DIFFERENTIAL REINFORCEMENT AS TREATMENT FOR PROBLEM BEHAVIOR MAINTAINED BY AUTOMATIC REINFORCEMENT. A REVIEW OF THE LITERATURE: 2015-2020

by

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(Under the Direction of Joel Ringdahl)

ABSTRACT

Automatically reinforced problem behavior is challenging in finding an effective treatment. The purpose of this literature review is to evaluate the effectiveness of differential reinforcement as treatment for problem behavior maintained by automatic reinforcement. A search of the literature published from 2015 to 2020 resulted in 15 articles with 37 applications being included in this review. Differential reinforcement alone as treatment was efficacious in 2 out of 15 studies, while the other 13 studies used differential reinforcement plus additional components as a treatment package and demonstrated promising treatment outcomes. Results from this study showed that there are several high-quality studies, but also a wide variation in study quality, thus, additional high-quality studies are needed regarding this subject to draw a more comprehensive conclusion.

INDEX WORDS: automatic reinforcement, differential reinforcement, stereotypy, SIB, pica.

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CHAPTER 1

INTRODUCTION

Individuals who exhibit problem behavior maintained by automatic reinforcement are difficult to identify effective treatments due to the challenge of finding a competing stimulus with the reinforcement produced by the problem behavior. Automatically reinforced behavior poses more unique obstacles to researchers and practitioners than problem behaviors that are maintained by social reinforcement, because it is often impossible to separate the reinforcer from the problem behavior itself (Vollmer, 1994). That is, extinction can be difficult, if not impossible, to implement.

Researchers evaluated the effectiveness of various assessments and interventions in treating problem behavior maintained by automatic reinforcement (Iwata et al., 1994; LeBlanc et al., 2000). A few reinforcement-based treatments as well as treatment packages that combine reinforcement-based with punishment strategies have demonstrated their effectiveness (Rooker et al., 2018). Commonly used reinforcement-based treatments for targeting automatically maintained problem behaviors include noncontingent reinforcement (NCR) and differential reinforcement. Differential reinforcement implies withholding reinforcers for target behavior while providing reinforcers for appropriate behaviors. Several differential reinforcement programs exist, including differential reinforcement of other behaviors (DRO), differential reinforcement of alternative behavior (DRA), differential reinforcement of low rates of behavior (DRL), and differential reinforcement of incompatible behavior (DRI).

Rooker et al. (2018) reviewed the literature regarding treatments for automatically reinforced self-injurious behaviors (SIB). Considering that SIB is the most frequently known topography within problem behaviors that are maintained by automatic reinforcement, Rooker and colleagues evaluated both effective and ineffective treatments in the literature from 1982 to 2015. They found that NCR was the most widely implemented treatment component in treating automatically reinforced SIB. In addition, Rooker et al. (2018) found that the preference assessment prior to conducting the treatment was crucial, and that by using a competing stimulus assessment (CSA) as opposed to a regular preference assessment improved the effectiveness of treatment. Rooker and colleagues also found that although NCR was the most effective reinforcement-alone treatment, DRO and DRA were both demonstrated to be more effective than NCR when grouped with other components in a treatment package. Overall, Rooker et al. (2018) found that automatically reinforced SIB is more resistant to consequence-based reinforcement treatments, such as DRO and DRA. Rooker et al. (2018) reviewed literature that consisted of treatments for automatically reinforced SIB solely, therefore, that leaves an opportunity for this paper to extend the literature by expanding the category of topography of automatically maintained problem behavior not limited to SIB. In addition, Rooker and colleagues evaluated articles up until the year 2015, therefore, this review continues the search and gaps research to the current year 2020.

Gover et al. (2019) also conducted a literature review regarding treatments for problem behavior maintained by automatic reinforcement through analyzing environmental enrichment, or NCR, as an intervention. Gover and colleagues discovered that environmental enrichment as the only component in a treatment for automatically maintained problem behavior is with moderate effect in reducing problem behavior, however, when combined with other

manipulations interventions such as prompting and blocking, environmental enrichment was shown with increased efficacy. Different from Rooker et al. (2018), Gover and colleagues included all types of automatically maintained problem behavior, instead of restricting to only SIB. This opens up opportunity for this study to investigate another reinforcement-based intervention, differential reinforcement, for treating problem behavior that are maintained automatic reinforcement.

