The Effects of Differential Reinforcement, a Competition Game and a Response Cost Procedure on Rate of Task Completion

Konstantinos Rizos, Natalie Leow-Dyke, Jo Highley, Emma Hawkins, Grant Gautreaux

Jigsaw CABAS® School, Dunsfold, Surrey

Nicholls State University, Thibodaux, Louisiana
Abstract

Four interventions were implemented to examine their effects on rate of task completion for a twelve-year-old female with autism spectrum disorder. The targeted behaviour required for the participant to complete three mastered worksheets within two minutes. An alternating treatments design was used to compare the effects of those interventions. Intervention 1 utilized differential reinforcement through the use of a preferred edible. Interventions 2 and 3 incorporated a competition game contingency between the participant and the teacher with Intervention 3 adding a supplementary reinforcer (edible) in the game contingency, and Intervention 4 utilized a response cost procedure. The results showed that under Interventions 3 and 4, the participant completed the worksheets in time in most sessions, suggesting that both a competition game contingency and a response cost procedure may be used as effective tactics to decrease latency and subsequently increase the rate of task completion.

Keywords: autism spectrum disorder, differential reinforcement, response cost, task completion
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There are many factors that may influence the motivation of an individual with an autism spectrum disorder (ASD). These may relate to their learning history as well as the establishing operations that are in place in the individual’s environment. A common problem among children with an ASD that may interfere with their learning is non-compliance, particularly referred to as a delay in response latency or even failure to complete an instructional task (Donohue, Casey, Bicard & Bicard, 2012). Many antecedent- and consequent-based interventions have been implemented in order to increase compliance and subsequently reduce response latencies such as differential reinforcement, behaviour momentum and prompting procedures (Donohue et al, 2012). Cooper, Heron and Heward (2007) define response latency as the elapsed time from the onset of the stimulus which may be a written antecedent or task direction delivered by a teacher to the initiation of a response.

Several experiments have attempted to reduce response latency and thus, increase compliance and task completion. For example, Bouxsein, Tiger and Fisher (2008) examined whether task completion may be influenced by the specificity of instructions delivered. The participant was a young man with Asperger’s syndrome. In the general-instruction condition, the therapist provided a general instruction for the participant to cut out as many shapes as they could while providing the task materials. General praise was also delivered regardless of the number of tasks completed. In the specific-instruction condition, the instructions presented included a specific goal and time frame. The results showed that when given
general instructions, few tasks were completed. However, in the specific-instruction condition the participant completed the number of tasks specified in the instruction in every treatment session except one. The authors suggested that the specific instructions served as a more effective discriminative stimulus for task completion.

Alternatively, Donohue, Casey, Bicard & Bicard (2012) used differential reinforcement of short latencies in order to decrease response latency and increase task completion and accuracy. The participant had a diagnosis of an ASD as well as a severely limited verbal repertoire. He received praise and a preferred stimulus following any trial where he responded correctly below the predetermined criterion. The results showed that this tactic was effective in reducing the response latencies of a participant who took a long time to respond to questions and instructions with additional prompting. It was also reported that differential reinforcement was effective in increasing correct responses while decreasing the number of non-responses. In particular, the number of tasks completed was gradually shaped over time. This study demonstrates the significance of differentially reinforcing short latencies to increase compliance and thus increase opportunities to learn.

By reducing response latency this may have the collateral effect of increasing task completion. For instance, Heinicke, Carr and Mozzoni (2009) implemented a token economy with contingency-specifying rules in which the participant had to earn a specific number of tokens in order to receive a play break. By responding to instructions within a pre-set time limit, the participant was able to earn these tokens. The results showed an immediate reduction in latencies following the introduction of the treatment. There was also a reported increase in the number of worksheets completed accurately.
This study sought to examine the effect of differential reinforcement along with a response cost and a competition game with the teacher to increase the rate of task completion. A response cost is usually implemented to decrease high rates of inappropriate behaviour which need to be suppressed immediately. In these cases, a preferred item is removed in order to decrease the occurrence of the target behaviour. Contingent upon the occurrence of the target behaviour, a predefined amount of reinforcer may be removed which may have been previously earned. For example, Keeney, Fisher, Adelinis and Wilder (2000) implemented a response cost procedure to reduce levels of destructive behaviour in a woman with severe developmental delays. Contingent upon the occurrence of the target behaviour music or attention (which was freely available at the start of the session) was withdrawn for 30 seconds. Destructive behaviour was subsequently reduced by 87% from baseline levels. Musser, Bray, Kehle, Thomas and Jenson (2001) also demonstrated that response cost tactic was effective in suppressing behaviour over an extended period of time. In their study, a multi-component intervention consisting of a token economy, mystery motivator and a response cost successfully reduced disruptive classroom behaviour in three children with social and emotional disorders. During the follow-up phase, disruptive intervals remained at an average of 10%.

