A COMPARISON OF NONCONTINGENT AND SYNCHRONOUS REINFORCEMENT ON TASK ENGAGEMENT

by

Elizabeth M. Hardesty, B.S.

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by

Elizabeth M. Hardesty

APPROVED BY

_____

Dorothea C. Lerman, Ph.D., Chair

_____

Sarah A. Lechago, Ph.D., Committee Member

_____

Jennifer N. Fritz, Ph.D., Committee Member

APPROVED/RECEIVED BY THE COLLEGE OF HUMAN SCIENCES AND HUMANITIES:

_____

Samuel Gladden, Ph.D., Associate Dean

_____

Glenn M. Sanford, J.D., Ph.D., Dean

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ABSTRACT

A COMPARISON OF NONCONTINGENT AND SYNCHRONOUS REINFORCEMENT ON TASK ENGAGEMENT

Elizabeth M. Hardesty

University of Houston-Clear Lake, 2022

Thesis Chair: Dorothea C. Lerman

Synchronous schedules of reinforcement are those in which the onset and offset of a reinforcer are synchronized with the onset and offset of a target behavior. The current study replicated and extended Diaz de Villegas et al. (2020) through the evaluation of a synchronous schedule of reinforcement with a noncontingent schedule of reinforcement by evaluating the on-task behavior (completing math facts) of school-age children. A concurrent-chains preference assessment was then used to determine the preferred schedule of reinforcement. In addition, task preference assessments were conducted prior to and after the reinforcer assessment to determine potential mechanisms of

noncontingent reinforcement. Results indicated that while synchronous schedules of reinforcement are more effective at increasing on-task behavior, noncontingent schedules of reinforcement may be more preferred. Additionally, the use of synchronous and noncontingent schedules of reinforcement are insufficient at manipulating the preference of a task item.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I:

INTRODUCTION

Reinforcement schedules of covariation are those in which some parameter of a response class determine some dimension of a reinforcer (Williams & Johnston, 1992). Conjugate and synchronous schedules of reinforcement are two subtypes of covaried schedules. A conjugate schedule is a continuous schedule in which the reinforcer is delivered or some dimension (e.g., magnitude, rate, amplitude, intensity) of the reinforcer changes as a result of a specific parameter (e.g., intensity, rate, duration) of a response (Weisberg & Rovee-Collier, 1998). A synchronous schedule (SSR) is a continuous schedule where the onset and offset of a reinforcer are synchronized with the onset and offset of a target response (Ramey, 1972; Rovee-Collier & Gekoski, 1979; Weisberg & Rovee-Collier, 1998).

Recent literature has suggested both schedules may have many clinical applications. First, these schedules may have utility in the assessment of extinction-related phenomena because there is greater point-to-point correspondence between responding and reinforcement (Williams & Johnston, 1992). Specifically, conjugate preparation (i.e., measurement of more than one dimension of a target behavior) may be useful for studying extinction-induced variability (Falligant et al., 2018). Second, schedules of covariation are ubiquitous in nature, such as in the development and acquisition of early operants and complex motor skills as well as social interactions (Rapp, 2008; Williams & Johnston, 1992). These schedules may also be useful in the maintenance and treatment of automatically reinforced behaviors (Falligant et al., 2018;

MacAleese et al., 2015; Rapp, 2008) by allowing an analysis of certain aspects of the behavior that maintain the behavior (see Dozier et al., 2012, for example). Last, stimulus preference can be determined with a schedule of covariation because a behavior either must be consistently present (e.g., prolonged button press) or a certain dimension of the behavior must be present (e.g., force of the button press) to result in a consequent stimulus (Falligant et al., 2018; Rapp, 2008).

The majority of research pertaining to SSR has focused on infant operant behavior of the following: motor movement (Siqueland, 1968; Siqueland & Lipsitt, 1966; Smith et al., 1963), preference of stimuli (Friedlander, 1966, 1966; Horowitz, 1974; Peláez-Nogueras et al., 1996, 1997), and increasing vocalizations (Ramey, 1972; Smith et al., 1963). Other areas of study include preference assessment methods for adults with disabilities (Saunders et al., 2000, 2003; Saunders & Saunders, 2011) and increasing physical activity (Biddiss & Irwin, 2010; Faith et al., 2001; Ward & Dunaway, 1995). Notably, Ward and Dunaway (1995) evaluated the laps run per minute by four target high school students when music was presented contingent on the student running at the predetermined pace criterion. The contingent presentation of music increased the number of laps run per minute to meet or exceed the predetermined criterion. Additionally, when the music was presented contingent on the students running at a slower pace, the number of laps run per minute decreased to less than the predetermined criterion. However, the experimenters did not demonstrate experimental control via the study's embedded changing criterion design (i.e., responding was above the criterion across all sessions and did not increase to the designated criterion).

Other behavior-analytic research that has evaluated SSR has included Williams and Johnston (1992) and Diaz de Villegas et al. (2020). Most recently, Diaz de Villegas et al. compared SSR to accumulated reinforcement to increase on-task behavior of typically developing preschool children. Music was used as the stimulus presented at the onset of on-task behavior and removed at the offset of on-task behavior during SSR sessions. During accumulated reinforcement sessions, music was presented at the end of session for the total duration the participant was on-task during the session. The authors found that participants remained on-task for a larger duration of session during SSR conditions. Further, participants preferred SSR sessions to accumulated reinforcement and control, or extinction, sessions during a concurrent chains assessment.

While Diaz de Villegas et al. (2020) is the first behavior analytic study to evaluate SSR as a means to increase on-task behavior, a noncontingent schedule of reinforcement (NCR) is better suited as a control condition when evaluating the potential effects of contingent reinforcement (Thompson & Iwata, 2005). To fully evaluate the reinforcing effects of SSR, an NCR condition should be included to control for the presence of the music per se. For example, it is unclear whether participants in Diaz de Villegas et al. preferred SSR due to its immediate consequences or due to the pairing of a preferred stimulus (music) with a nonpreferred task (Carr et al., 1980; Lomas et al., 2010). NCR is a schedule of reinforcement wherein a reinforcer is delivered independent of responses after the passage of a predetermined amount of time (Vollmer et al., 1993). This schedule of reinforcement has specifically been used to decrease problem behavior (for review, see Phillips et al., 2017; Richman et al., 2015). Previous evaluations of NCR have speculated

that motivating operations, disruption of the response-reinforcer relation, and reinforcement of covaried behaviors are three potential mechanisms by which NCR is effective (Richman et al., 2015).