Similar to environmental enrichment as a treatment, NCR has also been researched as a commonly used treatment for problem behavior maintained by automatic reinforcement. Carr et al. (2009) demonstrated that NCR without extinction yielded positive effects on reducing automatically reinforced target problem behavior, and after schedule thinning was applied to the treatment, positive intervention outcomes remained. They found that the combination of fixed time interval reinforcer delivery, extinction, and schedule thinning to be an effective intervention. Carr and colleagues limited the inclusion criteria to be only for those studies that have conducted a functional analysis demonstrating that NCR was used as a function-based treatment, but the excluded studies also showed the effectiveness of NCR as a treatment for problem behavior, which further indicated that NCR produced consistent positive results in treating problem behavior of individuals with developmental disabilities.

The literature review conducted by Rapp and Vollmer (2005) surrounding assessment and treatment for stereotypy found that the evaluation of the previous research suggested that most stereotypy was maintained by automatic reinforcement, either automatic positive reinforcement or automatic negative reinforcement. Rapp and Vollmer (2005) found that several antecedent manipulations strategies such as environmental enrichment, and consequence manipulations interventions such as differential reinforcement and/or punishment, were all

effective treatments for reducing automatically reinforced stereotypy. The treatment effects on the untargeted stereotypy, however, were observed to go at counter-therapeutic direction when the target stereotypy response was decreased.

Despite all the research and literature reviews conducted regarding the topic of evaluating treatments for problem behavior that are maintained by automatic reinforcement, there is limited literature reviews carried out specifically concerning differential reinforcement as treatment for automatically reinforced problem behavior. Thus, the purpose of this study is to investigate the effectiveness of differential reinforcement either as a treatment by itself or combined with other procedures in an intervention package for treating automatically maintained problem behavior of all forms through reviewing studies published in the last 5 years. Additionally, the quality and rigor of the studies, and the different factors that may impact the effectiveness of differential reinforcement as a treatment were analyzed.

CHAPTER 2

METHODS

Search terms

A search of the literature was conducted from the University of Georgia libraries limiting the published years between 2015 and 2020 using the following search terms: “automatic reinforcement AND differential reinforcement,” “automatically maintained AND differential reinforcement,” “automatically reinforced AND differential reinforcement,” “self-injur* AND differential reinforcement,” “stereotypy AND differential reinforcement,” and “pica AND differential reinforcement.” The initial search resulted in identifying 130 articles, but after duplicates were removed, the criteria scholarly peer-reviewed article was selected, and title and abstracts were reviewed, 21 articles remained for coding. The article identification process was organized through Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart, a basis for reporting systematic reviews on treatment evaluations (Moher et al., 2009).

Inclusion Criteria

The first basic inclusion criterion is that articles being scholarly peer-reviewed articles published in academic journals, thus books and dissertations were the first ones being excluded from the search. Next, articles that are either meta-analysis or systematic reviews were also excluded from the study because this paper aims to evaluate original research studies that consist of single case designs.

The articles were reviewed and included if both differential reinforcement and automatic reinforcement were used as crucial components of the articles, therefore, the ones with only automatic reinforcement or differential reinforcement were excluded.

An important inclusion criterion was that the participants' target behavior was demonstrated to exhibit an automatic function through a pre-treatment assessment, including any type of functional analysis (FA; Iwata et al., 1982/1994) or extended no-interaction sessions (Querim et al., 2013). FA has different types, such as traditional FA, brief FA, trial-based FA, and any of these types are acceptable for determining the function of the target problem behaviors through manipulating the environment to set up contingencies that would evoke and assess problem behavior. Articles that did not conduct a pre-treatment FA (regardless of FA format) were excluded. For example, if the study only relied on a caregiver interview for information on the function of client's problem behavior, the article was excluded from this review.

Another criterion for inclusion is that differential reinforcement being a part of treatment for problem behavior maintained by automatic reinforcement. Differential reinforcement may be combined with other strategies to form a treatment package, but the articles that included differential reinforcement in the assessment process did not meet the inclusion criteria.

Coding Variables

The selected articles were coded in three general categories: setting/participants characteristics, research design validity, and treatment characteristics. Within setting/participants characteristics, articles were analyzed for the participants' age, gender, diagnosis, target problem behavior topography, therapist, and settings. Therapist of the sessions could be the staff members from an outpatient clinic, or the participant's teachers, or the caregivers of the participant.

