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Evaluating the Efficacy of Shaping with a Percentile Schedule to Increase the Duration of Sustained Interaction Following a Bid for Joint Attention in Children with Autism

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Evaluating the Efficacy of Shaping with a Percentile Schedule of Reinforcement to Increase
Duration of Sustained interaction in Children Diagnosed with Autism

by

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A thesis proposal submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
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ABSTRACT

This study examined the use of shaping with a percentile schedule to increase the duration of the interaction following a bid for joint attention in children with autism. Specifically, the therapist initiated a bid for joint attention and reinforced longer successive approximations in seconds of sustained interaction with the therapist and activity. A percentile schedule ranked the most recent 10 observations and reinforcement was provided if the current observation equaled the sixth ranking. Most-to-least prompting was used if the child failed to meet the calculated criterion. Shaping with a percentile schedule of reinforcement was effective at increasing the duration of sustained interaction following a bid for joint attention, for all participants from an average baseline duration of 13 s to an average intervention duration of 215 s.

Chapter One: Introduction

Autism Spectrum Disorder (ASD) is becoming increasingly more prevalent, with current official statistics from The Autism and Developmental Disabilities Monitoring (ADDM) Network indicating that 1 in 88 children or on average 1% of the population is diagnosed with autism. Diagnoses have almost doubled since the 2002 estimate of 1 in 150 children. It is reported similarly regardless of race, ethnicity, or socioeconomic status, although it is diagnosed five times more in males than in females (Center for Disease Control and Prevention, 2012).

There are three major categories of symptoms that children with autism exhibit: language and communication delays, social interaction delays, and repetitive behaviors or stereotypy (Roome, 2011). Within the category of social delays is a skill called joint attention which is a triadic interaction, in which a person shares attention with another person in relation to an activity or event (Martins, Mateus, Osorio, Martins, & Soares, 2014). Joint attention is a precursor behavior that is fundamental for the development of social functioning (Charman, 2003). It begins to develop in neuro-typical infants around 9 months of age and continues development through the end of the first year (Striano, Stahl, & Cleveland, 2009). Children with autism often have delays in this area and joint attention behaviors (giving, showing, following gaze and point etc.) comprise a significant part of assessments that screen for autism (Charman, 2003). . Charman (2003) conducted a longitudinal study in young children with autism that showed that joint attention was positively associated with high levels of language and lower social and communication deficits.

Joint attention behaviors can be divided into two main categories (Striano et al., 2009). The first are responses to the behaviors or bids of others; for example, looking at an object that someone is pointing at. The second category is behaviors that initiate bids for attention from other people; for example, saying “look!” to get someone to look at an object. Several interventions are employed to teach these behaviors including peer training, direct instruction, and pivotal response treatment (PRT) techniques. (Jones, Carr, & Feeley, 2006; Pierce & Schreibman, 1995; Taylor & Hoch, 2008; Vismara & Lyons, 2007; Whalen & Schreibman, 2003; Zercher, Hunt, Schuler, & Webster, 2001). Although all of the studies showed positive effects on joint attention behaviors, direct instruction methods produced consistent, generalized responding with both preferred and non-preferred activities.

Because joint attention is crucial for social functioning by establishing a shared focus between two individuals and an object, it logically follows that the interaction ought to be sustained to increase its complexity and extend the duration. The role of attending in social interactions is to aid in the effective facilitation of social understanding. Jackson et al. (2003) showed that children with autism were significantly less likely to engaged in sustained play than children with mental retardation,

There is a lack of research in the area of the interaction that follows a response to a bid for joint attention. However, a number of studies have examined increasing play behaviors and thus extending duration of engagement irrespective of a bid for joint attention (Christie, Johnsen, & Peckover, 1998; Delano, & Snell, 2006; Machalicek, et al., 2009; Reignhartsen, Garfinkle, & Wolery, 2002). Social stories, activity schedules, child choice, and longer free play periods all demonstrated increased appropriate play behaviors and longer durations of engagement.

Franco, Davis, and Davis (2013) taught six non-verbal children with autism to engage in social interactions by teaching them to intentionally communicate during salient play routines. All children improved their ability to sustain social interaction. Sustained interaction was targeted as a component following an initiation or response to a bid for joint attention by Kamps et al. (1992). Three 7-year-old high functioning male students with autism participated in the study along with non-handicapped peers. Dependent variables included joint attention initiations, joint attention responses, interactions that followed as a result of the initiation-response sequence and a 21-item social skills rating scale. Social skills training occurred for the first half of each session. The researchers gathered post-training probes for the remaining half of the session. Feedback and followup conditions followed the training condition. The children with autism showed increases in the frequency of social behaviors and the duration of interaction and results maintained during follow-up.

