Michigan Autism Training Video Treatment Manual:
Differential Reinforcement
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Suggested Reference
# Differential Reinforcement

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Differential Reinforcement

A. Brief Description of Differential Reinforcement

B. Purpose and Appropriate Use of Differential Reinforcement

The two most widely used variations of differential reinforcement are differential reinforcement of other behavior (DRO) and differential reinforcement of alternative behavior (DRA). Other variations include differential reinforcement of low rate behavior (DRL), differential reinforcement of high rate behavior (DRH), and differential reinforcement of successive approximations to a terminal response (most commonly known as shaping). Each of these variants is described below along with examples.

B. 1. Differential Reinforcement of Other Behavior- DRO

Involves delivery of a reinforcer contingent on the omission of problem behavior for a pre-designated interval of time. For example, a five-minute DRO would be in place if an individual with attention-maintained self-injurious behavior (SIB) receives a reinforcer (in the case of attention maintained SIB the reinforcer would usually be attention) after going five minutes without SIB (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). Although this re-setting variation of DRO is most common, another variation is whole interval DRO, in which a reinforcer is lost for that interval if the target behavior occurs at any time during that interval (Repp, Deitz, & Deitz, 1976; Repp, Deitz, & Speir, 1974). A third variation is momentary DRO, in which a reinforcer is delivered at a scheduled time if the target behavior is not occurring at that specific moment (Vollmer, Ringdahl, Roane, & Marcus, 1997). This third variation is sometimes used in lieu of a fixed time (FT) schedule to avoid accidental reinforcement of the target response while maintaining the ease of a delivery schedule because behavior does not need to be observed throughout the entire interval.

B. 2. Differential Reinforcement of Alternative Behavior- DRA

Involves delivery of a reinforcer contingent on the commission of some specific alternative response(s), while minimizing reinforcement of problem behavior (preferably via extinction). For example, an individual with aggression maintained by access to food would be given food by handing an adult a picture card or by engaging in some other type of appropriate communication, but would not gain access to food via aggression (e.g., Vollmer, Borrero, Lalli, & Daniel, 1999). One type of DRA is known as functional communication training, in which the alternative response is some type of communicative response that is reinforced in order to functionally replace problem behavior (Carr & Durand, 1985). If the alternative adaptive response is not currently in the individual’s repertoire, a shaping procedure can be used. The procedure is shapes replacement skills by delivering a reinforcer when a closer approximation to the terminal response occurs while simultaneously placing previous approximations on extinction.
The first step in the case of either DRO or DRA is to identify the reinforcer(s) maintaining problem behavior via functional analysis. When the reinforcer(s) are identified, they are initially applied on a rich schedule contingent on appropriate behavior (DRA) or contingent on the nonoccurrence of behavior (DRO). Reinforcement of the problem behavior is ideally eliminated via extinction (although difficulties inherent to extinction will be discussed shortly). Finally, the reinforcement schedule is gradually thinned to a point where it becomes manageable in a home, work, or school environment.

The methods most commonly used to thin the reinforcement schedule in DRO include: a) the interresponse time (IRT) adjusting method, b) the proportional method, and c) the fixed unit method. In the IRT adjusting method, the initial DRO interval is based on the IRT from baseline (pre-treatment). Then, as behavior rates decrease, the IRT by definition increases and the new DRO interval thereby increases. In the proportional method, as behavior rates achieve a pre-established goal, the DRO interval is increased by some pre-established proportion, such as 50%. For example, suppose the initial DRO interval is 1 minute and the goal is to decrease target behavior by 80% for three consecutive days. Once this goal has been met, the therapist might add 30 seconds to the DRO interval (50%) and therefore the new interval would be 1 minute and 30 seconds. In the fixed unit method, the therapist adds a set amount of time to the DRO interval each time the therapeutic goal is met. For example, the DRO interval might increase by 20 seconds every time the goal is obtained and the unit is not based on a percentage of the previous interval.

An effective method for thinning the reinforcement schedule in DRA involves using signaled periods in which reinforcement is or is not available (Hanley, Iwata, & Thompson, 2001). The time interval signaling that reinforcement is unavailable is gradually increased as the individual learns to “tolerate” longer delays to reinforcement. For example, a parent or teacher might show the individual a green card to indicate that they are available to provide attention and a red card to indicate that they are unavailable to provide attention.

Another solution may be to use DRA, because DRA pits two ratio schedules against one another. Basic research has shown for many years that responding is allocated almost exclusively to the richer ratio schedule; thus, even at treatment integrity levels as low as 55% would favor response allocation to appropriate behavior (Vollmer, Roane, Ringdahl, & Marcus, 1999). As a result, DRA is generally favored over DRO due to a more hearty resistance to treatment integrity failures.