It is important to note that response cost (RC) in conjunction with NCR, which closely resembles an SSR procedure, has been used effectively to treat problem behavior (e.g., Dupuis et al., 2015; Falcomata et al., 2004; Keeney et al., 2000; Nolan & Filter, 2012; Ritschl et al., 1972; Saylor et al., 2012). However, these applications are different because the removal of the stimulus is dependent on a target behavior and reintroduced after a programmed amount of time during RC. SSR is the application of a stimulus contingent on a target behavior and the stimulus is removed contingent on the absence of the target behavior. For example, Ritschl et al. (1972) measured the number of out-of-seat behaviors of students across baseline and music + time-out conditions. In baseline, staff members presented the typical antecedents and consequences. During the music + time-out condition, music was presented continuously through loud speakers on the bus. If any student on the bus engaged in out-of-seat behavior for 1 s, the music was turned off for 5 s. The frequency of out-of-seat behaviors decreased from an average of 11 to near-zero levels during the music + time-out contingency. Because this intervention closely resembles an SSR contingency, it presents promising rationale to further evaluate clinical applications of SSR.

Results of Falcomata et al. (2004), in which both NCR (i.e., presentation of music) and NCR+RC (i.e., presentation of music that was paused contingent on an inappropriate vocalization) decreased inappropriate vocalizations of an 18-year-old man

with autism, provides further support for the clinical application of SSR. However, a more substantial decrease in inappropriate vocalizations was observed under NCR+RC compared to NCR alone. The authors then implemented a choice assessment where the participant could select one of two rooms. The first room consisted of noncontingent access to music, and the second room replicated the conditions of the alone condition during the functional analysis. Interestingly, the participant consistently chose the room with noncontingent access to music. Further, inappropriate vocalizations remained at near-zero levels in this room. In all, more research is needed to prove the applicability of SSR for increasing socially important behaviors (i.e., external validity of SSR).

It is estimated that 50.8 million students were impacted by school closures in the spring of 2020 due to the COVID-19 pandemic (Decker et al., 2020). As a result, remote learning became the primary method of education for many students. In a survey of middle and high school students, just 41% reported that they were motivated to complete schoolwork remotely (Mathewson, 2020). Additionally, teachers reported that students spent half as much time learning remotely than they did in-person (Gewertz & Sheehan, 2020). As of February 13, 2022, children between the ages of 0-17 made up 17.5% of all COVID-19 cases in the United States (CDC, 2022b). In conjunction, the majority of states mandated an in-person and remote modality be offered to students for the 2020-2021 academic year and re-opening guidelines included quarantining for at least 5 days after exposure during the 2021-2022 academic year (Lieberman, 2020); (CDC, 2022a). Therefore, the use of an SSR to increase on-task behavior of school-age children that can be delivered via telehealth was evaluated in the current study (i.e., music presented via

computer speakers that the experimenter controls). Behavior analytic research pertaining to the application and evaluation of schedules of covariation could further advance research and practice. The purpose of the current study is to extend the findings of Diaz de Villegas et al. (2020) by comparing the duration of on-task behavior under NCR and SSR schedules.

CHAPTER II:

METHOD

Participants

Three typically developing children between the ages of 7 and 11 years old participated in this study. Eligible participants could not engage in problem behavior more than once per day and had at least four mastered tasks (e.g., sorting, addition, matching, tracing) as reported by caregivers. All participants were able to remain seated for more than 5 min and follow one- or two-step instructions via Zoom™ (e.g., click on the blue icon). During an initial assessment, all participants were observed as being on-task for no longer than 50% of the assessment. All participants attended regular educations classes in public schools (through various modalities) and were not diagnosed with any intellectual or developmental disabilities. Cara was a 7-year-old female child who was on summer break after session 12. She attended school virtually the academic year prior to the study. Jojo was a 7-year-old female child who attended hybrid school in the spring and in-person school in the fall during the course of the study. Jojo was on summer break for sessions 1-17. Jay was an 11-year-old male child who was homeschooled and attended additional virtual schooling two days of the week throughout the study.

Setting and Materials

All conditions and sessions were conducted via a HIPAA-compliant telehealth platform (i.e., Zoom™). The study required the use of a computer or laptop with Internet access and a webcam. Participants also needed headphones or a speaker for the computer.

All sessions were conducted within the participant's home during a time when caregivers were available to help with any technological issues that may arise. Materials for this study included interactive, online work cards (i.e., Boom Learning™ program); alternative task materials (e.g., moderately preferred activity materials); an individualized song card; and a music player (i.e., Spotify™). The work cards consisted of tasks indicated by caregivers as mastered tasks and confirmed as mastered by the experimenter. The alternative task was a moderately preferred stimulus selected by the participant prior to the beginning of each session.

Response Measurement

All sessions were video recorded and data collected on a commercially available iPod app (i.e., Countee™). The experimenter acted as the primary observer and trained data collectors who served as secondary, independent observers.

During the preference assessments, selections were scored when the participant used the mouse to click on or tap the stimuli on the screen. The percentage of selection was calculated by dividing the total number of times each item was selected by the total trials the item could be selected and multiplied by 100. A hierarchy of preference was established with the most preferred stimuli being those with the highest percentage selected.