Shaping has been shown to have a positive effect on a range of behaviors with both animal and human populations, but has yet to be used with joint attention. Shaping is the differential reinforcement of successive approximations of a target behavior (Cooper, Heron, & Heward, 2007). Four “Golden Rules” are fundamental to shaping (Galbicka, 1994). The first is differential reinforcement of operant behavior. The second is that the termination criterion must be defined. The third is that small steps must be used. Last is that movement, not position should be reinforced. For example, swimming 100 yards further than the prior approximation (movement) as opposed to swimming 800 yards (position).

Shaping has been used throughout the literature with both humans and animals. A range of target behaviors has been studied, including manipulating head-banging in monkeys (Schaefer, 1970), increasing compliance of horses entering a trailer (Ferguson & Rosales-Ruiz,

2001), increasing the height of arm extension in an international pole-vaulter (Scott, Scott, & Goldwater, 1997), increasing voice volume in young students (Fleece et al., 1981), increasing exhale durations as a preparatory measure for a smoking cessation study (Rae & Williams, 2002), and improving stimulus discrimination in children with developmental disabilities (Mosk & Bucher, 1984). Each of these studies has resulted in positive outcomes through the use of shaping.

Although the efficacy of shaping has been established, prior to the development of percentile schedules of reinforcement, what was missing with regards to shaping was any formalized way of implementing the four “golden rules;” namely, establishing successive criteria such that a sufficiently large portion of responses are reinforced, making sure that the criteria are relative, and sensitive to current behavior, and that reinforcement is provided objectively, consistently, and intermittently (Galbicka, 1994). Platt (1973) developed a quantitative method called the percentile schedule of reinforcement as an answer to this lack of precision in shaping techniques. Specifically, it allows for the calculation of precise criterion levels for reinforcement through the output of the mathematical equation: $k=(m+1)(1-w)$, where w denotes the density of reinforcement and m indicates the number of recent observations to be taken into consideration. The output, k , is the ranked response of the included observations in the calculation, that the current response must surpass in order to access reinforcement (Athens, Vollmer, & St. Peter Pipkin, 2007).

These variables are much better illustrated through an example. The target behavior will be swimming, measured through distance in meters swam without stopping in a given observation. The value of w will be placed at 0.5, meaning that half of the participant’s responses should meet criterion for reinforcement (Athens et al., 2007). This value has been used in the

successful implementation of percentile schedules in previous investigations (Lamb, Morral, Kirby, Iguchi & Galbicka, 2004). The five most recent observations of swimming distance will be included. These are: 100M, 325M, 50M, 200M, and 250M. These observations are ranked from least to most: 50M, 100M, 200M, 250M, and 325M. Then m is given the value of 5 in the equation, thus making it $k=(5+1)(1-0.5)$. Solving this equation gives: $k=(6)(0.5)$, $k=3$. The value of k equaling three means that the third ranked distance is the one that must be surpassed in the current observation in order for reinforcement to be contacted. In this case, the third ranked distance is 200M, so if the individual swims more than 200M consecutively, his swimming will be reinforced. Any consecutive swim that is a distance of 200M or less will not be reinforced (Athens et al., 2007).

A few studies to date, across a range of behaviors, such as addiction, eye contact, task engagement, and behavioral variability, have begun investigating the value and effectiveness of percentile schedules of reinforcement (Athens et al., 2007; Hall, DeBernardis & Reiss, 2006; Lamb et al., 2004; Miller & Neuringer, 2000). Miller and Neuringer (2000) used a percentile schedule to increase variability in behavior, a property of behavior that allows for novel and adaptive behavior to emerge. The activity the subjects engaged in was a computer game involving left and right responses. The use of a percentile schedule, in which only variable responses were reinforced was compared to phases in which 50% of trials were reinforced, regardless of variability. Results showed that variability was significantly higher in the percentile condition than in the 50% reinforcement condition.

The utility of the percentile schedule was also examined by Athens et al. (2007) and Hall et al. (2007) to increase duration of academic task engagement and increase eye contact in

children with Fragile X Syndrome, respectively. Both studies had positive outcomes through the use of a percentile schedule.

Percentile schedules have been used successfully with other target behaviors, and because they have not been evaluated to increase joint and sustained interaction, it is possible that they might be useful. In addition, although joint attention responses have been targeted in several different ways, extending or sustaining the duration of attention following a bid for joint attention, has not yet been targeted. In order to have a social interaction with someone, it is crucial to not only establish, but to sustain joint attention. Sustaining joint attention is the minimal requirement for successful conversation (Campbell, 1998). Because shaping has been successful with such a wide variety of behaviors, it was hypothesized that shaping might be effective at increasing the duration of sustained interaction. The purpose of this study was to use shaping with a percentile schedule of reinforcement to increase the duration of sustained interaction, following a bid for joint attention in children with autism. In order to provide a systematic, objective intervention, a percentile schedule was used to determine when the observations met the criterion for reinforcement.

