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Differential Reinforcement of Prompted and Independent Responses: An Alternative Procedure to Decrease Prompt Dependency

A Thesis Presented

by

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In partial fulfillment of the requirements

for the degree of

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Differential Reinforcement of Prompted and Independent Responses: An Alternative Procedure to Decrease Prompt Dependency

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Submitted In partial fulfillment of the requirement for the degree of

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Abstract

This study attempted to identify a procedure which would be effective at decreasing prompt dependency and facilitating acquisition of sight word to picture discrimination. Several assessments were conducted to determine the most effective and most preferred reinforcer for each of the two participants while also identifying another stimulus which had moderate reinforcing effects. Three sets of three sight words were then taught to each of the participants using three reinforcement procedures. Reinforcement for independent and correct responses was the same across all three procedures, the highest preference stimulus; however, these conditions differed in that reinforcement for correct, prompted responses was either the same (noDR), was a moderate reinforcer (DR1), or reinforcement was not provided (DR2). The results of this study suggest that providing the most effective and preferred reinforcer following independent and correct responses while delivering a moderate reinforcer contingent on prompted and correct response was the most effective reinforcement procedure.

Differential Reinforcement of Prompted and Independent Responses: An Alternative Procedure to Decrease Prompt Dependency

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Differential Reinforcement of Prompted and Independent Responses: An Alternative Procedure to Decrease Prompt Dependency

One of the issues faced in the education of persons with disabilities is prompt dependency (Oppenheimer, Saunders, & Spradlin, 1993). Prompts and fading strategies are used in education in an attempt to minimize errors and increase the probability that the correct response will occur and contact reinforcement. Ideally, transfer of stimulus control from a controlling prompt to the sample stimulus is achieved over time by fading the prompt (Fisher, Kodak, & Moore, 2007). However, for certain individuals, correct responding is persistently dependent on the controlling prompt and little progress is made in fading out the prompts. This phenomenon has been defined as prompt dependency and limited applied research has been conducted examining procedures for decreasing and/or preventing the development of prompt dependency (Clark & Green, 2004). Reinforcement is an important factor in establishing and maintaining new behavior and several reinforcement-based procedures have been developed to treat challenging behavior. These procedures include differential reinforcement of other (DRO), incompatible (DRI), and alternative (DRA) behaviors.

Although differential reinforcement has some limitations with respect to decelerating problem behavior when compared to procedures such as non-contingent reinforcement, one of its advantages is the strengthening of appropriate behavior (Fisher, Kuhn, & Thompson, 1998). Vollmer, Iwata, Zarcone, Smith, and Mazaleski (1993) compared the effects of differential reinforcement of other behavior to noncontingent reinforcement. All of the participants in their study engaged in self-injurious behavior maintained by access to attention. During the DRO condition, attention was delivered contingent on the absence of self-injury during predetermined periods of time. The results of their study suggested that DRO as well as NCR were both effective treatments. In a study conducted by Marcus and Vollmer (1996), differential

reinforcement of alternative behavior in the form of a mand was used to treat problem behavior maintained by access to tangibles. The treatment packet combined DRA with NCR to address the limitations of these procedures and this combination resulted in an increase in mands and a decrease in problem behavior. The effectiveness of differential reinforcement of incompatible behavior was assessed in a study conducted by Skiba, Pettigrew, and Alden (1971) in which the authors attempted to decrease thumb sucking by providing reinforcement for engaging in activities such as folding hands and writing in a notebook. Although the results of this study suggested that DRI resulted in a decrease in thumb sucking, the effectiveness of this procedure was overshadowed by some of the limitations involved in conducting research in a classroom setting.

Research on the use of differential reinforcement within the context of discrete trial teaching is limited. Typically, differential reinforcement is in place for correct and incorrect responses, in that both correct independent and prompted responses receive reinforcement while incorrect responses are placed on extinction. This procedure seems to be an effective way to teach discrimination, but providing the same reinforcer for both correct prompted and correct independent responses could also produce prompt dependency. Past research (Olenick & Pear, 1980; Karsten & Carr, 2009) has evaluated the effects of differential reinforcement of correct prompted and correct independent responses and this could be an alternative procedure to decrease prompt dependency.

One important variable that needs to be considered in the study of prompt dependency is prompting. Few researchers have systematically compared prompting procedures. Prompting should facilitate transfer of stimulus control but it may also support the development of prompt dependency. In a study conducted by Steege, Wacker, and McMahon (1987), two variations of

the least-to-most prompt sequences were compared. The traditional sequence consisted of a six-step prompt sequence in which the participants always received instructional prompts in the same hierarchical order, while the prescriptive sequence involved presenting a level of prompting according to ongoing assessments of the participants' performance. The purpose of this comparison was to assess which variation of the least-to-most prompting was more effective and more efficient. There were four participants in this study, between the ages of 11 and 19 years, all were diagnosed with mental retardation. In order to evaluate the two variations, data were collected on correct performance, number of trials to criterion per task and per participant, and the duration of training. The results of this study suggested that both prompting procedures were effective in that the participants acquired the tasks irrespective of the prompting procedure. However, the prescriptive method was more efficient for 3 out of 4 participants in that it required fewer trials and less time to meet the mastery criterion.

In another study comparing prompting procedures, Libby, Weiss, Bancroft, and Ahearn (2008) taught children with autism to build LEGO® structures. During Study 1, they compared most-to-least (MTL) and least-to-most (LTM) prompting procedures. In Study 2, they compared LTM to MTL without and with a delay (MTLD). Lego® constructs associated with each of the prompting procedures were compared for difficulty and they consisted of the same number of steps. There were six participants in this study, ranging in age from 9 to 15 years. The participants were diagnosed with an autism spectrum disorder and they all had the fine motor skills necessary to construct the Lego® structures. The results of this study suggested that the MTLD prompting procedure was the most effective, perhaps because it provided an opportunity for the participant to respond independently while still limiting the number of errors. Although

the MTL prompt procedure is sometimes associated with fewer errors, it also prevents the participant from engaging in independent responding until the final prescribed prompt step.

Combined, the results of the studies conducted by Steege et al. (1987) and Libby et al. (2008) have added to the literature on prompting procedures by demonstrating that it is possible to assess whether a certain prompting procedure is more effective and/or more efficient. An issue that was not addressed by either study is what should be done if the participant reaches the independent step but waits for a prompt instead of responding and therefore does not acquire the skill. These two studies also did not assess whether certain prompting procedures are more efficient for certain skills or whether the same prompting procedure will be just as effective if used to teach simple discrimination, fine motor tasks, leisure, or domestic skills.

Another variable that may affect prompt dependency is differential reinforcement for correct independent and prompted responses, as well as consequences for incorrect responding. A few studies (Olenick & Pear, 1980; Touchette & Howard, 1984) have used differential reinforcement either alone or in combination with other procedures to produce discrimination learning. However, decreasing prompt dependency was not one of objectives of these studies and the findings of these studies are inconsistent. In the study conducted by Olenick and Pear, the authors assessed whether the use of differential reinforcement of correct prompted and correct independent response would affect the skill acquisition of their participants. The author's rationale was that providing more dense reinforcement for correct prompted responses would facilitate acquisition since these were the responses that the participants had not yet acquired. A total of three children participated and they were all diagnosed with developmental delays. The participants were taught to label pictures, and responses were reinforced according to the reinforcement procedure in place during each phase. During the first phase, food reinforcement

was delivered nondifferentially on either a fixed ratio 6 or 8 (FR) schedule for both correct prompted and correct independent responses. In Phase 2, reinforcement was delivered differentially for correct prompted and correct independent responses according to separate FR6 or FR8 schedules. In Phase 3, correct independent responses were reinforced on a continuous reinforcement schedule (CRF) while correct prompted responses were reinforced on either a FR6 or FR8 schedule. Phase 4 was the opposite of Phase 3 in that correct independent responses were reinforced according to a FR6 or FR8 schedule while correct prompted responses were reinforced on a CRF schedule. The authors also conducted a Phase 5 which was a direct replication of Phase 3.