Research design validity component of coding was evaluated using the Single-Case Analysis and Review Framework (SCARF; Ledford et al., 2016). Rigor, quality, and treatment outcomes were assessed for each single-case design within each article. For example, if the article has a multiple-baseline across participants design, then the three participants would be evaluated separately in three rows, however, if the study only involves a single participant with A-B-A-B design, then the study could be evaluated on a single row. SCARF seeks to investigate whether the study can be replicated with the participants, settings, and therapists who exhibit the same characteristics and result in similar treatment outcomes. The scores 0-4 were coded for each design with visual analysis by each reader, and the overall quality and rigor score 0-4 was assessed for all the included articles as a whole. Generalization and maintenance were also evaluated using SCARF.

Treatment characteristics intend to code the type of interventions for problem behavior that are maintained by automatic reinforcement. Different treatment characteristics include the types of differential reinforcement interventions used by itself or combined with other interventions that are proven to be effective in treating automatically maintained problem behavior, such as NCR, and punishment-based strategies such as response blocking, response interruption and redirection. Another important treatment characteristic is the type of pre-treatment assessment used in each study, which shows how the automatic function is demonstrated, whether by conducting a functional analysis or extended-ignore sessions.

CHAPTER 3

RESULTS

The search and inclusion criteria resulted in 15 articles being included in this review. Within those studies, there are 35 participants overall. Table 1 shows the inclusion process for the article selection, many studies were excluded due to failing to meet the requirement of including both differential reinforcement and automatic reinforcement as main components in the paper. In addition, several articles were excluded because they did not conduct a pre-treatment assessment to assess the function of the target problem behavior. One article was excluded because although it contained differential reinforcement as a component of the treatment package, it only appeared in the NCR treatment contingency manipulations. Another article was excluded due to the reason that differential reinforcement was not applied in the treatment phase, but instead, it was used during the preference assessment.

Journals

The articles included in this review were published in seven different academic journals. (see Table 2). More than a third of the studies were published in *Behavior Interventions*, and following that, about a quarter of the articles were published in the *Journal of Applied Behavior Analysis*. Although the number of articles met the inclusion criteria is not large, the results still demonstrated that these two academic journals publish the most articles on evidence-based interventions for treating problem behavior. These results also align with the findings from Gover et al. (2019) that *Journal of Applied Behavior Analysis* and *Behavior Interventions* being

the top two journals that had significantly a greater number of publications than any other journals.

Settings/participants Characteristics

The general population characteristics were evaluated to see if there is a certain pattern associated with using differential reinforcement to treat problem behaviors that are maintained by automatic reinforcement. Table 3 displays the summary of the characteristics from analyzing different variables within the categories. The review included 25 male and 10 female participants from the 15 included articles. Nearly three quarters of the participants were males, which is also consistent with the statistics of the population of individuals with Autism Spectrum Disorder (ASD). Results showed that 88.6% of the participants were at or under the age of 15 years, suggesting that the interventions are most likely to yield similar outcomes with young children and teens. A majority of the participants had a diagnosis of autism spectrum disorder, and in addition to the 24 participants who had a single ASD diagnosis, many of the eight individuals who possessed multiple diagnosis had ASD and ID.

The most common form of target problem behavior from the studies was stereotypy (63.9%) with SIB (16.7%) and pica (16.7%) making up a smaller portion of the included literature. One participant from a study engaged in both pica and property destruction were targeted in the intervention. The most commonly used setting from all the included studies was school/residential school/specialized school (34.3% of the participants). Combined with the home settings, almost half of the participants' (48.6%) interventions were conducted either at their schools (34.3%) or homes (14.3%). About 40% of the participants received their treatments at a clinic or a hospital setting. The most common interventionist was the therapists (82.9% of the participants), including people who work at clinics, hospitals, or the schools. One of the

participants' sessions were implemented by the participant's father, with a consultant who is a Board Certified Behavior Analyst (BCBA) with at least two years of experience present at all sessions coaching the father and providing feedback. In addition, another two participants' sessions were conducted by multiple therapists, either by the mother of the participant and a BCBA or with a staff member from the clinic. Parent training was conducted before caregivers implemented the sessions.

