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Signaling the Availability of Varying Quality of Reinforcement in a Token Economy

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Abstract

Token economies are commonly used to both increase and decrease behavior. Salient signaling may enhance the discriminability within a token economy system, thus increasing treatment effectiveness. Varying the quality of reinforcement to match the behavior of an individual may also impact responding. The current research compared the effectiveness of a no-signal condition, within-stimulus prompt condition, and an extra-stimulus prompt condition to signal the varying quality of reinforcement within a token economy system. Tokens were delivered to participants contingent on correct responding in a mastered skill task. In addition, Xs were delivered contingent on target behavior during session, with varying magnitudes of reinforcement being made available depending on the occurrences of target behavior. Results for Alex and Tommy indicate slightly higher rates of target behaviour observed in the control condition compared to the treatment conditions. However, results from the treatment conditions were undifferentiated. Results for Nathan were undifferentiated. Results suggest that varying qualities of reinforcement may be effective within a token economy system however, a prevailing method of signaling was not established.

Keywords: token economy, signaling, within-stimulus, extra-stimulus

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Chapter I: Overview

Introduction

A token economy is a system designed to change behaviour by specifying target behavior(s), delivering tokens contingent on the occurrence or non-occurrence of that behavior(s), and having back-up reinforcers available which an individual may exchange the tokens in order to gain access to these items or activities (Cooper, Heron, & Heward, 2007). There are many benefits to using token economy systems. When conditioned effectively, the tokens become generalized conditioned reinforcers. An individual may be required to earn multiple tokens which are delivered on a prescribed schedule of reinforcement prior to gaining access to the back-up reinforcer. Delivering tokens in lieu of primary reinforcers allows multiple responses to be delivered, therefore increasing the rate of instruction delivery and may prevent or slow down any potential satiation effects on the terminal reinforcer. Token economies have been employed to enhance the effectiveness of procedures designed to reduce behavior (e.g., Conyers et al., 2004; Himle, Woods, & Bunaciu, 2008), to increase or teach new behaviors (e.g., McGinnis, Friman, & Carlyon, 1999; Tarbox, Ghezza, & Wilson, 2006), and with a group for both skill acquisition and behavior decrease (e.g., Donaldson, Vollmer, Krous, Downs, & Berard, 2011).

Signals, or prompts, have also been incorporated in many treatment packages as a means of enhancing the discriminability between conditions. Signals have been used in the delivery of reinforcement during a noncontingent reinforcement (NCR) procedure (Gouboth, Wilder, & Booher, 2007) and a functional communication training (FCT) procedure (Fisher, Kuhn, & Thompson, 1998). Gouboth et al. (2007) targeted decreasing aggression and inappropriate interruptions in two participants. The authors compared the effectiveness of noncontingent

reinforcement (NCR) with and without a signal. Results showed that NCR with signaling was more effective in decreasing inappropriate interruptions for one participant and aggression in the other, suggesting that the addition of a signal may add to the behavior-reducing effects of an NCR procedure. Further, these results suggest that if an individual is made aware of behavioral expectations prior to intervention implementation, the effectiveness of treatment may be enhanced, and problem behavior may be decreased.

The type of signal may influence how effective it is in reducing behavior. Whereas Gouboth et al. (2007) used a vocal-only signal, Fisher et al. (1998) incorporated a visual signal during functional communication training with two participants. One participant was taught to say, “excuse me please” in the presence of a picture of the participant playing with a preferred therapist in order to access 30s of attention. The same participant was also taught to say, “I want my toys please” in the presence of a picture of the participant playing with toys to access 30s access to toys. The second participant used sign language and was taught to sign “games” and “hugs” in the presence of a boy playing with toys and a boy playing with an adult in order to access toys and attention respectively. The authors found an increase in functional requests for both attention and tangible items in the presence of the conditioned signals, as well as a decrease in challenging behavior. This study illustrated that if trained effectively, visual signaling has the potential to establish and increase functional communication.

Fisher, Kodak, and Moore (2007) evaluated a least-to-most prompting procedure consisting of modeling and physical guidance when compared to a picture-prompt (defined as identity matching by the authors) procedure when teaching receptive identification skills to two participants who had a diagnosis of Autism. The authors found the picture-prompt procedure to be more effective for both participants. Carp, Peterson, Arkel, Petursdottir, and Ingvarsson

(2012) extended this research by comparing the effectiveness of a picture prompt and a gesture prompt when teaching receptive identification skills in four children who had a diagnosis of Autism. Although two of the participants required some procedural modifications, ultimately the authors found picture prompts to be the more effective teaching method. Collectively, these results suggest that the picture prompt may serve to increase the discriminability between stimuli and conditions.

Schreibman (1975) compared the effectiveness of within-stimulus and extra-stimulus prompting with six children who had an Autism diagnosis. The extra-stimulus procedures consisted of a point prompt with a prescribed fading procedure. The within-stimulus prompt consisted of altering a component of the teaching stimuli in order to enhance the discriminability of the stimuli (e.g., the graphics on the correct stimuli were more pronounced). The authors found that the participants were more successful when the within-stimulus prompt was used.

Summers, Rincover and Feldman (1993) also compared extra-stimulus and within-stimulus prompts when teaching receptive preposition (“in” versus “on”) skills to five pre-school children who had a developmental disability diagnosis. Extra-stimulus prompting consisted of a least-to-most procedure in the following order: model, gesture, positional, and physical. The within-stimulus prompt consisted of the researcher altering their voice volume when delivering the instruction during a trial and then systematically fading out the prompt. For example, during step one of the within-stimulus prompting procedure the researcher would say “in” using a normal conversation volume compared to saying “on” in a loud voice and saying it three times. The authors had four of the participants experience the extra-stimulus prompt condition before moving to the within-in stimulus condition. The remaining one participant experienced the

within-stimulus condition solely. The authors found that within-stimulus prompts to be more effective when compared with extra-stimulus prompts.

Signaling the occurrence of problem behavior has also been shown to be a component of an effective intervention. Donaldson et al. (2011) implemented the Good Behavior Game (GBG) with five kindergarten teachers across three elementary schools. In the GBG, hash marks are delivered when a team fails to follow a rule. Reinforcement is then delivered to the team that received the fewest hash marks or to both teams if they meet a designated criterion for success. Donaldson et al. (2011) found that the rate of inappropriate behavior decreased when the GBG was implemented first by an experimenter and then continued by the teacher. Furthermore, the procedure and results were maintained at a one-month follow-up observation. The results of Donaldson et al. (2011) suggest that immediate visual feedback contingent on a behavior targeted for decrease may aid in enhancing a treatment package.