**B. 3. Differential Reinforcement of Low Rates- DRL**

Involves delivery of a reinforcer when a response occurs after an interresponse time of greater than X, where X is a pre-designated time value. This type of schedule is used when behavior is only problematic when it occurs too often. For example, an individual
with disabilities might eat too rapidly and hence endanger their health. By using DRL, the individual would only be allowed to complete a bite if it had been X seconds since the previous bite (Wright & Vollmer, 2002).

B. 4. Differential Reinforcement of High Rates- DRH

Involves delivery of a reinforcer when a set number of responses is completed during a pre-designated interval of time. This type of schedule is used when behavior is only problematic when it occurs too slowly. For example, a teacher might require a student to complete 50 math problems in 30 minutes in order to earn extra recess time.

C. Applicability

Most of the research on differential reinforcement has been conducted with individuals who are intellectually disabled or who have been diagnosed with autism spectrum disorder. Most commonly, the target behavior in such studies is some form of destructive behavior such as SIB, aggression, or destruction of property (Vollmer & Iwata, 1992). In some cases, differential reinforcement is used as treatment for less dangerous behavior such as tantrums (Vollmer, Northup, Ringdahl, LeBlanc, & Chauvin, 1996), and nighttime waking (France & Hudson, 1990), among other topographies. In fact, the procedures have been demonstrated to be effective across a wide range of human and nonhuman animal subjects. The efficacy of differential reinforcement is regarded as a fundamental principle of behavior analysis. The procedure is applicable to typically developing children (Kellam, Ling, Merisca, Brown, & Ialongo, 1994), adults in the workplace (Austin, Weatherly, & Gravina, 2005; Johnson & Fawcett 1994), domestic animals such as pet dogs (Dorey, Tobias, Udell, & Wynne, 2012), zoo animals (Dorey, Rosales-Ruiz, Smith, & Lovelace, 2009), elderly individuals with and without dementia (Trahan, Donaldson, McNabney, & Kahng, 2014), and so on.

D. Treatment Validity and Treatment Matching

Differential reinforcement is identified as a viable treatment for behavior disorders not by the topography or form of the behavior disorder, but by the function of the behavior disorder. Most commonly, when the reinforcer for problem behavior is identified via functional analysis, that same reinforcer or type of reinforcer is used as the reinforcer to strengthen other or alternative behavior. Thus, if problem behavior is maintained by positive reinforcement, differential positive reinforcement is used. If problem behavior is maintained by negative reinforcement, differential negative reinforcement is used. With that said, there has been some recent evidence that using differential positive reinforcement is effective for the treatment of negatively reinforced escape behavior (Mevers, Fisher, Kelley, & Fredrick, 2014; Slocum & Vollmer, in press). The presumed mechanisms underlying the efficacy of differential positive reinforcement as treatment for escape behavior include a) competing schedules of reinforcement that outweigh the schedule of reinforcement for escape behavior, and b) the positive reinforcement reduces the establishing operation for escape behavior by essentially making the instructional context more pleasant.
E. Recommended Personnel and the Role of Caregivers

The behavioral caregiver training literature has shown that differential reinforcement can be taught to caregivers of all sorts including parents, teachers, siblings, and staff (Marcus, Swanson, & Vollmer, 2001; Vollmer, Marcus, & LeBlanc, 1994; Shore, Iwata, Vollmer, Lerman, & Zarcone, 1993). Usually, an initial functional analysis would be conducted by a professional behavior analyst. However, once a successful differential reinforcement procedure is evaluated and tailored to the individual client, caregivers are taught to implement the procedures in the natural environment using behavioral skills training and competency based training. Behavioral skills training involves didactic instruction, role play, modeling and feedback. Competency-based training involves ensuring that the caregiver demonstrates sufficient implementation integrity prior to completion of the training protocol.

Basic research has shown for many years that responding is allocated almost exclusively to the richer ratio schedule; thus, even at treatment integrity levels as low as 55% would favor response allocation to appropriate behavior (Vollmer, Roane, Ringdahl, & Marcus, 1999). As a result, DRA is generally favored over DRO due to a more hearty resistance to treatment integrity failures.

If these implementation percentages remain high and problem behavior remains low, no booster training is needed. If integrity levels slip below previous levels and behavior begins to deteriorate, it is likely that booster training is needed. Booster training is usually an abbreviated version of the initial behavioral skills training and competency-based training.

If problem behavior rates increase even though treatment implementation integrity remains good, it is possible that some new variable is influencing problem behavior. Practitioners implementing differential reinforcement should recognize that behavioral function sometimes changes over time (Lerman, Iwata, Smith, Zarcone, & Vollmer, 1994). When this happens, the reinforcer(s) used in the treatment procedure may need to be adjusted. Thus, an occasional re-test of the functional analysis can be useful if the effects of the procedure begin to break down even when good integrity remains in place. Other variables to consider include new medical complications (as discussed above or possibly intermittent reinforcement inadvertently delivered in a context outside of the observational session. This latter problem might be addressed by conducting observations in multiple settings and at various times of the day.