During each session, data were collected on the percentage of session the participant was on-task, latency to task completion, and the number of task items completed. On-task behavior was defined as the participant being oriented to the screen with the Boom Learning™ card being the only item on the screen (i.e., no other internet

tabs open or other programs, except Zoom™) occurring concurrently with at least one of the following behaviors: overt tacting of instructions, manipulating prompts (e.g., math blocks, pictures, stimuli on screen), counting fingers, moving the mouse on the screen in a directed way (i.e., not in circles, up-and-down, or zig-zag across the screen), eyes moving around the screen, or typing an answer in the box. On-task behavior was not scored if more than 2 s passed between the on-task behaviors listed above (i.e., the participant stopped tacting the instructions and does not begin to move the mouse an answer selection). On-task behavior was calculated into a percentage of session on-task by dividing the total number of seconds on-task by the total number of seconds in the session and multiplying by 100. Latency to task completion was defined as the number of seconds after the Boom Learning™ card is presented to the participant before the participant input an answer in the answer box. Task items completed was defined as the participant correctly completing the task presented on the Boom Learning™ card. The total number of task items completed was calculated by summing the number of completed task items during the session.

Interobserver Agreement (IOA)

An independent, secondary observer collected reliability data on at least 33% of sessions recorded videos using the same data collection method as the primary observer. IOA for selections and task completion were calculated with an exact measure. An agreement for selection was defined as both observers reporting the same stimuli being selected. An agreement for task completion was defined as both observers reporting the task as complete within a 2-s interval. IOA was then calculated by dividing the number of

agreements by the sum of agreements and disagreements and multiplying by 100. IOA for on-task behavior was calculated using exact agreement according to Diaz de Villegas et al. (2020). Latency to task completion was calculated using a mean duration-per-occurrence method. This was calculated by dividing the smaller duration of time by the larger duration of time for each task and multiplying by 100. All percentages were summed, and the sum was divided by the total number of completed tasks.

IOA was collected for 56% of all sessions for Cara. The mean agreement for on-task behavior is 93.9% (range, 83.7%-100%) during baseline sessions, 96.9% (range, 84.7%-100%) during NCR sessions, and 92.1% (range, 83.3%-100%) during SSR sessions. The mean IOA for reinforcer delivery is 98.5% (range, 92%-100%) across all sessions. The mean percentage of agreement across all sessions is 97.9% (range, 85.3%-100%), 93.5% (range, 75.3%-100%), and 99.3% (range, 92%-100%) for alternative task engagement, latency to task completion, and number of tasks completed, respectively.

IOA was collected for 51% of all sessions for Jojo. The mean agreement for on-task behavior is 96.6% (range, 87.3%-100%) during baseline sessions, 98.1% (range, 87%-100%) during NCR sessions, and 97.5% (range, 92.7%-100%) during SSR sessions. The mean IOA for reinforcer delivery is 99.8% (range, 97.7%-100%) across all sessions. The mean percentage of agreement across all sessions is 96% (range, 82.3%-100%), 97.5% (range, 77.2%-100%), and 99.8% (range, 98.3%-100%) for alternative task engagement, latency to task completion, and number of tasks completed, respectively.

IOA was collected for 41% of all sessions for Jay. The mean agreement for on-task behavior is 86.2% (range, 81.7%-99%) during baseline sessions, 90.6% (range,

81.7%-98.7%) during NCR sessions, and 94.8% (range, 86.7%-99%) during SSR sessions. The mean IOA for reinforcer delivery is 99.6% (range, 95%-100%) across all sessions. The mean percentage of agreement across all sessions is 97% (range, 88%-100%), 93.7% (range, 66.7%-99.8%), and 99.9% (range, 98.7%-100%) for alternative task engagement, latency to task completion, and number of tasks completed, respectively.

Across all participants, the IOA for alternative task engagement ranges widely due to the location of the alternative task. Typically, the alternative task would be placed to the side of the computer screen. The definition for engaging in the alternative task required observers to place one hand on the alternative item. Additionally, the agreement for latency to task completion dips below the standard 80% in the range for Jay and Jojo due to them completing a small number of tasks that occurred at the beginning of session. In other words, Jay would complete a single task scored at second 2 or second 3, this would result in a 67% IOA calculation.

Procedural Integrity

Data were collected on the experimenter presenting the stimuli for at least 33% of all reinforcement sessions (i.e., synchronous and noncontingent reinforcement). Observers collected data on the duration of reinforcer delivery. Reinforcer delivery was defined as the reinforcer being presented to the participant. Procedural integrity was calculated by dividing the duration of on-task behavior by the duration of reinforcer delivery and multiplying by 100.

Procedural integrity was collected for 56% of all sessions for Cara. The mean procedural integrity for baseline sessions was 100%. The mean procedural integrity was 99.67% (range, 98%-100%) during NCR sessions, and the mean procedural integrity was 93.1% (range, 82%-99.6%) during SSR sessions. Mean IOA for procedural integrity was 97% (range, 82%-100%). Procedural integrity was collected for 51% of all sessions for Jojo. The mean procedural integrity for baseline sessions was 100%. The mean procedural integrity was 100% during NCR sessions, and the mean procedural integrity was 98.4% (range, 91%-100%) during SSR sessions. Mean IOA for procedural integrity was 99% (range, 91%-100%).

Procedural integrity was collected for 41% of all sessions for Jay. The mean procedural integrity for baseline sessions was 100%. The mean procedural integrity was 99.3% (range, 94.2%-100%) during NCR sessions, and the mean procedural integrity was 93.3% (range, 85.5%-99%) during SSR sessions. Mean IOA for procedural integrity was 98% (range, 86%-100%). Procedural integrity varied most during SSR sessions for all participants as the onset and offset of the music had to be exactly matched to the onset and offset of on-task behavior. Therefore, any deviations by at least one second decreased the procedural integrity.

Pre-Assessment Procedures

Initial assessments included assessing if the participant followed one- and two-step instructions delivered by the experimenter via Zoom™. The instruction assessment consisted of the experimenter delivering 10 one-step instructions (e.g., click on the blue square, drag the zebra to the box, etc.) and 10 two-step instructions (e.g., drag the zebra

to the box and click the red button). The assessment lasted no longer than 10 min. If the participant responded correctly, the experimenter delivered a specific praise statement containing the correct answer (e.g., “Nice job, that is the red box!”). If the participant responded incorrectly, the experimenter delivered a general praise statement pertaining to compliance (e.g., “Thanks for working.”). If the participant did not respond within 15 s, the experimenter would have repeated the instruction. Inclusion was determined if the participant complied with at least 15 total instructions.