Altering different parameters or dimensions of reinforcement may impact the effectiveness of a treatment package. More specifically, altering the quality of reinforcement may increase or decrease the effectiveness of an intervention. Hoch, McComas, Johnson, Faranda, and Guenther (2002) assessed the impact of varying magnitude and quality of reinforcement had on choice responding during play sessions with three boys diagnosed with Autism. More specifically, the authors investigated if an increase in choosing the play area with a sibling present would be observed when the magnitude and/or quality of reinforcement was manipulated. The variation in reinforcement associated with each play space was individualized; the magnitude of reinforcement was altered for the first participant, the quality of reinforcement was altered for the second participant, and the quality along with the magnitude was altered for

the third participant. The procedures and results of participant two are of particular relevancy to the current study.

Hoch et al. (2002) began with an unequal-quality condition in which one play area contained highly preferred items and the other contained less preferred items. Selection of either play area resulted in 50s access. The location of the participant's brother was randomized. During the second phase of the unequal-quality condition, the location of the participant's brother was always with the highly preferred items. Thus, the sibling was consistently paired with the highly preferred items. The authors included an equal-quality (low) condition in which choosing either area resulted in access to less preferred toys for 50s. Finally, the authors included an equal-quality (high) condition in which choosing either area resulted in access to highly preferred toys for 50s. When the quality of reinforcement was equivalent in both locations, the location of the sibling was counterbalanced. The authors found the choice between the play area with and without the sibling to be undifferentiated when only low-preferred items were available and when the sibling was not consistently paired with either quality. However, when the sibling was consistently paired with the highly quality reinforcer, the participant chose the area with the higher quality reinforcement 100% of the time for five consecutive sessions. Once effectively paired, the authors finally found that the participant chose the play area with the sibling approximately 80% of the time when both locations had the same reinforcers (either high- or low-preferred). The results of this study are significant in that they suggest the impact that altering the quality of reinforcement may have on behavior.

The purpose of the current study was twofold. First, the effect of reinforcer quality on behavior was examined by making the quality of available backup reinforcers in a token economy contingent on the occurrence of problem behavior during a teaching session.

Specifically, the quality of the backup reinforcer decreased as the frequency of problem behavior increased. Second, this study extended the literature on signalling by comparing the use of a within-stimulus prompt versus an extra-stimulus prompt to signal the availability of varying quality of reinforcement.

Chapter II: General Method

Participants and Setting

Three boys with autism diagnoses participated in the current study. Tommy was 4 years old and had been attending centre-based Intensive Behavioral Intervention (IBI) for 24-30 hours per week for 7 months. Nathan was 6 years old and had been attending centre based IBI for 2 years. Finally, Alex was 5 years old and had been attending centre based IBI for 1 year. All participants had a documented history of problem behavior during work tasks. Participants also had a history of consistent attendance at the centre for treatment sessions, a history of using visual signals, and a history using token economy systems.

The study was conducted in a centre-based IBI setting. Sessions were conducted in each participant's individual work space, each of which contained a desk, chairs, data collection materials, a timer, the participant's identified reinforcers, and study materials (described below). Sessions were conducted Monday-Friday between 9:00am-3:00pm.

Materials

Three choice boards were used that had items of varying value. The blue choice board was reserved for highly preferred items/activities, the yellow choice board was reserved for moderately preferred items/activities, and the black choice board was reserved for low preferred items/activities.

Three two-tiered token boards were also used. The top half of each board contained a ten-piece token board where tokens were delivered for correct instruction responses. The bottom half was a five-piece token board where Xs were delivered contingent on the occurrence of a target

problem behavior. On the within-stimulus token board, no choice-board icon was present on the board, but the five spaces for Xs were color coordinated to the choice boards available. Specifically, the first space was blue to signal the availability of the blue choice board, spaces 2-4 were yellow to signal the availability of the yellow choice board, and the fifth space was black to signal the availability of the black choice board. On the extra-stimulus token board, a space displaying which choice board was available was present on the bottom half, next to five white spaces where Xs were delivered. The specific color displayed in this space changed contingent on the criteria outlined below. The token board used for the control and no-signal condition looked the same as the extra-stimulus signal token board, with the exception that there was no signal displaying which choice board is available.

Design

An ABACAD withdrawal design was used in which A represented the control condition, B extra-stimulus signaling, C the no-signal condition, and D within-stimulus signaling. Three to six sessions per participant were completed daily until the extra-stimulus, no-signal and within-stimulus conditions were run 10 times each.

Preference Assessment

A multiple stimulus without replacement preference assessment was completed daily prior to any sessions being run. Eight items or corresponding pictures of items or activities were presented simultaneously to the participant. These eight items were selected based on a review of previous preference assessments and discussions with the clinical team. Once all eight items were presented, the participant was instructed to select one using a verbal instruction (e.g., “choose one” or “take one”). Once the participant selected an item, he had access to that item for

5-10s or until consumed if he selected an edible. Following the brief access, the item was removed, not replaced in the array and the participant was instructed to select another item. A hierarchy was then developed with the results of the assessment. The identified reinforcers were distributed on the three choice boards as follows: corresponding pictures of the first four items selected were placed on the blue choice board, pictures of the fifth and sixth items selected were placed on the yellow choice board, and pictures of seventh and eighth items were placed on the black choice board.

Dependent Variables

Two variables were evaluated: the frequency of target behavior, represented by the number of Xs delivered during a session, and the duration of the session. Target behavior differed across participants and was selected based on discussion with the clinical team, a review of historical data, and direct observation. The target behavior selected for Tommy was *stereotypy* and was defined as any or all of the following: body tensing (stretching his legs out in front of himself while seated on a chair or on the floor), holding his arms up when not contextually appropriate, or tapping his fingers or palms of hands on his shoulder, chest, or against one another. An occurrence of stereotypy ended after 3 consecutive seconds without engaging in the target behavior. The target behavior selected for Nathan was also stereotypy. Nathan's *stereotypy* was defined as repetitive tapping fingers or palms of hands on objects or self, and/or repetitive, non-contextual finger and/or hand movements. An occurrence of stereotypy ended after 3 consecutive seconds without engaging in the target behavior. The target behaviors selected for Alex were aggression, elopement, property destruction, and screaming. *Aggression* was defined as any instance of hitting, biting, pulling or pushing, scratching, or attempting to scratch another

person. *Elopement* was defined as leaving the desk/chair without permission from an adult, or not following an instruction from an adult to "come sit" within 5 seconds. *Property destruction* was defined as swiping materials off the table, throwing items, and tipping over furniture/throwing furniture. *Screaming* was defined as yelling or raising his voice volume so it could be heard from across the room or is loud enough to cause listeners within 10ft discomfort. An instance of screaming ended following 3 seconds without engaging in the target behavior.

