Differential Reinforcement of High Rates of Behavior to Increase Work Productivity in Adults with Intellectual Disability

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Author Note

This paper was written in partial fulfillment of the requirements of the MS degree in Psychoeducation at the Université de Montréal by the first author. This research project was supported in part by a salary award from the Fonds de Recherche du Québec – Santé (# 30827) to the second author. We thank L’Appart à moi and L’Appartenence for their collaboration during the study, Marie-Catherine Milette for her support during data collection.

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This is the peer reviewed version of the following article:


which has been published in final form at https://doi.org/10.1111/jar.12614. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions
Abstract

Background. Due to deficits in adaptive and cognitive functioning, productivity may pose challenges for individuals with intellectual disability in the workplace.

Method. Using a changing-criterion embedded in a multiple baseline across participants design, we examined the effects of differential reinforcement of high rates of behavior (DRH) on the rate of data entry (i.e., productivity) in four adults with intellectual disability.

Results. Although the DRH procedure increased the rate of correct data entry in all four participants, none of the participants achieved the criterion that we set with novice undergraduate students.

Conclusions. Our results indicate that DRH is an effective intervention to increase rate of correct responding in individuals with intellectual disability, but that achieving the same productivity as workers without disability may not always be possible.

Keywords: data entry, differential reinforcement of high rates, intellectual disability, productivity, work
Differential Reinforcement of High Rates of Behavior to Increase Work Productivity in Adults with Intellectual Disability

Productivity, which represents the amount of work completed by an individual within a given period of time, is an important dimension of work integration in individuals with and without disability (Drucker, 1999). Due to inherent deficits in adaptive and cognitive functioning, work productivity may pose specific challenges for individuals with intellectual disability (Lysaght, Ouellette-Kuntz, & Lin, 2012). More specifically, difficulties in completing multi-step tasks, completing a sequence of tasks, and maintaining sufficient productivity may make it difficult for these individuals to find and maintain a job (Siberski et al., 2015). One potential solution to increase productivity in this population is to implement differential reinforcement of high rates of behavior (DRH; Hemmes & Eckerman, 1972; Horner, Lahren, Schwartz, O'Neill, & Hunter, 1979; Girolami, Kahng, Hilker, & Girolami, 2009).

In the only published example of the use of DRH to improve work productivity in this population, Horner et al. (1979) increased the rate of harness cable assembly in a 25-year-old individual with intellectual disability. During DRH, the participant received social reinforcement (i.e., attention, praise) when he met a specific rate of assembly, which was signaled by a wristwatch. Despite not meeting the same rate as other workers, the study showed that DRH more than doubled work productivity. The purpose of our study was to extend prior research by examining the effects of DRH on data entry in four individuals with intellectual disability.

Method

Participants and Settings

We recruited four adults with intellectual disability from agencies providing residential and community integration services. Gary was a 27-year-old male with a moderate intellectual
disability and Down syndrome who worked as an office clerk. Gisele was a 26-year-old female with a moderate intellectual disability and Down syndrome who was receiving training for general work skills. Laura was a 30-year-old female with a mild intellectual disability who volunteered at a daycare. Finally, Sabrina was a 28-year-old female with a mild intellectual disability who worked as a clerk in a butcher shop. All participants used computers for personal leisure activities, but none had experience with systematic data entry with Microsoft Excel. Each individual completed the tasks in a room at the university or at home, and provided written consent to participate. Ethical approval was reviewed and granted by a research ethics committee at the Université de Montréal.

**Data Entry Task**

Each participant completed two tasks on an Excel spreadsheet using a computer. For task A, the participants entered data from the Brief Assessment of Service Satisfaction in Persons with Intellectual Disability (BASSPID; Lanovaz, Argumedes, Lamontagne, Duquette, & Morizot, 2013). More specifically, we created a set of 500 BASSPID questionnaires by hand. The participant had to enter the identification number (one to three digits), age (two digits), and total score (typically two digits) from these questionnaires in three adjacent, correspondingly labeled columns in the spreadsheet. The task involved entering the data from each questionnaire on a different row. Task B was the same as task A, except that the participant had to enter the identification number, the self-injury frequency score, and the self-injury severity score from the Behavior Problems Inventory (BPI-01; Rojahn, Matson, Lott, Esbensen, & Smalls, 2001). We selected data entry as the target vocational skill because (a) we wanted to broaden their skill sets and data entry is a common task in office environments and (b) the participants were unfamiliar with this task.
Data Collection

For each participant, we programmed our spreadsheet to measure the rate of correct responding and the percentage of errors. The spreadsheet scored a correct response when the participant entered the same number as in the questionnaire in the corresponding row and column of the spreadsheet. An error was automatically scored when the participant entered a number in the incorrect row or column, or entered the incorrect number. The last author completed calibration checks for all spreadsheets following the completion of the study. The calibration checks involved manually verifying that the spreadsheet accurately identified correct responses. A calibration score was calculated by dividing the number of correctly calibrated cells (agreement between manual check and automatic scoring) by the number of total number of cells. Table 1 displays per participant calibration means and ranges for tasks A and B. The calibration checks also led to the identification of a single procedural error (see DRH for Gary below).