Chapter Two: Method

Participants and Setting

The participants in this study were three children, ages 5 to 10, diagnosed with autism. HJ was 10 years old, verbal, spoke in full sentences, had completed the VB-MAPP grid and performed academically at a neurotypical 2nd grade level. He had been receiving ABA therapy for five years. MC was 10 years old, verbal, spoke in full sentences, had completed the VB-MAPP grid and performed academically at a neurotypical 1st-2nd grade level. He had been receiving ABA therapy for over 8 years. CL was 5 years old, had a large vocabulary repertoire, but mainly used 1-3 word phrases to communicate, and performed academically at a neurotypical preschool grade level. He had been receiving ABA therapy for just over 1 year. All participants had demonstrated the ability to engage in joint attention prior to the study, but failed to demonstrate the behavior consistently.

They were selected from a local behavior clinic where they receive therapy services. Children were chosen for participation based on identification of a lack of joint and sustained interaction from the child's therapist. Children were not included if they had severe or intrusive behavior problems that would have interfered with the study. A behavior analyst working at the clinic, who knew each of the children aided in the selection process. Informed consent was obtained from the parents prior to doing anything with the child.

The study took place at a local behavior clinic during hours that each child was scheduled for therapy services. To prevent distractions, the trials took place in a private therapy room that was 5 x 2.6 m. The children all had prior exposure to this room.

Materials

All trials were video recorded using a Sony Cybershot camera for the purpose of determining interobserver agreement (IOA). The games, activities, and reinforcers that were included were found at the clinic.

Target Behaviors and Data Collection

The target behaviors were joint attention and sustained interaction. Joint attention is the shared focus of two individuals on an object or activity (Charman, 2003). Behaviorally, “focus” in the joint attention definition was defined by the observable behaviors of eye contact toward therapist and/or activity, and body positioning/orientation toward therapist and/or activity. In particular, the frequency of responding to bids for joint attention was measured and defined as given a verbal stimulus from the therapist (*i.e.*, “Come play this game with me!”), the child would make eye contact with the activity indicated by the bid. He or she had 5 s from the time that the verbal stimulus was given to respond to the bid.

Sustained interaction referred to the length of time in seconds following the response to the bid for joint attention that the child approached, and appropriately engaged with the activity and the therapist. Onset was when the child made eye contact with the activity and/or therapist. (Appropriately engaging in the activity was defined as behaviors that were relevant to the activity and the bid for joint attention. For example, if the bid for joint attention was “Come play with Pop the Pig,” appropriate topographies included rolling the dice, watching the therapist play with the game, tacting the numbers or colors etc. See Appendix B for additional examples. Offset

was when the child ceased appropriate engagement with the activity for more than 3 s and/or the distance between the child and therapist increased beyond 1 m and/or the child engaged in inappropriate/problem behavior for more than 3 s (i.e., throwing the toys).

Responses to the bid for joint attention were collected for each trial (occurrence/nonoccurrence). A maximum of 10 trials were collected on a given day. Duration was recorded in seconds for each of the interactions and the predetermined criterion according to the percentile schedule calculation was indicated on the data sheet for the upcoming trial. In addition, if the child received reinforcement following a trial, it was indicated by a checkmark on the data sheet. If the child received prompting following a trial, it was also indicated by a checkmark in a separate column on the data sheet. See Appendix A.

Interobserver Agreement

Interobserver agreement (IOA) was calculated during baseline and intervention phases. It was collected for a minimum of 33% of trials. An additional trained therapist watched the recorded trials and indicated whether the child responded to the bid for joint attention, the duration of the interaction, the percentile formula calculations, and the consequence following the trial, namely prompting or reinforcement.

Agreement for responding to the bid for joint attention occurred when both therapists recorded the occurrence of the behavior or the nonoccurrence of the behavior. A disagreement occurred when one therapist recorded an occurrence and the other therapist recorded a nonoccurrence. Average IOA was calculated by dividing the number of agreements by the number of opportunities for agreement. For HJ, IOA was collected for 33% of intervention trials and agreement was 100%. For MC, IOA was collected for 38% of intervention trials and

agreement was 100%. For CL, IOA was collected for 35% of intervention trials, and agreement was 100%.

IOA for duration of the interaction was calculated between the two therapists for each trial. The lower number of seconds was divided by the higher number of seconds. For HJ, IOA was collected for 38% of trials and average agreement was 97%. For MC, IOA was collected for 37% of trials and average agreement was 99%. For CL, IOA was collected for 35% of trials and average agreement was 97%.

Design and Procedure

A multiple baseline across participants design was used to evaluate the effects of shaping with a percentile schedule of reinforcement on duration of sustained interaction and responses to bids for joint attention.

Percentile schedule. The percentile schedule formula was calculated through an Excel worksheet for each trial. The reinforcement density, w , was set to 0.5 and the number of recent observations, m , taken into consideration for each calculation was 10. Thus for each trial, the, k , value was equal to 5.5, but for simplicity, this was rounded to the nearest whole number, 6.

