., 2012). Another limitation to the use of PECS is that, while it can be readily used to request or label stimuli, it is rarely used for conversational communication, unlike other communication modalities (Tincani, 2004).

Greenberg, Tomaino, and Charlop (2014) adapted the PECS protocol in order to elicit vocalizations in children with autism. Greenberg et al. first used a 3-s time-delay procedure for the two participants, who were proficient in PECS Phase IV, during which they waited 3 s for a vocalization of the requested item after the participant exchanged the picture before saying, "I want (item)" and giving the participant the requested item. If the participant did not meet criteria, the researchers moved to a 3-s time-delay plus prompt procedure. The researchers waited 3 s for a vocalization after the picture was exchanged. If after 3 s and the participant did not vocalize, the researcher gave the vocal prompt. If the participant had still not vocalized after three vocal prompts, the item was put away and the sentence strip was placed back onto the participant's

PECS book. Both participants showed increases in vocalizations after both procedures were implemented and after the vocal prompt was faded out.

Another recent study used a similar procedure that incorporated a delay to reinforcement in order to elicit vocalizations during PECS (Cagliani, Ayres, Whiteside, & Ringdahl, 2017). One different between this study and Greenberg et al. (2014) was that the participants were trained up to PECS Phase IIIb (discrimination between preferred items when given the vocal prompt, "Pick which one you want."; Bondy & Frost, 2002) instead of PECS Phase IV. Another difference was that the delay to reinforcement increased by 1 s each day, whereas Greenberg et al. (2014) implemented a constant time delay of 3 s. The results of Cagliani et al. (2017) showed that three of the four participants demonstrated an increase in vocalizations as a result of the implementation of the time delay in conjunction with PECS. However, research on increasing vocalizations during PECS is still limited, and research on including an alteration of reinforcer magnitude to increase vocalizations is similarly limited.

Reinforcement Magnitude

The schedule of reinforcement can alter response rate depending on how large or small the reinforcement is, how frequently or infrequently it is given, and when it is given (Lerman, Kelley, Vorndran, Kuhn, & LaRue, 2002). In previous research, altering the magnitude of reinforcement has shown that participants will allocate their responding to the response that produces the higher magnitude reinforcer (Catania, 1963; Hoch, McComas, Johnson, Faranda, & Guenther, 2002). According to Neuringer (1967), rate of response and magnitude influence each other: when the magnitude is high, rate of response is also high; when the response determines the magnitude it receives, the rate of response will vary based on whether it receives high or low magnitude. Additionally, when the magnitude reinforcement is consistent, the response rate stays

more consistent than when magnitude is varied noncontingently (Hernstein, 1964; Neuringer, 1967).

Peterson, Frieder, Smith, Quigley, and Norman (2009) evaluated a concurrent schedule arrangement in which problem behavior, mands for break, and mands to work were available at the same time. Mands for work and mands for break were assigned to either long duration high-quality attention or short duration low-quality, while problem behavior consistently received the shortest duration of low-quality attention. The results of this study showed that the participants allocated responding to the requests that received long duration, high-quality attention. The conclusion of the study was that students will allocate their responding to the response that receives high-quality and longer duration reinforcement.

Lerman et al. (2002) ran functional analyses with their participants to establish the function of problem behavior, before creating individualized communication trainings (e.g., card touches to request access to preferred tangibles and break) for each participant. Similar to Peter et al. (2009), two participants engaged in escape-maintained problem behavior. Card touches were reinforced with either 20-s access to reinforcement or 60-s access to reinforcement. The results of the individualized communication training showed that participants engaged in the card touches at higher rates when accessing the higher magnitude of reinforcement (e.g., break or preferred tangible). The second experiment involved a reversal design, where the card touches were reinforced with 20-s reinforcement, 60-s reinforcement, or 300-s reinforcement and problem behavior was on extinction. Results of the second experiment showed that magnitude of the reinforcement impacted rate of picture touches for one participant but did not reliably differentiate amongst the remaining participants. The results suggest that further evaluation of magnitude as a sole factor that modifies reinforcement should be done.

Reed (1991) demonstrated that participants allocate their responding to simple schedules of reinforcement instead of complex schedules of reinforcement. The researchers evaluated the effects of four different schedules of reinforcement: two simple, variable interval schedules of 30-s and 60-s access to reinforcement, one concurrent variable interval schedule of reinforcement, and one multi-variable schedule of reinforcement. The results in Reed's (1991) article suggest that simple schedules of reinforcement allowed participants to contact reinforcement associated with higher magnitude easier than more complex schedules of reinforcement. Additionally, the higher magnitude was picked more often during simple schedules, but there was no differentiation when both magnitudes were concurrently presented in the complex schedules of reinforcement. Smaller reinforcement magnitudes did not influence response allocation as much as larger reinforcement magnitudes did when presented with a simple variable-interval schedule. Further evaluation of the preference of magnitude should be studied, in order to confirm whether or not magnitude preference has an impact on response allocation.

Skill Acquisition

Skill acquisition programs often arrange reinforcement in such a way that independent responses result in a higher magnitude of reinforcement, while prompted responses result in a lower magnitude of reinforcement (Olenick & Pear, 1980; Touchette & Howard, 1984; Fiske et al., 2014; Hausman, Ingvarsson, & Kahng, 2014). Responses that received equal magnitude of reinforcement for correct independent answers and correct prompted answers was not as effective for teaching a new skill as when the independent responses received higher magnitude than prompted answers (Olenick & Pear, 1980).

Delayed prompting and contingencies of reinforcement both had equal effects on all three participants in the study by Touchette and Howard (1984). While it is useful to use different

prompting procedures for skill acquisition, it is equally important to use different schedules of reinforcement and prompting procedures to promote independent responding. Hausman et al. (2014) conducted a study in which independent responses were reinforced immediately, while prompted responses were always reinforced, never reinforced, or reinforced on a fixed-ratio schedule of three responses (FR 3). The results showed that a continuous, dense schedule of reinforcement for independent responding, while prompted responses are on extinction, can potentially lead to acquisition of skills at a quicker rate (Fiske et al., 2014; Hausman et al., 2014).

Other research has evaluated the acquisition of skills using differential reinforcement, where quality of reinforcement is altered based on independent or prompted responses (Karsten and Carr, 2009; Cividini-Motta and Ahearn, 2013; Fiske et al., 2014). A study by Karsten and Carr (2009) concluded that using differential reinforcement is an effective way to teach students new skills and increase their independence with responding. The study used picture sequences and tacts as the skill targeted for acquisition. Each participant showed faster skill acquisition for both motor (picture sequence) and vocal (tacts) responses for the differential reinforcement condition as opposed to the non-differential reinforcement condition. Cividini-Motta and Ahearn (2013) conducted research where independent responses were given the highest-preferred item, while prompted responses either received the highest-preferred item, a moderately-preferred item, or no reinforcement. The results showed that participants who received the highest-preferred and the moderately-preferred item had the most increase in independent responses.