Instructions consisted of previously mastered tasks and were participant specific. Examples of tasks include one-step receptive instruction (e.g., clap hands, touch head), receptive identification tasks (e.g., find the ball in an array of three), expressive labeling of pictures and items, gross motor imitation, fine motor imitation, and independent tasks (e.g., puzzles, beading). For Alex, every third instruction was an independent activity. This decision was based off reports from the clinical team that the target behaviors were more likely to occur during independent activities where the participant was not receiving direct attention. This restriction was removed after Alex's 18th session due to the long duration each session was taking to complete. Previously mastered tasks were used as opposed to tasks which were still in acquisition in order to control for a consistent schedule of reinforcement and token delivery, to eliminate the need for additional prompting of acquisition tasks within the treatment session, and to allow for consistent tasks to be used across participants.

Procedure

Sessions were conducted by each participants' primary therapist, as well as two other therapists with a history of working with the participant; these additional therapists were selected by the primary researcher and the participant's senior therapist.

If applicable to the condition, each of the three choice boards was presented with the visual representations of highly, moderately, and low preferred items/activities on the corresponding boards. A timer was started at the delivery of the first instruction and stopped following the delivery of the final instruction token. Instructions were presented, and tokens delivered for correct responses on a variable ratio 3 (VR3) schedule of reinforcement. Additionally, social praise was delivered on a fixed ratio 1 (FR1) schedule contingent on correct responses. Contingent on the occurrence of an error, the error was interrupted, the instruction re-presented, and the correct response prompted. Physical, gestural, and verbal prompts were used and were task specific. Neutral praise was provided contingent on the correct response following an error. All correct responses (prompted and independent) were calculated into the VR3 schedule of token reinforcement. Once all 10 tokens had been earned, the participant could exchange the tokens for 2-min access to their choice of item, or 1 piece of an edible, from the corresponding choice board earned. The participant did not have to choose something on the corresponding choice board; they had the option to instead reset the token board and begin working again. Contingent on the occurrence of the target behavior for decrease, a X was delivered along with descriptive feedback.

Extra-stimulus signaling. The blue choice-board icon was placed on the token board at the start of each session and remained there following the delivery of 1 X. The delivery of a second X resulted in the blue icon being removed and the yellow choice-board icon being placed on the token board, indicating access to the yellow choice board. The yellow icon remained in place if a third and fourth X were delivered. The delivery of a fifth X resulted in the black choice board icon being placed on the token board indicating access to the black choice board.

Within-stimulus signaling. The procedure was the same as in the extra-stimulus signaling condition with one exception. The visual representation indicating which choice board is available was embedded within the choice board. Therefore, it was not required to change the visual representation of which choice board was available contingent on the number of Xs delivered on the corresponding five-piece token board. The first X was placed in a blue space, indicated that the blue choice board was still available. The second, third, and fourth Xs were placed in yellow spaces, indicating the availability of the yellow choice board; the fifth X was delivered in a black space to indicate the availability of the black choice board.

No signal. The procedure was the same as the extra-stimulus signaling condition with one exception. There was neither an extra-stimulus or a within-stimulus signal to indicate the varying quality of reinforcement available. That is, Xs were delivered according to the same contingency outlined above, but the corresponding available choice board was not indicated to the participant until the end of the treatment session, which was signaled by the delivery of the 10^{th} token.

Control. The procedure was the same as the no-signal condition with one exception. Xs were delivered contingent on the occurrence of the target behavior; however, the choice board available did not change contingent on problem behavior. That is, during the control condition only the blue choice board was available irrespective of the number of Xs delivered during a session. The blue choice board was selected to mimic the reinforcement conditions in a typical token economy system within an IBI setting, where an individual would typically select a highly preferred item or activity to access contingent on the completion of a token board.

Data Collection

Data were collected on the frequency of stereotypy episodes for Tommy and Nathan. Frequency of aggression, property destruction, elopement and screaming were collected for Alex. The number of Xs delivered during each session was also recorded, as well as the color choice board accessed and reinforcer selected. Trial-by-trial data indicating when a token was delivered was also collected to ensure a consistent VR3 schedule of reinforcement. Finally, the duration from the delivery of the first instruction to the delivery of the final acquisition token was recorded. All primary scoring was completed by the participant's therapist in session.

Interobserver agreement (IOA) was collected for all three participants. 90% of sessions were videotaped for Alex, 96% for Tommy and 90% for Nathan. Sessions were observed and scored by the primary researcher using an IOA data sheet (see appendix C). IOA was calculated by dividing the number of correctly implemented components by the total number of components. Results for Alex, Tommy, and Nathan were 99%, 98%, and 91%, respectively.

Chapter III: Results

Figure 1 displays the session duration data for Tommy. Duration of session during the control condition ranged from 2m 10s-4m 30s with an average of 3m 14s. In the extra-stimulus condition the duration ranged from 2m 27s-6m 10s with an average of 4m 11s. The no-signal condition ranged from 1m 57s-3m 39s with an average duration of 3m 33s. Duration of session during the within-stimulus condition ranged from 1m 4s-3m 41s with an average of 3m 28s. No data were collected during session 46 due to technical difficulties.

Figure 1 also displays the number of Xs delivered across sessions for Tommy. The range of Xs delivered during the control condition was between 0-5 with an average of 3.6. During the extra-stimulus condition the number of Xs delivered ranged between 1-5 with an average of 3.7. The no-signal condition ranged from 2-5 with an average of 3.5. The range in the within-stimulus condition was 0-5 with an average of 3. Although the results for Tommy are undifferentiated, it can be noted that target behaviour was always observed in the extra-stimulus and no-signal conditions. Additionally, the highest count of target behavior occurred in the control condition. This may suggest that the varying quality of reinforcement signaled in the extra-stimulus, no-signal, and within-stimulus conditions may have had some impact on the occurrence of target behavior.