Preference assessments for tasks and colors were conducted before the study. A paired-stimulus preference assessment (PSPA; Fisher et al., 1992) was conducted for six different colors through the Boom Learning™ program. Two color stimuli were presented simultaneously with the participant instructed to “pick one”. The selected stimuli were recorded. The next pair of stimuli was then presented along with the instruction to “pick one”. This repeated until each stimulus was presented with every other stimulus. Stimuli were presented quasirandomly so that no same stimulus was presented across two consecutive trials. The moderately preferred colors were selected as discriminative stimuli for the conditions of the experiment.

A multiple stimulus without replacement preference assessment (MSWO; DeLeon & Iwata, 1996) was conducted for tasks items. The participant completed one task item for each task to act as pre-assessment exposure. Four mastered tasks were presented simultaneously with the participant instructed to “pick one”. The selected task was recorded and the participant was instructed to complete five items of the task presented via Boom Learning™ cards (e.g., match five different items, sort five shapes, solve five

math problems, etc.). The experimenter also collected latency to task item completion. Following the completion of all five task items, the experimenter delivered praise for working and a 30 s break. Following the break, the remaining task items were presented simultaneously to the participant with the instruction to "pick one". This procedure repeated until only one task item is presented. The least preferred task was selected as the target task for the assessment.

Alternative activities were determined by asking the participant what they would like to play with during the session. The experimenter then provided an instruction to the participant to go get what they wanted to play with during the session prior to the start of each session. The experimenter also provided an opportunity to change the alternative item or activity between sessions conducted on the same day. Alternative activities ranged for each participant throughout the duration of the study.

Preferred songs were determined by asking the caregivers of each participant to list approximately 5 preferred songs. The listed songs were presented to participants at the beginning of each reinforcer session on a song card. Additionally, the participants reported songs they would like to hear. If a participant reported the same song at least six consecutive times, the song was added to the song board.

General Procedures

The experimenter and caregiver met at the beginning of session to set up the computer for the participant. The experimenter instructed the caregiver to share the full screen of the computer the participant will use through the Zoom™ feature. The caregiver also ensured any alternative task items are present on the same surface as the

computer. The participant was then instructed to sit in front of the computer. The experimenter oriented the participant to the learning card and delivered a brief rule stating the contingencies of the condition (i.e., "This is the [color] condition. You are going to work for 5 min. When you are [describe task], X [extinction or reinforcement] will happen. When you [alternative task], nothing will happen. You can either [task] or [alternative task] whenever you want and you can switch between the two."). The task materials were on cards colored corresponding to the condition. All baseline cards were white in color; SSR cards were colored red. And NCR cards were colored yellow, purple, or orange for Cara, Jojo, and Jay, respectively.

Sessions were 5 min. Breaks between sessions were 1-5 min in length and consisted of the participant playing online games or activities with the primary experimenter or talking with the experimenter. No more than four sessions were conducted in one day. The session began with the experimenter providing the rule to the participant with the first Boom Learning™ card presented on the participant's screen. If the participant responded to the task correctly, the computer program provided a bell-ding noise and present the next task. If the participant responded to the task incorrectly, the computer program sounded, "whoops" and represented the task item.

Prior to the reinforcement phase, the experimenter introduced the song card to the participants by showing the participant the card, selecting each icon, and playing a portion (about 10 s) of the song for the participant. Prior to each reinforcement session, the experimenter presented the song card to the participant and said the name of each song while indicating to the icon on the screen with the mouse. The experimenter

instructed the participant to select at least three songs they would like to listen to. Whichever songs were picked were played on the experimenter's computer and presented to the participant through Zoom™. The order of presentation for the songs was the same as the order the participant chose the songs.

If at any point in the study, a participant indicated listening to the song made it difficult to focus (i.e., saying, "I don't want to listen to music", singing or dancing during the task, or consistently getting answers incorrect during music sessions), the experimenter would have used music without words or music in a foreign language. If the participant continued to emit these responses, the task would have been modified or the next preferred task from the preference assessment would have been used for the remainder of the assessment. Both SSR and NCR conditions would have been modified in the same manner at the same time. However, this did not occur during the study.

Baseline

On-task behavior resulted in no programmed consequences. Preferred songs were not presented for the duration of the session. All stimuli for the baseline condition were white.

Synchronous Reinforcement (SSR)

On-task behavior resulted in access to a preferred song. If the participant was not on-task (according to the operational definition), the song was paused until the participant began to engage in the task again.

Noncontingent Reinforcement (NCR)

Preferred songs were presented for the duration of the session. Neither on-task nor off-task behavior resulted in programmed consequences. The song continued to be presented even if the participant was off task.

Post-Assessment Procedures

After a comparison of the different schedules was completed, a preference assessment using a concurrent chains procedure (Hanley et al., 1997) was conducted to determine participant preference of each condition. Before session, the participant was presented with the color associated with the three different conditions on the screen. The experimenter reminded the participant of the contingencies for each condition and instructed the participant to "pick your favorite one". The placement of the color stimuli on the screen was randomly assigned each session. The condition associated with the color stimuli the participant selected was conducted as described above. Data collection was the same as described above, including selection of stimuli. At least five consecutive sessions were conducted in this phase. This phase was terminated after one of the following criteria were met: (1) the participant selected a single condition five consecutive times; (2) the participant selected a single condition four or more times during the initial five sessions; (3) the participant selected only a reinforcement condition instead of the control condition for at least five of the first six sessions; or (4) none of the criteria listed above were met after 12 consecutive sessions.

Upon the conclusion of the concurrent chains procedure, the experimenter conducted a final MSWO for the same task items present in the pre-assessment MSWO. The procedures and data collection of this assessment were exactly as described above.

Experimental Design

Multielement and reversal designs were used to compare SSR and NCR on on-task behavior and to compare each reinforcement condition to baseline. The order of reinforcement conditions in the multielement design was quasirandom such that no more than two sessions of the same condition were conducted consecutively. Due to the limitation of a multielement design, carryover effects may have been present during the initial comparison. Therefore, we implemented a reversal design. This also allowed for within participant replication of the baseline and treatment effects. A nonconcurrent multiple baseline design across participants was also utilized.