The results of this study suggested that providing continuous reinforcement for correct independent responses while delivering reinforcement for correct prompted responses according to a FR6 or FR8 schedule was the most effective reinforcement procedure. During Phases 1 and 2, the participants never mastered any of the picture-naming. In Phases 3 and 5, all the participants showed a dramatic increase in the rate at which picture-naming reached mastery criterion. During Phase 4, the participants initially mastered some picture-naming, but the rate of acquisition eventually declined to near zero similarly to Phases 1 and 2.

A similar study comparing differential reinforcement of corrected prompted and correct independent responses was conducted by Touchette and Howard (1984). The authors were interested in assessing whether an exaggerated discrepancy in reinforcement probability favoring correct independent responses would expedite transfer of stimulus control. Three students between the ages of 6 and 13 years of age participated in this study and the authors described them as being severely mentally retarded. This study consisted of three phases in which the schedule of reinforcement provided for correct prompted and correct independent responses was

manipulated. In Condition A, correct responses both before and after the prompt were reinforced on a continuous reinforcement schedule (CRF/CRF). Condition B favored correct responses that occurred before the prompt and these responses were reinforced according to a CRF schedule while correct responses after the prompt were reinforced according to a FR 3 schedule of reinforcement (CRF/FR3). The reinforcement contingencies in place for Condition B were swapped during Condition C. The results of this study suggested that learning occurred during all three experimental conditions and that the mean correct responses across conditions were similar for all of the participants. The authors concluded that a functional relationship between the accuracy of responding and the contingencies of reinforcement in effect was not produced.

A more recent assessment of the effects of differential reinforcement of prompted responses on the skill acquisition of children diagnosed with an autism spectrum disorder was conducted by Karsten and Carr (2009). Instead of manipulating the rate of reinforcement as it was done in the studies conducted by Olenick and Pear (1980) and Touchette and Howard (1984), the authors opted to manipulate the quality of the reinforcer delivered. In this study, two reinforcement procedures were in effect, one in which a high quality reinforcer (food-plus-praise) was delivered contingent on both correct prompted and correct independent responses and another in which high quality reinforcement was delivered contingent on correct independent responses while praise alone was delivered for correct prompted responses. This assessment was completed with two participants, both male, ages 3 and 5 years old. The results of this study indicated that both reinforcement procedures led to acquisition; however, the authors concluded that the differential reinforcement condition was more efficient since acquisition was quicker during that phase.

One of the few studies to address the problem of prompt dependency was conducted by Fisher and colleagues (2007). The authors suggested that a way to overcome prompt dependency

is to arrange prompts that ensure that the participant looks at and discriminates the distinguishing visual characteristics of the comparison stimuli by requiring a differential observing response (DOR). The authors used a multielement design to assess whether the inclusion of a DOR within a prompting hierarchy would facilitate the development of conditional discrimination. There were two participants in their study, a 12-year-old girl and a 10-year-old boy, both diagnosed with an autism spectrum disorder. During the pretest phase, the therapist presented the sample stimulus vocally and then the comparison stimuli which consisted of four pictures. Reinforcement was withheld for both correct and incorrect responses. During the LTM prompting condition, the therapist presented the sample stimulus vocally and then the four comparison stimuli. Successive prompts within each trial provided increasingly more assistance to the individual. In the identity matching condition, the second prompt in the sequence was replaced by an identity matching task which was the DOR. The therapist presented the sample stimulus and then held a picture identical to one of the comparison stimuli (this was the correct response, or S+). The therapist then stated, “this is a… point to…” and LTM prompting was used to ensure that the participant touched the correct comparison stimuli.

Even though this was not the focus of this study, differential reinforcement of prompted and independent responses and an error correction procedure were used. Correct independent responses resulted in 20-s access to a preferred item or one small food item. Correct prompted responses resulted in the presentation of the next trial, while incorrect responses resulted in the therapist repeating the sample stimulus and then physically guiding the correct response (error correction procedure). Both participants’ performances were significantly better in the identity matching condition suggesting that the inclusion of the DOR procedure facilitated discrimination.

In a related study conducted by Glat, Gould, Stoddard, and Sidman (1994), the authors attempted to make the delayed-cue method of prompting more effective by requiring the participant to engage in a differential observing response. The authors described a case study in which the participant was taught to match dictated-word stimuli to printed-word stimuli. A series of three experiments were conducted in order to assess whether the inclusion of the overt observing response was indeed the mechanism responsible for transfer of stimulus control from the prompt to the sample stimulus. During the first experiment, discrimination training originally consisted of attempts to fade the prompts by using the delayed-cue procedure, however after a large number of trials had been conducted and the participant had still not acquired the discriminations, a DOR consisting of repeating the sample dictated word was introduced. Once the participant met the mastery criteria, the DOR was no longer required in order to assess whether performance would be maintained. During the second experiment, the authors evaluated the effects of exposing the participant to twice the number of trials required in the first experiment without adding the sample-repetition. This was done in order to investigate whether the sample-repetition was necessary or if transfer of stimulus control would result simply from prolonged exposure to the pairings. In the third experiment, sample-repetition and no-sample-repetition conditions were compared in an alternating design to rule out whether mere exposure to the sample-repetition was sufficient. Transfer of stimulus control did not occur in the second experiment until the DOR was added and it only occurred in the condition which required the sample-repetition in the third experiment. These results indicated that the inclusion of the DOR was indeed required in order for the participant to acquire the discriminations.

The combined results of these studies suggest that differential reinforcement might affect skill acquisition; however, additional research is necessary before definitive conclusions can be

drawn. That said, some of these studies did not include participants who were identified as exhibiting prompt dependency. Therefore we are unable to recognize whether these findings would be similar with participants who were identified as displaying prompt dependency. It is also unclear from these findings whether reinforcement rate or quality is a crucial variable in establishing or preventing prompt dependency. In addition, research should assess both the reinforcing effect of the stimuli to be delivered as well as preference. It is possible that two stimuli might be just as effective during a reinforcer assessment but that participants show clear preference for one of the stimuli during a preference assessment. Since an evaluation incorporating all of these variables could lead to the further development of teaching procedures, the purpose of this study was to investigate whether differential reinforcement of prompted and independent responses in the context of discrimination training is an effective procedure to decrease prompt dependency and facilitate skill acquisition.

METHOD

Participants and Setting

Two individuals who lived in a residential facility for persons with autism and related disabilities participated. Both of the participants engaged in problem behavior consisting of aggression, self-injury, environmental destruction, or a combination of these topographies. Data were collected on these behaviors but they did not interfere with their participation in the study. Both participants were diagnosed with an autism spectrum disorder.

