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Differential Reinforcement of Other Behavior Versus Response Cost: Effects of Immediate and Delayed Consequences in Token Economies

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Differential Reinforcement of Other Behavior Versus Response Cost: Effects of Immediate and Delayed Consequences in Token Economies

by

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

Token economies incorporating differential reinforcement of other behavior and response cost have been shown to be effective for decreasing behavior. However, these token economies in the literature have differed in their findings of the effectiveness of and preference for differential reinforcement of other behavior and response cost. They have also differed in the way they implemented token economies including factors such as the immediacy of a consequence and the use of verbal feedback. Therefore, we examined two versions of response cost, one in which the contingency is experienced immediately and one in which it is experienced at end of an interval, with differential reinforcement of other behavior. We also examined these contingencies with the addition of verbal feedback and the participant preference for conditions. Results demonstrated that there was a faster decrease in errors during the response cost immediate conditions when compared to response cost delay and DRO conditions. All conditions resulted in fewer errors than the conditions without verbal feedback and preference was found to be variable. Response cost immediate resulted in the most raffle tickets earned during the no verbal feedback phases and most of the verbal feedback phases.
Introduction

A token economy is a system in which an individual is rewarded with a token contingent upon specified, desirable behavior. These earned tokens can later be exchanged for backup reinforcers. A token economy can also include a response cost in which the tokens are removed contingent on specified undesirable behavior (Hackenberg, 2009). Token economies can incorporate many features including reinforcement and punishment contingencies. Three varieties of the token economy have been studied: token reinforcement, response cost, and token reinforcement combined with response cost. A token reinforcement system is when an individual can only gain tokens contingent on the absence or presence of a specified behavior and cannot lose them once they are gained. A response cost system is when the individual starts out with a specified amount of tokens and can lose these tokens contingent on the absence or presence of a specified behavior, but cannot earn back the tokens. A combined token reinforcement and response cost system incorporates both of the above systems. The individual can both gain and lose tokens contingent on specified behavior (Cooper, Heron, & Heward, 2007).

Token economies are effective in a variety of settings as well as a variety of populations (Hackenberg, 2009). They can address multiple behaviors for increase or decrease simultaneously. Token economies can also be adaptable to a variety of situations, making it easy to incorporate the best contextual fit for each individual using the token economy for behavior change. Although token economies are considered effective (Everett, Hayward, & Meyers, 1974; Foxx, Hopkins, & Anger, 1987; Hackenberg, 2009; Robinson, Newby, & Ganzell, 1981; Tarbox,
Ghezzi, & Wilson, 2006), it is not always made clear what aspects of each token economy are necessary and sufficient for behavior improvement.

Token reinforcement and response cost have both been found to be effective components of token economies for increasing and decreasing behavior. Myers (1975) conducted a comparison of response cost and token reinforcement and concluded that response cost was more effective than token reinforcement. In McLaughlin and Malaby (1977), targeting behaviors for increase and decrease with elementary school students in special education, and Truchlicka, McLaughlin, and Swain (1998), targeting correct spelling with middle school students in special education, a comparison of response cost, token reinforcement, and token reinforcement combined with response cost were assessed. The results for both of these studies concluded that token reinforcement combined with response cost was more effective than token reinforcement or response cost alone. Response cost as well as a combined token reinforcement with response cost system have been found to be more effective than token reinforcement alone (McLaughlin & Malaby, 1974). Iwata and Bailey (1974) found no difference in the effectiveness between token reinforcement and response cost when targeting behaviors for increase and decrease with elementary school students in special education. These studies have compared response cost with token reinforcement in many ways and have come to different conclusions in regards to which type of token economy is the most effective. It remains unclear as to why each study may obtain one result over another result.

Preference for the different types of token economies has also been examined (Iwata & Bailey, 1974; Jowett Hirst, Dozier, & Payne, 2016; McLaughlin & Malaby, 1977), but results have varied across studies. Jowett Hirst, Dozier, and Payne (2016) conducted two studies comparing token reinforcement and response cost separately for increasing on task behavior in a
preschool program using group and individual contexts. They found that response cost was preferred over token reinforcement in their first study using a group context and that response cost and token reinforcement were preferred equally in their second study using an individual context. Iwata and Bailey (1974) found no difference in preference for the three types of token economies by their participants in a classroom setting when targeting rule violations and off task behavior for decrease and number of arithmetic problems completed for increase. McLaughlin and Malaby (1977) compared token reinforcement and token reinforcement combined with response cost targeting letter tracing and disruptive behavior in the classroom setting. They found that their participants preferred token reinforcement more often. The conditions under which participants choose one type of token economy over another are unknown. If the token economy results in the organism contacting more reinforcement, the amount of reinforcement earned may be a factor as to why one token economy system is more effective and or preferred.

Token economies are implemented in a number of ways and incorporate many different features (Conyers et al., 2004; Iwata & Bailey, 1974; Myers, 1975). Some features that can vary from one token economy to another include the schedule of reinforcement, what types of tokens are being used, who delivers the tokens, when tokens can be exchanged for backup reinforcers, and many more. Studies comparing DRO and response cost have found inconclusive results. This could be due to varying factors in the implementation of the token economies. Noticeable differences in literature comparing DRO and response cost include the immediacy of token delivery and the inclusion of verbal feedback with the delivery of tokens. These features could possibly account for the effectiveness of, or preference for certain token economies. Experimental research has shown that immediacy of reinforcement can impact acquisition strength (Renner, 1964) and delays in reinforcement can slow down the rate of learning (Perkins,
1947). However, verbal cues may reduce the potential impact of delayed reinforcement (Renner, 1964).