Quality and Rigor

The results from the SCARF evaluation of single-case designs are displayed in Figure 1. Each data point represents one design within a study. The top graph is the visual analysis for overall study quality and rigor, and middle graph is the quality and rigor of maintenance measurement, and the bottom graph is the quality and rigor for generalization measurement. As demonstrated in the graph, the further on the x-axis the higher the quality and rigor of the design, and the further on the y-axis the higher the positive effects of the treatment outcomes.

The second quadrant demonstrated the highest quality and rigor of studies with strongest positive effects in interventions (N =13), with another 5 designs on the line between the first and second quadrant, indicating the designs had moderate quality and rigor, but strong positive effects. The fourth quadrant indicates the studies that are high quality but have minimal positive effects or negative effects (N = 2). Quadrant one displays designs with low quality and rigor but strong positive effects on treatment outcomes (N = 10). Lastly, quadrant three indicates studies that have low quality and negative effects or minimal positive effects (N = 4).

The middle graph in Figure 1 indicates the overall quality and rigor of maintenance measurement. The second quadrant demonstrates studies with high quality and strong positive intervention results (N = 2). The fourth quadrant indicates studies with high quality and rigor, but

negative or minimal positive effects of results (N = 0). The first quadrant indicates studies with low quality evidence of positive effects (N = 0). Quadrant three shows studies with low quality evidence of negative or minimal positive effects (N = 10).

The bottom graph in Figure 1 indicates the quality and rigor of generalization measurement for all the studies. The second quadrant indicates studies with high quality evidence of positive treatment outcomes (N = 8). The fourth quadrant shows studies with high quality evidence of negative or minimal positive effects (N = 0). Quadrant one demonstrates studies that have low quality evidence of positive treatment effects (N =0). Lastly, quadrant three indicates studies with low quality evidence of negative or minimal effects (N = 10).

Treatment characteristics

Table 4 displays treatment characteristics for the articles. The most frequently used treatment type described in the reviewed articles was DRA plus punishment (32.4% of total applications). DRA as a treatment on its own in treating automatically reinforced problem behavior was only described for 10% of the treatment analyses conducted. About a quarter of the cases used DRO as a sole intervention strategy, and 16.2% applied DRO plus punishment treatment package to reduce target problem behavior. Four cases evaluated NCR as a treatment first, then added DRO to the intervention. One participant of the studies had self-monitoring plus DRL as a treatment, and interestingly, DRL was not used as a treatment alone in any of the articles that are included in this review. Differential reinforcement strategies combined with a punishment procedure was only conducted when the reinforcement-based intervention did not work, therefore, DRO or DRA plus punishment interventions were preceded by DRO or DRA only interventions, but those were not reflected in Table 4. Overall, differential reinforcement as a component of the treatment package that included a punishment procedure accounted for more

than half of the total applications (59.4%), suggesting that differential reinforcement alone was not sufficient enough to create a major change in reducing problem behavior nor increasing appropriate behavior.

All the included articles met the inclusion criteria of containing a pre-treatment assessment, but they conducted it in different forms. The most common form of pre-treatment assessment was a functional analysis (60% of the participants), and it usually involved four or five conditions to assess the function of a problem behavior. Nearly a third of the applications included a pre-treatment assessment in the form of a series of no-interaction sessions in order to confirm the problem behavior was maintained independent of social consequences, suggesting an automatic function. One participant in a study used a functional behavior assessment to assess and verify the problem behavior was maintained by automatic reinforcement. There were two cases where the participants did not get a functional analysis prior to treatment, that article was still included in the review, because the therapists conducted a functional analysis with the third participant, but with the two participants, QABF was filled out by tutors who had worked with them for more than six months, and the information showed that problem behavior were maintained by automatic reinforcement.

Different types of preference assessments were also coded for each article. The most commonly implemented ones were paired stimulus preference assessment (25.7% of all applications), and multiple preference assessments (25.7%). For the participants who had multiple preference assessments, four of those participants received a free-operant preference assessment and a competing stimulus assessment (CSA) assessment, and the other five participants received paired stimulus preference assessment and CSA. Therefore, all participants who had multiple preference assessments before treatment all included a competing stimulus

assessment. As a result, CSA became the most used type of preference assessment (28.6%). Interestingly, authors did not specify the types of preference assessment they used to identify reinforcers for about 23% of the participants across studies. Of the reinforcers used, 57.1% were preferred non-food stimuli; 22.9% were preferred foods; and 20% included both food and non-food stimuli as reinforcers during pre-treatment assessments and interventions.