The most recent 10 observations were ranked from shortest to longest duration. In order for reinforcement to be delivered, the current joint attention observation needed to be equal or greater than the sixth ranked duration. For example, if the current joint attention observation was 3 s and given these ten ranked observations 1 s, 1 s, 2 s, 2 s, 2 s, 3 s, 4 s, 4 s, 6 s, 6 s, the current joint attention observation equals the sixth ranked duration (3) then reinforcement would be delivered to the child. The formula was calculated before each trial had begun so that prompting or reinforcement could be delivered immediately.

Therapist training. Although the majority of the trials were conducted by the main therapist/researcher, other highly trained and qualified therapists at the clinic conducted some of the trials. All therapists completed an intensive training and passed ongoing comprehensive exams required by the verbal behavior clinic to ensure they were qualified to work with the children. A behavioral skills training approach was employed to teach the therapists how to run the trials. The purpose and procedures were first explained to the therapist and then a sample trial was modeled to give a concrete example of the prior explanation. The leading therapist then watched the additional therapists rehearse the steps and provided both positive and corrective feedback. These steps continued until the therapist was proficient in running the trials. Proficiency was defined as three consecutive trials at 100% accuracy.

Preference assessment. A multiple stimulus without replacement preference assessment (DeLeon & Iwata, 1996) was completed prior to the study for both potential reinforcers and activities. For the reinforcers, seven edible items reported by the parents or the child's therapist as preferred were presented to the child. He or she was instructed to "pick one." Upon selection, all of the items were removed. The remaining items continued to be represented until all of the items had been selected. They were ranked according to the order in which they were chosen and the top three items were used as potential reinforcers for the child to choose from prior to each trial.

The same process occurred for activities, except that 10 activities were evaluated. Once the activities were ranked, the five lowest ones were chosen as activities that would be included for that particular child. The purpose was to select middle to low preferred activities; as these were activities in which the child might be less likely to engage in joint and sustained interaction.

Baseline. All of the five activities were spread out across the room. Only the child and the therapist were in the room. The child was able to walk around the room for 5 min before the first trial occurred. Then the therapist placed a vocal bid for joint attention, such as “Come look at this!” The child had 5 s to begin engaging in joint attention by making eye contact with the activity. If the child responded, the trial was marked with a plus (+) and the stopwatch began to record duration. Duration was recorded until the child moved more than 3 ft from the therapist or ceased eye contact with the activity or therapist for more than 3 s. If the child did not respond to the bid, the trial was marked with a minus (-) and duration was scored as 0 s. No reinforcement or prompting was provided following the trial. Once the therapist began recording duration, he or she provided comments regarding the activity on average every 4 s. See Appendix B for examples of activities and associated comments. The child could not be currently playing with the item that the therapist used for the bid. A minimum of 30 s occurred in-between trials and no more than 10 trials were run in a given day. Duration in seconds was graphed and baseline trials continued until stable.

Intervention. Once baseline trials stabilized, intervention trials were conducted. The setting was contrived in the same way as in baseline, with the same five activities. Three of the highly preferred edible activities were also available for reinforcement. Prior to the beginning of the trial, the therapist placed the edibles in front of the child and asked what he or she would like to work for. In addition, the percentile schedule formula was calculated to determine the number of seconds that the interaction must equal for the child to receive reinforcement. For each trial, the therapist placed a bid for joint attention. The child had 5 s to respond to the bid for joint attention. If the child responded and the duration of the interaction met the sixth ranked duration, reinforcement was delivered. The child was provided the chosen edible along with praise

immediately. The child was allowed to continue to interact with the activity until termination criteria were met. Termination criteria were defined as the child removing eye contact for 3 or more s, moving 3 or more ft away from the activity for 3 or more s, engaging in inappropriate/problem behavior for 3 or more s, or 15 min of consecutive engagement with the activity. If the child did not respond to the bid or the duration did not equal the sixth ranked duration established by the percentile schedule, an error correction procedure followed. The bid was repeated and the therapist approached the child, guided him/her to the activity and used hand-over-hand prompting to engage with the activity and therapist for the required duration. Prompting faded as the child increased independence with the activity. Namely, if the participant began to play with the toy, hand over hand prompting was faded to partial prompting, then gestural. Praise was provided following the prompting procedure. A transfer trial immediately followed, in which the child was given the prompt for joint attention again with the same activity. If needed the therapist used most-to-least prompting, beginning with hand-over-hand and fading to a gestural prompt as the child increased independence with the activity. If the transfer trial was completed without prompting, both the edible and praise were delivered. If prompting was required, however, only praise was used for reinforcement. Throughout the intervention phase, prompting was only required for one participant during one trial. Following the prompting procedure, he completed the transfer trial successfully.