Communication is a skill that can be taught through a training procedure, such as PECS. PECS uses prompt-fading procedures (Bondy & Frost, 1994, 2001), where the student is eventually able to communicate independently. Because communication can be treated as a form of skill acquisition, it is possible to alter the magnitude of reinforcement that a child receives to increase independent responding. Research has shown effectiveness when different factors of

reinforcement are modified, and research has also shown that increasing magnitude of reinforcement and quality of reinforcement can effectively increase independent responding (Olenick & Pear, 1980; Touchette & Howard, 1984; Karsten and Carr, 2009; Cividini-Motta and Ahearn, 2013; Fiske et al., 2014; Hausman et al., 2014). Because research has been done to show how reinforcement can affect independent responding, further research should be done on how reinforcement magnitude can influence allocation of responses.

Purpose

This study was conducted to determine the effects of altering the magnitude of a reinforcer on response allocation across two communication modalities. The researchers hypothesized that when magnitude is manipulated, the student would allocate his response to the communication modality that would result in a higher magnitude reinforcer. For example, if vocalizations received higher magnitude of requested items, the participant would allocate responding to vocalizations, and if picture exchange received higher magnitude of requested items, the participant would allocate responding to the picture exchange.

The participant had a history with PECS. He had started at Phase I in April 2018 and used PECS to communicate until the middle of May. He started with Phase I in August 2018. In the classroom, picture exchanges were frequent ways to communicate, because most students in the classroom were non-vocal, and only communicated through pictures. According to the PECS protocol, vocalizations are not typically reinforced until Phase IV (Bondy & Frosty, 1994, 2001). However, through observations and anecdotal reporting, this student was vocalizing infrequently. In order to increase consistency in vocalizations, the researcher decided that it would be beneficial for him to be a participant in the study. As a result, the following study did not follow the PECS protocol, and the second communication modality is considered only a picture exchange.

CHAPTER 2

METHOD

Participant

One individual with SDD participated in this study. The individual was a 5-year-old male. He was proficient with Phase I of PECS. He was able to vocalize; however, he often tacted (labeled) items, but did not mand (request) for them.

Materials and Setting

The researcher kept a basket that contained all the materials for the study in an accessible area of the classroom or teachers' workroom. The basket was located on top of a shelf, where students would not be able to reach it, but the researcher was able to access it quickly. The basket contained a timer, two pens, three sets of data sheets for the current condition (primary, interobserver agreement, and procedural fidelity data sheets), and two bags of each of the following edible reinforcers: barbecue chips, Doritos, and Skittles. One of the two bags contained high magnitude reinforcers, and the other contained a low magnitude reinforcers.

The study took place in the participant's classroom and in a workroom for teachers located across the hall. When the study took place in the classroom, the primary data collector ran the study with the participant during times where the rest of the class was outside of the classroom, such as the end of recess, free play in the gymnasium, and after the participant was done with breakfast or lunch. Sessions were conducted when the participant had a high preference for the items in the array, such as during snack times. However, the participant showed preference for barbecue chips and Skittles consistently throughout the day, and if sessions were not able to be run during snack times, the researcher picked other times during the day to run the study.

Dependent Measures and Definitions

The current study measured two dependent variables: targeted vocalizations and picture exchanges. Based on observations of the participant throughout the school day, it was determined he was able to say "Chip," "Skittle," and "Dorito." To be scored as a targeted vocalization, the entire word had to be spoken by the participant. Approximations did not meet the response definition and were not scored. The only vocalizations that were recorded in a session were between when the timer was started as the researcher stated the contingency and stopped when the participant engaged in the targeted vocalization. If the participant vocalized a different item from the item that they were requesting during the session (e.g., if the participant said "Skittle" when the session reinforcer was "Doritos"), that vocalization was not recorded. A picture exchange was defined as when the participant placed the picture in the researcher's hand and let go of the picture.

A 5-s changeover delay was added to the protocol before the first forced trial session. The 5-s changeover delay was implemented when the participant engaged in both responses simultaneously (e.g., the participant handed the picture while vocalizing). During the 5-s changeover delay, neither picture exchanges nor vocalizations resulted in reinforcement. After 5-s had elapsed, the researcher restated the appropriate contingency. The researcher only accepted picture exchanges when the participant did not vocalize, and only accepted vocalizations when the participant did not exchange a picture card.

Experimental Design

The experimental design was a reversal design with an embedded concurrent schedule. Prior to each intervention, forced trial sessions were conducted to allow the participant to contact the magnitude of reinforcement for each response. In the first reversal (Intervention A), vocalizations were reinforced with high magnitude of the requested item, and picture exchanges

were reinforced with low magnitude of the requested item. In the second reversal (Intervention B), vocalizations were reinforced with low magnitude of the requested item, and picture exchanges were reinforced with high magnitude of the requested item. In the third reversal (Intervention A), vocalizations were reinforced with high magnitude of the requested item, and picture exchanges were reinforced with low magnitude of the requested item.

Procedures

Pre-Intervention Assessment

Two paired-stimulus assessments (Fisher et al., 1992) were conducted with the participant. A rank order of preferred edible items was then determined. In the first preference assessment, barbecue chips were ranked as the highest preferred item, and Skittles were ranked as the second highest preferred item. Doritos and hot fries were picked an equal amount of times (three times each), which is why a second preference assessment was conducted with the participant. The second preference assessment yielded the same results: Doritos and hot fries were equally preferred. However, when Doritos and hot fries were paired against each other, the participant picked the Doritos. Thus, Doritos were included as the third preferred item in the array.

Next, the researcher observed the participant's vocalization ability for each of these preferred items. If he had not been able to completely vocalize each item's name, an approximation would have been accepted. Through observations, the researcher determined that the participant was able to say "Dorito" and "Skittle." Instead of "barbecue chip," "chip" was accepted as the vocalization. A magnitude assessment (adapted from Catania, 1963 and Fisher et al., 1992) was conducted to determine whether or not the participant was able to discriminate different magnitudes. Three sessions that consisted of 10 trials with highly-preferred items (chips, Doritos, and Skittles) were conducted. The participant picked the higher magnitude for

highly preferred items on 80% of the trials during the first session, 100% of the trials during the second session, and 90% of the trials during the third session.