Results

Pre- and Post-Assessment Results

Table 1 lists the top 10 preferred songs for each participant ranked in order of most to least selected. Table 2 lists the alternative task items for all participants. Table 3 summarizes the data collected during the initial instruction assessment and initial on-task assessment for all participants. Each participant met criterion for inclusion in the study.

Table 1.

List of songs in order of most-to-least selected by each participant.

Song Rank	Cara	Jojo	Jay
1	"The Middle" by Zedd, Maren Morris, and Grey	"Fancy Like" by Walker Hayes	"Thunder" by Imagine Dragons
2	"Thank U, Next" by Kidz Bop Kids	"Boomerang" by JoJo Siwa	"The Fox (What Does The Fox Say?)" by Kidz Bop Kids
3	"Happier" by Marshmello and Bastille	"Run Run Rudolph" by JoJo Siwa	"Rhinestone Eyes" by Gorillaz
4	"If I Can't Have You" by Shawn Mendes	"Havana" by Kidz Bop Kids	"Believer" by Imagine Dragons
5	"Mood" by Kidz Bop Kids	"Spooky Sounds – 2013 Version" by The Kiboomers	"Broken" by Gorillaz
6	"Savage Love" by Kidz Bop Kids	"Mood" by Kidz Bop Kids	"On Melancholy Hill" by Gorillaz
7	"Talk" by Kidz Bop Kids	"Old Town Road" by Kidz Bop Kids	"Lover" by Taylor Swift
8	"Youngblood" by Kidz Bop Kids	"We Are Never Ever Getting Back Together" by Kidz Bop Kids	-
9	"Someday" by Milo Manheim and Meg Donnelly	"Bop!" by JoJo Siwa	-
10	"What's My Name" by China Anne McClain, Thomas Doherty, and Dylan Playfair	"Lava" by Kuana Torres Kahele, Napua Greig, and James Ford Murphy	-

Table 2.

List of alternative task items for each participant.

Cara	Jojo	Jay
Legos	Paper and markers	Lego Sets
Exercise ball	Stuffed animals	Rocks
Goo	Balance board	
Bouncy balls	Play dough	
Arts and crafts materials (i.e., stickers, markers, glue, etc.)	Goo	

Table 3.

Summary of initial assessment data for each participant.

Participant	Number of Completed Instructions	Percentage of Assessment On-Task
Cara	20	35%
Jojo	19	23%
Jay	20	48%

Figure 1 shows results for the PSPA of color stimuli prior to the assessment for Cara, Jojo, and Jay, respectively. The x-axis denotes the color stimuli presented. The left y-axis denotes the rank order, and the right y-axis denotes the total number of selections. The open bars depict the total number selections. The closed bars depict the rank order of each color. Cara's moderately preferred colors were red and yellow. Jojo's moderately preferred colors were red and purple. Jay's moderately preferred colors were red and

orange. Based on these results the following colors were associated with the corresponding condition: SSR sessions were associated with red stimuli for all participants; NCR sessions were associated with yellow, purple, or orange stimuli for Cara, Jojo, and Jay, respectively.

Figure 1.

PSPA results for color stimuli across all participants.