Eddie was a 16-year-old boy who had been attending the residential facility for 10 years. He communicated using a voice-output device and some manual signs. Eddie was able to follow two-step directives and he had recently been diagnosed with a seizure disorder. Bill was a 12-year-old boy who had been attending the facility for eight years. He communicated vocally as well as through the use of manual signs. Bill and Eddie could follow multistep directives and, at

the time of this study, were not receiving any psychotropic medication. Both participants were on a token economy system at the onset of this study and they met the prompt dependency definition used by the authors. *Prompt dependency* was defined as occurring when the participant consistently waited for prompts and no progress was made at fading out the prompts (Clark & Green, 2004). In order to determine whether potential participants were prompt dependent several observations of each of them were conducted. In these observations, the potential participant was observed with one of his primary teachers while completing a match-to-sample discrimination program and data were collected on whether the participant waited for the teacher prompt, which was delayed up to 10 s. In addition, the author reviewed the participants' progress on IEP objectives. It was noticed that the two participants included in this study quickly moved through the prompting hierarchy, starting at no delay and progressively increasing by 1 s until the final step. However independent responding did not occur. Instead, they continued to wait for the prompt and therefore repeatedly met criteria to move back to the previous prompting step.

All sessions during the pre-training phase were conducted in a 1.5 m by 3 m room which was adjacent to the participants' classroom. The room was equipped with a one-way mirror, a table, two chairs, and a video camera. Pre-training sessions were conducted once or twice a week with each participant. Training sessions were conducted in the participants' classroom. Additional training sessions were conducted in a room at each of the participants' residences. Eddie and Billy lived in different residences and both were located in towns nearby the central facility. Training sessions were conducted one to three times per day, typically four to five days per week, based on the participants' availability.

Materials used during the assessments and training phase included poker chips (which were used as tokens) and a token board, Portuguese sight words, 3.8 by 3.8 cm pictures of the

things described by the sight words, 3-choice array data sheets, a 3-stimuli presentation board, a slant board, preferred edibles, timers, different colored construction paper which were associated with the different conditions during the pre-training assessments, a 3.8 by 3.8 cm picture of a poker chip, a 3.8 by 3.8 cm picture of a smiley face, and a 3.8 by 3.8 cm red square. During the pre-training assessments, two small different colored circles were placed on the table in front of the participants and these circles were the targets that the participants touched during the free-operant response, target touching.

Reinforcer Assessment

Response Measurement and Interobserver Agreement

Target touching was defined as the participant making opened-hand contact with two different colored shapes placed on the table in front of him in an alternating manner. *Reinforcer selection* was defined as the first contact of the participant's hand with one of the cards presented on the table. Data were collected on frequency of target touching per reinforcer assessment condition and the number of times each initial link was selected during the concurrent-chain reinforcer assessment. A second observer independently recorded data on the frequency of target touching during the reinforcer assessment conditions as well as on the selections made during the initial link of the concurrent-chain preference assessment. Interobserver agreement for the reinforcer assessment was calculated by dividing each session into 10-s intervals and calculating agreement scores for each interval and then averaging these scores across the total number of intervals for each session. Agreement scores were calculated by dividing the smaller count by the larger count and then multiplying by 100. Interobserver agreement for the concurrent-chain reinforcer assessment was calculated on a trial-by-trial basis. The total number of agreements was divided by number of agreement plus disagreements and multiplied by 100. Interobserver

agreement was collected for over 33% of the sessions across both assessments. Mean agreement scores for the reinforcer assessment were 95% (range, 90% to 100%) for Eddie, and 93% (range, 90% to 97%) for Bill. Mean agreement scores for the concurrent-chain assessment were 98% (range, 97% to 100%) for Eddie, and 99% (range, 98% to 100%) for Bill.

Procedure

A series of reinforcer assessments based on the procedures described by Smaby, MacDonald, Ahearn, and Dube (2007) were conducted in order to identify the most efficient and preferred reinforcer for each of the participants. The first reinforcer assessment assessed whether verbal praise alone functioned as a reinforcer for each participant. In this assessment, an extinction component alternated with a reinforcement component a total of three times in the component sequence. Once it was determined that verbal praise functioned as a reinforcer, another reinforcer assessment was conducted comparing verbal praise, token, and token-plus-verbal praise. Similarly to the previous assessment, extinction components alternated with each of the reinforcement components, however each reinforcer was assessed once per component sequence. Lastly, a concurrent chain preference assessment was conducted to assess whether the participants showed a preference for one of the reinforcers and whether the preference matched the results of the reinforcer assessment, meaning that the most potent reinforcer found in the second reinforcer assessment was also the reinforcer chosen during the preference assessment. The reinforcing efficacy of each stimulus was determined by the response rate during each of the reinforcer components compared to the response rate during the previous extinction component. The response rate of the reinforcer components was compared to the response rate during the last minute of the extinction component.

Reinforcer Assessments

Baseline. During this condition, a timer was set for 5 min. Two small different colored circles were placed on the table in front of the participants and these circles were the targets that the participants touched during the free-operant response, target touching. A red piece of laminated construction paper was placed on the table in front of the participant. Red was the color associated with extinction. Prior to starting the session the therapist stated “red” and manually guided the participant to complete the free-operant response six times. No consequences were provided for responding. The therapist then stated, “red” and started the timer. The session lasted until the 5 min ended or until the participant stopped responding for 1 min. Responses other than the target response were ignored.

Verbal Praise. During this condition, a timer was set for 1 min. Two small different colored circles were placed on the table in front of the participant and these circles were the targets that the participant touched during the free-operant response, target touching. A white piece of laminated construction paper was placed on the table in front of the participant. White was the color associated with verbal praise. Prior to beginning the session, the therapist stated, “white” and the participant was manually guided to complete the response six times. Verbal praise consisting of a short statement such as, “great job, Eddie” was provided contingent on each response. The therapist then stated, “white” and started the timer. The session lasted 1 min and each target response was immediately followed by verbal praise. Responses other than the target responses were ignored.

Token. During this condition, a timer was set for 1 min. Two small differently colored circles were placed on the table in front of the participants as in the other conditions. A green piece of laminated construction paper was placed on the table in front of the participant. Green

was the color associated with token delivery. Prior to beginning the session, the therapist stated, “green” and the participant was manually guided to complete the response six times. A token was placed on the token board contingent on each response. The therapist then prompted the participant to trade-in the tokens for one small edible, which was selected from an assortment of edibles. The therapist then stated, “green” and started the timer. A token was delivered contingent on each response. When the participant had earned all six tokens, the timer was stopped and the participant was prompted to trade in his tokens for an edible. Once the edible was consumed, the timer started again but the therapist did not state anything to the participant. Responses other than the target responses were ignored.

Token-plus-verbal praise. During this condition, a timer was set for 1 min. Two small different colored circles were placed on the table in front of the participants as in the other conditions. A yellow piece of laminated construction paper was placed on the table in front of the participant. Yellow was the color associated with verbal praise plus token delivery. Prior to beginning the session, the therapist stated, “yellow” and the participant was manually guided to complete the response six times. A token was placed on the token board and verbal praise was delivered contingent on each response. The therapist then prompted the participant to trade in the tokens for one small edible which was again paired with verbal praise. The therapist then stated, “yellow” and started the timer. A token and verbal praise were delivered contingent on each response. When the participant had accumulated six tokens the timer was stopped and the participant was prompted to trade in his tokens. Once the edible was consumed, the timer started again but the therapist did not state anything to the participant. Responses other than the target response were ignored.

Concurrent Chain Preference Assessment

During this assessment, four small clear plastic bins were placed on the table in front of the participant. Each bin was placed upside down and underneath the bins were the discriminative stimuli associated with each condition. A picture of a token, a picture of a smiley face, and a red square were used. The bin which was associated with the token condition contained the picture of the token while the bin associated with verbal praise contained the smiley face. The bin which was associated with token-plus-verbal praise contained both a picture of a token and a picture of a smiley face but both pictures were taped together so that the participant could grab both at the same time. Lastly, the bin associated with extinction contained the red square.