Forced Trials: High Magnitude Vocalizations

In the forced trials, there were two conditions: vocalizations and picture exchange. The picture card was available in both conditions to provide the participant with a form of communication and for consistency in both conditions. In the vocalization condition, high magnitude of the requested item was given for vocalizations, and picture exchange was on extinction. In the picture exchange condition, low magnitude of the requested item was given for exchanging the picture, and vocalizations were on extinction. There was a 3-min cap for all sessions.

Prior to each session, an array of the three highly preferred items was presented, and the participant was prompted to pick one option. The picture card was immediately placed in front of the participant, while the researcher labeled the item he picked. The researcher would then state one of the following contingencies, based on which condition was going to be run: “If you say [chip/Skittle/Dorito], you can get a big [chip/Skittle/Dorito],” or “If you hand me the picture, you can get a small [chip/Skittle/Dorito].” Forced trial sessions were counterbalanced, where the picture exchange was assigned to A, and the vocalization condition was assigned to B; the following pattern was established: ABBABAABABBABAAB. Prior to each trial, the researcher would state one of the following contingencies based on the condition: “If you want a [chip/Skittle/Dorito], hand me the picture,” or “If you want a [chip/Skittle/Dorito], say [chip/Skittle/Dorito].”

During the first few sessions, it was observed that the participant had more opportunities to respond during the picture exchange condition than the vocalization condition. One reason this occurred was because the participant consumed the smaller magnitude of the requested item

faster than the larger magnitude of the item. Due to this difference, after 11 sessions, the procedure was modified. Specifically, as soon as the participant engaged in the response, the timer was paused while he consumed the requested item. The timer was restarted when consumption ended, and the researcher began to restate the contingency. The reinforcement amount of Skittles was also modified. Instead of receiving five Skittles for vocalizations, the participant received one Skittle; for picture exchanges, the participant received one-fourth of a regular-sized Skittle.

If the participant exchanged the picture while vocalizing, a 5-s changeover delay was implemented; neither response was reinforced, and after the 5 s elapsed, the researcher would restate the contingency. Following every 5 s that the participant did not engage in the correct response, the researcher would restate the contingency. The session ended either when the participant completed 10 trials, or when 3-min of session time (exclusive of consumption) elapsed.

Intervention A: High Magnitude Vocalizations

After the participant contacted reinforcement sufficiently during forced trials, the researcher began Intervention A. During Intervention A, vocalizations and picture exchange were both available concurrently (at the same time). Prior to the start of a session, an array of chips, Skittles, and Doritos was presented to the participant. Once he picked an item, the researcher would label the item for him (e.g., “Chip. You picked chips.”), while placing the picture card with the corresponding item in front of him. A timer was set for 3 min. The researcher held up both a low magnitude and high magnitude of the requested item, and stated the contingency, “If you say [chip/Skittle/Dorito], you can get a big [chip/Skittle/Dorito]. If you hand me the picture, you can get a small [chip/Skittle/Dorito].”

Using a pincer grip (thumb and forefinger), the researcher held each magnitude of the requested item. The researcher also held out three fingers of the hand holding the lower magnitude of the item to indicate that the participant could exchange the picture. The researcher would state a contingency similar to this: “If you want something, let me know,” before each trial. If the participant vocalized “chip,” “Skittle,” or “Dorito,” he would receive a high magnitude of the requested item. If the participant exchanged the picture, he would receive a low magnitude of the requested item. The timer was paused between each trial and restarted after he had consumed the item and the researcher restated the contingency. The session ended either when 10 trials, or when 3-min of session time (exclusive of consumption) elapsed.

Forced Trials: High Magnitude Picture Exchange

In the vocalization condition, low magnitude of the requested item was given for vocalizations, and picture exchange was on extinction. In the picture exchange condition, high magnitude of the requested item was given for exchanging the picture, and vocalizations were on extinction. There was a 3-min cap for all sessions.

Prior to each session, an array of the three highly preferred items was presented, and the participant was prompted to pick one option. The picture card was immediately placed in front of the participant, while the researcher labeled the item he picked. The researcher would then state one of the following contingencies, based on which condition was going to be run: “If you say [chip/Skittle/Dorito], you can get a small [chip/Skittle/Dorito],” or “If you hand me the picture, you can get a big [chip/Skittle/Dorito].” Similar to the first set of forced trials, the second set of forced trials were also counterbalanced, where the picture exchange was assigned to A, and the vocalization condition was assigned to B; the same pattern was established for the set of forced trials.

As soon as the participant engaged in the appropriate response, the timer was paused to allow him time to consume the requested item. The timer was restarted as the researcher began to restate the contingency. If the participant exchanged the picture while vocalizing, a 5-s changeover delay was implemented; neither response was reinforced. After the 5 s elapsed, the researcher would restate the contingency. Following every 5 s that the participant did not engage in the correct response, the researcher would restate the contingency. The session ended either when 10 trials, or when 3-min of session time (exclusive of consumption) elapsed.

Intervention B: High Magnitude Picture Exchange

After the participant contacted reinforcement sufficiently during forced trials, the researcher began Intervention B. During Intervention B, vocalizations and picture exchange were both available concurrently (at the same time). Prior to the start of a session, an array of chips, Skittles, and Doritos was presented to the participant. Once he picked an item, the researcher would label the item for him (e.g., “Chip. You picked chips.”), while placing the picture card with the corresponding item in front of him. A timer was set for 3 min. The researcher held up both a low magnitude and high magnitude of the requested item, and stated the contingency, “If you say [chip/Skittle/Dorito], you can get a small [chip/Skittle/Dorito]. If you hand me the picture, you can get a big [chip/Skittle/Dorito].”

Using a pincer grip (thumb and forefinger), the researcher held each magnitude of the requested item. The researcher also held out three fingers of the hand holding the higher magnitude of the item to indicate that the participant could exchange the picture. The researcher would state a contingency similar to this: “If you want something, let me know,” before each trial. If the participant vocalized “chip,” “Skittle,” or “Dorito,” he would receive a low magnitude of the requested item. If the participant exchanged the picture, he would receive a low magnitude of the requested item. The timer was paused between each trial and restarted after he

had consumed the item and the researcher restated the contingency. The session ended either when 10 trials, or when 3-min of session time (exclusive of consumption) elapsed.

Interobserver Agreement and Procedural Fidelity

Interobserver Agreement (IOA) and procedural fidelity data were calculated throughout the duration of the study. The picture exchanges and vocalization agreement were obtained by conducting a point-by-point agreement comparison of the observers' records.