Myers (1975) compared a token reinforcement only system, differential reinforcement of other behavior (DRO), and combined token reinforcement with response cost in the context of a token economy to decrease self-injurious behavior in a classroom setting. Myers (1975) found that token reinforcement with response cost was more effective than DRO alone. The DRO component in this study involved giving participants tokens after a specified amount of time without the target behavior. The DRO plus response cost component in this study gave the participants immediate behavior specific feedback and removal of the token upon the target behavior but continued giving tokens on an interval schedule. Conyers et al. (2004) compared DRO and response cost in the context of a token economy to decrease disruptive behaviors in a classroom setting. Response cost was found to be more effective than DRO. The DRO component in this study involved giving the participant a token after a specified amount of time along with a praise statement. The response cost component in this study included giving the participants delayed behavior specific feedback and removal of the token upon a specified amount of time. In both of these studies the punishment contingencies shared the feature of behavior specific feedback upon removal of a token and resulted in a decrease of the target behavior. By contrast, Iwata and Bailey (1974) found equivalent results for the effectiveness of DRO and response cost unlike the above two studies who found a response cost component to be more effective than DRO. Iwata and Bailey (1974) targeted rule violations and off task behavior for decrease and the number of arithmetic problems completed for increase in a classroom setting. Another difference in this study compared to the previous two studies is that Iwata and Bailey (1974) gave no behavior specific feedback with the removal of tokens during response
cost. A cueing device was used to indicate the end of an interval and each student either had a token removed or a token added at that time. It is possible that Iwata and Bailey (1974) weakened the punishment contingency by giving no behavior specific feedback at the end of the interval. Participants had tokens either earned or lost at the end of an interval with no specific feedback as to why. There was no behavior specific feedback for token loss or gain because participants were simply given or had a token removed when behavior occurred after a predetermined interval.

The goal of this translational study was to compare token economies incorporating DRO and response cost in regards to effectiveness and preference. Immediate and delayed feedback are features typically built into token economies. We examined the influences of feedback timing as well as the use of verbal feedback on reducing errors. The choice to examine these token economies in the experimental setting versus the applied setting was due to the social validity concerns related to response cost. Response cost can lead to collateral reductions of desired behavior, avoidance behaviors, and increased aggression (Cooper, Heron, & Heward, 2007). Examining these relationships with an arbitrary task using adult participants that are typically developing will give the opportunity to manipulate the response cost and DRO variables without likely producing any significant negative effects associated with response cost that could transfer into their daily lives. Targeting a behavior of social significance using response cost or using a vulnerable population could lead to social validity concerns. A better understanding of these factors in the experimental setting will help inform treatment plans in the natural setting for individuals using token economies.

It may be that response cost, as it is typically used, has a natural advantage over DRO because it is immediate, whereas DRO contingencies are experienced at the end of an interval.
Both response cost and DRO may function to signal whether someone has engaged in a correct or incorrect response, but response cost may provide more information depending on timing in relation to the response. Therefore this study directly compared two versions of response cost, one in which the contingency was experienced immediately and one where it was experienced at end of an interval, with DRO. These contingencies were then examined with the addition of verbal feedback. This study evaluated the variable of immediacy and verbal feedback for effectiveness of response cost in relation to DRO. Preference for conditions and the amount of reinforcers earned in each condition was also evaluated.
Method

Participants and Setting

Four undergraduate female students (20 to 23 years old) participated in this study. The primary investigator and research assistants conducted all sessions at the University of South Florida (USF). Participants are referred to as Nancy, Angela, Holly, and Brandi.

Materials

Seven different-colored token boards and their corresponding eight tokens were used throughout the study. One of those seven token boards was designated for the baseline condition. Three token boards were designated for the conditions without verbal feedback and three token boards were designated for the conditions with verbal feedback. Each participant was taught different conditional discrimination tasks. The conditional discrimination tasks included six or nine sets of four cards with different letters on them (i.e., A-X) and six or nine sets of four different cards with open or closed shapes on them (i.e., square, circle, star, triangle, plaque, hexagon, pentagon, octagon, cross, parallelogram, moon, and heart). These shapes and letters had arbitrary relationships for matching purposes that were unique to each participant and each condition (e.g., In DRO condition, A = open star, B = open triangle, C = closed square, and D = open circle). All sessions were video recorded throughout the study with a camcorder.

Tokens could be earned in each session and exchanged for raffle tickets at the end of each session. The raffle took place after all participants completed all phases of the study. All raffle tickets earned by each participant were put into a basket. The primary investigator selected one ticket from the basket. The participant whose raffle ticket was selected received their highest
preferred prize. Once a participant’s raffle ticket had been selected, their remaining tickets were removed from the basket. The primary investigator continued to select tickets until all participants received a prize and all backup reinforcers were dispersed. The array of prizes included two theme park tickets and various gift baskets including items such as shirts, hats, coupons, coffee mugs, a cooler, and coffee beans.

**Variables**

Percentage of matching errors was recorded to determine the effectiveness of each condition on participant learning of conditional discrimination tasks. The investigator assessed participant preference for conditions with the amount of instances a condition was chosen in a concurrent-chains arrangement. The investigator recorded the amount of raffle tickets provided during each condition to show how much reinforcement was earned per participant in each phase.

**Response Measurement**

Throughout the study, the target behavior was matching and the measured dependent variable was matching errors. During each session, researchers had a key card with the correct alphabet letter to shape relationships for each condition to collect data on participant responding. They scored the participant’s responses as correct or incorrect on a data collection tool created by the primary investigator. The participants’ responses were scored as correct if they matched the correct shape card with its corresponding alphabet letter. Their responses were scored as incorrect if they did not respond during the 10-s trial or they matched a shape card with any alphabet letter that was not its designated corresponding letter. The researcher also recorded the number of tokens and raffle tickets earned for each participant in every session.
Interobserver Agreement and Treatment Integrity

A research assistant collected data for at least 34% of all sessions per participant and calculated interobserver agreement and treatment integrity. Interobserver agreement was calculated for 62% of Nancy’s sessions, 42% of Angela’s sessions, 37% of Holly’s sessions, and 34% of participant Brandi’s sessions. Interobserver agreement was calculated using the partial interval agreement method in which sessions were divided into 10-s intervals. Agreement was calculated by dividing the smaller frequency by the larger frequency in each interval. The results were averaged across all intervals (Bostow & Bailey, 1969). Interobserver agreement averaged 99.7% (range, 99.4% to 100%) across all sessions per participant. Interobserver agreement was 99.4% for Nancy, 100% for Angela, 100% for Holly, and 99.4% for Brandi.