Training. In order to make sure that each participant understood the consequences associated with each condition, a training session consisting of 40 trials (10 for each condition) was conducted first. The bins were placed in front of the participant and the participant was manually guided to lift the bin and grab the stimulus placed under it. This consisted of the initial link of the chain. The participant was then guided to place the picture on the table and hand the therapist another card. This response was necessary because in the token condition the participant was required to give the therapist the token board in order to receive the edible. This consisted of the terminal link of the chain. The same stimuli used in the reinforcer assessment as the discriminative stimuli were used in this assessment. The terminal links consisted of a red card for the extinction component, a white card for verbal praise, a green card containing six tokens for the token condition, a yellow card containing six tokens for the token-plus-verbal praise condition. The placement of the bins remained the same throughout training and the order of the conditions was determined randomly.

Preference Assessment. The procedure for the reinforcer assessment was similar to training. The bins were placed on the table in front of the participant. Prior to starting the session, the therapist manually guided the participant to choose each of the initial links twice in order to make sure that the participant was exposed to each condition. The therapist then stated, “choose” at the beginning of each trial. The consequence associated with the initial link chosen during the trial was provided and another trial was initiated once the reinforcer was delivered and consumed if applicable. Each session consisted of 20 trials and placement of the bins was rotated after each trial. Preference was determined by calculating the percentage each of the components was chosen during each session. Preference scores were calculated by dividing the total number of trials each component was chosen by the total number of trials per session (20) and multiplying by 100.

Training Phase

Response Measurement and Interobserver Agreement

Independent responses were defined as any response emitted prior to the teacher prompt. If the step prescribed was 2-s delay manual guidance at the forearm, an example would be the participant touching the comparison stimuli before the 2-s delay. *Prompted responses* were defined as any response emitted with the teacher prompt. Again, if the step prescribed was 2-s delay manual guidance at the forearm, an example would be the participant touching the comparison stimuli only after being prompted by the teacher. *Mastery criterion* was defined as two consecutive sessions with 90% or above independent and accurate responding. *Problem behavior* was defined according to each of the participant’s behavioral guidelines and it included any instance of aggression, self-injury, environmental destruction, or bolting. *Errors* were

defined as the participant touching the incorrect comparison stimuli either prior to or with the teacher prompt.

Data were collected on the number of independent and prompted responses, number of errors, number of sessions needed to meet mastery criteria, and frequency of problem behavior during sessions. These data were compared across conditions in order to assess which one of the reinforcement procedures was more effective. Another observer simultaneously and independently collected data during over 33% of all sessions across training conditions. Interobserver agreement was calculated on a trial-by-trial basis. The total number of agreements was divided by number of agreements plus disagreements and multiplied by 100. Mean agreement scores for the training phase were 99% (range 98% to 100%) for both participants.

Procedural Integrity

Procedural integrity data were collected during the training phase to ensure that the teaching procedures were followed as described in the protocol. These data were collected by the same observers that collected interobserver agreement data. Procedural integrity data were collected for each trial and were a function of whether the appropriate sample and comparison stimuli were presented as prescribed on the data sheet, whether the comparison stimuli were presented after the participant touched the sample stimulus, whether the prompt provided by the therapist corresponded to the prompt prescribed, and whether data were recorded after trial completion. Data were also collected on whether all the materials necessary and associated with the reinforcement condition were available. A procedural integrity score was calculated for each session by dividing the number of correctly implemented trials by the total number of trials and multiplying by 100. The mean procedural integrity scores for Eddie were 99.7% (range, 97-100%), and 99.5% for Bill (range, 96-100%).

Procedure

During the training phase, one set of three sight words each was taught using each of the reinforcement procedures described below. The sight words consisted of nine Portuguese words which were grouped into sets of three words (Table 1). The sets of words were randomly assigned to one of the reinforcement conditions. They were chosen by the first author but they were also reviewed by another employee from the New England Center for Children with a masters degree in Applied Behavior Analysis. This person compared the sets of words to ensure that they were similar in length and contained similar letter sequences. This was done to guarantee that the words being taught using each of the reinforcement conditions were of equal difficulty. The sets of words were randomly assigned to each of the conditions for each of the participants.

A match-to-sample procedure was used to teach the sight words. A data sheet containing nine sessions with 9 trials each was used. The placement of the correct response varied across trial and session so that the participant did not develop a response pattern based on position. On the table in front of the participant were a slant board and the discriminative stimuli associated with the appropriate reinforcement condition. At the beginning of each trial, the therapist showed the participant the sample stimulus and stated “match.” The comparison stimuli, which were presented on a 3-stimulus array board, were then placed on the slant board in front of the participant. The therapist followed the prompting procedure as prescribed in the beginning of the session: S*tep 1* consisted of immediate full manual guidance; *Step 2* was 2-s delay manual guidance at the forearm; *Step 3* was 2-s delay manual guidance at the forearm; *Step 4* was 2-s delay light touch; and *Step 5* was independent. If the participant touched the correct comparison, the therapist delivered the consequence associated with the appropriate reinforcement procedure

and then recorded the data. If the participant touched the incorrect comparison, the therapist recorded the data. After recording the data, the comparison stimuli were removed from the slant board and another trial began.

The length of each session was nine trials or until the session was discontinued. The criterion to increase a step at the end of the session was 7/9 correct responding and the criterion to discontinue a session was two consecutive errors or three errors in the same session. In addition, if after meeting the mastery criterion for one set of words the participant had not made significant progress with the other sets, the reinforcement program for one of these sets was changed to the reinforcement program which was used with the set that met mastery criterion first.

No differential consequence (NoDR). During this condition, the most potent and preferred reinforcer was delivered contingent on both prompted and independent responses. Since for both participants, the most potent and preferred reinforcer was token-plus-verbal praise, a picture of a token and of a smiley face was placed on the table near the token board. This was done to signal to the participant that prompted responses were going to be followed by a token-plus-verbal praise. After accumulating six tokens, the participant was prompted to trade in his tokens for a small edible which was paired with verbal praise. Training lasted until each of the participants mastered all three sets of words and the total number of sessions required differed across participants. Once a participant met mastery criterion for one set of words, the reinforcement procedure in place for that set of words was then used to continue the training for one of the other sets of words while training for the last set of words continued the same. If the participant mastered the set of words for which the reinforcement procedure was altered and had not yet

mastered the last set of words, which was the case for both participants, then that reinforcement procedure was used to continue training for the last set of words.

Differential Reinforcement 1 (DR1). During this condition, a moderately potent and preferred reinforcer was delivered contingent on prompted responses while the most potent and preferred reinforcer was delivered contingent on independent responses. Since for both participants, the moderately potent and preferred reinforcer was verbal praise, a picture of a smiley face was placed on the table near the token board. This was done to signal to the participant that prompted responses would be followed by verbal praise only. After earning six tokens, the participant was prompted to trade in his tokens for a small edible paired with verbal praise.

Differential Reinforcement 2 (DR2). During this condition, no reinforcement was delivered contingent on prompted responses while the most potent and preferred reinforcer was delivered contingent on independent responses. A small red square was placed on the table near the token board to signal to the participant that prompted responses wouldn't be followed by any form of reinforcement. After earning six tokens, the participant was prompted to trade in his tokens for a small edible paired with verbal praise.

Experimental Design

During the reinforcer assessment a multiple schedule was arranged to determine experimental control (similar to Smaby et al., 2007). For the preference assessment, a concurrent chain arrangement was implemented and during the training phase a multielement design was used to ensure experimental control.