Experimental Design and Procedures

We used a changing-criterion embedded in a concurrent multiple baseline across participants design to examine the effects of DRH on rate of correct responding and percentage of errors. However, we implemented video modeling prior to introducing DRH to teach the task to the participant and examine whether video modeling alone would increase correct responding. We systematically alternated tasks A and B across sessions to minimize repetitiveness and promote generalization. Two-hour meetings (i.e., four to eight 10-min sessions) were scheduled once or twice per week with each participant.

Baseline. The research assistant asked the participants to sit in front of a computer on which the spreadsheet was already open. Then, she provided the questionnaires for one of the
tasks to the participants and asked them to enter as much data as possible. The research assistant provided no further support with the exception of thanking the participants for their help at the end of the session. Each session lasted 10 min; a session ended earlier if the participant produced no correct responding for five consecutive minutes.

**Video Modeling.** During video modeling, the participant watched an approximately 1.5 min video model prior to each session. The video showed the point-of-view of a person completing the task targeted in the session with step-by-step voiceover instructions. Apart from watching the video beforehand, the 10-min session remained exactly the same as baseline.

**DRH.** Because the participants could clearly express their preference, we started each session by asking them to verbally choose a preferred activity, which we used as a reinforcer. The research assistant then said: “You have 10 min to enter the data from ## questionnaires correctly if you want to meet your target of ## correct responses per minute”. We set the initial rate criterion at a value equal to or marginally higher than the mean rate of the last six sessions of video modeling. If the participant met the criterion, the research assistant provided 10 min of access to the selected preferred activity (e.g., game, YouTube video). Otherwise, the research assistant said, “Nice effort, but you did not complete enough questionnaires. Are you ready to try again?”. It should be noted that Gary did not receive his preferred activity even though he met the criterion on sessions 51 and 54 due to an initial calibration error, which we retroactively corrected. We increased the criterion by two or three responses per minute when the participant met the target criterion for at least three consecutive sessions and responding remained stable. Due to a procedural error, we incorrectly introduced a new criterion at session 83 for Gary, but he had met the criterion for four of five preceding sessions. When the participant did not meet the response criterion for two sessions, the criterion was lowered to a criterion marginally above
the average rate the participant achieved during the two previous sessions. Participation ended when each participant became unavailable due to their summer vacations.

**Determination of the Novice Rate**

To determine a standard of comparison for our data entry, we recruited four undergraduate students in social sciences to enter the same data in spreadsheets. We showed them the video models and asked them to enter data for three 10-min periods for task A. The mean rate of correct responding across students was 31-per-min and the percentage of errors was 0.5%.

**Results and Discussion**

Table 2 presents mean correct responding during the last three video modeling and last three DRH sessions for each task and for each participant in addition to the relative change. None of the participants met the final target achieved by the novice data transcribers and only one participant had less than 0.5% of errors. Nevertheless, all four participants increased their rate of correct responding when compared to the video modeling phase. Figure 1 shows the rate of correct responding on tasks A and B across baseline, video modeling, and DRH conditions for Gary, Gisele, Laura, and Sabrina. Figure 2 shows the percentage of errors across both tasks for all participants. The percentage of errors was measured only as a secondary (collateral) analysis to assist in contextualizing the results. Therefore, our decision to implement video modeling with each participant relied solely on the rate of correct responding. The participants all made errors during the initial baseline sessions for at least one of the tasks. Following video modeling, percentage of errors remained consistently low across sessions with marginally more errors observed during task A. However, the decreasing trends in errors observed during baseline prevent the demonstration of experimental control for most tasks. A review of errors show that
Gary frequently interchanged the digits 3 with 8 and 9 with 4, which could be due to difficulties reading handwriting. Gisele and Lauren occasionally repeated incorrect digits in multi-digit numbers.

Although DRH increased correct responding for each participant, none of the participants met the rate of data entry obtained by novice transcribers. The mean rates of correct responding for our participants were approximately 50% the value of the novice rate, which is consistent with Horner et al. (1979). Taken together, these results raise an important social and ethical question: Should we expect individuals with intellectual disability to achieve the same productivity as individuals without disability? The cognitive and adaptive challenges associated with intellectual disability may place limits on the level of productivity attainable by some individuals in this population. Some authors have argued that we should not expect individuals with intellectual disability to achieve the same level of productivity and that some of the benefits of workplace integration remain intangible (Lysaght et al., 2015). Nevertheless, increased work productivity has several benefits such as higher pay, the potential for advancement to higher positions or better work, and a decrease in dependency on other sources of financial support (Martin & Hrydowy, 1989).