Treatment integrity was calculated for 38% of Nancy’s sessions, 40% of Angela’s sessions, 37% of Holly’s sessions, and 37% of participant Brandi’s sessions. For treatment integrity, the research assistant recorded if the therapist’s behavior followed the procedures for each condition and phase (see appendix B). Treatment integrity averaged 99.1% (range, 98.5% to 99.6%) across all sessions per participant. Treatment integrity was 98.8% for Nancy, 99.4% for Angela, 99.6% for Holly, and 98.5% for Brandi.

Procedures and Experimental Design

Preference assessment. Participants were given a list of the possible backup reinforcers and instructed to rank the items from most preferred to least preferred. A hierarchy of preference for backup reinforcer prizes was formed from this preference assessment for each participant. Five colors were presented to participants and they were instructed to rank the colors from most preferred to least preferred. A hierarchy of preference for colors was formed from this preference assessment for each participant. The color preference assessment informed the color of each
conditions token board. Out of these five colors, the lowest preferred color was paired with the contingency that we hypothesized to be preferred by participants (response cost immediate) and the color with the highest preference for each participant was paired with the contingency that was hypothesized to be the least preferred by participants. The color with moderate preference for each participant was paired with the third contingency. The token board colors determined for each participant for DRO, response cost delay, and response cost immediate without verbal feedback was the same colors in the verbal feedback phase except that a red border was used on the token boards.

**Token economy evaluation.** Experimental control was demonstrated using a reversal with an embedded multielement design. Baseline included a multielement comparison of three conditions of different shape to letter relationships. The no verbal feedback phase consisted of DRO, response cost delay, and response cost immediate conditions. These conditions did not include verbal feedback. After one condition had three sessions of discriminated responding compared to the other two conditions or one condition had zero errors while the other two conditions had 50% or more errors, with a minimum of three sessions, the verbal feedback phase began. The verbal feedback phase was identical to the no verbal feedback phase except, verbal feedback was provided. This phase was conducted until two conditions reached zero errors within the same series. The choice phase included a concurrent-chains arrangement in which participants chose one of the six token boards representing each condition (DRO, response cost delay, and response cost immediate with or without verbal feedback) and received the corresponding contingencies. The choice phase was conducted until the participant chose the same condition across three consecutive sessions or 10 sessions passed. All phases were replicated with a new set of corresponding shape to letter relationships. Replication was
completed twice for three participants and once for the fourth participant. The arbitrary relationships between shapes and letters were the same for baseline, no verbal feedback, verbal feedback, and choice phases during one round of implementation. Replication consisted of new shape to letter relationships.

At the start of each session, four letter cards were placed in front of the participant corresponding to the condition being implemented. The experimenter placed one shape card in front of the participant and delivered the instruction "match." After 10 s, the experimenter removed that shape card and presented the next shape card. This was done until all four shape cards were presented. After all shape cards were presented once, the experimenter shuffled those four shape cards during a 10-s interblock interval and the participant experienced the consequence for that condition. After, all shape cards were presented again. After the participant placed a shape card on top of a letter card, an experimenter recorded whether the match was correct or incorrect, and delivered the consequence corresponding to the current condition being implemented. For example, if the participant matched the provided shape card to the incorrect letter card during the response cost immediate with verbal feedback phase, the experimenter immediately removed a token and said “incorrect”. Each shape card was presented twice during each session. The researcher recorded the amount of tokens the participant had at the end of each session. If the participant earned six or more tokens at the end of the session they received one raffle ticket.

**Baseline.** During baseline, a white token board was present. Participants were instructed to match the shape cards with their corresponding alphabet letter and responding did not result in the loss or gain of tokens. Each session consisted of eight 10-s trials and a 10-s interblock interval between the fourth and fifth trial. Each condition had four different shape to letter
relationships. Baseline consisted of at least three sessions for each condition or until responding was stable.

**DRO.** During the DRO condition, participants started with zero tokens on their token board and were able to earn up to eight tokens for correctly matching shapes with their corresponding letter. The absence of errors per 10-s trial was reinforced with tokens after four trials and a 10-s interblock interval followed every four trials. If the participant did not respond or responded incorrectly within the 10-s trial, no tokens were provided for that trial at the end of the 40-s interval and matching continued until all eight trials were presented. No verbal feedback was delivered with the presentation of tokens.

**Response cost delay.** During the response cost delay condition, participants began each session with all eight tokens on their token board. Tokens were removed at the end of a 40-s interval during a 10-s interblock interval contingent on the amount of incorrect matching or instances of no responding during the 10-s trials (e.g., if a participant incorrectly matched the shape in two of the four trials, he/she had two tokens removed at the end of the interval). If the participant correctly matched all shapes with their alphabet letter during the 40-s interval, no tokens were removed. No verbal feedback was delivered with the removal of tokens.

**Response cost immediate.** During the response cost immediate condition, participants began each session with all eight tokens on their token board and a token was removed immediately during all eight 10-s trials contingent on an instance of incorrect matching or no responding. If the participant correctly matched during the 10-s trial, no tokens were removed and matching continued until all eight matching trials were delivered. No verbal feedback was delivered with the removal of a token.
**DRO with verbal feedback.** During the DRO with verbal feedback condition, participants started with zero tokens on their token board and were able to earn up to eight tokens for correctly matching shapes with their corresponding letter. The absence of errors per 10-s trial was reinforced with tokens after four trials and a 10-s interblock interval followed every four trials. If the participant did not respond or responded incorrectly within the 10-s trial, no tokens were provided for that trial at the end of the 40-s interval and matching continued until all eight trials were presented. Verbal feedback was provided contingent on an instance of correct responding. If the participant matched correctly during a 10-s trial, they were told, “correct” immediately.