F. Challenges and Troubleshooting

Because differential reinforcement is commonly used to treat destructive behavior, collaboration with medical personnel is recommended. This recommendation is made for at least three reasons. One, session termination criteria should be established for the functional analysis, baseline, and early stages of treatment (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). Medical personnel are better suited to judge when some form of behavior, such as SIB, is too dangerous. Two, medical variables may function as causal variables in some cases, such as skin allergies (self-scratching), ear infections (ear hitting), tooth infections (mouth or jaw hitting) (Cataldo & Harris, 1982). Three, medical variables may interact with environmental variables producing maintained responding. For example, if someone is not feeling well and they have no
appropriate means of describing their illness, they may engage in aberrant escape behavior in situations when they normally would not.

Another precaution in the use of differential reinforcement is that the extinction component is sometimes difficult if not impossible to implement. Because extinction is a critical feature of differential reinforcement, the absence of extinction can compromise the procedure’s efficacy. There are several reasons why extinction might be difficult or impossible, but a few will be listed here. One, if problem behavior is maintained by attention in the form of physical contact, some aggression and SIB might need to be physically interrupted for legal and/or ethical reasons. For example, a teacher could not allow a student to aggress toward other students and a caregiver may be required to block self-injurious blows to the eyes in order to protect a client’s vision. Two, if the behavior is automatically reinforced (i.e., reinforced without social mediation) it may be difficult to identify the specific source of reinforcement and even if it could be identified that source of reinforcement may be difficult to eliminate because it is produced directly by the behavior itself. Three, if problem behavior is maintained by escape, the individual may be stronger or faster than the therapist, who is then unable to continue the instructional activity. To address these problems related to the use of extinction, differential reinforcement can be arranged such that reinforcement is greater along dimensions other than probability, such as quality, immediacy, and magnitude (Athens & Vollmer, 2010). For example, a teacher might minimize attention when blocking aggression by not talking to the student, but then would maximize reinforcement for appropriate requests for attention by chatting with the student, inviting the student to sit near the teacher, giving high fives, and so on.

Another challenge to differential reinforcement procedures is treatment integrity. The behavior analyst would typically measure the percentage of correct caregiver responses to appropriate behavior and correct caregiver responses to inappropriate behavior (along with measurement of the target individual’s behavior). Follow up observations should be frequent initially but can become gradually less frequent as the behavior continues to improve in the natural setting. DRO procedures are highly sensitive to treatment integrity failures. Caregivers must continue to implement the procedures with sufficient fidelity to ensure sustained efficacy. For example, if a therapist accidentally reinforces the target response just one out of every twenty times it occurs, the behavior is reinforced on a variable ratio 20 schedule, even though treatment integrity is at 95%. Thus, it would be more efficient for the individual to continue engaging in problem behavior. Another solution may be to use DRA, because DRA pits two ratio schedules against one another.

There are two main alternatives to differential reinforcement, noncontingent reinforcement (NCR) and differential reinforcement plus punishment. NCR involves initially eliminating the establishing operation for problem behavior by providing continuous free access to the reinforcer and then gradually thinning the schedule of free reinforcers (Vollmer et al., 1993). For example, if problem behavior is maintained by attention, the treatment involves providing continuous attention in order to stop the behavior immediately, and then gradually thinning the schedule to a fixed-time (FT) schedule that is more practical (such as FT 5 minutes or FT 10 minutes).
At times punishment contingencies are superimposed on differential reinforcement contingencies in order to further suppress problem behavior and to allow occasions to reinforce appropriate behavior (Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998). For example, the appropriate alternative behavior would produce the functional reinforcement, just as in a typical DRA procedure, but the problem behavior would encounter some aversive consequence such as a basket hold, reprimand, or token loss.

G. Task Analyses and Other Materials

- Appendix A: Differential Reinforcement Sequence
Appendix A

DIFFERENTIAL REINFORCEMENT SEQUENCE

PROCEDURE: There is no established task analysis for implementing differential reinforcement as treatment, but based on empirical evidence the following general sequence is recommended.

1. Conduct a functional analysis to identify reinforcer(s) maintaining the problem behavior.

2. Choose an initial reinforcement schedule. For DRO this is usually based on the inter-response time prior to treatment. For DRA this is usually as rich a schedule as possible, such as FR1.

3. Select a schedule thinning strategy. For DRO, this is either IRT adjusting, proportional adjustments, or fixed increments. For DRA, this is usually done via signaled reinforcement availability and unavailability periods with the unavailability period increased to a practical interval given family, classroom, or work setting constraints.

4. Implement competency based training via behavioral skills training to all caregivers. Or, select key caregivers and not only train them to implement procedures, but train them to train others (i.e., pyramidal training).

5. Conduct follow up observations and make adjustments as necessary.
References


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