CHAPTER 4

DISCUSSION

Rooker et al. (2018) reviewed articles published between 1982 and 2015 describing treatments for SIB maintained by automatic reinforcement. Their review found that automatically reinforced SIB is more resistant to consequence-based reinforcement treatments, such as DRO and DRA relative to NCR; however, when these interventions added additional components to the treatment package, they were more effective than NCR. This literature review expanded the inclusion criteria used by Rooker et al. (i.e., SIB) to include all forms of automatically reinforced problem behavior, not limited to SIB, and specifically focusing on evaluating differential reinforcement as a treatment.

The articles included in this literature review have a wide range of quality and rigor, despite the fact that there are several studies with high quality evidence of positive treatment outcomes. This finding aligns with Rooker et al. (2018) in suggesting that additional high-quality studies are needed in the subject of treatment for problem behavior maintained by automatic reinforcement. An interesting correlation was identified through the SCARF graphs consistent among the overall study quality and rigor, maintenance measurement, as well as generalization measurement, that the higher the quality the stronger the positive treatment outcomes. The correlation suggests that additional high-quality studies are needed, with strong positive treatment results.

From seeing the top graph in Figure 1, I have confidence that some of the studies included in this literature review have great quality and rigor, however, there is a range of quality

noted for the studies on the subject of differential reinforcement as treatment for automatically reinforced problem behavior. There were also 10 designs whose data points demonstrated strong positive treatment outcomes but showed evidence of low quality and rigor. Therefore, the results from those studies should not be interpreted with full confidence. Although a great portion of the studies are of high quality and rigor, additional high-quality studies are needed, because the graph displays a remarkable correlation that higher quality studies tend to associate with greater positive treatment results. The results of the middle graph in Figure 1 indicated that the majority of the studies demonstrated low quality evidence of negative or minimal effects, and with the only two studies that showed positive results for maintenance are both with high quality and rigor. Therefore, I am confident that the treatment outcomes are generally maintained even after treatment was withdrawn, in addition, more high-quality studies are needed, because the graph also demonstrates the relation that the results from higher quality studies have strong maintenance effect. In the bottom graph of Figure 1, given that 8 studies are in the second quadrant, those results can be accepted with confidence, and that generalization is achieved with studies that have high quality evidence of positive outcomes. Several studies are in the second quadrant in the graph, nevertheless, more high-quality measurement of generalization is still needed.

For the cases that were conducted at the clinic or hospital setting suggested that the target behaviors were rather serious. At professional settings, padded rooms and trained staff with appropriate protective equipment are available and can ensure safety of both the clients and the staff. The results showed that nearly half of the total applications (48.6%) were conducted at participants' homes or schools. This finding is promising, because schools and homes are considered the least intrusive environment, and as professionals, we are obligated to conduct

sessions in the least intrusive environment or the participants' natural environment whenever possible. The results were also reassuring in which those cases not only indicated convincing treatment outcomes, in addition, maintenance as well as generalization were both measured and demonstrated meaningful outcomes. This may suggest a possible correlation between studies that are conducted at the participants' natural environments with higher maintenance and generalization confidence. Moreover, by having parents serve as the interventionists pose great social significance because they are the ones who would implement the interventions eventually, and by having the opportunity to practice and get feedback from professionals would help caregivers know what to expect when using the intervention at home. Caregivers would also have the chance to ask for change to the intervention if they notice something that they are not able to do at home.

Differential reinforcement as treatment for problem behavior maintained by automatic reinforcement is suitable across a variety of participants, especially with mainly children and teens who are diagnosed with ASD. In Table 3, although the finding of the number of participants with ASD diagnosis is not surprising, the one article that included three participants diagnosed with down syndrome signifying future research direction that differential reinforcement as a treatment for problem behavior maintained by automatic reinforcement targets at the function of the behavior regardless of diagnosis. Several studies have conducted assessment and/or treatment at participants' homes with caregivers serving as therapists conducting sessions, and success was achieved, in addition, caregivers expressed treatment satisfaction which suggests the treatments had significant social validity. More research is needed in assessments and/or treatments conducted at participants' natural settings with care

providers, because ultimately those individuals are the ones who spend the most times with the participants after clinic-based treatment ends.