For the first forced exposure condition, IOA was taken for approximately 60% of all sessions. IOA agreed from 90% to 100% of all session. For Intervention A, IOA was taken for 60% of sessions, and it agreed 100% of the time. For the second forced exposure session, IOA was taken for approximately 60% of all sessions. IOA agreed 83% for picture exchanges in the vocal condition, 86% for picture exchanges in the picture exchange condition, and 100% for vocalizations in both the picture exchange and vocalization conditions. For Intervention B, IOA was taken for 75% of all sessions, and it agreed 100% of the time. For Intervention A (i.e., third reversal), IOA was taken for 33.3% of all sessions, and it agreed 100% of the time.

For the first forced trials condition, procedural fidelity was taken for 60% of sessions, and the procedure was implemented with 100% fidelity. It was taken for 60% of sessions in Intervention A, and the procedure was implemented with 100% fidelity. For the second condition of forced trials, procedural fidelity was taken for 60% of sessions, and the procedure was implemented with 100% fidelity. For Intervention B, procedural fidelity was taken for 50% of sessions. The procedure was implemented with 100% fidelity for the first two sessions, 90% for the sixth session, and 100% for the last two sessions. In the sixth session, the participant exchanged the picture while vocalizing during the last trial; however, a changeover delay was not implemented by the researcher, and the participant received low magnitude reinforcement.

For Intervention A (i.e., third reversal), procedural fidelity was taken for 33% of sessions, and the procedure was implemented with 100% fidelity.

IOA and procedural fidelity was calculated for the magnitude assessment and the paired-stimulus preference assessment as well. IOA was taken for 33.3% of the magnitude assessment sessions, and 50% of the paired-stimulus preference assessments. IOA agreed 100% of the time for both assessments. Procedural fidelity was also at 100% for both assessments.

CHAPTER 3

RESULTS

Figures 1 and 2 display the results of the forced trials conducted prior to the interventions, graphed as rate of responding. The researchers used the graph to determine when to move to intervention. When the participant had contacted reinforcement for the contingency in each condition, and he was consistently allocating his responding to the communication modality that was being reinforced, the researchers introduced intervention. Figures 3 and 4 display the data from intervention graphed as rate of response allocation, and Figures 5 and 6 display the data graphed as percent of response allocation.

Before the procedure was changed in the forced trials, the participant contacted reinforcement quickly for the picture exchange condition and did not engage in appropriate responses for the vocalization condition. In the vocalization condition, the participant engaged in different topographies of problem behavior when he did not receive the chip, including crying, eloping towards the door of the workroom, and dropping from his seat to the floor. It is possible that the participant did not understand the contingency during the vocalization condition in the beginning of the forced trials. After the procedure was modified, the participant stopped exchanging the picture during the vocalization condition and the rate of vocalizations stayed high and stabilized. Although vocalizations still occurred during the picture exchange condition, data was stable, and Intervention A was started.

For Intervention A, the participant showed clear allocation of responding to vocalizations. He did not exchange the picture card during any of the sessions, and solely allocated responding to vocalizations; thus, the participant vocalized for 100% of all sessions. As a result, the participant received high magnitude of the requested item for each of the 10 trials in

each of the five sessions. After five sessions, the research started the second set of forced trials with the participant.

During the second set of forced trials, the participant received high magnitude for picture exchange and low magnitude for vocalizations. The first few trials showed some carryover from Intervention A, where vocalizations were high in both the vocal condition and picture exchange condition. The participant did not exchange the picture in the vocal condition. As the participant contacted high magnitude reinforcement for picture exchanges, the data path in the picture exchange condition crossed, and the rate of vocalizations dropped to low levels while the rate of picture exchanged increased in level. The rate of vocalizations in the vocal condition also decreased in level, and the participant exchanged the picture a few more times in the vocalization condition. Once the researcher saw that the data path was stable, and the participant had contacted reinforcement enough times, the researcher moved to Intervention B. The participant started saying an approximation that sounded like “skull” instead of “skittle,” which did not result in reinforcement.

In Intervention B, picture exchange received low magnitude reinforcement and vocalizations received high magnitude reinforcement. Prior to the first session, the participant engaged in problem behavior, including crying and eloping from his area. The researcher waited until he was not engaging in problem behavior before starting the session. For the first session, the participant vocalized eleven times and exchanged the picture one time. During this session, the participant threw the chip for the first two trials when he received the lower magnitude. In the second session, he vocalized for 90% of trials and exchanged the picture for 10% of trials. In the third session, he vocalized for 50% of trials and exchanged the picture for 50% of trials. When he received the lower magnitude of the requested item, he threw it during two out of five trials.

He consumed the chip for four out of five trials; for one trial, he picked the chip off the floor and ate it.

In the fourth and fifth sessions of Intervention B, the data paths for vocalizations and picture exchanges crossed. The participant exchanged the picture for 100% of all trials and did not vocalize at all in both the fourth and fifth sessions. In the sixth session, he exchanged the picture 100% of trials and vocalized 10% of trials. Also, in the last trial of the sixth session, the participant exchanged the picture while vocalizing. Instead of implementing a changeover delay of 5 s, the researched reinforced the request with low magnitude of the requested item. For the seventh session, the participant vocalized and exchanged the picture at the same time for the last trial; the researcher implemented a changeover delay where neither response was reinforced; the participant then allocated his responding to the picture exchange. In the final session, the participant did not vocalize at all, and exchanged the picture 100% of all trials.

In the return to Intervention A, the participant allocated his responding to both picture exchange and vocalizations 50% of trials for the first session. In the second session, the participant allocated his responding to picture exchanges for 70% of trials and vocalized for 30% of trials. The participant exchanged the picture for 20% of trials and vocalized for 80% of trials in the third session. This can be attributed to carryover and a history of reinforcement from the previous intervention, where picture exchanges were reinforced with low magnitude reinforcement. In the last three sessions, the participant allocated his responding 100% of trials to vocalizations and 0% of trials to picture exchanges.

Overall, the participant was able to contact high magnitude of reinforcement. He showed a clear preference for allocating his responding to the communication modality that received the higher magnitude reinforcement.

CHAPTER 4

DISCUSSION

The results of this study showed that communicative responding occurred differentially to produce high magnitude reinforcement relative to low magnitude reinforcement. This relation was observed regardless of which communication strategy (vocalization or picture exchange) was paired with the high magnitude reinforcer.