**Response cost delay with verbal feedback.** During the response cost delay with verbal feedback condition, participants began each session with all eight tokens on their token board. Tokens were removed at the end of a 40-s interval during a 10-s interblock interval contingent on the amount of incorrect matching or instances of no responding during the 10-s trials (e.g., if a participant incorrectly matched the shape in two of the four trials, he/she had two tokens removed at the end of the interval). If the participant correctly matched all shapes with their alphabet letter during the 40-s interval, no tokens were removed. Verbal feedback was provided contingent on an instance of incorrect or no responding. If a participant incorrectly matched or did not respond during a 10-s trial, the participant was told “incorrect” immediately after the response.

**Response cost immediate with verbal feedback.** During the response cost immediate with verbal feedback condition, participants began each session with all eight tokens on their token board and a token was removed immediately during all eight 10-s trials contingent on an instance of incorrect matching or no responding. If the participant correctly matched during the 10-s trial,
no tokens were removed and matching continued until all eight matching trials were delivered. Verbal feedback was provided contingent on an instance of incorrect or no responding. If a participant incorrectly matched or did not respond during a 10-s trial, the participant was told “incorrect” immediately after the response.

**Choice.** After baseline and the two intervention phases were completed, a concurrent-chains arrangement as described by Hanley, Piazza, Fisher, and Maglieri (2005) was employed to determine participant preference of conditions. All six token boards associated with each intervention condition were placed in front of the participant. The experimenter then stated, “Pick the learning system you liked the most and we will experience that next.” The participant experienced the corresponding contingency of the condition chosen (e.g., if the participant selected the purple token board, the condition representing that token board was implemented). This concurrent-chains arrangement was implemented until a clear preference or lack thereof was determined with a maximum of ten sessions and a minimum of three sessions.

**Reversal.** All phases were replicated and the procedures were identical to those described above except a new set of corresponding shape to letter relationships were used. Angela, Holly, and Brandi experienced two reversals and Nancy experienced one reversal.

**Data Analysis**

During baseline, no verbal feedback, and verbal feedback phases, percentage of errors were visually analyzed in a within subjects design to determine which condition reduced errors most effectively. During the choice phase, the number of selections for each condition during the concurrent-chains arrangement sessions was used to determine participant preference. The participant choosing the same condition three times consecutively suggested a preference for that condition. The relationships between effectiveness of a condition, preference for a condition, and
the amount of raffle tickets earned in a condition were analyzed as well.
Results

Figure 1 shows the percentage of errors for each session and participant for baseline, no verbal feedback, verbal feedback, and choice phases. During baseline phases for all participants, percentage of errors made for all conditions were variable. During the no verbal feedback phases, Nancy, Angela, and Brandi had a faster decrease in errors during the response cost immediate conditions when compared to response cost delay and DRO conditions. Holly had a different condition in each reversal that declined the fastest in errors. When verbal feedback was added, all conditions (with the exception of the second reversal for Holly during the DRO condition) resulted in fewer errors than the conditions without verbal feedback. The choice conditions resulted in variable findings across participants. Nancy preferred DRO with verbal feedback during both choice conditions, Holly preferred response cost immediate with and without verbal feedback during two out of three choice conditions, and Angela and Brandi showed no preference during the concurrent-chains arrangement.

Figure 2 shows the percentage of raffle tickets earned for no verbal feedback and verbal feedback phases. All participants earned the most raffle tickets in the response cost immediate condition for the no verbal feedback phases. Nancy, Angela, and Brandi earned the most raffle tickets in the response cost immediate condition for the verbal feedback phases. Holly earned the most raffle tickets in the DRO condition for the verbal feedback phases.
Discussion

When no verbal feedback was used, response cost immediate conditions were the most effective at reducing percentage of errors when compared to response cost delay and DRO conditions. When verbal feedback was included, all conditions effectively reduced percentage of errors.

It was expected that response cost immediate contingencies would be preferred in comparison to DRO and response cost delay contingencies because participants would learn matching relationships at a faster rate during response cost immediate which could potentially result in a higher amount of reinforcers earned. This was not the case for our participants. This could be because the use of a concurrent-chains arrangement may not be appropriate to use to determine preference in the population used. In regards to preference, Nancy chose DRO with verbal feedback during the choice conditions and stated that she liked being told when she was correct. Angela showed no preference during the choice conditions and stated that she chose a different token board every session so that she would not get bored. When asked about which one she preferred the most, she stated she preferred DRO with verbal feedback during one meeting and then stated she preferred response cost immediate with verbal feedback during a second meeting. During the choice condition, Holly showed no preference during the first choice phase, chose response cost immediate with verbal feedback during the second choice phase, and chose response cost immediate without verbal feedback during the third choice phase. When asked which condition she preferred the most, she stated she liked response cost immediate because the sound of the token ripping off of the board helped her remember the relationships.
Brandi showed no preference for any conditions during the choice phases. When asked about which condition she preferred the most, she stated she liked response cost immediate because she remembered it the most and DRO because she liked being told when she was right.