Results from this review suggest that differential reinforcement alone as treatment for automatically reinforced problem behavior is generally not effective enough, but when paired with additional components, especially with a punishment procedure, the effectiveness in both reducing problem behavior and increasing appropriate behavior improved greatly. Although most of the studies had to use additional components with differential reinforcement to strengthen the treatment outcome, two studies demonstrated effectiveness in reducing target problem behavior with differential reinforcement only treatment. One of them was targeting SIB, specifically in the topography of nail biting, and the other study had target problem behavior as stereotypy. This finding is significant that it aligns with subtype 1 of automatically reinforced SIB in Hagopian et al. (2015), because subtype 1 is more similar to socially reinforced SIB, therefore, it is more likely to identify a competing stimulus using CSA prior to treatment. This finding also may expand the research because the other study that indicated differential reinforcement alone was sufficient to reduce automatically reinforced stereotypy suggesting that the subtypes discovered in Hagopian et al. (2015) may not be limited to SIB, however, additional research is needed on this subject.

All the included articles consisted of a type of pre-treatment assessment, either a functional analysis or a series of no-interaction sessions to determine or confirm the function of the target problem behavior. Pre-treatment assessments demonstrated to be crucial in predicting the effectiveness of the treatment, especially when using a functional analysis. Hagopian et al. (2015) and Hagopian et al. (2017) discovered that when functional analysis results showed that when target problem behavior solely occurs in the alone/ignore condition, or if the problem

behavior occurs across all conditions in the functional analysis, treatment selection as well as its effectiveness would be different accordingly. If so, there is an advantage for using functional analysis as opposed to conducting a series of no-interaction sessions, because no-interaction sessions only indicate the target problem behavior has automatic function, whereas a functional analysis can visually display the differentiation of levels of problem behavior within each condition. Future research should include whether the automatic function was demonstrated through observing the problem behavior only occurring in the alone condition or across all conditions in the functional analysis and use the results to better predict whether reinforcement-based treatment is sufficient enough in reducing problem behavior.

One limitation to this literature review is the absence of interobserver agreement on both the article identification and the coding process. When two independent observers search on the UGA libraries website using the same search terms and see the degree to which they obtain the same number of articles in each article identification step, and whether they report the same 15 articles that are included in this literature review with the inclusion criteria. In addition, if two independent observers evaluate the coding variables for each included article would detect whether coding variables need to be more clearly defined, thus better determine if the data evaluation results came from the articles instead of data collection and analysis errors. The second limitation to this review is the number of published scholarly peer reviewed articles on this topic was restricted, particularly with the rather strict inclusion criteria. Another limitation is that systematic reviews and meta-analyses were not used for harvesting more articles on the topic, because they were already excluded at the beginning. In addition, the majority of the included articles did not report the procedural fidelity data for both the assessment and treatment process, therefore, it is difficult to have full confidence in trusting the treatment results that came

from those studies. More high-quality studies are needed that focus on investigating differential reinforcement as treatment for automatically maintained problem behavior.

Overall, despite the limitations, differential reinforcement was demonstrated to be a promising treatment for problem behavior that are maintained by automatic reinforcement. Nevertheless, some treatment results from some studies provide conflicting information with each other on whether differential reinforcement as a treatment by itself was adequate or that it needs to combine with other intervention strategies, punishment in particular, in order to reduce the level of target problem behavior to achieve treatment significant outcomes.