The session duration data for Nathan are displayed in Figure 2. During the control condition the duration ranged from 4m 4s-15m 12s with an average of 9m. The extra-stimulus condition ranged from 6m 10s-16m 49s with an average 8m 44s. In the no-signal condition ranged from 4m 52s-15m 18s with an average duration of 9m 30s. Finally, the duration ranged 4m 45s-11m 37s in the within-stimulus condition with an average of 8m 44s.

Figure 2 also displays the number of Xs delivered across sessions for Nathan. The range of Xs delivered during the no-signal condition was between 3-5 with an average of 4.8. The range of Xs delivered during the within-stimulus condition was between 4-5 with an average of 4.9. During the control and extra-stimulus conditions, Nathan received 5 Xs during every session. These high rates of target behavior observed across conditions may suggest that the reinforcement Nathan received from engaging in those target behaviors may have been more powerful than the back-up reinforcers identified on the choice boards.

The session duration for Alex is represented in Figure 3. Following session 18 a revision was made to the instructions being delivered. During sessions 1 -18 every third instruction delivered was an independent activity. During sessions 19-60 there was no schedule dictating the frequency of independent activities being delivered. During sessions 1-18 the data in the control condition ranged from 22m 30s-35m 30s with an average of 26m 52s. The range in the extra-stimulus condition is 18m 36s-24m 44s with an average duration of 21m 43s. The no-signal condition ranged from 16m 38s-28m 42s with an average duration of 22m. Within-stimulus range: 23m 26s-43m 58s with an average duration of 38m 8s. During sessions 19-60 the control condition ranged 3m 55s-12m 4s with an average duration of 8m 16s. The extra-stimulus condition ranged from 5m 58s-11m 22s with an average duration 8m 51s. The no-signal condition ranged from 4m 39s-10m 15s with an average duration of 7m 10s. Finally, the within-stimulus condition had an average duration of 7m 16s and a range of 7m 27s-10m 28s.

Figure 3 also displays the number of Xs delivered for Alex. For sessions 1-18 the range of Xs delivered during the control condition was 0-1 with an average of 0.1. The within-stimulus condition ranged from 0-3 with an average of 1.3. 0 Xs were delivered in the extra-stimulus and

no signal conditions. For sessions 19-60, the average number of Xs delivered in the control condition was 0.4 with a range of 0-5. The extra-stimulus conditioned ranged from 0-1 with an average of 0.14. 0 Xs were delivered in the no-signal and within-stimulus sessions. It should be noted that following session 18, with the exception of 1 session where 1 X was delivered in the extra-stimulus condition, target behavior was only observed in the control condition. This suggests that the extra-stimulus, no-signal, and within-stimulus conditions all controlled Alex's behaviour equally.

Chapter IV: Discussion

The current study assessed the effect of varying the quality of reinforcement contingent on problem behavior, thus extending the literature on signalling. The results of the current study did not match those of Summers et al. (1993) and Schreibman (1975), who found within-stimulus signalling to be more effective when compared to extra-stimulus signalling. The current study did not find any distinctive differentiation made across any condition for all three participants.

For both Alex and Nathan, target behaviors occurred more in the control condition versus the treatment conditions. The implications from the results for these two participants is that the varying quality of reinforcers available contingent on target behaviour may have been effective. However, the results also indicate that the method of signaling which choice board was available was undifferentiated. This suggests that the signals employed may not have been salient enough for the participants.

A possible reason for the undifferentiation observed in the treatment conditions may be due to a previous learning history with the X as a signal. Xs are often used across different environment (e.g., home, school, community programming) to signal inappropriate or undesirable behavior. If in other environments the presentation of a X resulted in an undesirable condition (e.g., error correction, delayed or no access to reinforcement) it could be that the contingency associated with that symbol may have generalized to the current study.

Another factor leading to the undifferentiated results in the treatment conditions may due to reinforcer effectiveness. The reinforcers used were not reserved for the current study. That is, all three participants were able to earn access to these items outside of the study. Reserving the

items may have served to establish them as more potent reinforcers. Due to the clinical need to complete other programming, it was not possible to reserve 8 items per participant.

There are several limitations within the study that should be noted. Prior to beginning the study, it would have been advantageous to collect baseline data on the target behaviors being assessed as well as the duration to complete a 10-piece token board; however, this was not possible due to time constraints and participant availability. Prior to beginning the study, Alex's clinical team reported that rates of target behaviors had decreased; baseline data would have served as a comparison to the same data collected during the study and may also have provided more information as the effectiveness of the conditions.

Second, the current study had limitations related participant selection; specifically related to relative reinforcer value. Hoch et al. (2002) demonstrated the impact of differentiated preferences in reinforcers. In the current study, however, two participants (Tommy and Nathan) did not have strong preference differentiation. That is, therapists would report that both participants were often willing to take any reinforcer offered and did not demonstrate overly strong preference some items over others. Incorporating a more stringent inclusion criteria around reinforcer preferences may serve to improve the effectiveness of the varying quality of reinforcement component.

Also associated to the participant pool were the target behaviors selected. The target behaviors selected for both Nathan and Tommy were hypothesized to be a function of automatic reinforcement. A critical component of the current procedure was that the participant have strong preferences for items or activities that are not accessed automatically, thus making these participants less. That is, the procedure may have been more effective if targeting socially

medicated behavior or behavior which are hypothesized to be a function tangible, escape/avoidance, or attention.

Finally, enhancing the signal may also result in an improved outcome. Gouboth et al. (2007) employed a verbal signal during FCT and found it to be more effective when compared to no signal. Further, Fisher et al. (1998) extended previous literature by combining verbal and visual signals when implementing functional communication training. Adding a verbal component to the signal may serve to enhance the saliency of the signal, for example, by providing verbal feedback in combination with the visual "X" delivery contingent on the occurrence of the target behavior(s) or providing a verbal explanation of which choice board the participant earns access to. Additionally, providing a verbal explanation of the contingency prior to running a session may also improve the efficacy of the procedure.

Future research should investigate the efficacy of this procedure when applied to target behaviors that are a function of attention, escape or access to tangible items. It would be ideal to conduct a functional analysis prior to implementation to ensure that behaviors are being selected based on function. Secondly, future research should explore selecting target behaviors that are discrete rather than episodic. Discrete behaviors are often clearer for both the therapist and the participant and may result in faster and stronger association being formed between the occurrence of a target behavior and the delivery of a X. IOA results are slightly lower for Nathan and Tommy in part due to inconsistent data collection and X delivery contingent on target behavior.