Using a concurrent-chains arrangement may not have been an appropriate way to measure preference with college students. Research suggests that typically developing individuals can be asked to verbally report preference (Northup, Jones, Broussard, & George, 1995). Simply asking might be more conclusive to which token economy system was the most preferred. Some participants stated that they did not pick the same board consecutively so that they would not get bored while another participant said she wanted to see if she could do them all. Because two conditions during the verbal feedback phases had to be at zero errors before beginning the choice phase, the participants were making zero errors in two or more relationships (i.e., they are proficient in two separate conditions matching relationships) before they chose which condition they wanted to experience next. Participants could choose from multiple token boards during the choice condition and still be able to earn a raffle ticket because they are making no errors in more than one condition. It could have been that there was no motivating operation for participants to correctly tact their preferred token economy during the concurrent chains arrangement. It may be best to examine different ways of identifying preference in college students. Future research could use new relationships when examining preference during the choice phase or examine preference before the relationships are learned and they have experienced all contingencies. Preference for response cost immediate with and without verbal feedback could have been hard for participants to differentiate. Most participants learned the response cost immediate relationship during the no verbal feedback phase and when
verbal feedback was introduced, they never experienced the contingency of being told
“incorrect.” This could influence which token economy was chosen as preferred.

Another limitation could be that Nancy may have engaged in stimulus overselectivity
when the tasks were presented. Behavior can become under control of a single stimulus element
during conditional discrimination tasks (Dube et al., 2016). A particular stimulus feature that
may have controlled participant responding could have been irrelevant for learning the
relationships and therefore slow the rate of participant learning. For example, when a shape card
was presented to Nancy, she would count the sides of the shape several times and sometimes run
out of time to match the shape card in the 10-s trial. She was counting the sides of each shape
because she determined that that feature was important to learning the relationships. This
example of stimulus overselectivity could account for a slower rate of learning for the
participant.

Another limitation of this study could be associated with the preference assessment of
colors used to determine the token board colors. The color with the lowest preference was paired
with the contingency expected to be the most effective in decreasing errors (i.e., response cost
immediate). Brandi stated at the end of her visit that she preferred the color token board that
represented response cost immediate, but she did not want to choose it because it was her least
favorite color. Research suggests that an individual could have a color bias and that the bias
could impact their choices (Luczynski & Hanley, 2009). Her preference for colors could have
affected which condition she preferred. This could be a factor that interfered with participant
preference of conditions. Future research could use a larger array of colors during the color
preference assessment and choose the colors that are all moderately preferred to inform the
colors of the token boards for each condition.
During this study it was possible for a participant to engage in the correct responses by chance during baseline when no feedback was given. This made it more likely that the condition in baseline where a participant matched correctly without feedback would decline the fastest in errors during the no verbal feedback phase. This situation did not necessarily represent learning as a result of the condition contingencies, but as a result of the chance responding in baseline. For example, Holly had fewer errors in baseline for the DRO condition the first implementation and learned that condition the fastest in the no verbal feedback phase. During the first session of the DRO condition in the no verbal feedback phase, this participant placed all four shapes on the correct letters her first try and therefore learned the DRO relationship after the first session. This happened again for this participant in the second reversal. She had the least amount of errors in the response cost delay condition during baseline and learned that condition the fastest when the no verbal feedback phase begun. We may not have been able to see acquisition as controlled by the treatment condition. Future researchers could include more than four relationships per session, making the task more difficult, to reduce the chance of a participant matching the shapes and letters correctly during baseline. Future research could also create a baseline criterion and exclude the relationships that participants correctly matched more than half of the relationships during baseline and include only relationships that have 60% or higher errors. This would ensure that all relationships moving from baseline to intervention would have around the same percentage of errors.

Nancy took a larger amount of sessions compared to other participants to learn the relationships. Due to time constraints we had to end the meeting after the no verbal feedback phase and pick up a week later using the same relationships but in the verbal feedback phase. She did not recall the previously learned relationships and had to relearn all relationships at the start
of the verbal feedback phase. The results showed that the use of verbal feedback with all three conditions resulted in similar decreases to the percentage of errors made as compared to when no verbal feedback was used and response cost immediate declined in errors at a faster rate than DRO and response cost delay. This further shows that response cost immediate is more effective than DRO and response cost delay for decreasing errors when no verbal feedback is used and that if verbal feedback is used, they are equally effective.

There are implications for the current study. The results suggest that when implementing a token economy to decrease errors, response cost immediate may be the most effective method to use when verbal feedback is not provided. If verbal feedback is provided, DRO, response cost immediate, and response cost delay may be equally effective within token economies for decreasing errors. If this were to be used in a classroom setting where the immediate removal or presentation of a token is impractical, using immediate verbal feedback contingent on the targeted behavior with the removal or presentation of a token being delayed could possibly be an effective strategy to decrease errors. Future research could manipulate the token delivery or removal delay length to evaluate those effects in the classroom.
References


Appendices
Appendix A: Figures

Figure 1. The percentage of errors for each session and participant is shown for baseline, no verbal feedback, verbal feedback, and choice phases. The choice condition shows percentage of errors with
the symbol (Open/Closed Triangle = Baseline Differential Reinforcement of Other Behavior; Closed Triangle = Differential Reinforcement of Other Behavior without verbal feedback; Open Triangle = Differential Reinforcement of Other Behavior with Verbal Feedback; Open/Closed Square = Baseline Response Cost Delay; Closed Square = Response Cost Delay without Verbal Feedback; Open Square = Response Cost Delay with Verbal Feedback; Open/Closed Circle = Baseline Response Cost Immediate; Closed Circle = Response Cost Immediate without Verbal Feedback; Open Circle = Response Cost Immediate without Verbal Feedback) representing the condition that was chosen by the participant. BL = Baseline; VF = Verbal Feedback; C = Choice; DRO = Differential Reinforcement of Other Behavior; RC-D = Response Cost Delay; RC-I = Response Cost Immediate.
Figure 2. The percentage of raffle tickets earned is shown for no verbal feedback and verbal feedback phases. VF = Verbal Feedback; DRO = Differential Reinforcement of Other Behavior; RC-D = Response Cost Delay; RC-I = Response Cost Immediate.
Appendix B: Therapist Script

**Baseline**

**Before baseline phase say:**
“The goal is to earn as many raffle tickets as possible by correctly sorting shapes to letters. Specifically, you will be given a shape and will have to match it to a letter. After, that shape will be removed and you will be given another shape to match. Throughout this experiment, I will either give you tokens or remove tokens and you will need to have a certain amount of tokens on the token board after each session to earn a raffle ticket.”