To date, research on increasing vocalizations has involved delay to reinforcement (Greenberg et al., 2014; Cagliani et al., 2017; Cagliani et al., 2018) to elicit vocalizations during PECS. Research on the alteration of reinforcer magnitude involves individualized functional communication responses, aside from vocalizations, such as pressing a button (Neuringer, 1967; Reed, 1991) or touching a picture card (Lerman et al., 2002; Peterson et al., 2009). However, there is limited research on altering the reinforcement magnitude in order to elicit a particular communicative response. This study's findings extend the literature on both reinforcer magnitude and communication by demonstrating that altering the magnitude of reinforcement directly impacts the response allocation across two communication modalities.

Future studies can seek to alter reinforcer magnitude in order to increase vocalizations. The results of this study can be applied to other students who may not be allocating their responding to vocalizations, even though they are able to vocalize. Additionally, the results of this study show that in the future, it will be possible to study the effects of reinforcer magnitude in order to elicit a desired communicative response.

Limitations

One limitation of the study is that the contingency may not have been clear enough for the participant to understand from the beginning. The participant engaged in some problem

behavior during the first set of forced trials and during Intervention B, which could have been a result of not understanding the contingency.

Another limitation is that the study ended with reinforcing picture exchanges with high magnitude reinforcement. Since the participant in this study has the ability to vocalize, it is important to reinforce vocalizations at the end of the study. Future research should include another reversal, where vocalizations are reinforced with high magnitude reinforcement of the requested item. Returning to an intervention condition that reinforces vocalizations with high magnitude reinforcement should be built into the original study.

A third limitation is that data was not collected on rate of vocalizations outside of the study's conditions, both as a pre-assessment and post-assessment. The researcher relied on anecdotal evidence to support the claims that the participant had limited and inconsistent vocalizations prior to the study. In order to have more support for this claim, the researcher should have taken baseline levels of vocalizations by using a clicker to collect rate of vocalizations per day prior to the study. After the study was concluded, the researcher should have taken post-intervention data where rate of vocalizations was collected per day. If future research includes vocalizations as one of the options for the communications modalities, a pre-intervention and post-intervention data collection period vocalizations; speech and vocalizations are more socially valid and easily applicable in the communicate than exchanging pictures.

Future Research

Future research should include participants who can produce approximations for words. Using this procedure, researchers can shape approximations to become clearer vocalizations by altering the reinforcement magnitude. If participants in the future do not allocate responding to a communication modality that results in high magnitude reinforcement, a preference assessment should be conducted to assess preference of communication modality. It is possible that students

may prefer to allocate responding to a communication modality regardless of the magnitude. Some reasons to explain this could be due to a reinforcement history with one communication modality, response effort needed for one communication modality, or the preference for one communication modality is more reinforcing than a higher magnitude of reinforcement. In the future, running magnitude assessments throughout the study would be beneficial, since it is possible that preference for magnitude changes over time. This study only used edible reinforcers; however, future research can include leisure items as well. Instead of altering the size, researchers can alter the amount of time that the participant receives the item.

Future research should include collecting data on vocalizations or approximations both prior to the implementation of the study and after the study ends. Additionally, future research should build in maintenance of vocalizations after intervention has ended, and generalization of vocalizations to other settings. Future studies can include other communication modalities aside from picture exchange and vocalizations (e.g. Speech-Generating Device (SGD) or Microswitch). Future research can also include altering different factors of reinforcement, including quality, schedule of reinforcement, delay to reinforcement, etc. Expanding on the current reinforcement magnitude literature and using a variety of interventions will be beneficial to both children and adults who may have communication deficits.

Implications

As the research on altering reinforcement magnitude for response allocation and preference increases, this research can be applied to students who may have the ability to produce vocalizations but are not allocating their responding to speech. Altering the magnitude of requested items can be applied to different populations who have communication deficits.

REFERENCES

Boyle, C., Boulet, S., Schieve, L., Cohen, R., Blumberg, S., Yeargin-Allsopp, M., Visser, S., & Kogan, M. (2011). Trends in the prevalence of developmental disabilities in US children 1997-2008. *Pediatrics, 127*, 1034-1042.

Cagliani, R. R., Ayres, K.A., Whiteside, E., & Ringdahl, J.E. (2017). Picture exchange communication system and delay to reinforcement. *Journal of Developmental and Physical Disabilities, 29*, 925-939.

Cagliani, R.R., Ayres, K.A., Ringdahl, J.E., & Whiteside, E. (2018). The effects of delay to reinforcement and response effort on response variability for individuals with autism spectrum disorder. *Journal of Developmental and Physical Disabilities,* 1-17.

Catania, A.C. (1963). Concurrent performances: A baseline for the study of reinforcement magnitude. *Journal of the Experimental Analysis of Behavior, 6*(2), 299-300.

Cividini-Motta, C. & Ahearn, W.H. (2013). Effects of two variations of differential reinforcement on prompt dependence. *Journal of Applied Behavior Analysis, 46*, 640-650.

Fisher, W., Piazza, C.C., Bowman, L.G., Hagopian, L.P., Owens, J.C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*(2), 491-498.

Fiske, K.E., Cohen, A.P., Bamond, M.J., Delmolino, L., LaRue, R.H., & Sloman, K.N. (2014). The effects of magnitude-based differential reinforcement on skill acquisition of children with autism. *Journal of Behavioral Education, 23*, 470-487.

Fosset, B. & Mirenda, P. (2007). Augmentative and alternative communication. In S.L. Odom, R.H. Horner, M.E. Snell, & J. Blacher (Eds.), *Handbook of Developmental Disabilities*

(pp. 330-348). New York, NY: The Guilford Press.

Frost, L. & Bondy, A. (1994). The picture exchange communication system. *Focus on Autistic Behavior. 9*(3), 1-19.

Frost, L. & Bondy, A. (2001). The picture exchange communication system. *Behavior Modification, 25,* 725-744.

Ganz, J.B., Simpson, R.L., & Lund, E.M. (2012). The picture exchange communication system (PECS): A promising method for improving communication skills of learners with autism spectrum disorders. *Education and Training in Autism and Developmental Disabilities, 47,*(2), 176-186.

Greenberg, A.L., Tomaino, M.E., & Charlop, M.H. (2014). Adapting the picture exchange communication system to elicit vocalizations in children with autism. *Journal of Developmental and Physical Disabilities, 26*, 35-51.

Hausman, N.L., Ingvarsson, E.T., & Kahng, S. (2014). A comparison of reinforcement schedules to increase independent responding in individuals with intellectual disabilities. *Journal of Applied Behavior Analysis, 47*, 1-5.