As mentioned previously, future research should also explore enhancing the saliency of the X signal. That is, providing a verbal explanation along with the delivery of the X may increase the probability that a participant attends to the signal and therefore may increase the

effectiveness of the signal itself. Additionally, providing the participant with a visual and/or verbal rule of the contingencies associated with accessing the various choice boards may also serve to improve the efficacy of the procedure.

The current study employed a ratio-based token economy where tokens were delivered contingent on the participant engaging in a previously mastered skill when given an instruction. Future research should explore incorporating varying qualities of reinforcement within time-based token economies such as Differential Reinforcement of Other Behaviour (DRO) procedures. Within a time-based token economy, there is the opportunity to move the procedure to one that is self-monitored. A system that is self-monitored rather than socially mediated may have a higher probability of transferring to other environments and therefore is of higher social validity.

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Appendix A: Figures

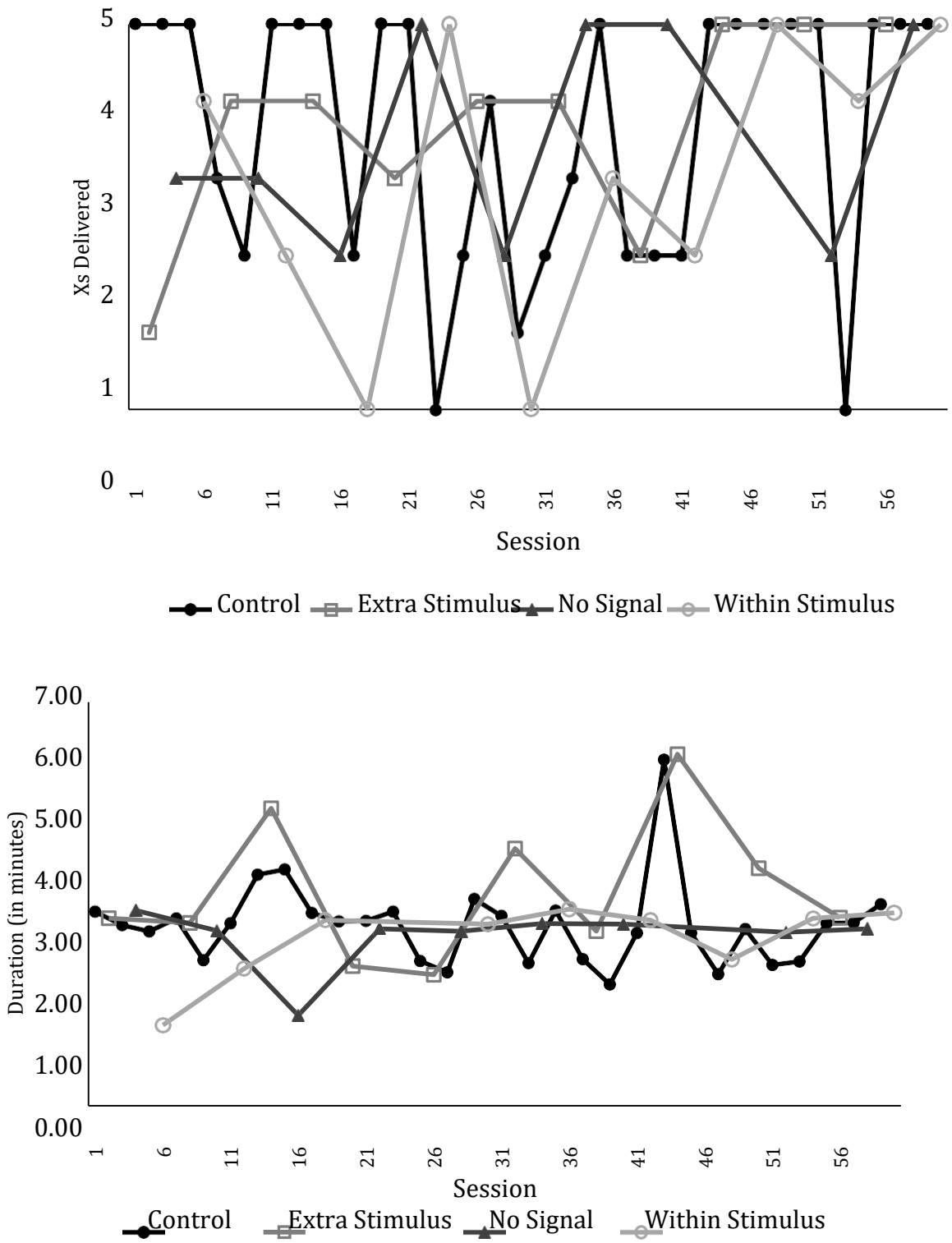

Figure 1. Count of Xs delivered for Tommy and duration of sessions for Tommy.