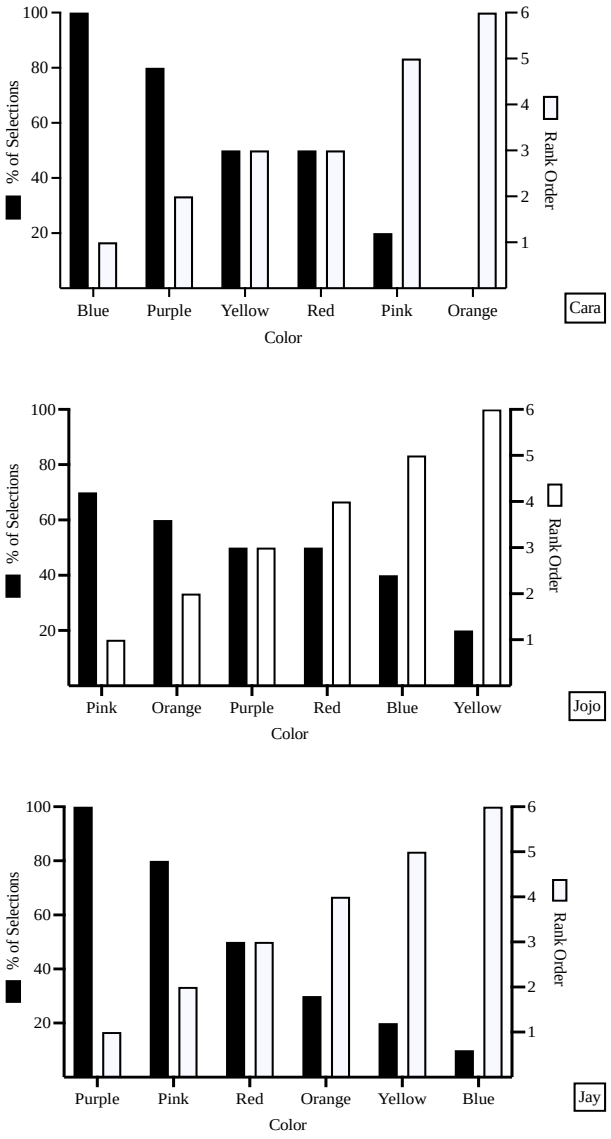
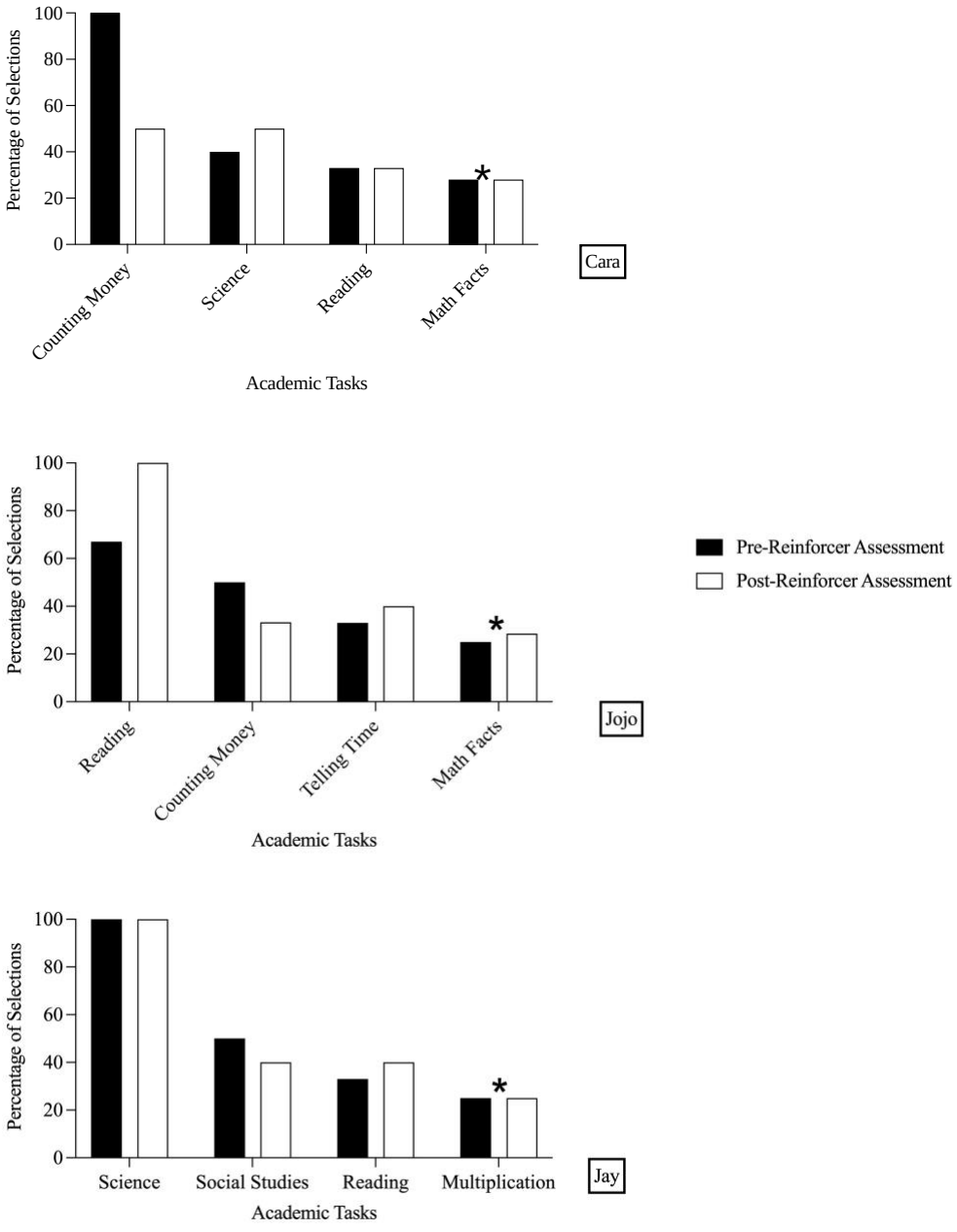


Figure 2 shows the MSWO results for task items before and after the reinforcer comparison for Cara, Jojo, and Jay, respectively. The x-axis denotes the task presented, and the y-axis denotes the percentage of selection for each task. Closed bars indicate results from the MSWO conducted before the reinforcer comparison. Open bars indicate results from the MSWO conducted after the reinforcer comparison. The asterisk indicates the task used during the reinforcer assessment. These data present the potential for task preference to change after the pairing of task with reinforcement. All participants were observed to select math facts as the least preferred academic task (addition and subtraction for Cara and Jojo, multiplication for Jay). This task was selected for the reinforcer assessment. After the reinforcer assessment, all participants selected the math facts last in the post-assessment MSWO.

Figure 2.

MSWO results for task stimuli pre- and post-assessment across all participants. The asterisk indicates the task stimuli utilized during this study.