**REMEMBER:**
- Use white token board
- No tokens or verbal feedback used
- Place correct 4 letter cards in front of participant based on current condition
- Present each shape card twice 10-s apart
- Shuffle letter cards before each session and shuffle shape cards before second presentation
- Maintain a 10-s pause between 1st and 2nd interval

**After each session throughout the phase say:**
“You have not earned enough tokens for a raffle ticket” (Remove letters and set up new letters for next session).

**No Verbal Feedback Phases**

**Before no verbal feedback phase say:**
“The goal is to earn as many raffle tickets as possible by correctly sorting shapes to letters. Specifically, you will be given a shape and will have to match it to a letter. After, that shape will be removed and you will be given another shape to match. Throughout this experiment, I will either give you tokens or remove tokens and you will need to have a certain amount of tokens on the token board after each session to earn a raffle ticket.”

**REMEMBER:**
- Do not use verbal feedback
- Use correct colored token board for session (will not have border)
- Place the correct 4 letter cards in front of participant based on current condition
- Present a shape card and remove it after 10-s and present next shape card
- Present each shape card twice
- Shuffle letter cards before each session and shuffle shape cards before second presentation
- Maintain a 10-s pause between 1st and 2nd interval

**FOR DRO:**
- Start session with 0 tokens on board
- Present correct amount of earned tokens (based on number of instances of correct sorting during interval) at the end of both 40-s intervals
FOR RC-I and RC-D:
- Start session with 8 tokens on board
- RC-Delay: Remove correct amount of tokens (based on number of errors made during the interval) at the end of both 40-s intervals
- RC-Immediate: Remove a token during 10-s trial if an error is made.

After each session throughout the phase say one: (need 6 tokens to earn raffle)
“You have earned enough tokens for a raffle ticket” (Give a raffle ticket and remove letters and token board and set up new letters and token board for next session)

or

“You have not earned enough tokens for a raffle ticket” (Remove letters and token board and set up new letters and token board for next session)

Verbal Feedback Phases

Before with verbal feedback phase say:
“The goal is to earn as many raffle tickets as possible by correctly sorting shapes to letters. Specifically, you will be given a shape and will have to match it to a letter. After, that shape will be removed and you will be given another shape to match. Throughout this experiment, I will either give you tokens or remove tokens and you will need to have a certain amount of tokens on the token board after each session to earn a raffle ticket.”

REMEMBER:
- Use correct colored token board for session (will have a red border)
- Place the correct 4 letter cards in front of participant based on current condition
- Present a shape card and remove it after 10-s and present next shape card
- Present each shape card twice
- Shuffle letter cards before each session and shuffle shape cards before second presentation
- Maintain a 10-s pause between 1st and 2nd interval

FOR DRO:
- Say “correct” upon every instance of correct sorting
- Start session with 0 tokens on board
- Present correct amount of earned tokens (based on number of instances of correct sorting during interval) at the end of both 40-s intervals

FOR RC-I and RC-D:
- Say “incorrect” upon every instance of incorrect sorting
- Start session with 8 tokens on board
- RC-Delay: Remove correct amount of tokens (based on number of errors made during the interval) at the end of both 40-s intervals
- RC-Immediate: Remove a token during 10-s trial if an error is made.

After each session throughout the phase say one: (need 6 tokens to earn raffle)
“You have earned enough tokens for a raffle ticket” (Give a raffle ticket and remove letters and token board and set up new letters and token board for next session)

or
“You have not earned enough tokens for a raffle ticket” (Remove letters and token board and set up new letters and token board for next session)

Choice Phases

Before choice phase say:
“The goal is to earn as many raffle tickets as possible by correctly sorting shapes to letters. Specifically, you will be given a shape and will have to match it to a letter. After, that shape will be removed and you will be given another shape to match. Throughout this experiment, I will either give you tokens or remove tokens and you will need to have a certain amount of tokens on the token board after each session to earn a raffle ticket.”

“Select which learning system you liked the most and would like to experience next.”

REMEMBER:
- Present all 6 token boards and instruct to choose
- Run correct session for chosen token board
- Run until same condition is chosen 3 times in a row with a maximum of 10 sessions.

After each session throughout the phase say one: (need 6 tokens to earn raffle)
“You have earned enough tokens for a raffle ticket” (Give a raffle ticket and remove letters and token board and set up new letters and token board for next session)

or
“You have not earned enough tokens for a raffle ticket” (Remove letters and token board and set up new letters and token board for next session)
Appendix C: Treatment Integrity Tool

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<thead>
<tr>
<th>Phase #:</th>
<th>Session #:</th>
<th>Condition:</th>
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Participant: ___________________
Name of data collector: ___________________

**Condition: Baseline**

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<td>White token board present.</td>
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<td>No verbal feedback was used.</td>
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<td>No tokens were delivered or removed.</td>
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Է Proficiency score.
Divide +’s by (total +’s and -’s) and multiply by 100.

| Phase #: | Session #: | Participant: ___________________
Name of data collector: ___________________ |
|----------|------------|---------------------------------------------------------------------------------
|          |            | **Condition: DRO**                                                                 |
|          |            |                                                                                  |
| +        | -          | Uses correct designated single color token board.                               |
|          |            |                                                                                  |
| +        | -          | Zero tokens on board before starting session.                                    |
|          |            |                                                                                  |
| +        | -          | Places correct 4 letters corresponding to condition on table in front of participant. Letter cards are placed in arbitrary order and shuffled before being placed (not including first presentation). |
|          |            |                                                                                  |
| +        | -          | Does not use any verbal feedback.                                               |
|          |            |                                                                                  |
| +        | -          | Presents correct amount of earned tokens (based on number of instances of correct sorting during first interval) at the end of first 40-s interval. |
|          |            |                                                                                  |
| +  
| -  
| Presents correct amount of earned tokens (based on number of instances of correct sorting during second interval) at the end of second 40-s interval. |
| +  
| -  
| Present raffle ticket at end of session if at least 6 tokens were earned -- no raffle ticket presented if at least 6 tokens were not earned. |