In each trial, as in baseline, once the child responded to the bid for joint attention, the therapist provided comments regarding the activity an average of every 4 s (See Appendix B for examples). The activity for which the bid was given was randomly rotated and the percentile formula was calculated prior to each trial to provide a fluid criterion measure that fluctuated with

current responding. As in baseline, no more than 10 trials were conducted on any given day and a minimum of 30 s occurred between trials.

Post intervention preference assessment. Following the intervention phase, a multiple stimulus without replacement preference assessment was completed for each child utilizing the same activities from the preference assessment completed prior to the study. The purpose of the preference assessment was to test whether the activities designated mid to low preference in the first assessment had increased in preference for the participant.

Maintenance. Four extinction sessions were conducted, in which the bid for joint attention was provided, but no reinforcement or prompting followed (i.e. identical to baseline). The purpose of the extinction sessions was to test whether the duration of the interaction had increased relative to baseline, suggesting that the activities had increased in reinforcer value. The termination criteria were the same as in the intervention phase with the exception that the continuous engagement criteria were set at the last reinforcement criterion time for each participant (i.e., 477 s for HJ, 299 s for MC, and 110 s for CL).

Treatment Integrity

To determine treatment integrity for the percentile schedule formula calculation, a second therapist entered the prior observation duration into the Excel worksheet, performed the calculation and determined the sixth ranked duration that the next trial must equal to contact reinforcement. Agreement was defined as both therapists indicating the same number, and disagreement was the therapists indicating different numbers. Agreement was calculated by dividing the number of agreements by the number of opportunities for agreement. Agreement for all participants was 100%.

In addition, the second therapist checked the column for either reinforcement or prompting depending upon whether the current observation fell below or above the sixth ranked duration. An agreement was defined as both therapists checking the same columns and a disagreement was defined as the therapists checking different columns. Agreement was calculated by dividing the total number of agreements by the total number of opportunities for agreement. Agreement for all participants was 100%.

Social Validity Measures

Social validity measures were collected for each of the participants following baseline and intervention phases. The last three baseline trials and the last three intervention trials were randomly presented for each child's parents to view. The camera was set at an angle that gave the parents an optimum view of the interaction. They were not told which phase they were watching during each video to increase objectivity. A relevant statement along with a likert scale (strongly disagree to strongly agree) was given to the parents to score. The statements evaluated the importance of joint attention and sustained interaction (1-strongly disagree, 5-strongly agree) as socially significant and valid behaviors, and how pleased they were with the degree of sustained interaction their child exhibited in each of the videos (1-strongly disagree, 5-strongly agree). See Appendix C for the data sheet.

Chapter Three: Results

Figure 1 shows the duration of sustained interaction, following a bid for joint attention for each participant in baseline, intervention, and maintenance. During baseline, HJ responded to the bid for joint attention in 60% of the trials and sustained the interaction with the activity for an average of 19.5 s, with a range of 0-126 s. During intervention, HJ responded to the bid for joint attention in 100% of the trials and sustained the interaction with the activity for an average of 303 s, with a range of 67-600 s. During the maintenance phase, HJ responded to all bids for joint attention and met the 500 s termination criterion for all 3 trials. HJ met all criteria for reinforcement as determined by the percentile schedule, with the exception of one trial.

During baseline, MC responded to the bid for joint attention in 29% of the trials and sustained the interaction with the activity for an average of 14 s, with a range of 0-146 s. During intervention, MC responded to the bid for joint attention in 100% of the trials and sustained the interaction with the activity for an average of 225 s, with a range of 16-448 s. During the maintenance phase, MC responded to all bids for joint attention and met the 330 s termination criterion for all 4 trials. MC met all criteria for reinforcement as determined by the percentile schedule. Both HJ and MC showed some variability and often exceeded the reinforcement criterion by continuing to engage in the activity after receiving reinforcement.

During baseline, CL responded to the bid for joint attention in 15% of the trials and sustained the interaction with the activity for an average of 5 s, with a range of 0-67 s. During intervention, CL responded to the bid for joint attention in 100% of the trials, and sustained the

interaction with the activity for an average of 117 s, with a range of 47-338 s. During the maintenance phase, CL responded to all bids for joint attention and met the 120 s termination criterion for all 4 trials. CL met all criteria for reinforcement as determined by the percentile schedule.