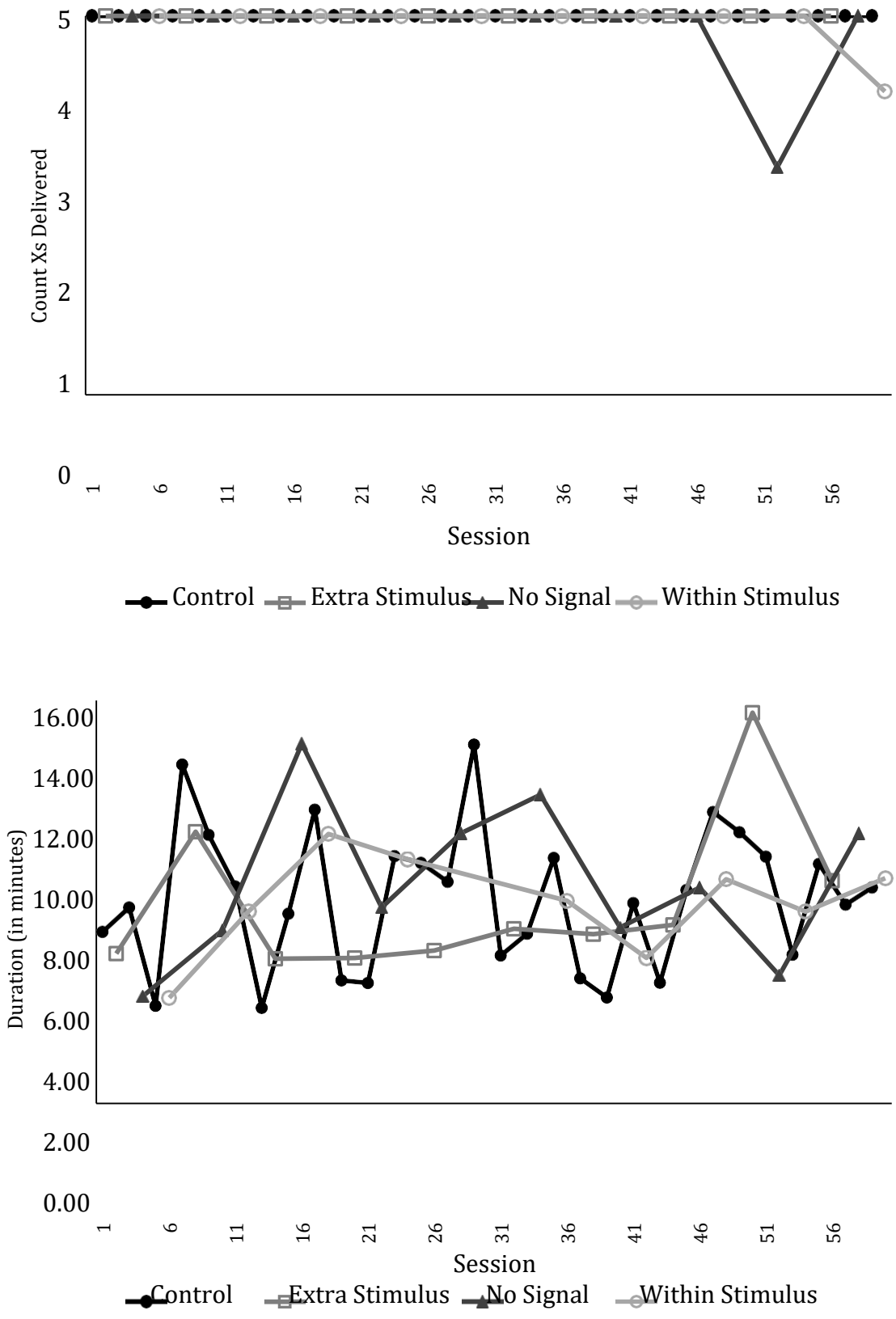

Figure 2. Count of Xs delivered for Nathan and duration of sessions for Nathan.

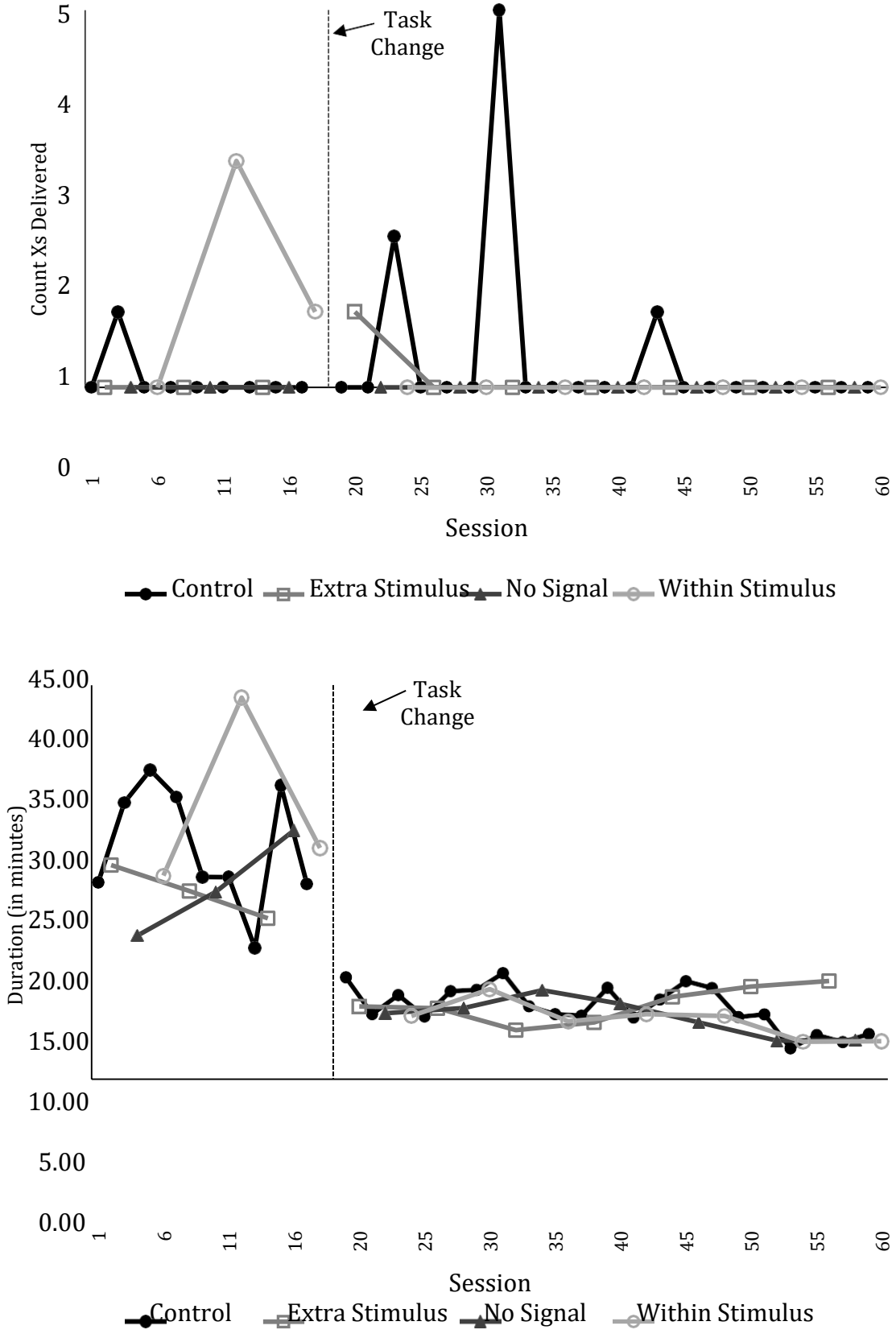

Figure 3. Count of Xs delivered for Alex and duration of sessions for Alex.

