Differential Reinforcement of High Rates of Behavior to Increase Work Productivity

in Adults with Intellectual Disability

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Author Note

This is the peer reviewed version of the following article:

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

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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%.

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Results and Discussion

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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.

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Table 1

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

Participants	Task A – BASSPID		Task B – BPI	
	Mean	Range	Mean	Range
Gary	99.8%	98.9% - 100%	99.9%	99.2% - 100%
Gisele	99.8%	98.5% - 100%	99.9%	98.7% - 100%
Laura	99.7%	96.8% - 100%	99.9%	98.9% - 100%
Sabrina	99.9%	98.7% - 100%	99.9%	99.1% - 100%

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

Task A – BASSPID

	Rate of correct responding			Percentage of errors		
Participant	VM	DRH	Relative change	VM	DRH	Relative change
Gary	10.0	16.1	+61%	1.6	1.1	-31%
Gisele	8.9	11.9	+34%	0.7	1.8	+157%
Laura	10.3	15.1	+47%	4.7	2.7	-43%
Sabrina	13.1	15.5	+18%	0.8	0.0	-100%

Task B – BPI

	Rate of correct responding			Percentage of errors		
Participant	VM	DRH	Relative change	VM	DRH	Relative change
Gary	9.8	15.6	+59%	0.3	1.7	+467%
Gisele	8.2	12.9	+57%	0.0	0.0	0%
Laura	10.6	15.0	+42%	1.6	1.7	+6%
Sabrina	11.7	16.0	+37%	0.1	0.0	-100%