Hernstein, R.J. (1964). Secondary reinforcement and rate of primary reinforcement. *Journal of the Experimental Analysis of Behavior, 7*, 27-36.

Hoch, H., McComas, J.J., Johnson, L., Faranda, N., Guenther, S.L. (2002). The effects of magnitude and quality of reinforcement on choice responding during play activities. *Journal of Applied Behavior Analysis, 35*(2), 171-181.

Karsten, A.M. & Carr, J.E. (2009). The effects of differential reinforcement of unprompted responding on skill acquisition of children with autism. *Journal of Applied Behavior Analysis, 42*, 327-334.

Lerman, D.C., Kelley, M.E., Vorndran, C.M., Kuhn, S.A.C., & LaRue, R.H. (2002).

Reinforcement magnitude and responding during treatment with differential reinforcement. *Journal of Applied Behavior Analysis, 34*(1), 29-48.

Mirenda, P. (2001). Autism, augmentative communication, and assistive technology: What do we really know? *Focus on Autism and Other Developmental Disabilities, 16*(3), 141-151.

Olenick, D.L. & Pear, J.J. (1980). Differential reinforcement of correct responses to probes and prompts in picture-name training with severely retarded children. *Journal of Applied Behavior Analysis, 13*(1), 77-89.

Peterson, S.M., Frieder, J.E., Smith, S.L., Quigley, S.P., & Van Norman, R.K. (2009). The effects of varying quality and duration of reinforcement on mands to work, mands for break, and problem behavior. *Education and Treatment of Children, 32*(4), 605-630.

Reed, P. (1991). Multiple determinants of the effects of reinforcement magnitude on free-operant response rates. *Journal of Experimental Analysis of Behavior, 55*(1), 109-123.

Schwartz, I.S., Garfinkle, A.N., & Bauer, J. (1998). The picture exchange communication system: Communicative outcomes for younger children with disabilities. *Topics in Early Childhood Special Education, 18*(3), 144-159.

Sulzer-Azaroff, B., Hoffman, A.O., Horton, C.B., Bondy, A., & Frost, L. (2009). The picture exchange communication system (PECS): What do the data say? *Focus on Autism and Other Developmental Disabilities, 24*(2), 89-103.

Tamara, K.R., Kamps, D.M., Kemmerer, K., & Potucek, J. (2002). Brief report: Increasing communication skills for an elementary-aged student with autism using the picture exchange communication system. *Journal of Autism and Developmental Disorders, 23*(3), 225-330.

Tincani, M. (2004). Comparing the picture exchange communication system and sign language training for children with autism. *Focus on Autism and Other Developmental*

Disabilities, 19(3), 152-163.

Touchette, P.E. & Howard, J.S. (1984). Errorless learning: Reinforcement contingencies and stimulus control transfer in delayed prompting. *Journal of Applied Behavior Analysis, 17*(2)*,* 175-18.

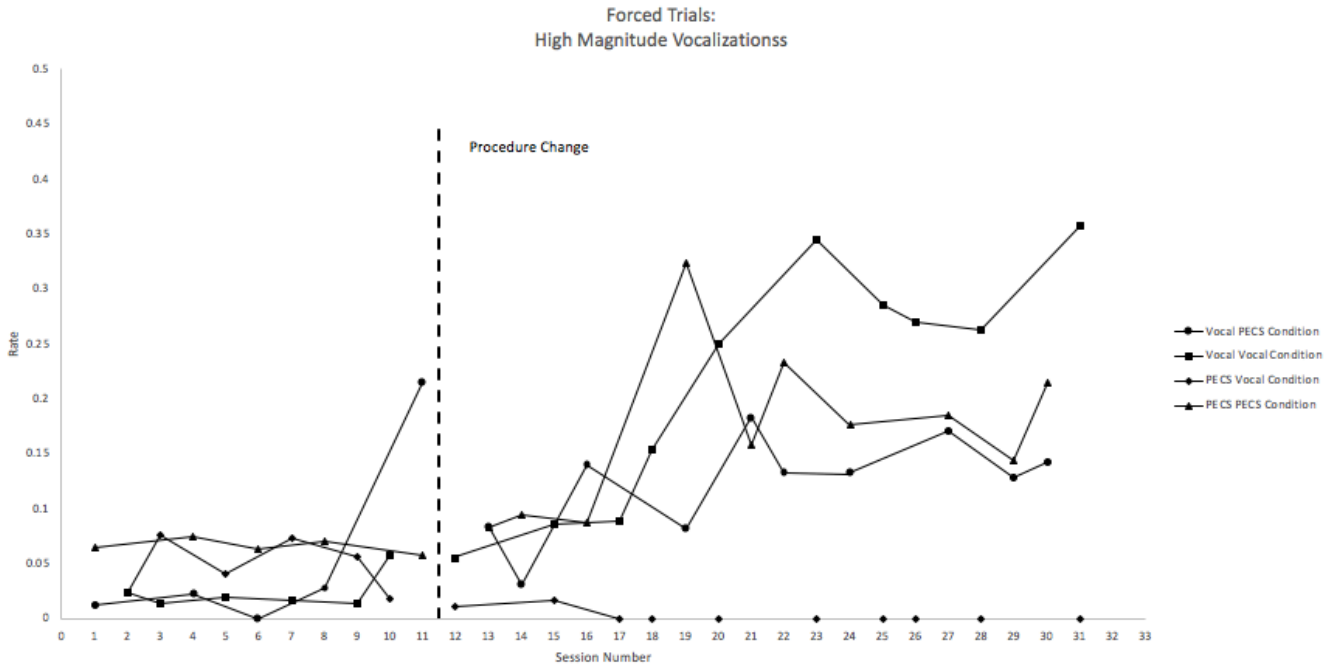

Figure 1. Rate of vocalizations and rate of picture exchange parsed out by the Picture Exchange condition and Vocalization conditions where vocalizations were reinforced with high magnitude reinforcement and picture exchanges were reinforced with low magnitude reinforcement. The black circles represent the rate of vocalizations in the Vocalization condition. The black squares represent the rate of vocalizations in the Picture Exchange condition. The black diamonds represent the rate of picture exchange in the Vocalization condition. The black triangles represent the rate of picture exchange in the Picture Exchange condition.