Appendix B: Materials

Session Data Collection

Date/IT						
Condition:	Control: Use blank token board (gains access to blue choice board regardless of number of Xs earned)					
Trials: R+: Immediate delivery of a token on a VR3 schedule of reinforcement	1	✓x R+	13	✓ x R+	25	✓ x R+
	2	✓x R+	14	✓ x R+	26	✓ x R+
	3	✓x R+	15	✓ x R+	27	✓ x R+
	4	✓x R+	16	✓ x R+	28	✓ x R+
	5	✓x R+	17	✓ x R+	29	✓ x R+
	6	✓x R+	18	✓ x R+	30	✓ x R+
	7	✓x R+	19	✓ x R+	31	✓ x R+
	8	✓x R+	20	✓ x R+	32	✓ x R+
	9	✓x R+	21	✓ x R+	33	✓ x R+
	10	✓x R+	22	✓ x R+	34	✓ x R+
	11	✓x R+	23	✓ x R+	35	✓ x R+
	12	✓x R+	24	✓ x R+	36	✓ x R+
Duration of Session	Count of Xs Delivered		Color of Choice Board Earned		Reinforcer Selected	
			Always blue			

Date/IT						
Condition:	Extra Stimulus: Use blank token board w/ the removable reinforcer board colour icon					
Trials:	1	✓x R+	13	✓ x R+	25	✓ x R+
	2	✓x R+	14	✓ x R+	26	✓ x R+
R+: Immediate delivery of a token on a VR3 schedule of reinforcement	3	✓x R+	15	✓ x R+	27	✓ x R+
	4	✓x R+	16	✓ x R+	28	✓ x R+
	5	✓x R+	17	✓ x R+	29	✓ x R+
	6	✓x R+	18	✓ x R+	30	✓ x R+
	7	✓x R+	19	✓ x R+	31	✓ x R+
	8	✓x R+	20	✓ x R+	32	✓ x R+
	9	✓x R+	21	✓ x R+	33	✓ x R+
	10	✓x R+	22	✓ x R+	34	✓ x R+
	11	✓x R+	23	✓ x R+	35	✓ x R+
	12	✓x R+	24	✓ x R+	36	✓ x R+
Duration of Session	Count of Xs Delivered		Color of Choice Board Earned		Reinforcer Selected	

Date/IT						
Condition:	No Signal: Use blank token board (gains access to the choice board corresponding with the number of Xs earned)					
Trials:	1	✓x R+	13	✓ x R+	25	✓ x R+
	2	✓x R+	14	✓ x R+	26	✓ x R+
R+: Immediate delivery of a token on a VR3 schedule of reinforcement	3	✓ x R+	15	✓ x R+	27	✓ x R+
	4	✓ x R+	16	✓ x R+	28	✓ x R+
	5	✓ x R+	17	✓ x R+	29	✓ x R+
	6	✓ x R+	18	✓ x R+	30	✓ x R+
	7	✓ x R+	19	✓ x R+	31	✓ x R+
	8	✓x R+	20	✓ x R+	32	✓ x R+
	9	✓x R+	21	✓ x R+	33	✓ x R+
	10	✓x R+	22	✓ x R+	34	✓ x R+
	11	✓x R+	23	✓ x R+	35	✓ x R+
	12	✓x R+	24	✓ x R+	36	✓ x R+
Duration of Session	Count of Xs Delivered		Color of Choice Board Earned		Reinforcer Selected	

Date/IT												
Condition:	Within Stimulus: Use token board with color of the reinforcer board embedded within the X boxes											
Trials: R+: Immediate delivery of a token on a VR3 schedule of reinforcement	1	✓	x	R+	13	✓	x	R+	25	✓	x	R+
	2	✓	x	R+	14	✓	x	R+	26	✓	x	R+
	3	✓	x	R+	15	✓	x	R+	27	✓	x	R+
	4	✓	x	R+	16	✓	x	R+	28	✓	x	R+
	5	✓	x	R+	17	✓	x	R+	29	✓	x	R+
	6	✓	x	R+	18	✓	x	R+	30	✓	x	R+
	7	✓	x	R+	19	✓	x	R+	31	✓	x	R+
	8	✓	x	R+	20	✓	x	R+	32	✓	x	R+
	9	✓	x	R+	21	✓	x	R+	33	✓	x	R+
	10	✓	x	R+	22	✓	x	R+	34	✓	x	R+
	11	✓	x	R+	23	✓	x	R+	35	✓	x	R+
	12	✓	x	R+	24	✓	x	R+	36	✓	x	R+

Duration of Session	Count of Xs Delivered	Color of Choice Board Earned	Reinforcer Selected

Multiple Stimulus Without Replacement Data Sheet

Date:_____ Therapist: _____

Item A: _____ Item E: _____

Item B: _____ Item F: _____

Item C: _____ Item G: _____

Item D: _____ Item H: _____

15s-30s access for each item when selected or one small piece if an edible

Trial #	Item Selected	Circle Placement of Item Selected
1		X X X X X X X X
2		X X X X X X X
3		X X X X X X
4		X X X X X
5		X X X X
6		X X X
7		X X
8		X

First 4 items selected on Blue Choice Board: _____

Items selected 5th and 6th on Yellow Choice Board: _____

Items selected 7th and 8th on the Black Choice Board: _____

Interobserver Agreement Data Sheet

Participant: _____

Date/Session: _____

Condition: _____

Item	**+ or -**	**Notes**
Start timer at beginning of session (at delivery of first instruction)		
Stop timer at end of session (once last token has been delivered)		
Deliver X contingent on occurrence of target behaviour		
No other feedback (e.g., verbal) delivered along with X		
Record count of Xs delivered		
Reinforce tasks on a VR3 schedule (10 tokens delivered within 25-35 instructions)		
Change signal (extra-stimulus condition only)		
Deliver correct color choice board		

Results: _____

Notes:

Appendix C: Institutional Review Board Approval

ST. CLOUD STATE UNIVERSITY
EDUCATION FOR LIFE.

Institutional Review Board (IRB)

720 4th Avenue South AS 210, St. Cloud, MN 56301-4498

Name: Caitlin Macdonell

Email: maca1102@stcloudstate.edu

IRB PROTOCOL DETERMINATION: Expedited Review-2

Project Title: Signaling the Availability of Varying Quality of Reinforcement in a Token Economy

Advisor Michele Traub

The Institutional Review Board has reviewed your protocol to conduct research involving human subjects. Your project has been: **APPROVED**

Please note the following important information concerning IRB projects:

- The principal investigator assumes the responsibilities for the protection of participants in this project. Any adverse events must be reported to the IRB as soon as possible (ex. research related injuries, harmful outcomes, significant withdrawal of subject population, etc.).