Results

Figures 1-4 show the results of the reinforcer and preference assessments for both participants. Figure 1 indicates that the response frequency during the verbal praise component

was significantly higher than during the preceding extinction component for both participants. These results suggest that verbal praise was an effective reinforcer. Figure 2 shows that the response frequency during all the reinforcer components was higher than during each preceding extinction component. For Eddie, when comparing the response frequency during each of the reinforcer components, response frequency was higher during the token component. For Bill, on the other hand, response frequency was higher in the verbal praise component during the first session and in the token component in the second session. Figure 3 contains the results of the concurrent chain preference assessments for Eddie, as well as the results of an additional session of the reinforcer assessment which was completed after the concurrent chain preference assessment. Since Eddie did not show a clear preference for either of the conditions, another session of the reinforcer assessment was completed and the results suggested that token-plus-verbal praise was the most effective reinforcer. Figure 4 includes the results of the concurrent chain preference assessment for Bill. Bill chose the token-plus-verbal praise condition most often suggesting that this was the most highly preferred condition. As a result of these assessments, token-plus-verbal praise was chosen to be the most effective and preferred reinforcer for both participants while verbal praise was chosen to be the moderate reinforcer.

Figures 5 and 6 show the results of the training phase. Eddie (Figure 5) mastered the set of words taught using the DR1 procedure much faster than the words being taught using the other procedures. In addition, Eddie made quick progress on the other words once the reinforcement procedure was changed to DR1. The results of Bill's training phase were very similar. Bill (Figure 6) mastered the set of words taught using the DR1 procedure rapidly and he quickly mastered the other words once the reinforcement procedure was changed to DR1. These results suggest that delivering the most potent reinforcer for independent responses while

delivering a moderate reinforcer for prompted responses is the most effective reinforcement procedure when using a match-to-sample procedure to teach sight word discrimination.

Discussion

The results of the current study suggest that differential reinforcement of prompted and independent responses within the context of a discrimination task can facilitate skill acquisition and decrease prompt dependency, at least within that task. Both participants quickly mastered the set of sight words associated with the reinforcement condition which favored independent responses by providing the most potent and preferred reinforcer contingent on such responses.

The present findings replicate and expand some of the results of past research evaluating the effects of differential reinforcement. The current findings support the results found by Olenick and Pear (1984) and Karsten & Carr (2009) which also demonstrated that differential reinforcement of prompted and independent responses facilitated skill acquisition. This study extends previous research (Olenick & Pear, 1984; Touchette & Howard, 1984) by manipulating reinforcer quality instead of rate and by also developing a procedure that could be easily followed by any staff working with the participants since staff were not required to track the rate of prompted versus independent responses in order to deliver the reinforcer according to the fixed ratio schedules associated with each topography It is also important to note that the current study is the only study to control for sight word difficulty across the reinforcement conditions, a variable that could be responsible for some of the findings in previous research.

It is unclear from the current findings which mechanism of action underlies the effects associated with differential reinforcement and prompt dependency. It is possible that the non-differential reinforcement procedure failed to produce acquisition because the delivery of high quality reinforcer following prompted responses adventitiously reinforced prompted dependency.

In addition, the tokens delivered contingent on independent responses only during the differential reinforcement conditions could have facilitated discrimination between the contingencies associated with each condition. In previous studies where tokens were delivered contingent on both prompted and independent responses (Touchette & Howard, 1984) and the variable manipulated was the schedule of reinforcement, it is possible that the participants did not have enough experience with the contingencies in place. It is also possible that the difference between continuous reinforcement (CRF) and a fixed ratio 3 (FR3) was not discriminable or enough of a difference for it to influence the behavior of the participants.

The fact that the DR2 condition did not result in skill acquisition was surprising. The authors speculated that delivering the most potent and preferred reinforcer contingent on independent responses while providing no reinforcement for prompted responses should lead to an increase in independent responses since the contingencies in place should make it clear to the participants that waiting for a prompt from the therapist was going to result in no reinforcement at all. The results of this study suggest that at least some reinforcement should be provided for prompted responses.

It is also important to note some of the limitations of the current investigation, which include the small sample size and the stimuli used during the training phase. Future studies should attempt to replicate these findings with a larger number of participants, participants of a different age, and with a different diagnosis to ensure that the findings can be generalized. Also, the stimuli chosen to be used during the training phase (Portuguese sight words) were selected because the participants did not have any experience with such stimuli. However the findings might have differed if the stimuli used were stimuli with which the participants had had a history of reinforcement of prompt dependency.

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Table 1

Sight Words Used During the Training Phase

Participant	Condition	Stimuli
Bill	NoDR	Bolsa Cama Meia
	DR1	Bolo Carro Melao
	DR2	Bone Calca Medalia
Eddie	NoDR	Bolo Carro Melao
	DR1	Bone Calca Medalia
	DR2	Bola Casa Mesa

Note. Each set of stimulus was randomly assigned to one of the reinforcement conditions for each of the participants.

Figure Captions

Figure 1. Results of the reinforcer assessment for Eddie and Bill. Response frequency during each of the components of the assessment.

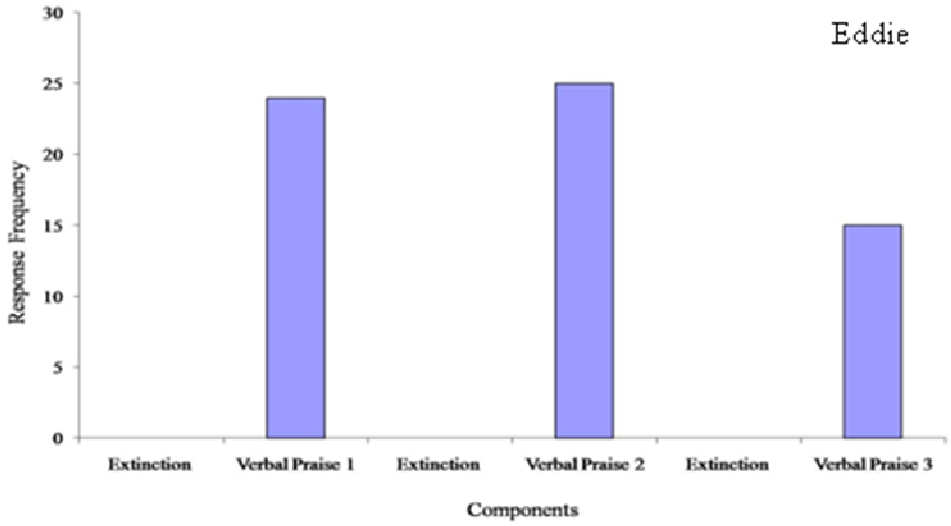
Figure 2. Results of the reinforcer assessment for Eddie and Bill. Response frequency during each of the components on the top panels

Figure 3. Results of the concurrent chain preference assessment for Eddie on top and results of the reinforcer assessment for Eddie on the bottom. The top panels represent the percentage chosen for each of the stimuli assessed and the bottom panel the response frequency during each of the components of the assessments.

Figure 4. Results of the concurrent chain preference assessment for Bill. Percentage chosen for each of the stimuli assessed.

Figure 5. Results of the training phase for Eddie. Percentage of responses correct and independent as a function of the reinforcement condition.

Figure 6. Results of the training phase for Bill. Percentage of correct and independent responses as a function of the reinforcement condition.