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Table 1: PRISMA flowchart

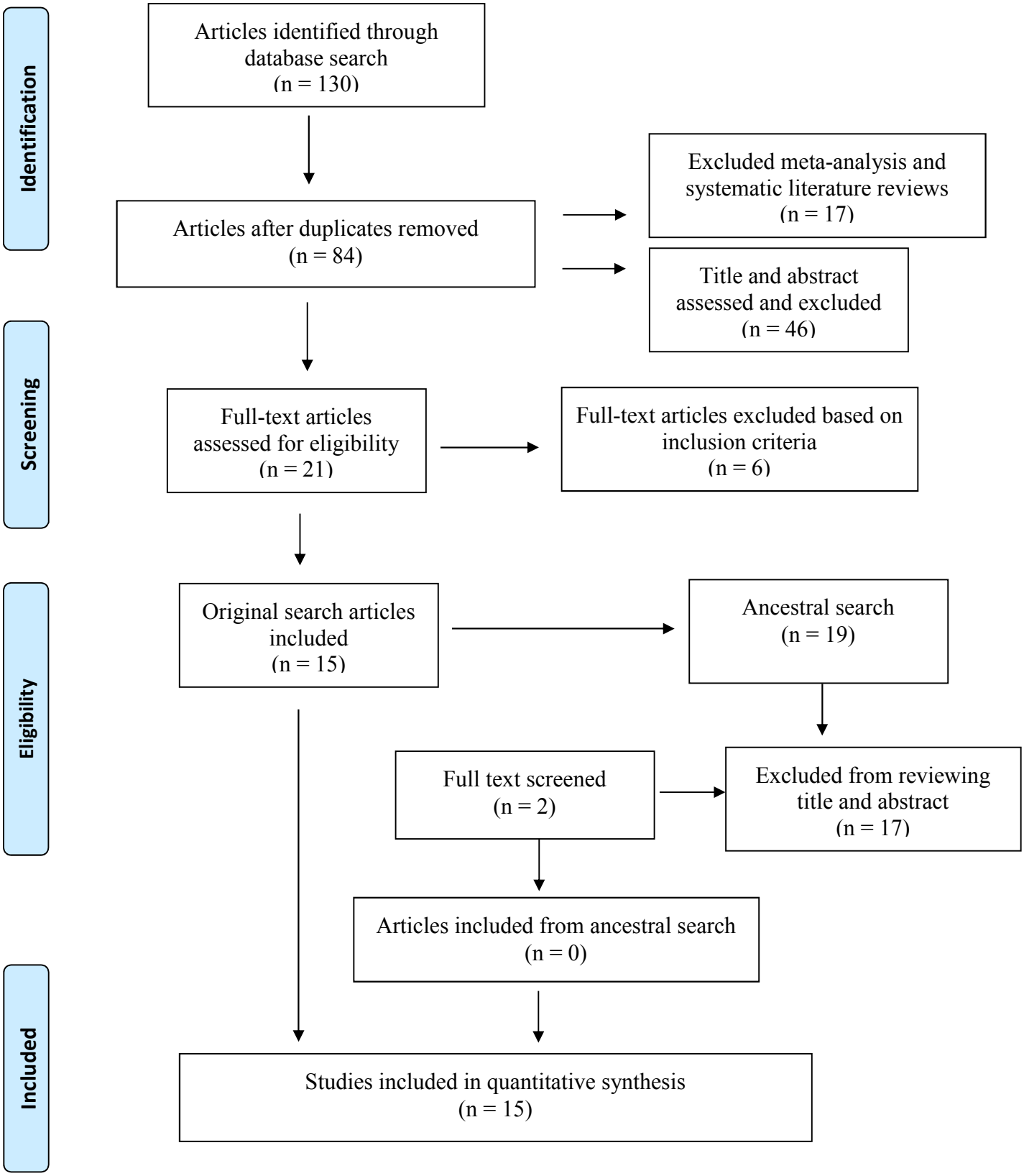


Table 2

Journals (total 15)	n	Percentage
Behavioral Interventions	5	33.3%
Journal of Applied Behavior Analysis	4	26.7%
Journal of Developmental and Physical Disabilities	2	13.3%
Developmental neurorehabilitation	1	6.7%
Behavior Modification	1	6.7%
Behavioral Analysis Practice	1	6.7%
Behavioral Development	1	6.7%

Table 3

General characteristics (total 35)	n	Percentage
Gender		
Male	25	71.4%
Female	10	28.6%
Age		
0-5	10	28.6%
6-10	13	37.1%
11-15	8	22.9%
16-20	2	5.7%
>20	2	5.7%
Diagnosis		
ASD	24	68.6%
Down syndrome	3	8.6%
Multiple (i.e. ASD and ID)	8	22.9%
Target problem behavior (total 36)		
SIB	6	16.7%
Stereotypy	23	63.9%
Pica	6	16.7%
Property destruction	1 (also pica)	2.8%
Setting		
Clinic	6	17.1%
Hospital/inpatient unit	8	22.9%
School/residential school/specialized school	12	34.3%
Home	5	14.3%
Day center	4	11.4%
Interventionist		
Therapist	29	82.9%
Caregiver	1	2.9%
BCBA/BCBA-D	3	8.6%
Multiple (i.e. therapist and caregiver)	2	5.7%