There is little or no research examining the use of a response cost on enhancing the motivational conditions to increase task completion. It may be that the potential to lose a reinforcer along with the competing element with the teacher, may serve as a motivating operation to complete an instructional task. Laraway, Snykerski, Michael and Poling (2003) report that motivating operations refer to particular antecedent events which may alter the effectiveness of other stimuli which function as reinforcement. Therefore the value of an edible reinforcer may be increased as a result of the potential to lose the reinforcer through
the response cost contingency. Additionally, this tactic may have a behaviour-altering effect by increasing behaviours i.e. responding quickly and completing a task, maintained by access to the edible reinforcer. Michael (2007) suggests that motivation operations may serve to alter not only the frequency of behaviour but also other behaviours such as response latency and magnitude.

Overall, the current study compares four different treatment procedures to increase the rate of task completion in a pupil with an ASD.

METHOD

Participant and Setting

The participant was an 11 year old female who was diagnosed with an ASD. She had an individualised token board for completing her school work in the school setting and was given written or vocal options to select her reinforcer. The participant reliably responded to questions about categories regarding their function, their properties and where they are found by pointing to a picture and a word from a selection of five answers. She completed reading activities such as matching word to picture, matching word to audio and ordering words to make a sentence on the computer. Also, the participant had an individualised point’s board for the total number of tasks completed in each lesson. The participant was given the opportunity to participate in the study because she emitted a low rate of completed tasks across all of her curricular programs, linked to a significant amount of time taken for her to complete those tasks although she would initiate a written response within 10 seconds or less upon the presentation of the tasks. The study took place at a school that used Applied Behavior
Analysis methodology for learners diagnosed with an ASD. The participant attended a classroom with three more students and four teachers with a 1:1 staff-to-student ratio.

Materials

The materials used consisted of a 8.27 x 11.75 inches printed data sheet and a black pen to record time taken to complete worksheets and number of worksheets completed. Mastered worksheets that the participant had reached criterion on in the past were used. Pencils, rubbers, two trays labeled ‘finished’, a timer and edibles were also used. A ‘race track’ token board with two two-dimensional cut – out cars was used for Intervention 4. Each worksheet included a box with a different number of shapes (stars, circles, squares etc.) for the participant to count and write down in a designated area next to the box for the response and written antecedents. Each worksheet had a different number and type of shapes but all shapes were identical in each box.

Definition of Behaviors

The behaviors studied were the number of minutes taken by the participant to complete three mastered worksheets along with the number of worksheets completed within 2 minutes. The independent variables were the four interventions implemented: differential reinforcement using a preferred stimulus (Intervention 1), competition game contingency (Intervention 2), competition game contingency with an added reinforcer (Intervention 3), and a response cost procedure (Intervention 4). The dependent variable measured was the rate of task completion. The rate of task completion was defined as the number of answered worksheets within a time limit of two minutes. Data were also collected on the number of minutes taken to complete the assigned tasks.
Data collection and Inter-observer agreement

There were 3 opportunities per day for data to be collected. The experimenter collected data on the time taken to complete three mastered worksheets under the various conditions and the number of worksheets completed within 2 minutes. Data were reported as the number of minutes taken to complete mastered worksheets as well as the number of worksheets completed under the various conditions (Figure 1.).

A second observer collected inter-observer agreement data on the time taken to complete the tasks as well as the tasks completed within that time. Inter-observer agreement scores were calculated by dividing the numbers of agreements by the total numbers of agreements plus disagreements and multiplying that number by 100%. Inter-observer agreement was collected for 30% of the alternating treatments sessions with a mean agreement of 99%.

Design and Procedure

An alternating treatments design was used to test the effects of the four interventions. The alternating treatments design is characterized by the rapid alteration of two or more distinct treatments (i.e., independent variables) while their effects on the target behavior (i.e., dependent variable) are measured (Cooper, Heron & Heward, 2007).

Screening phase. Prior to the beginning of the study, data were collected on the number of minutes taken by the participant to complete three mastered worksheets. The participant was required to follow a written antecedent on the worksheet to count the number of shapes (stars, circles, squares etc.) in a box, write down the number in a designated area
next to the box and put the finished worksheet in a tray. It took the participant 16.02 minutes to complete one worksheet the first time and 12.14 minutes the second time. This delay could have potentially resulted in a great loss of academic instruction time. It was then deemed not ethical to deprive the student of learning opportunities for such a great amount of time by continuing collecting the data and calculating a mean of time that would unavoidable be high enough to result in considerable loss of instructional time not only for baseline but for the subsequent alternating treatments sessions and the final treatment phase. Therefore, a decision was made to use a time limit in baseline (a cap of 2 minutes for completing three mastered worksheets).