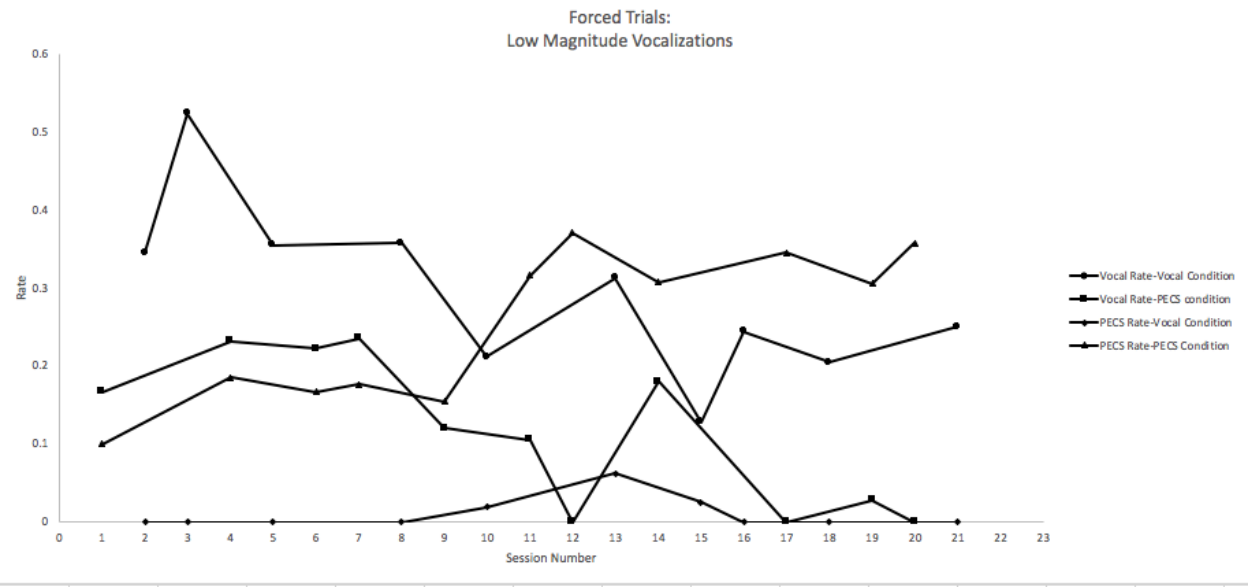

Figure 2. Rate of vocalizations and rate of picture exchange parsed out by the Picture Exchange condition and Vocalization conditions where vocalizations were reinforced with low magnitude reinforcement and picture exchanges were reinforced with high magnitude reinforcement. The black circles represent the rate of vocalizations in the Vocalization condition. The black squares represent the rate of vocalizations in the Picture Exchange condition. The black diamonds represent the rate of picture exchange in the Vocalization condition. The black triangles represent the rate of picture exchange in the Picture Exchange condition.

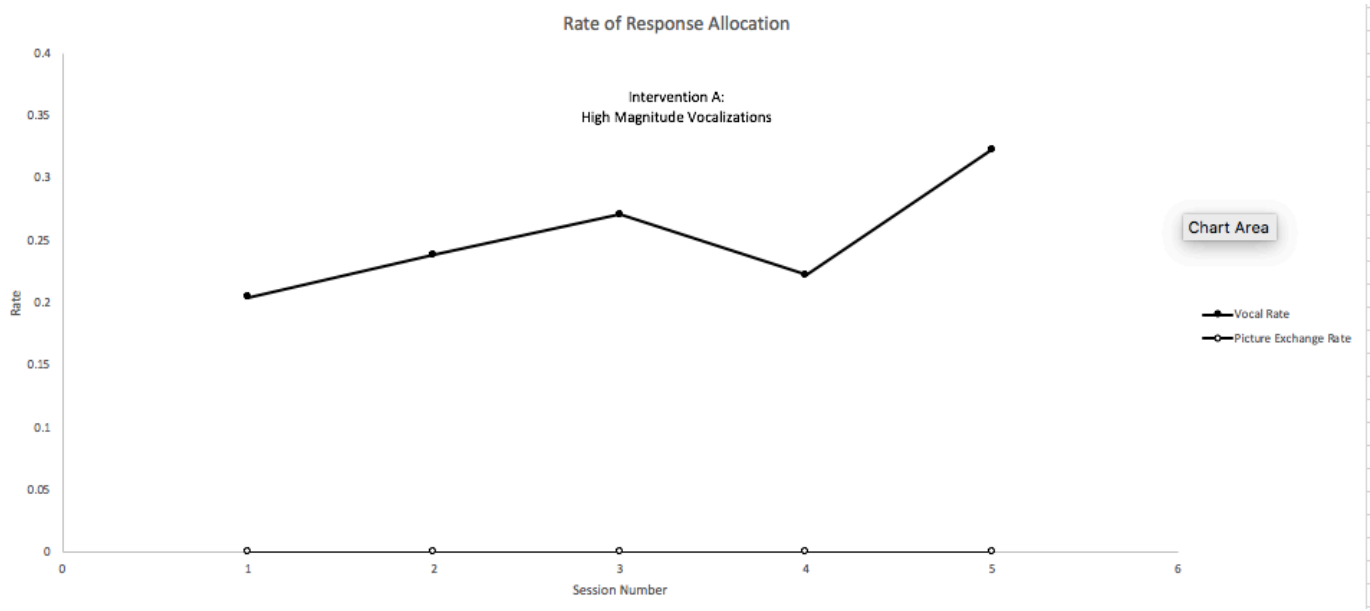

Figure 3. Rate of vocalizations and rate of picture exchange during Intervention A, where vocalizations were reinforced with high magnitude reinforcement and picture exchanges were reinforced with low magnitude reinforcement. The closed circles represent the rate of vocalizations and the open circles represent the rate of picture exchanges.