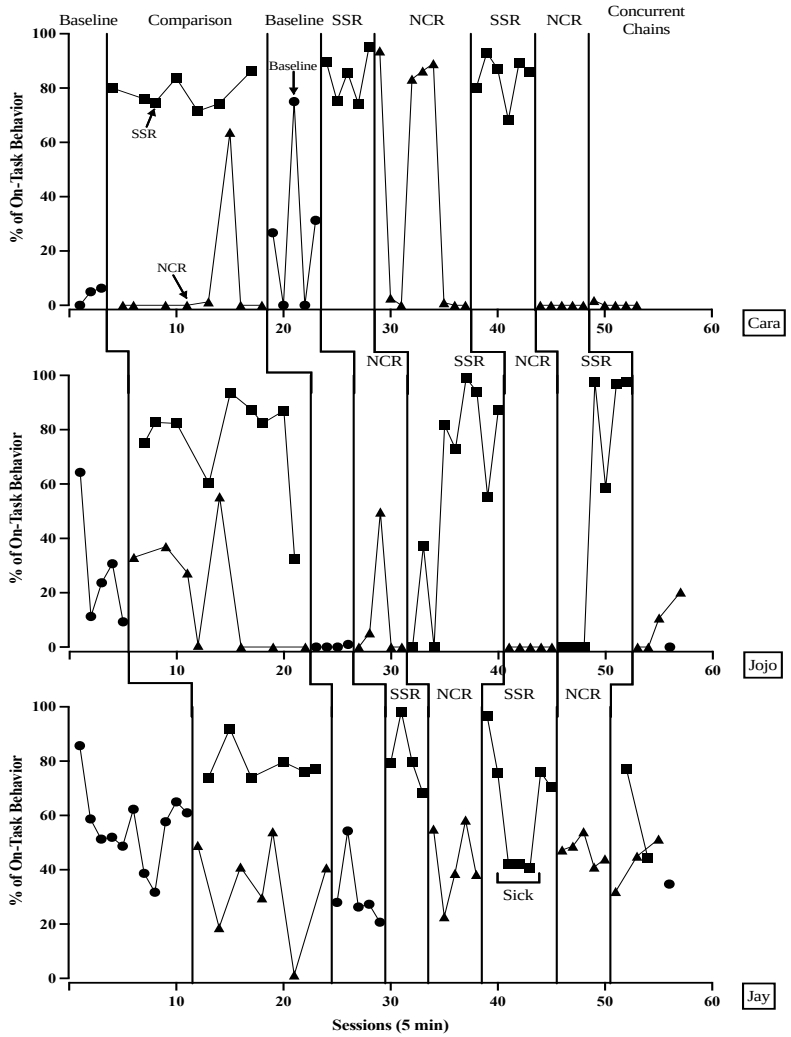


Assessment Results

Figure 3 shows the results for the percentage of 5-min sessions each participant was on-task across all conditions. The x-axis denotes the number of sessions. The y-axis denotes the percentage of session on-task behavior was observed in seconds. The closed circles indicate baseline sessions; the closed squares indicate SSR sessions. The closed triangles indicate NCR sessions.

Figure 3.

Multiple baseline across participants for Cara, Jojo, and Jay's percentage of session on-task.



The first panel displays the data for Cara. During baseline, the percentage of session on-task was low and stable. During the reinforcer comparison, the percentage of session on-task increased from baseline during SSR sessions only. The percentage of session on-task during NCR sessions decreased to 0% of session on-task for all except two sessions. Upon a reversal to baseline, responding became more variable than observed in previous baseline or reinforcement sessions. The percentage of session on-task returned to high and stable levels after a series of only SSR sessions. During a subsequent series of only NCR sessions, responding became variable between not being on-task at all during the session or being on-task for at least 80% of the session. Replication of the SSR-only condition demonstrated experimental control with a return of high and stable on-task behavior. However, responding during the replication of the NCR-only condition returned and remained stable at 0%. During the choice assessment, Cara selected NCR five consecutive times. Responding during the concurrent-chains procedure remained consistent with previous NCR conditions.

The second panel displays the data for Jojo. During baseline, the percentage of session on-task was variable but averaged below 35% of session on-task. During the reinforcer comparison, the percentage of session on-task increased from baseline in both NCR and SSR conditions initially. However, after repeated exposure to the contingencies, on-task behavior in the NCR condition decreased and remained at 0%. The percentage of on-task behavior in SSR conditions increased from baseline and remained high. In the last SSR condition, the percentage of session on-task reached a low of 32% compared to previous responding in this condition. Upon a reversal to baseline, the

percentage of session on-task decreased to zero, or near-zero, levels. During the series of NCR sessions, the percentage of on-task behavior remained at low levels with an exception of session 29, during which responding reached 49%. On-task behavior during the series of SSR sessions increased to previously observed levels. During a reversal to NCR-only, responding returned to and maintained at 0% of on-task behavior. Responding during the final SSR-only conditions also replicated previously observed levels of on-task behavior during SRR. Jojo selected NCR four times and baseline one time during the concurrent-chains assessment. Responding for the NCR conditions was observed to increase with successive selections of NCR while baseline responding maintained at 0%.

The third panel displays the data for Jay. During baseline, the percentage of on-task behavior was variable at a moderate level. During the reinforcer comparison, the percentage of on-task increased above baseline sessions in the SSR condition only. Sessions with NCR procedures showed a decrease in percentage of session on-task compared with baseline. Upon a reversal to baseline, the percentage of session on-task remained low with a slight decreasing trend. The percentage of on-task behavior increased to previous levels when the conditions were presented in a reversal design, except for three SSR sessions during which Jay reported that he was sick. During the concurrent-chains assessment, Jay selected NCR three times, SSR two times, and baseline one time. Responding during the NCR and baseline conditions were within previous levels of on-task behavior. However, a sharp decreasing trend was observed between the two SSR conditions. However, only two SSR conditions were conducted during this phase before the termination criterion was met.

Table 4 summarizes the average latency to task completion and average number of task items completed during the reinforcer assessment across conditions for each participant. All three participants were observed to have the smallest latency to task completion and largest number of tasks completed during SSR sessions. The largest latency to task completion was observed during NCR sessions for all participants.

Table 4.

Average latency to task completion and average number of task items completed during assessment and baseline for each participant.

Participant	Latency to Task Completion (s)			Number of Task Items Completed		
	Baseline	SSR	NCR	Baseline	SSR	NCR
Cara	121	12.3	244.7	2.8	21.2	4.5
Jojo	175.9	88.3	243.9	2.7	7.0	0.73
Jay	33.6	15.8	57.3	11.7	20.4	12.7

Table 5 summarizes the total number of selections in each condition, average latency to task completion, and average number of task items completed during the choice assessment across conditions for each participant. Results during the concurrent chains assessment were similar to the data collected during the formal assessment. Cara nor Jojo did not complete a single academic task during NCR sessions. Jay's results mirrored those observed in the reinforcer assessment such that he completed the least number of tasks during NCR sessions and the most tasks during SSR sessions.

Table 5.

Summary of choice assessment data for each participant.

Participant	Total Number of Selections			Latency to Task Completion (s)			Number of Task Items Completed		
	Baseline	SSR	NCR	Baseline	SSR	NCR	Baseline	SSR	NCR
Cara	0	0	5	-	-	241	-	-	0.2
Jojo	1	0	4	300	-	192	0	-	0.75
Jay	1	2	3	30.8	14.3	25.2	9	19.5	15

CHAPTER III:

DISCUSSION

Results indicate that SSR is an effective method to increase on-task behavior of typically developing school-aged children through a remotely delivered reinforcer. These results replicate and extend those presented in Diaz de Villegas et al. (2020). Alternatively, NCR appears to affect responding idiosyncratically at first with a decrease in responding during NCR over time. However, NCR was the preferred schedule of reinforcement for Cara and Jojo. Jay selected the NCR condition more than SSR and baseline conditions, yet he selected all three conditions during the concurrent-chains assessment, indicating no clear preference. Further, none of the participants' task preferences changed during the study. This suggests that the underlying mechanism of NCR may more likely be a motivational operation manipulation, as discussed later.