- For expedited or full board review, the principal investigator must submit a Continuing Review/Final Report form in advance of the expiration date indicated on this letter to report conclusion of the research or request an extension.

-Exempt review only requires the submission of a Continuing Review/Final Report form in advance of the expiration date indicated in this letter if an extension of time is needed.

- Approved consent forms display the official IRB stamp which documents approval and expiration dates. If a renewal is requested and approved, new consent forms will be officially stamped and reflect the new approval and expiration dates.

- The principal investigator must seek approval for any changes to the study (ex. research design, consent process, survey/interview instruments, funding source, etc.). The IRB reserves the right to review the research at any time.

If we can be of further assistance, feel free to contact the IRB at 320-308-4932 or email ResearchNow@stcloudstate.edu and please reference the SCSU IRB number when corresponding.

IRB Chair:

Dr. Benjamin Witts
Associate Professor- Applied Behavior Analysis
Department of Community Psychology,Counseling, and Family Therapy

IRB Institutional Official:

Dr. Latha Ramakrishnan
Interim Associate Provost for Research
Dean of Graduate Studies

OFFICE USE ONLY

SCSU IRB# 1829 - 2338	**Type:** Expedited Review-2	**Today's Date:** 7/27/2018
1st Year Approval Date: 7/25/2018	**2nd Year Approval Date:**	**3rd Year Approval Date:**
1st Year Expiration Date: 7/24/2019	**2nd Year Expiration Date:**	**3rd Year Expiration Date:**

ST. CLOUD STATE UNIVERSITY
EDUCATION FOR LIFE.

Institutional Review Board (IRB)

720 4th Avenue South MC 204K, St. Cloud, MN 56301-4498

Continuing Review / Final Report

Principal Investigator: **Caitlin Macdonell**

Co-Investigator:

Project Title: **Signaling the Availability of Varying Quality of Reinforcement in a Token Econo my**

If the project has been completed (no longer collecting data on human subjects) please indicate your projects status under Final Report and complete questions 1 through 5. If you have completed collecting data on human subjects but continue to analyze the data, as long as no new data is being obtained, your project would be considered completed.

If the project has not been completed (you are collecting data on human subjects) please indicate the status of your project under Continuing Review/Project Continuation and answer questions 1 through 5.

Final Report

✓ The Project has been completed.

___ Project has not and will not be conducted. Explain:

Continuing Review/Project Continuation

___ Data collection continues with enrolled participants.

___ Participant recruitment continues following approved IRB protocol.

Have any changes been made to your research project (changes in subject recruitment, informed consent documents, design, methodology, procedures, etc.) since it was approved by the IRB?

___ No

___ Yes, explain:

Final Report and Continuing Review/Project Continuation, please answer the following:

1. How many participants have participated in your study 3

2. Have any adverse events (complaints, unexpected reactions, discomfort, or problems) occurred during this research project

✓ No

___ Yes, explain:

3. Have any participants withdrawn from the research, either voluntarily or at the researcher's request?

✓ No

___ Yes, explain:

4. Has any new information been identified that may affect the willingness of subjects to participate in this research project?

✓ No

___ Yes, explain:

5. Have any changes been made to your research project (changes in subject recruitment, informed consent documents, design, methodology, and procedures, etc.) since it was approved by the IRB?

✓ No

___ Yes, explain:

Caitlin Macdonell — Principal Investigator's Signature

12/12/2018 — Date

SCSU IRB#: 1829 - 2338

Signaling the Availability of Varying Quality of Reinforcement in a Token Economy

Parental/Guardian Consent Form

Your child is invited to participate in a research study about evaluating the effectiveness of token economies on decreasing challenging behaviour when the quality of reinforcement is adjusted based on your child's behaviour (i.e., the less amount of challenging behaviour, the better the quality of reinforcement). Additionally, different methods of signaling the adjustment of quality of reinforcement will be evaluated.

If you agree to be part of the research study, your child will be asked to complete a number of work sessions consisting of completing 10-piece token board. During some work sessions your child will be able to the see what reinforcers they will able to earn. In other sessions, there will be a space where up to five "X"'s can be delivered. The "X"'s are delivered if/when your child engages in predetermined challenging behaviour. During these work sessions, the number of "X"'s delivered will tell your child what reinforcers are available.

Benefits of the research. By determining if varying the quality of reinforcement has an impact on decreasing challenging behaviour and an effective method of signaling that reinforcement adjustment it may be possible to increase the quality of life for individuals who exhibit challenging behaviour as well as those surrounding him/her. Decreased challenging behaviour may help an individual develop social skills, communication, independence, his/her ability to navigate different environments, and his/her ability to tolerate being denied or waiting for preferred items or activities.

Risks and discomforts. During the study your child may be denied access to more preferred items or activities depending on the frequency he/she engaged in challenging behaviour during a work session. Your child may be upset about this denial and that may result is other or more intense challenging behaviour (e.g., crying, screaming, yelling, flopping). The primary researcher will always be present or made aware or additional or increased challenging behaviour as soon as possible in order to closely monitor any behaviour changes and make adjustments as necessary.

Data collected will remain confidential. A pseudonym will be assigned to each participant. The primary researcher as well as the therapists implementing the protocol will be aware of confidential information. All other people will only be made aware of the pseudonyms. The raw data and information will be kept in a locked drawer in the primary researcher's office. The data will be destroyed once the primary researcher receives her degree. Parents/Guardians will have access to his/her child's data upon request.

Participating in this study is completely voluntary. You and/or your child can withdraw at any time any penalty. The decision whether or not to participate will not affect your or your child's current or future relations Geneva Centre for Autism.

If you or your child have questions about this research study, please contact:

Caitlin Macdonell
416-302-2097
caitlin.macdonell@gmail.com

Michele R. Traub, Ph.D., BCBA-D
Assistant Professor of Behavior Analysis
Department of Community Psychology, Counseling, and Family Therapy
mtraub@stcloudstate.edu
(320) 308-2043

Results of the study can be requested from the researcher.

Your signature indicates that you and your child have read the information provided here and have decided to participate. You or your child may withdraw from the study at any time without penalty after signing this form.

Student Name (Printed)	Parent(s')/Guardian(s') Name (Printed)
Parent(s')/Guardian(s') Signature	Date