Eddie
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20
15
10
5
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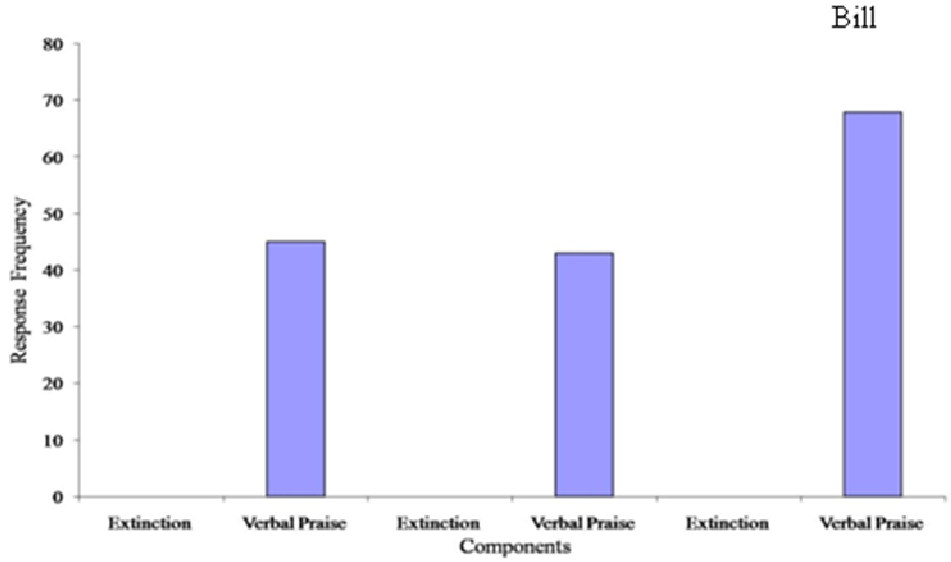
Extinction
Verbal Praise 1
Extinction
Verbal Praise 2
Extinction
Verbal Praise 3
Components


Bill
Response Frequency
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40
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10
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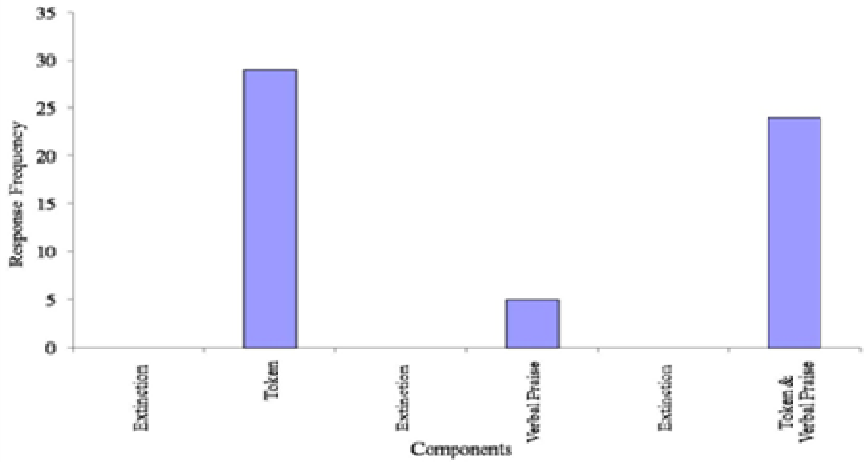
Extinction
Verbal Praise
Extinction
Verbal Praise
Extinction
Verbal Praise
Components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Token
Extinction
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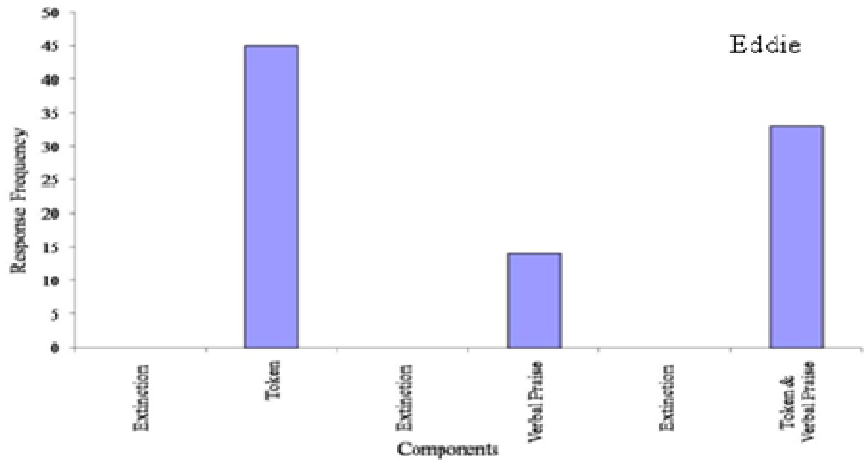
Extinction
Token & Verbal Praise
Components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Response Frequency
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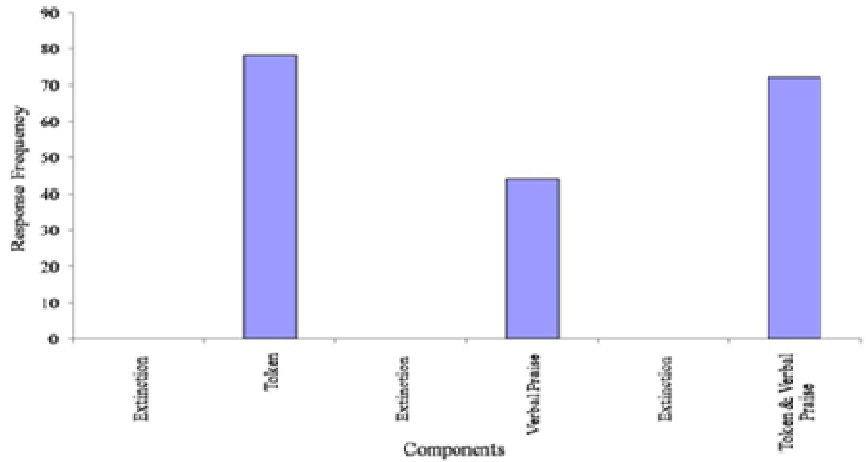
Extinction
Token
Extinction
Verbal Praise
Extinction
Token & Verbal Praise
Components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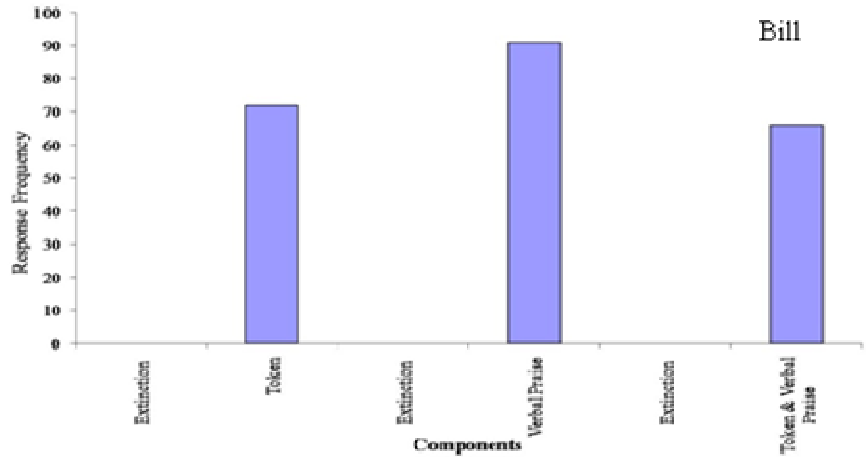
Extinction
Token
Extinction
Verbal Praise
Extinction
Token & Verbal Praise
Components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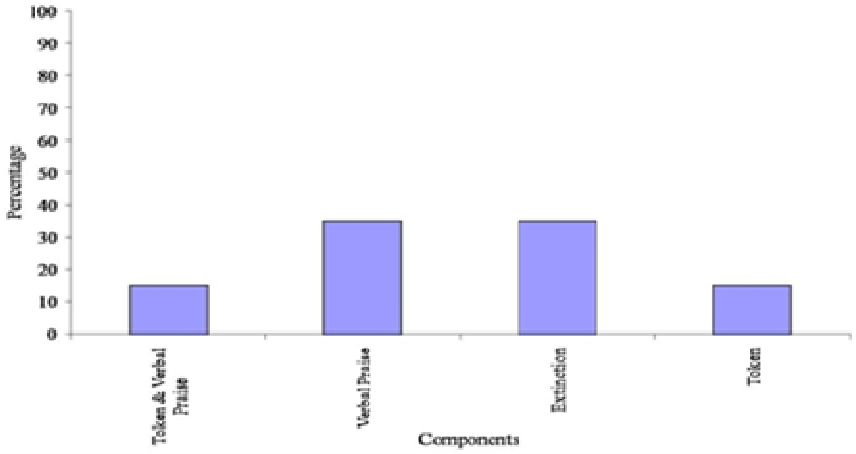
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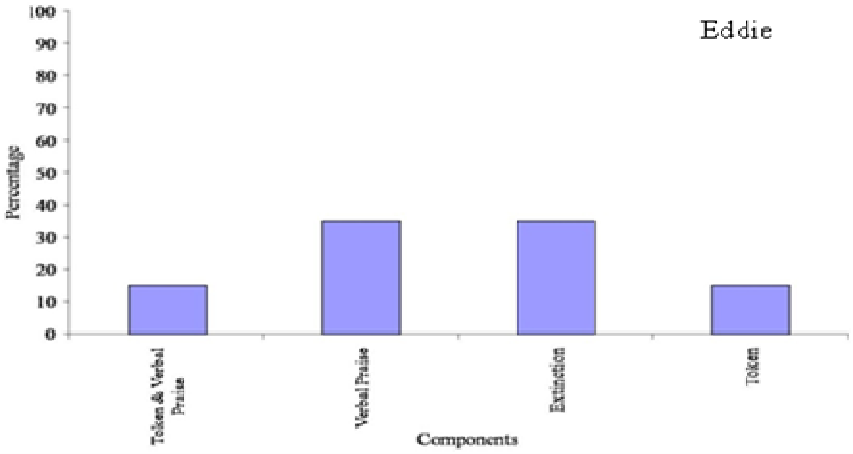
Percentage
Token & Verbal Praise
Verbal Praise
Extinction
Token
Components