For at least two participants, task B was more challenging than task A at baseline, which may have been due to questionnaire layout. Task B included a three-by-three grid with nine cells, only two of which had to be entered. Both participants attempted to enter the other values, resulting in incorrect responses. An inadvertent side-effect of this discrepancy was the variable patterns observed during DRH. We required that the participant meet the criterion on at least three consecutive sessions, which meant that the participant had to meet the criterion on at least one session of one task and two sessions of the other. This requirement often delayed the
introduction of a new criterion, weakening the experimental control demonstrated by our changing-criterion design. Furthermore, we had to occasionally decrease the DRH criterion to stimulate participant responding, but we did not see a corresponding decrease during these reversals.

Another limitation is the lack of a reinforcer assessment. Although our participants were able to vocalize their preferences, the reinforcing value of these activities remained unknown and may have affected the rate of participant responding. A third limitation is the time constraint associated with the project, which led to the termination of the participation of some individuals who were still improving and prevented generalization measures. If their participation had continued, some individuals may have displayed higher rates of correct responding. Moreover, the duration of access to the reinforcers following each session (i.e., 10 min) may counteract the benefits of added productivity during the task. To address this issue, practitioners should consider using tokens, or reinforcers that can be delivered briefly. As research on DRH to increase work productivity remains limited, future studies should consider the aforementioned limitations while conducting further replications with a broader range of populations and behaviors.
REFERENCES


Table 1

*Calibration means and ranges for the BASSPID and BPI spreadsheets across all participants*

<table>
<thead>
<tr>
<th>Participants</th>
<th>Task A – BASSPID</th>
<th>Task B – BPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Gary</td>
<td>99.8%</td>
<td>98.9% - 100%</td>
</tr>
<tr>
<td>Gisele</td>
<td>99.8%</td>
<td>98.5% - 100%</td>
</tr>
<tr>
<td>Laura</td>
<td>99.7%</td>
<td>96.8% - 100%</td>
</tr>
<tr>
<td>Sabrina</td>
<td>99.9%</td>
<td>98.7% - 100%</td>
</tr>
</tbody>
</table>

*Note. BASSPID: Brief Assessment of Service Satisfaction in Persons with Intellectual Disability, BPI: Behavior Problems Inventory.*
Table 2

_Mean rate correct responding, mean percentage of errors, and relative change for the last three sessions of video modeling and of differential reinforcement of high rates of behavior_

<table>
<thead>
<tr>
<th></th>
<th>Task A – BASSPID</th>
<th></th>
<th>Task B – BPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate of correct responding</td>
<td>Percentage of errors</td>
<td>Rate of correct responding</td>
</tr>
<tr>
<td></td>
<td>VM</td>
<td>DRH</td>
<td>Relative change</td>
</tr>
<tr>
<td>Gary</td>
<td>10.0</td>
<td>16.1</td>
<td>+61%</td>
</tr>
<tr>
<td>Gisele</td>
<td>8.9</td>
<td>11.9</td>
<td>+34%</td>
</tr>
<tr>
<td>Laura</td>
<td>10.3</td>
<td>15.1</td>
<td>+47%</td>
</tr>
<tr>
<td>Sabrina</td>
<td>13.1</td>
<td>15.5</td>
<td>+18%</td>
</tr>
<tr>
<td>Gary</td>
<td>9.8</td>
<td>15.6</td>
<td>+59%</td>
</tr>
<tr>
<td>Gisele</td>
<td>8.2</td>
<td>12.9</td>
<td>+57%</td>
</tr>
<tr>
<td>Laura</td>
<td>10.6</td>
<td>15.0</td>
<td>+42%</td>
</tr>
<tr>
<td>Sabrina</td>
<td>11.7</td>
<td>16.0</td>
<td>+37%</td>
</tr>
</tbody>
</table>

Note. BASSPID: Brief Assessment of Service Satisfaction in Persons with Intellectual Disability, BPI: Behavior Problems Inventory, VM: Video modeling, DRH: Differential reinforcement of high rates of behavior.
Figure 1. Rate of correct responding on tasks A and B across baseline (BL), video modeling (VM) and DRH conditions for Gary, Gisele, Laura, and Sabrina. Task A: Brief Assessment of Service Satisfaction in Persons with Intellectual Disability, Task B: Behavior Problems Inventory.
Figure 2. Percentage of errors on tasks A and B across baseline (BL), video modeling (VM) and DRH conditions for Gary, Gisele, Laura, and Sabrina. Task A: Brief Assessment of Service Satisfaction in Persons with Intellectual Disability, Task B: Behavior Problems Inventory.