Table 1 shows the data for the pre-baseline and post-intervention preference assessments. For all participants, activities ranked 6-10 in the pre-baseline assessment were used for baseline and intervention trials. In HJ's post-intervention preference assessment, Blocks moved from position 8 to position 3 and Zingo moved from position 10 to position 5. In MC's post-intervention preference assessment, Tinker Toys moved from position 8 to position 4, Connect4 moved from position 6 to position 3, and Blocks moved from position 10 to position 1. In CL's post-intervention preference assessment, Puzzles moved from position 8 to position 5, Drawing moved from position 9 to position 4, and Tinker Toys moved from position 10 to position 3. To test the social validity of the study, a parent (for HJ, his mom; for MC, his dad; and for CL, his mom) was asked to first rank the importance of both joint and sustained attention (1-strongly disagree to 5-strongly agree) and then they were presented with 6 videos, 3 baseline and 3 intervention. They were presented in random order and for each video, the caregiver was asked to rate the degree to which they were pleased with the interaction shown in the video (1-strongly disagree to 5-strongly agree). For HJ, the importance of each of the behaviors was rated as a 5. The degree of interaction in the baseline videos was rated an average of 2.3 and the degree of interaction in the intervention videos was rated an average of 5. For MC, the importance of each of the behaviors was rated as a 5. The degree of interaction in the baseline videos was rated an average of 2 and the degree of interaction in the intervention videos was rated an average of 5. For CL, the importance of the behaviors was rated as an average of 4.5. The degree of interaction

in the baseline videos was rated an average of 1 and the degree of interaction in the intervention videos was rated an average of 5.

Table 1*Results from the Pre and Post Preference Assessments*

HJ Pre	HJ Post	MC Pre	MC Post	CL Pre	CL Post
Pop Pig	Pop Pig	Break Ice	Blocks	AB Track	Car Track
Break Ice	Connect4	HiHo	HiHo	Car Track	Bowling
Sword Game	Blocks	Sword Game	Connect4	Ball Toys	Tinker Toys
Ship Game	Sword Game	Pop Pig	Tinker Toys	Shape Sorter	Drawing
Connect4	Zingo	Ship Game	Sword Game	Bowling	Puzzles
Tinker Toys	Ship Game	Connect4	Jenga	Jenga	AB Track
HiHo	Tinker Toys	Jenga	Zingo	Blocks	Shape Sorter
Blocks	Break Ice	Zingo	Pop Pig	Puzzles	Jenga
Jenga	HiHo	Tinker Toys	Break Ice	Drawing	Ball Toys
Zingo	Jenga	Blocks	Ship Game	Tinker Toys	Blocks

Note. Shaded words represent games that moved from bottom five to top five during the pre and post preference assessment