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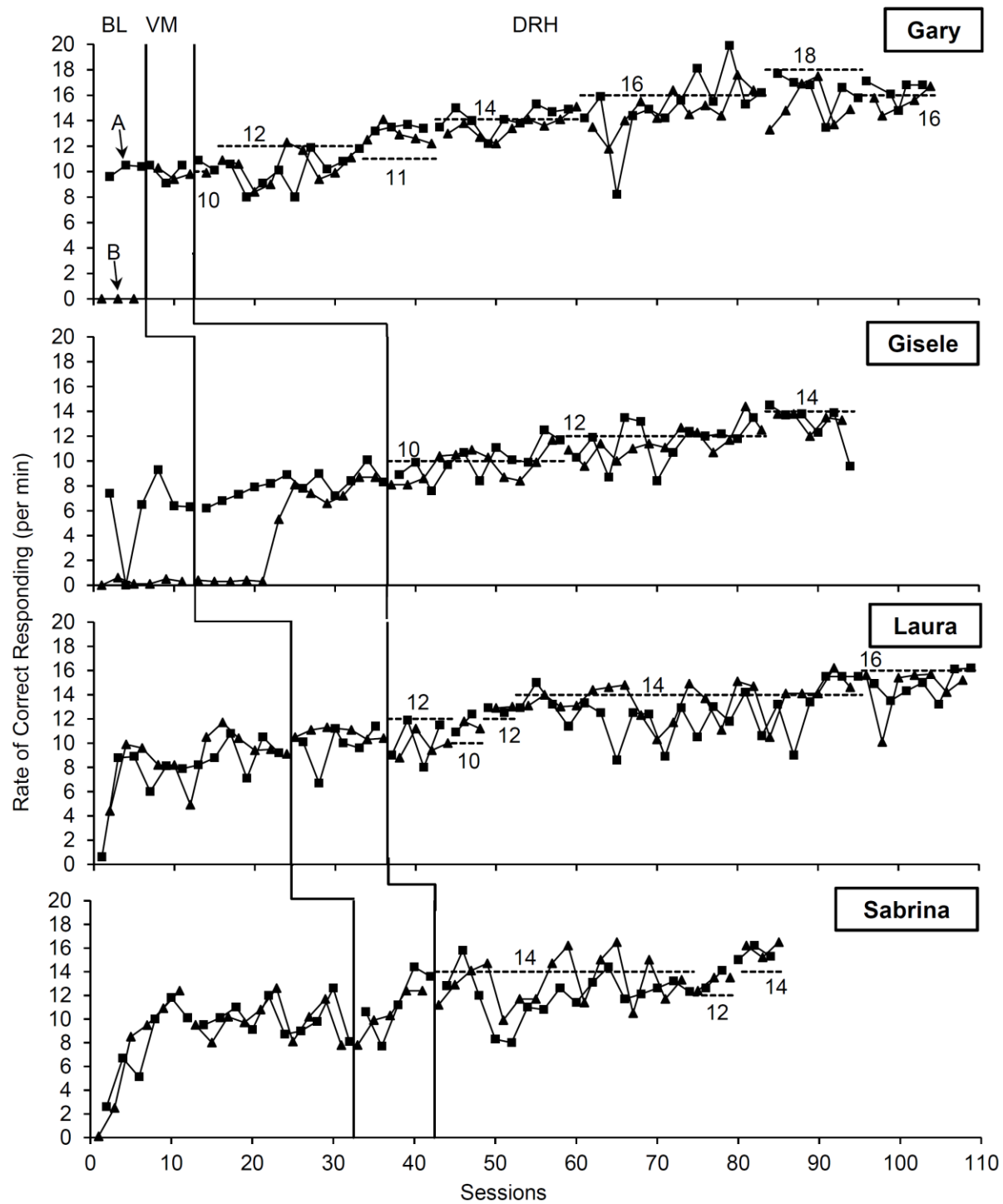
Figure 1. Rate of correct responding on tasks A and B across baseline (BL), video modeling (VM) and DRH conditions for Gary, Gisele, Laura, and Sabrina. Task A: Brief Assessment of Service Satisfaction in Persons with Intellectual Disability, Task B: Behavior Problems Inventory.
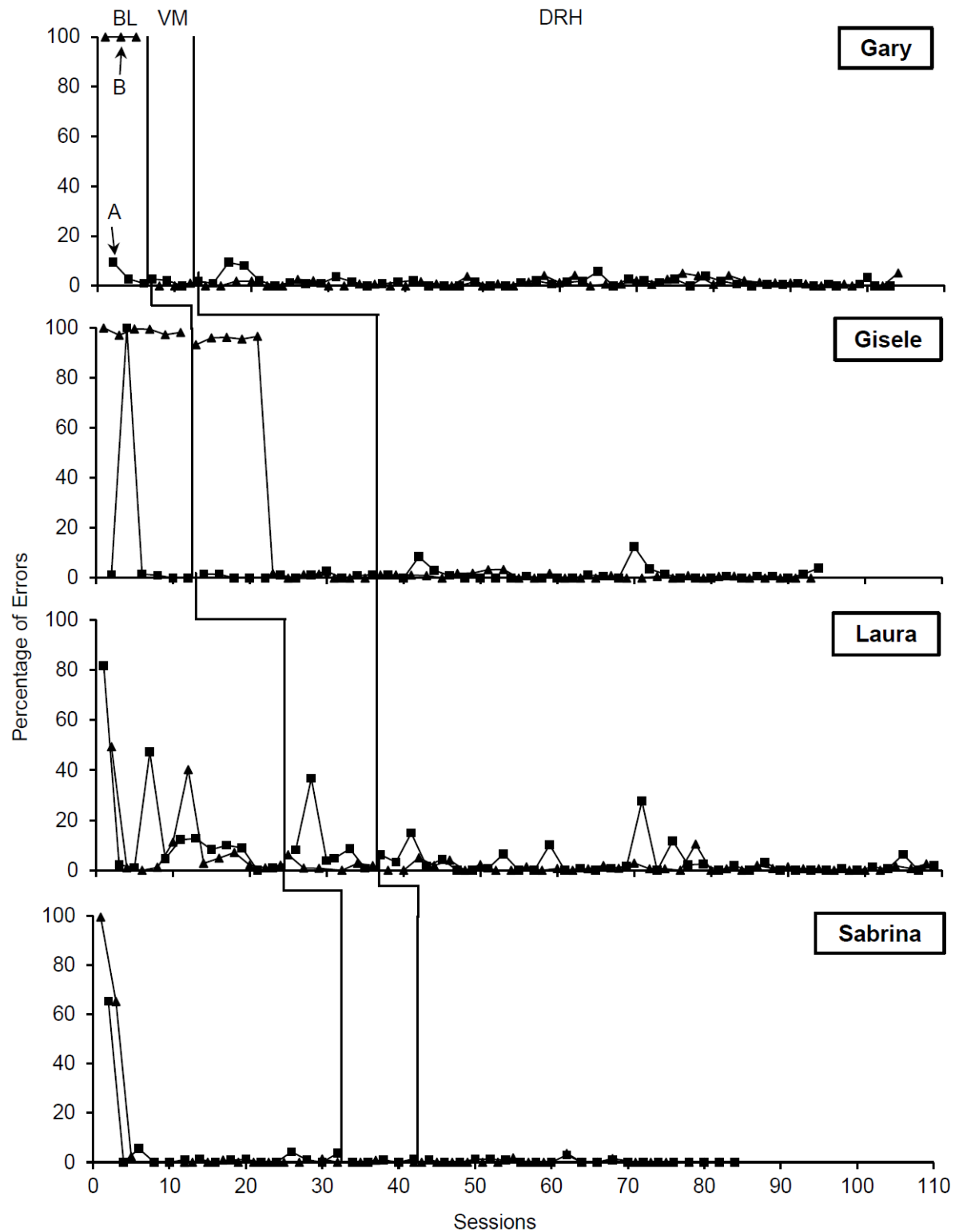
Figure 2. Percentage of errors on tasks A and B across baseline (BL), video modeling (VM) and DRH conditions for Gary, Gisele, Laura, and Sabrina. Task A: Brief Assessment of Service Satisfaction in Persons with Intellectual Disability, Task B: Behavior Problems Inventory.