**Baseline.** Baseline data were taken on the participant’s completion of three mastered worksheets within 2 minutes. The participant was required to sit at the table and complete three mastered worksheets within 2 minutes. The worksheets had the same layout and included the same requirements as described in the screening phase and all subsequent phases used the same type of worksheets.

**Intervention 1.** During Intervention 1, the participant was required to sit at the table and complete three mastered worksheets within 2 minutes in order to receive a preferred edible that she previously selected. Before starting, the teacher explained to the participant what she needed to do in order to receive the edible. The edible was in view throughout the duration of this phase. A timer, set at 2 minutes, and a tray where she put each of the worksheets that she completed were also on the desk during the procedure. The participant only had access to the preferred stimulus (edible) if she completed and placed all three worksheets in the finished tray before the timer went off, signaling the end of two minutes. The edible was placed back in the box if she did not complete the worksheets within that time.
and the participant was reminded that she needed to complete the worksheets in time in order to receive the edible.

**Intervention 2.** During Intervention 2, the participant participated in a competition game against the teacher on who was going to finish the mastered worksheets first. Both the teacher and the participant had a set of three worksheets that were similar in layout but not the same in the number and/or type of shapes. A second tray, where the experimenter put his own completed worksheets, was placed on the table, along with the timer and the participant’s tray. The participant had to complete the worksheets within 2 minutes in order to win the game. Again, the teacher went through the procedure with the participant prior to the beginning of the intervention by vocally explaining the game and what the participant needed to do in order to win the competition. The competition expectation served as a motivational operation with winning the game alone serving as a reinforcer. No additional reinforcement was given if the participant won the race. If the participant lost the game (not completing the worksheets in time) she was reminded that she needed to try and work at a faster pace next time in order to win. The experimenter slowed his pace of completing his set of worksheets to match the pace of the participant in order to keep the competition element at an attainable level and avoid making the participant withdraw from the procedure by completing the worksheets too quickly.

**Intervention 3.** Intervention 3 was implemented the same way as Intervention 2 with the addition of a previously selected edible that was always in view, in order to strengthen the motivational operation and enhance reinforcement. As with Intervention 2, the teacher explained how the game worked before initiating the procedure. The edible was consumed by whoever finished completing the three mastered worksheets first within the preset time limit. If the participant did not complete the worksheets within that time she was reminded that she
needed to try and complete the worksheets faster next time in order to win the game and the edible. As in Intervention 2, the experimenter made sure that he matched his pace of completing the worksheets with the participant’s pace.

*Intervention 4.* Intervention 4 involved a response cost procedure in which a race track was used with only start and finish places (no spaces to move up in between) and two two-dimensional cut out car pictures, one for the teacher and one for the participant. A previously selected edible that was in view throughout the procedure was placed next to the finish line. If the participant finished completing the three mastered worksheets and putting them on the tray within the time limit, she moved up to the finish line and consumed the edible. If not, the teacher moved up to the finish line and consumed the edible. If the participant did not complete the worksheets in time she was reminded that she needs to complete the tasks faster next time and before the timer goes off to prevent the teacher from consuming the edible. The teacher, as in Intervention 1, was not required to be present and actively participate during the completion of the worksheets.

*Final treatment phase.* Final treatment phase was implemented as described in the procedure for Intervention 4. Criteria levels were set for the participant to complete all three mastered worksheets within the set time limit for three consecutive sessions.