Figure 1

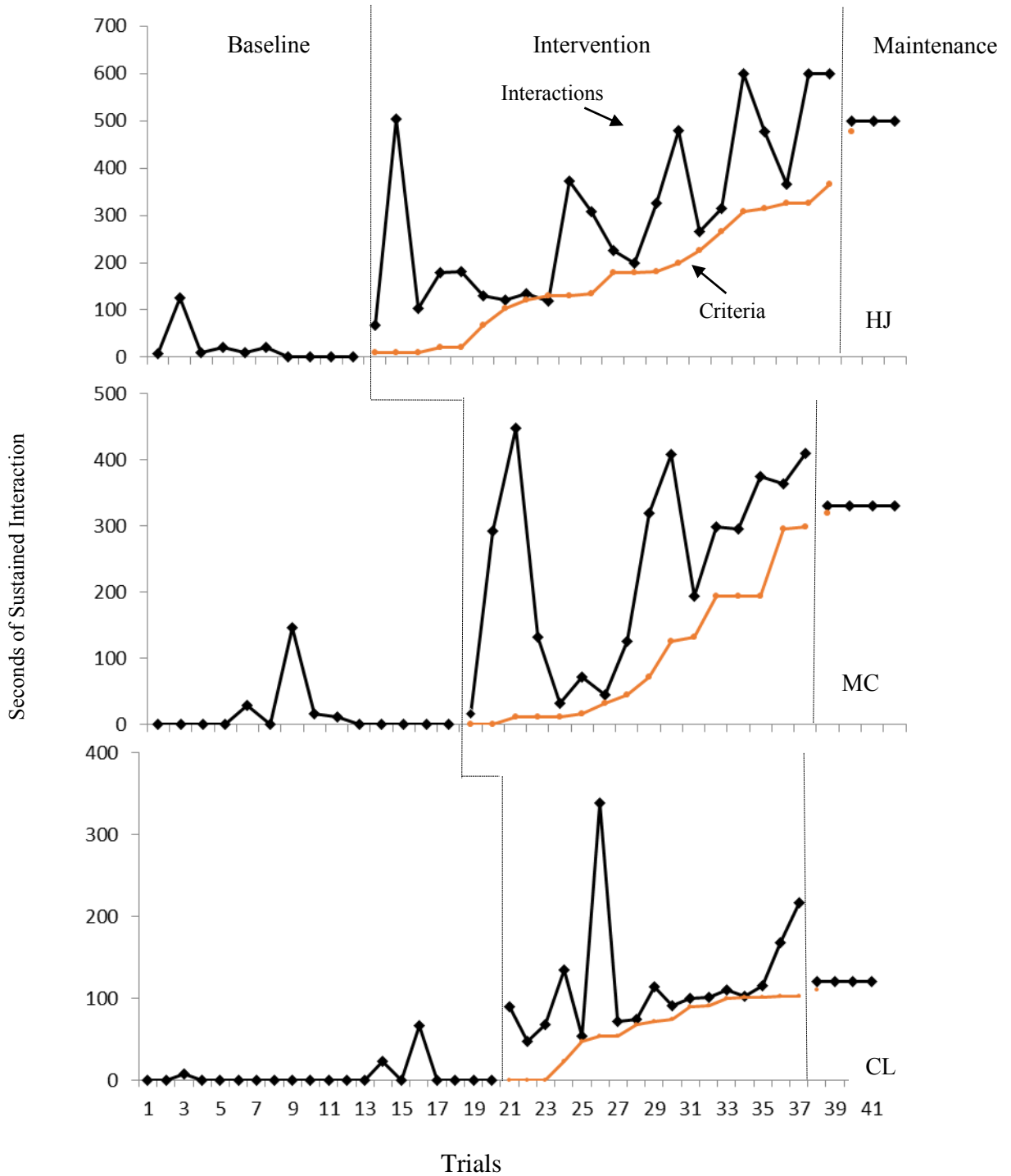


Figure 1. Duration in seconds of sustained interaction following a bid for joint attention, across baseline and intervention phases for each child. The red line indicates the criteria for reinforcement determined by the percentile schedule.

Chapter Four: Discussion

The current study evaluated the efficacy of shaping with a percentile schedule of reinforcement to increase the duration of sustained interaction following a bid for joint attention in children with autism. All three participants showed low durations of sustained interaction in baseline. Once shaping with a percentile schedule of reinforcement was implemented, all three participants showed gradual, but steady and significant improvement in sustained interaction following a bid for joint attention. The use of shaping with a percentile schedule, although it has never been used to increase the duration of sustained interaction, showed similar results as in Athens et al. (2007) and Hall et al. (2007). Durations increased slowly, along with each criterion, fluctuating with current behavior, but showing overall steady improvement. This study added to the current body of literature for both shaping and the percentile schedule as an effective intervention for increasing the target behaviors, namely frequency of joint attention and duration of sustained interaction. Not only did the target behaviors increase during the intervention phase, but they continued to occur in the absence of reinforcement or prompting during the maintenance phase.

All criteria were met during the intervention phase with the exception of one data point in which prompting was used to help the participant meet the criterion. Meeting all criteria showed that the percentile schedule calculations allowed two of the three participants to contact reinforcement during every trial following baseline and allowed the first participant to contact reinforcement 19 out of 20 trials following baseline, suggesting that the percentile schedule

allowed for the maximum density of reinforcement. In addition, it was effective at slowly increasing the length of time the children interacted with mid to low preference items.

All three participants showed variability in their data due to the fact that once reinforcement was delivered, the trial was not immediately terminated. The reason for this was that terminating the interaction immediately following delivery of reinforcement would have caused an artificial ceiling. Instead, the interaction was continued until one or more of the termination criteria were observed. Once one or more of the termination criteria were observed, the therapist ended the interaction and the entire duration was added to the percentile calculations for the next trial. Because of variability in the data, longer durations caused the criteria to increase at a faster rate and shorter durations caused the criteria to increase at a slower rate. Each participant, therefore, had different rates of progress throughout the study. The percentile schedule allowed the participants to move at their own pace, depending on their individual levels of functioning and fluctuations in behavior. However, it was effective at substantially increasing frequency of responding to the bid for joint attention, extending the duration of sustained interaction following the bid, and maintaining the final criterion for each of the participants.

For the sustained interaction definition, a variety of behaviors were considered appropriate. These behaviors included: watching the activity/therapist while the therapist played with it, playing with the game according to the specified rules (including turn taking etc.), and creative play with the activity (e.g. for Jenga, building a tower similar to blocks as opposed to playing the game by the rules). The main parameters for determining sustained interaction were eye contact with the therapist/activity, physical proximity of participant to the therapist/activity, and the absence of destructive play with the activity/absence of problem behavior during the interaction as a whole.

Preference assessments were conducted for all three participants prior to baseline and immediately following intervention. The same activities were used in both assessments and ranked according to the order in which the child chose the activities. Prior to baseline, the lowest ranked 5 activities were used for the study. Post-intervention, 2-3 of those activities, for each of the participants, had shifted in preference and moved from the bottom 5 to the top 5. This shift suggests that interactions with some of the activities had potentially increased in reinforcing value as a result of the study. Another possibility is that through the interactions with the activities, the participants learned new, fun, ways to engage with the activities, which also potentially increased their reinforcing value.