Eddie
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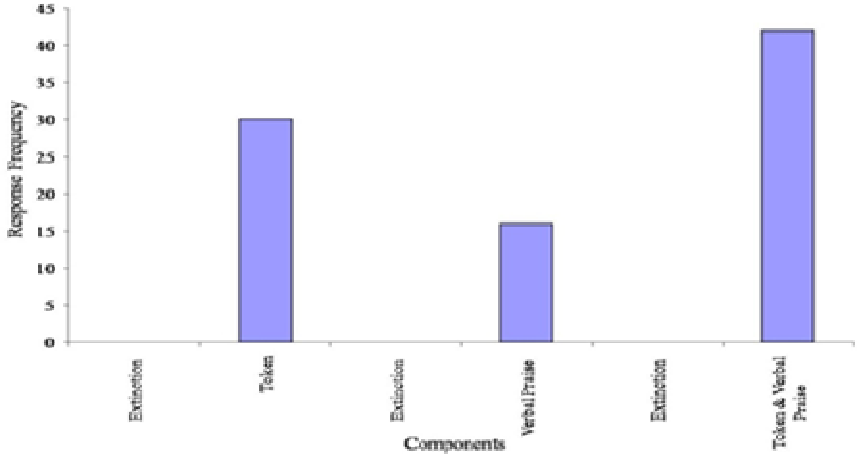
Percentage
Token & Verbal Praise
Verbal Praise
Extinction
Token
Components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Response Frequency
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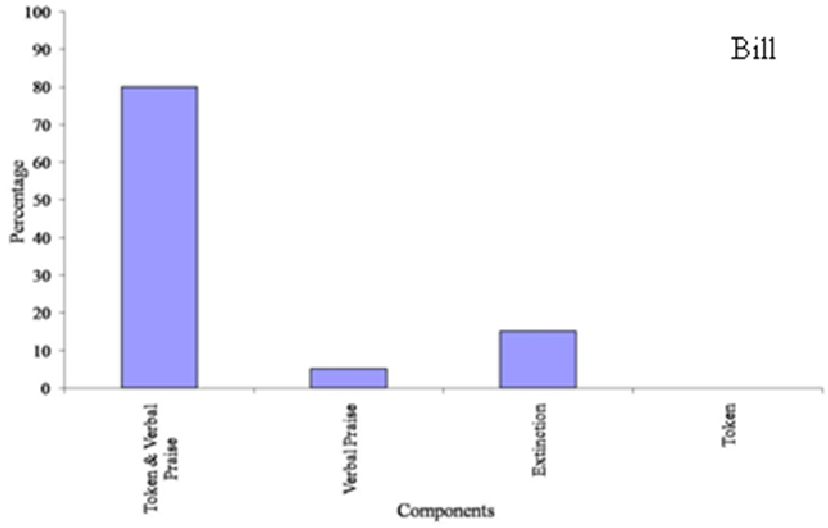
Extinction
Verbal Praise
Extinction
Token & Verbal Praise
Components