**Proficiency score.**
Divide +’s by (total +’s and -’s) and multiply by 100.

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<th>Phase #:</th>
<th>Session #:</th>
<th>Participant: ________________</th>
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<td></td>
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<td>Name of data collector: ________________</td>
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<tr>
<td></td>
<td></td>
<td><strong>Condition: Response Cost Delay</strong></td>
</tr>
</tbody>
</table>
| +  
| -  
| Uses correct designated single color token board. |
| +  
| -  
| All eight tokens on board before starting session. |
| +  
| -  
| Places correct 4 letters corresponding to condition on table in front of participant. Letter cards are placed in arbitrary order and shuffled before being placed (not including first presentation). |
| +  
| -  
| Does not use any verbal feedback. |
| +  
| -  
| Removes correct amount of tokens (based on number of errors made during the first interval) at the end of first 40-s interval. |
| +  
| -  
| Removes correct amount of tokens (based on number of errors made during the second interval) at the end of second 40-s interval. |
| +  
| -  
| Present raffle ticket at end of session if at least 6 tokens remain on board -- no raffle ticket presented if at least 6 tokens do not remain on board. |

**Proficiency score.**
Divide +’s by (total +’s and -’s) and multiply by 100.
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<th>Phase #:</th>
<th>Participant: ___________________</th>
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<tbody>
<tr>
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<td>Name of data collector: __________</td>
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<tr>
<td></td>
<td><strong>Condition: Response Cost Immediate</strong></td>
</tr>
</tbody>
</table>

+ Uses correct designated single color token board.
- All eight tokens on board before starting session.
+ Places correct 4 letters corresponding to condition on table in front of participant. Letter cards are placed in arbitrary order and shuffled before being placed.
- Does not use any verbal feedback.
+ Removes a token at the end of the 10-s trial contingent on error.
- Present raffle ticket at end of session if at least 6 tokens remain on board -- no raffle ticket presented if at least 6 tokens do not remain on board.

**Proficiency score.**
Divide +’s by (total +’s and -’s) and multiply by 100.

<table>
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<th>Phase #:</th>
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<tr>
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<td>Name of data collector: __________</td>
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<td></td>
<td><strong>Condition: DRO with Verbal Feedback</strong></td>
</tr>
</tbody>
</table>

+ Uses correct designated color token board with red border.
- Zero tokens on board before starting session.
+ Places correct 4 letters corresponding to condition on table in front of participant. Letter cards are placed in arbitrary order and shuffled before being placed (not including first presentation).
+ - Says “correct” upon every instance of correct sorting and remains silent upon instance of incorrect sorting.

+ - Presents correct amount of earned tokens (based on number of instances of correct sorting during first interval) at the end of first 40-s interval.

+ - Presents correct amount of earned tokens (based on number of instances of correct sorting during second interval) at the end of second 40-s interval.

+ - Present raffle ticket at end of session if at least 6 tokens were earned -- no raffle ticket presented if at least 6 tokens were not earned.

← Proficiency score.
Divide +’s by (total +’s and -’s) and multiply by 100.

<table>
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<tr>
<th>Phase #:</th>
<th>Participant: ___________________</th>
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<tbody>
<tr>
<td>Session #:</td>
<td>Name of data collector: ___________________</td>
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</tbody>
</table>

**Condition: Response Cost Delay with Verbal Feedback**

+ - Uses correct designated color token board with red border.

+ - All eight tokens on board before starting session.

+ - Places correct 4 letters corresponding to condition on table in front of participant. Letter cards are placed in arbitrary order and shuffled before being placed (not including first presentation).

+ - Says “incorrect” upon every instance of incorrect sorting and remains silent upon instance of correct sorting.

+ - Removes correct amount of tokens (based on number of errors made during the first interval) at the end of first 40-s interval.

+ - Removes correct amount of tokens (based on number of errors made during the second interval) at the end of second 40-s interval.

+ - Present raffle ticket at end of session if at least 6 tokens remain on board -- no raffle ticket presented if at least 6 tokens do not remain on board.
<table>
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<tr>
<th>Phase #:</th>
<th>Participant: ___________________</th>
</tr>
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<tbody>
<tr>
<td>Session #:</td>
<td>Name of data collector: ___________________</td>
</tr>
<tr>
<td></td>
<td>Condition: Response Cost Immediate with Verbal Feedback</td>
</tr>
</tbody>
</table>

| + | Uses correct designated color token board with red border. |
| - |

| + | All eight tokens on board before starting session. |
| - |

| + | Places correct 4 letters corresponding to condition on table in front of participant. Letter cards are placed in arbitrary order and shuffled before being placed (not including first presentation). |
| - |

| + | Says “incorrect” upon instance of incorrect sorting and remains silent upon instance of correct sorting. |
| - |

| + | Removes a token at the end of the 10-s trial contingent on error. |
| - |

| + | Present raffle ticket at end of session if at least 6 tokens remain on board -- no raffle ticket presented if at least 6 tokens do not remain on board. |
| - |

| ← Proficiency score. Divide +’s by (total +’s and -’s) and multiply by 100. | ← Proficiency score. Divide +’s by (total +’s and -’s) and multiply by 100. |

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<td>+</td>
<td>Uses correct designated color token board for chosen condition.</td>
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<td>+</td>
<td>+</td>
<td>Uses correct designated letters for chosen condition.</td>
</tr>
</tbody>
</table>
Proficiency score.
Divide +’s by (total +’s and -’s) and multiply by 100.