The maintenance phase showed that the skill of engaging in sustained interaction had increased and would maintain in the absence of prompting and reinforcement. Furthermore, in addition to the post preference assessment, it suggested an increase in reinforcing value of some of the activities. The reason for this hypothesis is that the maintenance phase replicated baseline, but produced 100% response to the bid and during the trials all three participants reached the duration that had been their final criterion at the end of the intervention phase.

While the study had many strengths, there were a few limitations. This study included only three participants. Although it was effective for all three participants, future research should replicate the study to ensure that it is effective for children of different ages and different verbal repertoires. In addition, all of the participants were diagnosed with autism. Even though they were each at different levels of functioning, the study should be replicated with other diagnoses and typically developing individuals to test the effects.

While the preference assessment showed a shift in preference for some of the activities for all participants, it is possible that this shift was due in part to lack of sampling/exposure to the

activities prior to the preference assessment. While all the activities had been available to the participants for use in the clinic, whether or not they had actually sampled the activities before was not taken into consideration. However, when they had the opportunity in baseline to engage with the activities they rarely did.

Another limitation is that the percentile schedule typically produces gradual change in behavior, which can be time consuming. Each trial did not always result in a longer duration than the prior trial, but fluctuated with current responding. HJ would often contact reinforcement and continue the interaction producing longer durations that allowed the percentile schedule to increase at a faster rate, while CL generally would contact reinforcement and immediately engage in one or more of the termination criteria causing the percentile schedule for his behavior to increase at a slower rate. Although it can take longer for a dimension of behavior to change with a percentile schedule, it allows for more frequent contact of reinforcement, which could potentially produce a greater change in behavior overall.

Future research should not only replicate this study, but might consider utilizing shaping with a percentile schedule to change the dimension of other behaviors. To date, very few studies have evaluated the percentile schedule as an effective measurement system that provides structure and symmetry to shaping. As it has been shown to increase several dimensions including frequency, variability and duration, the percentile schedule has the potential to change behavior as it is individualized, fluctuates with current responding, and allows for maximal contact of reinforcement.

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APPENDICES

Appendix A

Joint/Sustained Attention Data Sheet

Child: _____

Date/ Therapist Initials	Responding to Bid Plus (+) or Minus (-)	Duration Needed: Percentile Schedule	Duration of Current Observation	Reinforcement Provided	Prompting Provided
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Appendix B

Examples of Activities, Associated Comments, and Topographies of Interaction

Activity	Associated Comments	Topographies of Interaction
Car/Car Ramp	<p>“This is a red car.”</p> <p>“A car says vroom vroom.”</p> <p>“A car has a steering wheel”</p> <p>“I’m pushing the car down the ramp.”</p> <p>“You drive a car.”</p>	<p>-Pushing the car</p> <p>-Watching the therapist push the car</p> <p>-Making car sounds</p> <p>-Handing car to therapist/taking car from therapist</p> <p>-Moving parts of the car; wheels/steering wheel/doors etc.</p>
Pop the Pig	<p>“A pig says oink oink”</p> <p>“A pig is pink”</p> <p>“This is a number 4”</p> <p>“I’m pressing his head 4 times.”</p> <p>“Burgers are yummy.”</p>	<p>-Rolling the dice</p> <p>-Tacting the colors or numbers</p> <p>-Putting the pieces in the pigs mouth</p> <p>-Watching the therapist play with the toy</p> <p>-Pressing the pig’s head</p>
Blocks	<p>“We stack the blocks”</p> <p>“This is a square.”</p>	<p>-Stacking the blocks</p> <p>-Knocking them over</p>

	<p>“I’m putting all the blue blocks together.”</p> <p>“I’m knocking them over.”</p> <p>“Lets line them up.”</p>	<p>-Watching the therapist play with the blocks</p> <p>-Building something with the blocks</p> <p>-Handing the blocks to the therapist</p>
Magnadoodle	<p>“This is a pen.”</p> <p>“Scribble!”</p> <p>“Let’s erase.”</p> <p>“I’m going to draw a house.”</p> <p>“Slide the button over.”</p>	<p>-Scribbling with the pen</p> <p>-Erasing</p> <p>-Watching the therapist draw</p> <p>-Manipulating the toy</p> <p>-Telling the therapist what to draw</p>

Appendix C

Social Validity Questionnaire

Child: _____

Definition of Joint Attention: the shared focus or interaction of two people on an object or activity.

Definition of Sustained Interaction: length of time the child continues to engage appropriately with the activity

Circle one number for each question:

1. I think joint attention is important for my child.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

2. I think sustained interaction is important for my child.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

3. I was pleased with the degree of interaction my child showed in this video.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

4. I was pleased with the degree of interaction my child showed in this video.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

5. I was pleased with the degree of interaction my child showed in this video.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

6. I was pleased with the degree of interaction my child showed in this video.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

7. I was pleased with the degree of interaction my child showed in this video.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree

8. I was pleased with the degree of interaction my child showed in this video.

1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly Agree