RESULTS

During baseline, the participant completed zero number of worksheets during the 2 minute time limit set for the completion of the worksheets. During the alternating treatments,
the mean time taken to complete worksheets was 2 minutes for both Intervention 1 and Intervention 2. However the mean number of completed worksheets was 0.4 for Intervention 1 and 1.2 for Intervention 2. The data were low for task completion for both interventions with a range of 0 to 1 completed worksheets for Intervention 1 and 1 to 2 completed worksheets for Intervention 2. Mean time taken to complete worksheets for Intervention 3 was 1.42 minutes with a mean number of 2.6 worksheets completed and 1.46 minutes with a mean number of 2.8 worksheets for Intervention 4, making that treatment the most effective for increasing the number of completed worksheets. The data were high for task completion for both interventions with a range of 1.29 to 2 minutes for the time taken to complete the tasks and 2 to 3 worksheets completed for task completion for Intervention 3, and a range of 1.27 to 2 minutes for time taken to complete the tasks and 2 to 3 completed worksheets for task completion for Intervention 4. For the final treatment phase (Intervention 4 selected as the best treatment), the mean number of completed worksheets was 3 and the mean time taken for task completion was 1.20 minutes. Data were low for time taken to complete worksheets with a range of 1.15 to 1.27 minutes. Overall, task completion rate increased from an average of 2 minutes and 0 number of completed worksheets during baseline to 1.20 minutes and 3 tasks completed in final intervention. Results on the rate of task completion are depicted in Figure 1. Results on the number of sessions in which the participant completed all three mastered worksheets within the set time limit across the treatments are depicted in Figure 2.
In the present study, we tested the effects of four interventions on the rate of task completion. Differential reinforcement using a preferred stimulus was used along with a competition game contingency and a procedure that incorporated the element or response cost in order to increase compliance and motivation. The results showed that the potential to lose a reinforcer to another person along with the competing element with the teacher, may have served as a motivating operation to increase rate of task completion by decreasing response latencies, as demonstrated in the results under Intervention 3 conditions (Figure 1.). Intervention 4 appeared to be the most effective treatment, suggesting that the element of response cost was more efficient in decreasing the participant’s response latencies and subsequently increasing the rate of task completion. However, the response cost procedure was only slightly more effective than the competition game contingency with an added reinforcer. Intervention 1 appeared to be the least effective, suggesting that the value of the edible reinforcer may have been increased as a result of the potential to lose the reinforcer to another person through the competition game and response cost contingencies. Intervention 2 appeared to be more effective than Intervention 1, suggesting that the implementation of an operation with the basic mechanics of a competition game activity can slightly increase the number of completed tasks by decreasing response latencies, at least for the specific participant. However, that treatment was also unsuccessful in assisting the participant in completing all tasks within the specified time limit. The results of the present study support the idea that the application of either a response cost procedure or a game contingency with an additional reinforcing element may notably result in the decrease of response latency and subsequently increase rate of task completion for populations diagnosed with an ASD.

Limitations and further research. Being a case study, this experiment has a number of limitations. More notably, the results cannot be generalized for the entire population from
which the participant was taken. Future studies can be conducted that will include more participants to test this study’s findings for generalization. Additionally, more experiments can be conducted that will test the effects of the interventions in participants that have other disabling conditions with different characteristics. Another limitation that should be taken into account is the possibility of sequence effects, practice effects and maturation regarding the implementation procedure of the interventions. Future studies can be conducted that will mirror the sequence of the interventions or employ a different sequence altogether in order to counterbalance those effects. Furthermore, the experiment was evaluated with a limited number of familiar tasks. Different results may be obtained if utilizing unfamiliar tasks. This research area may be expanded by introducing the intervention in curricular programmes that require written responses to written antecedents. Pre- and post intervention data can be collected to test the effects of the treatment on the participants’ response latency and task completion. Learning rate can also be observed through the number of trials to criterion prior to the implementation and after the introduction of the intervention.

*Applications.* In many, if not most school settings that function under the principles and guidance of behavioural science, the use of response cost is reserved for addressing severe behaviours with due reason as response cost is an aversive procedure that requires a support plan if the participant becomes aggressive. Also, the punitive element of the procedure can be viewed as too intrusive to be considered a first choice tactic for addressing instructional problems such as decreasing response latencies and subsequently increasing the number of completed tasks. This study showed that one reinforcement tactic (Intervention 3) was almost as equally successful in subsequently increasing the participant’s rate of task completion as the response cost intervention. The competition game contingency without an added reinforcer was not sufficient to establish a motivating operation that increased the rate
of task completion by reducing response latencies. The addition of an edible reinforcer incorporated in the contingencies of a competition game appeared to establish a motivating operation that was more effective in resulting in an increase of rate of task completion than the edible (Intervention 1) or the game contingency (Intervention 2) alone. Although the response cost element appeared to be the crucial component behind the final intervention, the differences in effectiveness between Interventions 3 and 4 are not notably large (Figure 2.). Furthermore, response cost alone might not condition or pair the task with reinforcement. That being said, we suggest that Treatment 3, with its elements of positive reinforcement and participation in an appealing game activity can function as a better alternative to a procedure that uses response cost alone, even if the possibility to lose the reinforcer to another person was common in both interventions. The motivating operations that were established by the two procedures might have been different in matter of expectation on behalf of the participant (focusing on winning the sweet for Intervention 3 as opposed to focusing on not losing the sweet to the teacher for Intervention 4). However, the obvious limitations of Intervention 3, regarding the active involvement and constant participation of the teacher - a practise that can be time-consuming and may reduce the opportunities for self-management and independence - must be noted.

REFERENCES


Figure 1. Number of minutes taken to complete worksheets and number of worksheets completed across interventions and across sessions
Figure 2. Number of sessions in which all worksheets were completed within the set time limit across interventions.