Bill
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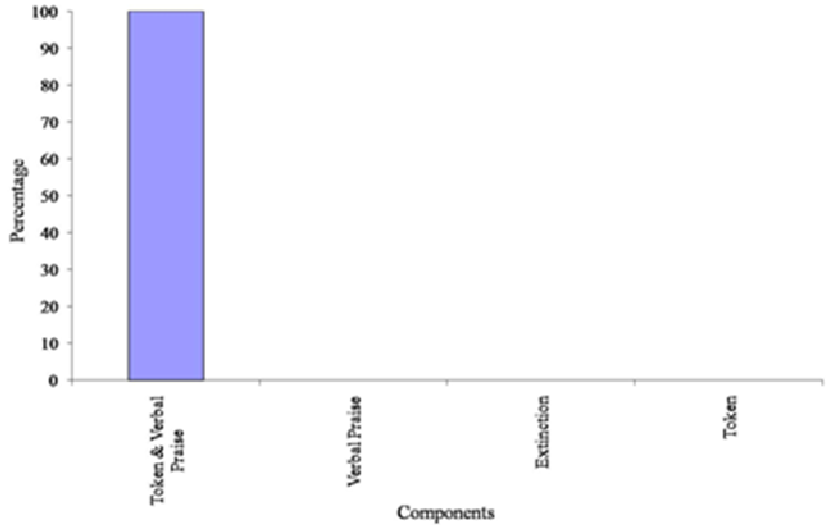
Token & Verbal Praise
Verbal Praise
Extinction
Token
Components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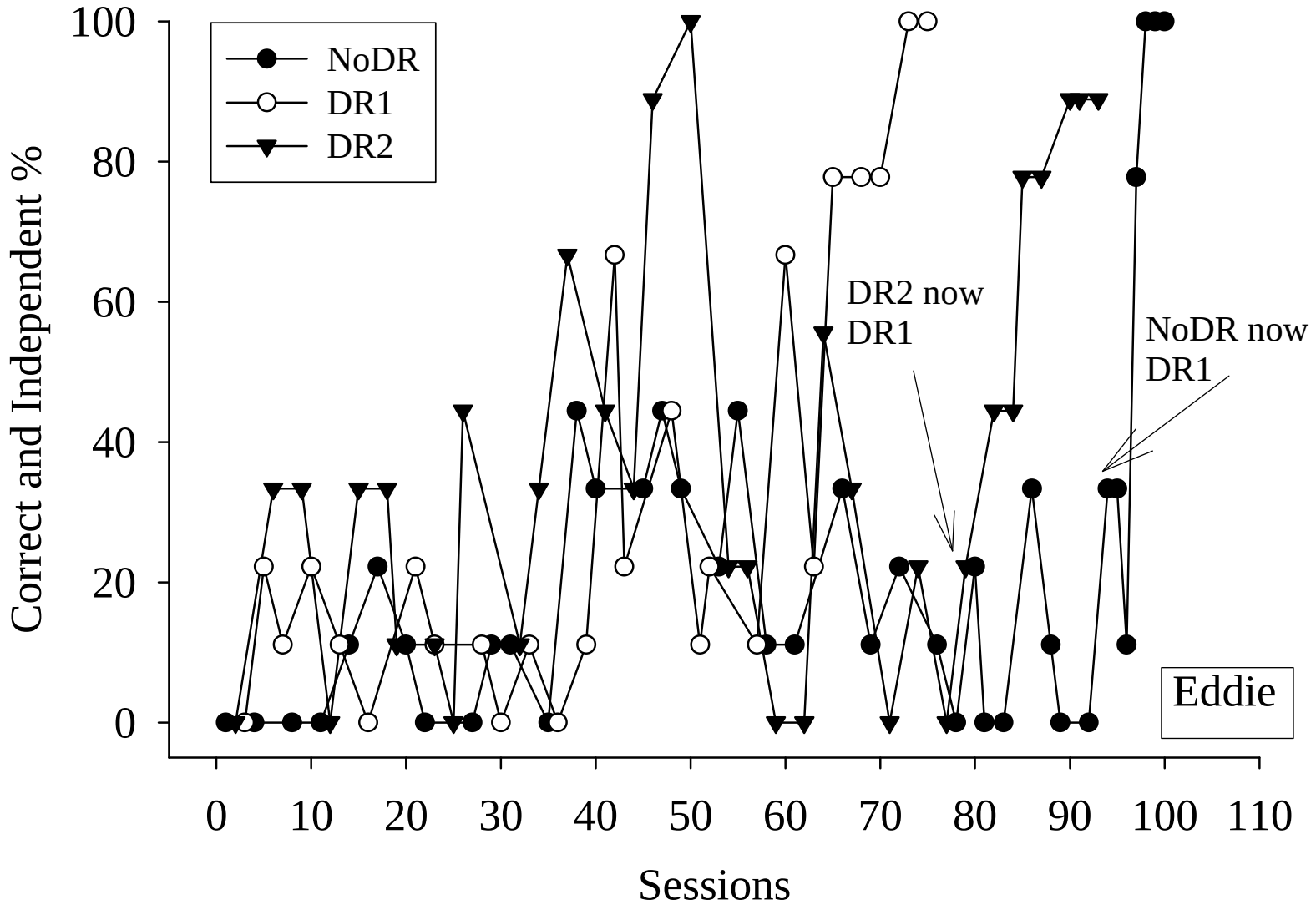
Token & Verbal Praise
Verbal Praise
Extinction
Token
Components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DR1
DR2
DR2 now
DR1
NoDR now
DR1
Eddie
Correct and Independent %
Sessions
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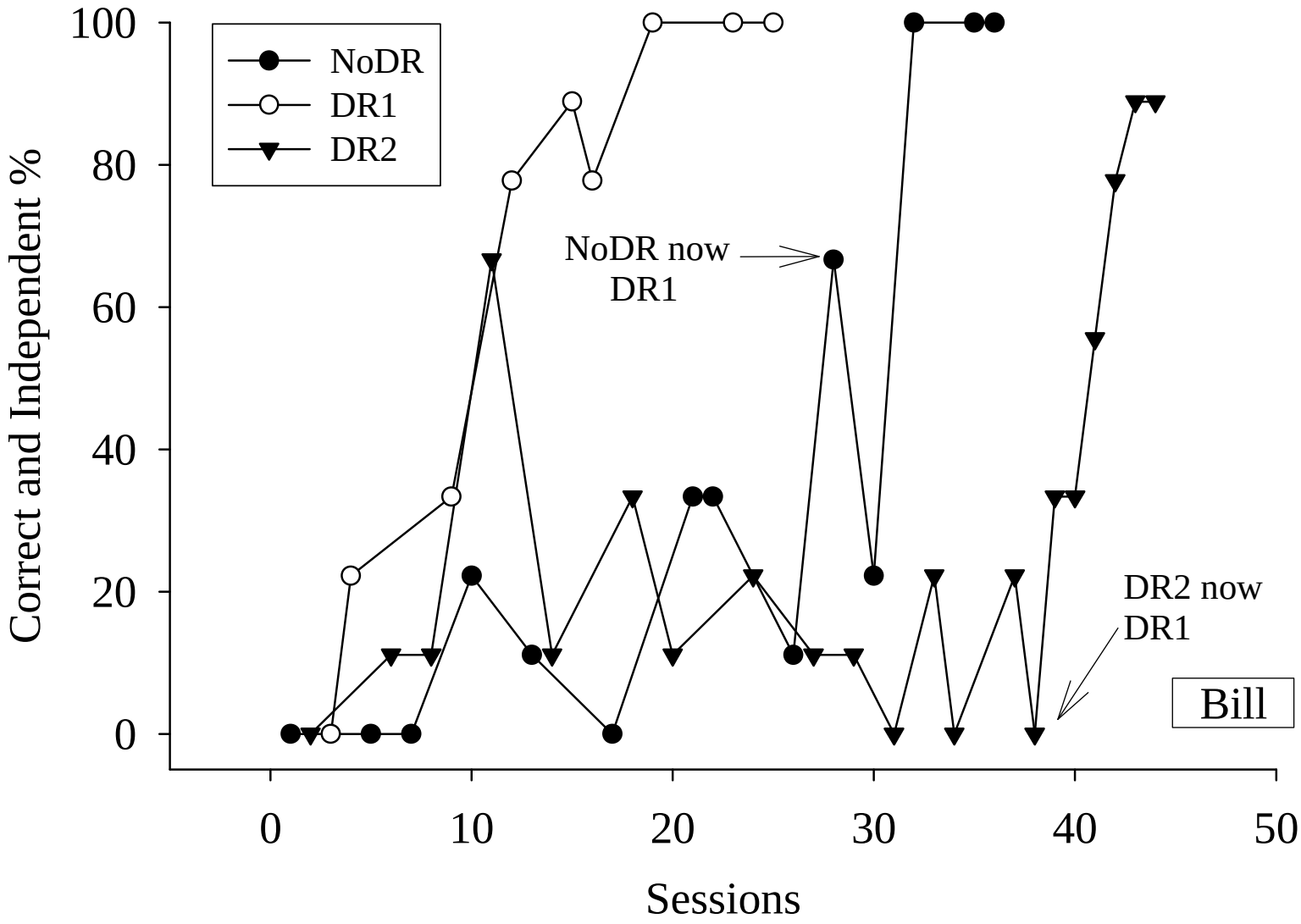
100
110


100
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Correct and Independent %
NoDR
DR1
DR2
NoDR now
DR1
DR2 now
DR1
Bill
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20
30
40
50
Sessions