These patterns of responding indicate that synchronous schedules of reinforcement should be selected based on the desired behavior change as one would with more frequently utilized schedules of reinforcement (e.g., fixed ratio, variable ratio, fixed interval, and variable interval). Perhaps synchronous schedules of reinforcement would be more appropriate than more common schedules of reinforcement for increasing the desired length of behaviors, such as sitting on the toilet before beginning an intensive toilet training protocol. However, little is known about the maintenance or fading of reinforcement schedules of covariation. This is an important avenue of research to evaluate, as well as the use of synchronous or conjugate schedules of reinforcement in the acquisition and maintenance of social skills.

Previous research comparing NCR and a response-contingent schedule of reinforcement has indicated that participants should have selected the SSR sessions during the concurrent-chains preference assessment (Hanley et al., 1997; Luczynski & Hanley, 2009, 2010). It has been hypothesized that individuals prefer response-contingent schedules of reinforcement because consequent stimulus is only accessed after a response is emitted. Therefore, the individual can respond when the motivating operation (MO) for the consequent stimulus is present. This can be related to current study as the individual can control whether the music is playing or not based on interacting with the academic materials. However, research has also shown that NCR may be more effective after the response-contingent schedule of reinforcement has been thinned (Luczynski & Hanley, 2010).

During reinforcer sessions, the average number of task items completed increased relative to the number of seconds each participant was on-task even though task completion was not directly targeted (i.e., the more on-task a participant is, the more task items completed). Interestingly, the average latency to task completion did not decrease as the average number of task completion increases, specifically in baseline sessions. Anecdotally, it was noted that fluency in responding to the math facts increased over time for all participants. Future research should compare SSR and a more frequently utilized schedule of reinforcement for changes in various dimensions of skill acquisition (e.g., fluency, percentage correct, trials to mastery, etc.).

While NCR has been proven to be effective to decrease problem behavior, there is current discussion of the underlying mechanism for why NCR is an effective procedure.

One potential underlying mechanism is the pairing of reinforcement with a stimulus decreases the aversiveness of the stimulus (e.g., the task). In turn, this is hypothesized to decrease the establishing operation for escape-maintained behavior. Another potential mechanism is the disruption between the response and consequence relationship. This decreases the establishing operation to engage in behaviors to access the reinforcer (e.g., responses to escape the task). The inclusion of the post-assessment preference assessment is to potentially provide evidence of either hypothesis. However, no observed changes in the rank of preference for task items may indicate that the disruption of the response and consequence relationship may be responsible for the efficacy of an NCR procedure in decreasing challenging behavior. This corresponds with the findings of Rapp et al. (2004) in which erratic gross-motor body movements were decreased in the presence of pre-recorded videos of the body movements (NCR) compared to a live video stream of the participant engaging in the body movements (SSR). It may also be that NCR is most effective at decreasing target behavior, as in reducing problem behavior, because it acts as an abolishing operation. This would correspond with the decrease in on-task behavior observed during this study.

Additionally, due to the nature of the reinforcer delivery, it can be conceptualized that the presence of the music with the presentation of the task mimics a pairing procedure. A SSR could replicate a response-dependent pairing procedure while an NCR would mimic a response-independent pairing procedure. Results of the current study indicated that the pairing of a reinforcer with a task item did not increase the preference of the task item, however we cannot confirm that the task was less aversive after multiple response-

dependent and response-independent pairings with a reinforcer (i.e., music). These results are contradictory to the findings of Dozier et al. (2012) in which praise functioned as a reinforcer after multiple sessions of response-dependent pairing of food and praise. However, Dozier et al. (2012) was evaluating a method to establish praise as a reinforcer while the current study evaluated preference for a task item after a completed reinforcer assessment.

While this study provides a unique method of reinforcer delivery to increase and maintain on-task behavior, it is not without its limitations. First, the inclusion of a rule prior to each session may have influenced responding. However, all participants contacted the contingency of each condition regardless of the presentation of the rule. In other words, even though the experimenter provided a contingency statement prior to each session, each participant engaged in both on-task and the alternative task in all conditions. Second, SSR provides a stimulus based on moment-to-moment responding. Due to this procedural aspect, it is unclear if the presented stimulus was a true reinforcer or if the feedback component by presenting and removing the stimulus influenced the responding of on-task behavior. Because rule-governed behaviors are typically not reinforced by a long-term reinforcer, the feedback provided by the stimulus may be sufficient to maintain responding in accordance with the rule. Future research should attempt to tease these two aspects of the delivered stimulus apart before generalizing these procedures to populations that may not have a history of rule-governed behavior. Last, the delivery of a stimulus contingent on moment-to-moment changes in a behavior may not be practical in natural settings without technological advancement or additional

instruments. Further research should evaluate the minimum procedural integrity necessary to produce and maintain a treatment effect.

Last, continuous reinforcement was used as the NCR schedule to control for the music. However, it would be a natural replication to yoke the NCR schedule of reinforcement to the SSR schedule of reinforcement provided in the prior session. This would help with the evaluation of SSR as it is likely that music is most reinforcing when provided without pauses or stopping. Therefore, SSR may be more preferred if songs are delivered with pauses in the NCR condition as well.

In addition to the above areas of research concerning evaluation of SSR, future researchers can utilize SSR as a parallel to evaluate behavior shaped and maintained by automatic consequences (Rapp, 2008). Additionally, due to a moment-to-moment relation between the response and consequence, SSR may provide additional methods to evaluate and manipulate the response-reinforcer relation (i.e., extinction; Rapp, 2008; Williams & Johnston, 1992). Last, different applications of SSR should continue to be evaluated. Such applications of SSR could include the use of SSR to modify group behavior (Diaz de Villegas et al., 2020) or to increase the duration of appropriate behaviors (e.g., appropriate transition behaviors).

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