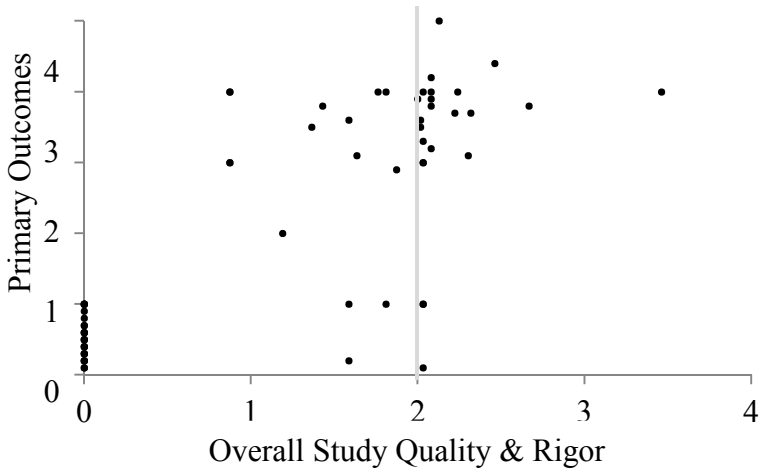
Note. ASD = autism spectrum disorder. ID = intellectual disability. SIB = self-injurious behaviors. BCBA = board certified behavior analyst.

Table 4:

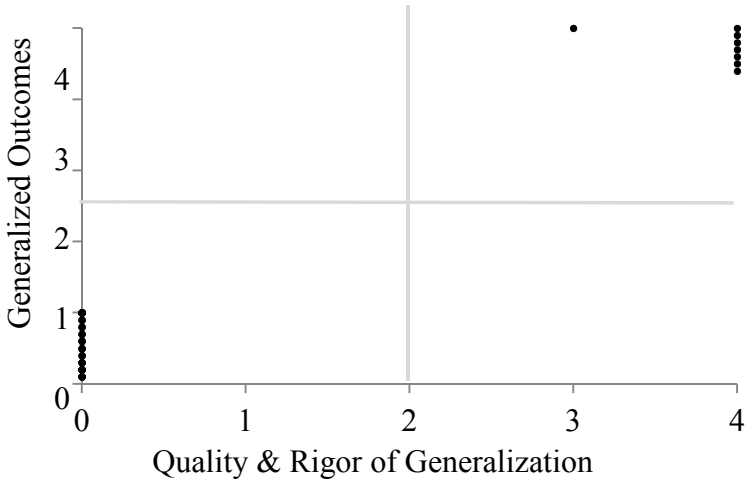
Treatment characteristics	n	Percentage
Differential reinforcement (total 37)		
DRO	10	27%
DRA	4	10.8%
DRO+punishment (i.e. DRO+RI/RIRD)	6	16.2%
DRA+punishment (i.e. DRA+response blocking)	12	32.4%
NCR+DRA+punishment	4	10.8%
Self-monitoring + DRL	1	2.7%
Reinforcer/competing stimulus (total 35)		
Edible	8	22.9%
Tangible	20	57.1%
Multiple	7	20%
Pre-treatment assessment (total 35)		
Functional analysis	21	60%
No-interaction sessions	11	31.4%
Functional behavior assessment	1	2.9%
QABF	2	5.7%
Preference assessment (total 35)		
MSWO	2	5.7%
CSA	1	2.9%
Paired stimulus	9	25.7%
Single stimulus	2	5.7%
Multiple item preference assessment	4	11.4%
Multiple	9	25.7%
Not specified	8	22.9%

Note. DRO = differential reinforcement of other behaviors. DRA = differential reinforcement of an alternative behavior. NCR = noncontingent reinforcement. DRL = differential reinforcement of low rates behavior. RI = response interruption. RIRD = response interruption and redirection. QABF = questions about behavior function. MSWO = multiple stimulus without replacement. CSA = competing stimulus assessment.

Figure 1:


Primary Outcomes
0
1
2
3
4
0
1
2
3
4
Overall Study Quality & Rigor


Maintained Outcomes
0
1
2
3
4
0
1
2
3
4
Quality & Rigor of Maintenance


Generalized Outcomes
0
1
2
3
4
0
1
2
3
4
Quality & Rigor of Generalization