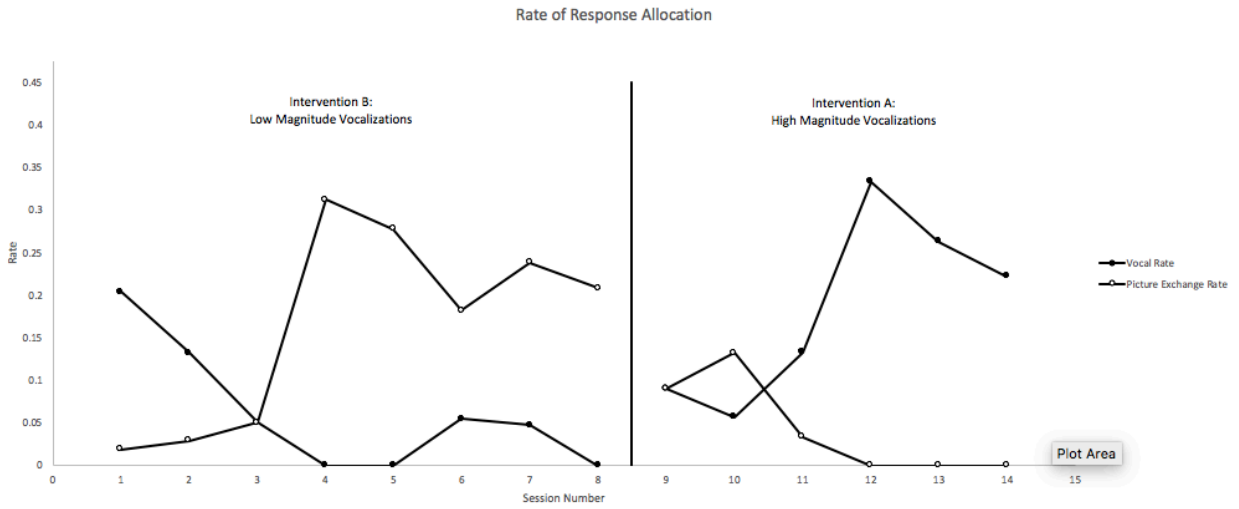

Figure 4. Rate of vocalizations and rate of picture exchange during Intervention B, where vocalizations were reinforced with low magnitude reinforcement and picture exchanges were reinforced with high magnitude reinforcement and Intervention A, where vocalizations were reinforced with high magnitude reinforcement and picture exchanges were reinforced with low magnitude reinforcement. The closed circles represent the rate of vocalizations and the open circles represent the rate of picture exchanges.

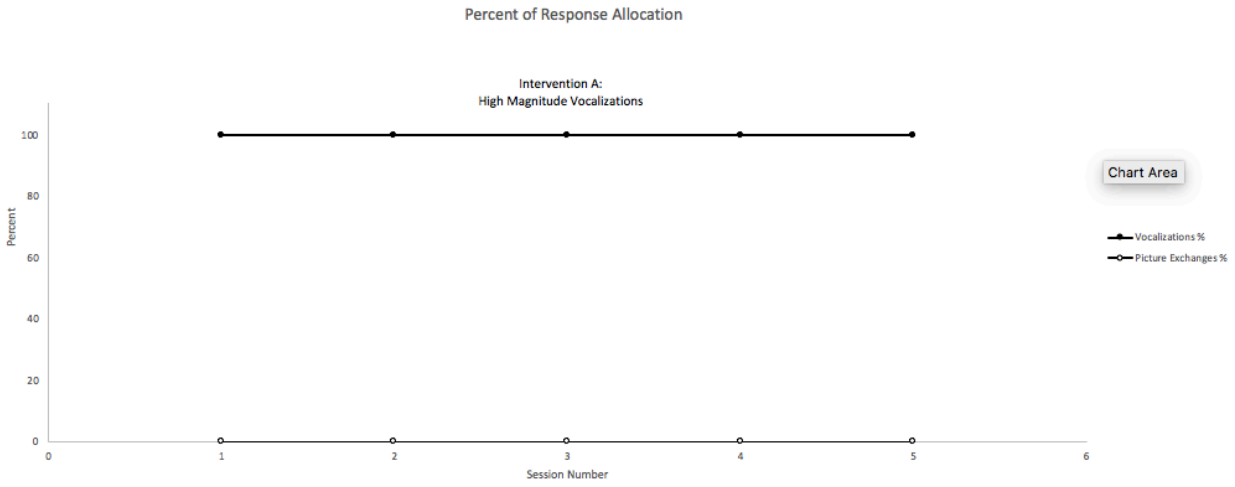

Figure 5. Percent of vocalizations per session and percent of picture exchange per session during Intervention A, where vocalizations were reinforced with high magnitude reinforcement and picture exchanges were reinforced with low magnitude reinforcement. The closed circles represent the percent of vocalizations and the open circles represent the percent of picture exchanges.

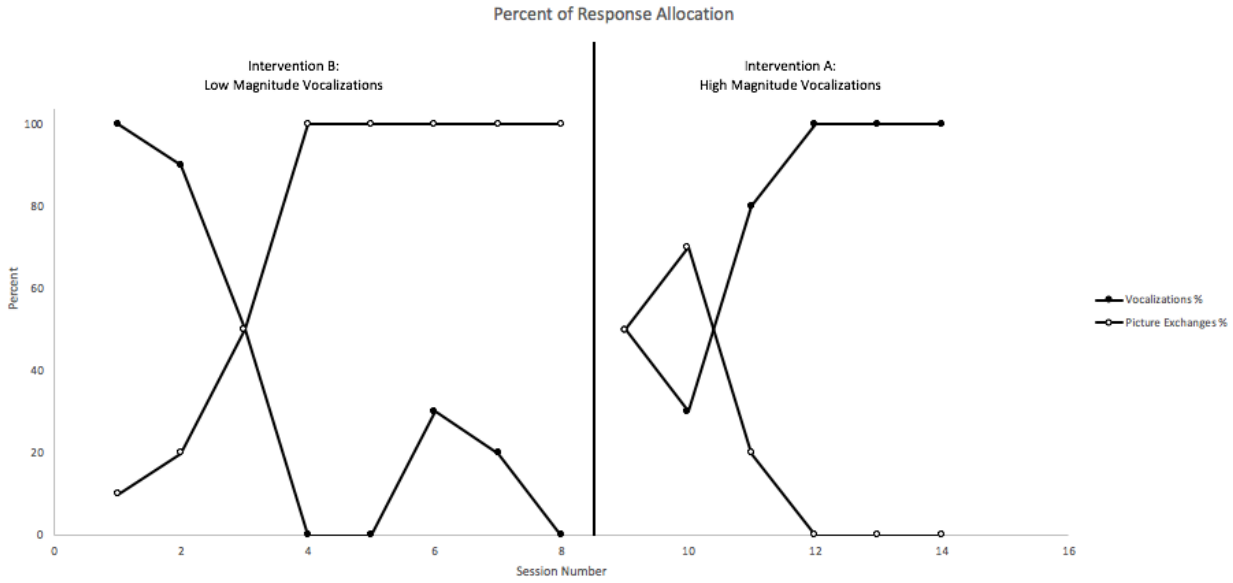

Figure 6. Percent of vocalizations per session and percent of picture exchange per session during Intervention B, where vocalizations were reinforced with low magnitude reinforcement and picture exchanges were reinforced with high magnitude reinforcement, and Intervention A, where vocalizations were reinforced with high magnitude reinforcement and picture exchanges were reinforced with low magnitude reinforcement. The closed circles represent the percent of vocalizations and the open circles represent the percent of picture exchanges.