SCORING CODES:
+  = Correct, complete performance.
-  = Incorrect, not complete. Part of the procedure was missing or performed differently.
Appendix D: USF IRB Approval

3/31/2017

Faith Reynolds
USF Psychology
4202 East Fowler Avenue
Tampa, FL 33620

RE: Expidited Approval for Initial Review
IRB#: Pro00029001
Title: Differential Reinforcement of Other Behavior Versus Response Cost: Effects of Immediate and Delayed Consequences in Token Economies

Study Approval Period: 3/30/2017 to 3/30/2018

Dear Ms. Reynolds:

On 3/30/2017, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
USF IRB PROTOCOL_FReynolds.docx

Consent/Assent Document(s)*:
SB_About Minimal Risk_FReynolds.docx.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:
(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D., Chairperson
USF Institutional Review Board
Appendix E: USF IRB Informed Consent

Study ID:Pro00029001 Date Approved: 3/30/2017

Informed Consent to Participate in Research Involving Minimal Risk and Authorization to Collect, Use and Share Your Health Information

Pro # 00029001

You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is called an informed consent form. Please read this information carefully and take your time making your decision. Ask the researcher or study staff to discuss this consent form with you, please ask him/her to explain any words or information you do not clearly understand. The nature of the study, risks, inconveniences, discomforts, and other important information about the study are listed below.

We are asking you to take part in a research study called:

Differential Reinforcement of Other Behavior Versus Response Cost: Effects of Immediate and Delayed Consequences in Token Economies

The person who is in charge of this research study is Faith Reynolds. This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge. Dr. Sarah Bloom is guiding her in this research.

The research will be conducted at the University of South Florida.

Purpose of the study

The purpose of this study is to find out which type of reward system is the most effective for reducing errors as well as the most preferred by individuals who are taking a part in the reward system. Features of the reward system such as immediacy and verbal feedback will be evaluated in regards to its impact on the effectiveness for reducing errors and participant preference for the system.

Why are you being asked to take part?

We are asking you to take part in this research study because you are an undergraduate student and 18-30 years old.

Study Procedures:

If you take part in this study, you will be asked to:

• Complete a preference assessment for colors and backup reinforcers. At the start of each session, four letter cards will be placed in front of the participant. The experimenter will hand the participant a shape card and instruct them to match the shape card with its corresponding
alphabet letter. Participants will be able to exchange their earned tokens for a raffle ticket after each session if applicable. Six tokens will be needed to earn one raffle ticket.

- The expected duration of participation is about 10 hours between two or more sessions. Participant can choose how many sessions they would like to have. If participant chooses 5 sessions, each session will consist of 2 hours, totaling 10 hours.
- Research will take place in the MHC building at USF during times convenient for participants.
- Sessions will be audio and video recorded so that co-investigators can record session data and interobserver agreement can be calculated. The primary investigator and co-investigators will have access to these tapes for research purposes. The tapes will be maintained for 5 years after the Final Report is submitted to the IRB. All tapes will be deleted after this period of time.

**Total Number of Participants**

About 12 individuals will take part in this study at USF.

**Alternatives / Voluntary Participation / Withdrawal**

Alternatives to participating in the study: An alternative assignment is to be noted in the course syllabus to have an opportunity to earn the same amount in extra credit.

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. Your decision to participate or not to participate will not affect your student status, recommendations, or access to future courses or training opportunities.

**Benefits**

We are unsure if you will receive any benefits by taking part in this research study.

**Risks or Discomfort**

This research is considered to be minimal risk. Participants will be videotaped and these videos could be at risk to potential data breach and/or loss of confidentiality.

**Compensation**

You may be compensated with extra credit in eligible courses or raffle prizes if you complete all the scheduled study visits. Participants are eligible to earn 2% to 5% of their final grade in extra credit depending on their instructor’s course syllabus. Participants will have to earn six out of the eight available tokens per session to trade their tokens for a raffle ticket. Participants will be contacted via their preferred method of phone or email if they are selected as a winner in the raffle. If you withdraw for any reason from the study before completion you will not be eligible for raffle prizes.

**Costs**

It will not cost you anything to take part in the study.

**Privacy and Confidentiality**

We will keep your study records private and confidential. Certain people may need to see your study record.
records. Anyone who looks at your records must keep them confidential. These individuals include:

- The research team, including the Principal Investigator, study coordinator, and all other research staff.
- Certain government and university people who need to know more about the study, and individuals who provide oversight to ensure that we are doing the study in the right way.
- Any agency of the federal, state, or local government that regulates this research.
- The USF Institutional Review Board (IRB) and related staff who have oversight responsibilities for this study, including staff in USF Research Integrity and Compliance.

We may publish what we learn from this study. If we do, we will not include your name. We will not publish anything that would let people know who you are.

**You can get the answers to your questions, concerns, or complaints**

If you have any questions, concerns or complaints about this study, or experience an unanticipated problem, call Faith Reynolds at (407) 247-0002.

If you have questions about your rights as a participant in this study, or have complaints, concerns or issues you want to discuss with someone outside the research, call the USF IRB at (813) 974-5638 or contact by email at RSCH-IRB@usf.edu.

---

**Consent to Take Part in this Research Study**

**And Authorization to Collect, Use and Share Your Health Information for Research**

I freely give my consent to take part in this study. I understand that by signing this form I am agreeing to take part in research. I have received a copy of this form to take with me.

_____________________________________________
Signature of Person Taking Part in Study

_____________________________________________
Printed Name of Person Taking Part in Study

Date

---

**Statement of Person Obtaining Informed Consent**

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I confirm that this research subject speaks the language that was used to explain this research and is receiving an informed consent form in their primary language. This research subject has provided legally effective informed consent.

_____________________________________________
Signature of Person obtaining Informed Consent

_____________________________________________
Printed Name of Person Obtaining Informed Consent

Date