HHS Public Access

Author manuscript

Psychol Rec. Author manuscript; available in PMC 2023 June 01.

Published in final edited form as:

Psychol Rec. 2022 June ; 72(2): 319–323. doi:10.1007/s40732-021-00456-z.

A Brief Review of Expanded-Operant Treatments for Mitigating Resurgence

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Abstract

Resurgence following expanded-operant treatments (i.e., increasing the number or variability of alternative responses to problem behavior) has been the focus of numerous studies over the last five years. Researchers have evaluated several techniques for expanding the operant such as serial-, lag-, and concurrent-training procedures. Given the increasing number of recent studies on the topic, the various forms of training used, and the variability in outcomes, it is critical to review this area of research and identify clear future directions. Our brief review identified 10 published studies and eight unpublished theses or dissertations on this topic; however, only three published studies directly evaluated expanded-operant treatments as a strategy for relapse mitigation. All three studies evaluated serial-training procedures, and results across the studies were inconsistent. We summarize the findings of each study and provide recommendations for future research.

Keywords

expanded-operant treatments; resurgence; serial training

Resurgence is the transient recurrence of some dimension (e.g., rate, force) of previously established, but not currently occurring, activity when reinforcement conditions worsen for current behavior (Lattal et al., 2017). Practitioners who understand the mechanisms underlying resurgence can better anticipate the circumstances predictive of resurgence and,

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Ethics Approval
Not applicable.

Conflict of Interest Statement
The authors declare that there is no conflict of interest.

Availability of Data and Materials
Not applicable.

ideally, promote or abate its occurrence. Consequently, there has been a recent surge of applied and translational work linking conceptual and basic research findings to socially important human behavior, such as the treatment of problem behavior (see Greer & Shahan, 2019; Kestner & Peterson, 2017; Ringdahl & St. Peter, 2017; Wathen & Podlesnik, 2018, for select reviews).

Recently, researchers have paid increased attention to techniques designed to mitigate the effects of poor treatment integrity (e.g., withholding reinforcement for alternative behavior during treatment), which often precipitates resurgence. Abatement of resurgence is increasingly becoming a focus in clinical settings as it is important that treatments for problem behavior remain effective and durable even in the face of inaccurate implementation (Greer & Shahan, 2019). Over the last five years, variations of one particular strategy (hereafter, called “expanded-operant treatments”) have received considerable attention. Expanded-operant treatments are those that increase the number or variability of appropriate alternatives to problem behavior through differential reinforcement. This straightforward approach appears to promote several desirable outcomes.

Expanded-operant treatments often increase the number of topographically distinct alternative responses, each with a history of reinforcement. Other potential outcomes include (a) increasing the likelihood that alternative responding will produce reinforcement (see Bloom & Lambert, 2015, for elaboration) and (b) reducing the magnitude of problem-behavior resurgence. This second potential effect serves as the focus of our review. Our purpose was to deliver a brief summary of the relevant findings to date and provide specific directions for future research.

Method

Search and Screening Procedures

One author searched two electronic databases, ERIC and PsycINFO, for studies on resurgence following expanded-operant treatments published in the last five years. We chose to limit the search to the past five years to ensure a current and relevant analysis. The author conducted the search in December of 2019. Search terms included: resurgence AND behav* AND (serial OR multiple OR lag OR sequential OR concurrent OR variab*). This initial search yielded 64 citations. Next, the author screened titles and abstracts for alignment with established inclusion criteria, which yielded six articles. The author then scanned the reference sections of those articles and lists of subsequently published research that cited included articles as reported by Google Scholar. This identified three additional articles. Finally, we received access to one conditionally accepted paper in the *Journal of Applied Behavior Analysis* and another in *Behavioral Development*. This resulted in 10 total articles.

Interobserver Agreement

A second author independently screened all initial-search citations for inclusion. We then calculated point-by-point agreement between primary and secondary authors and converted the resultant quotient to a percentage (yielding 95.2% agreement). Raters disagreed about

three articles. The authors discussed the disagreements and agreed to include one and exclude two of the three articles under consideration.

Inclusion/Exclusion Criteria—We included articles that (a) delivered reinforcement for one target response in baseline, (b) arranged differential reinforcement of alternative behavior (DRA) to produce two or more alternative responses or increase the variability of multiple alternative responses, (c) measured resurgence of the target response, and (d) included individual subject data.

Results

The results of our search provided evidence that research on the effects of expanded-operant treatments to mitigate resurgence has rapidly increased over the past five years. In addition to the articles identified by our search, we found eight dissertations or theses that we did not include for analysis because they had not undergone peer review. Of the 10 included articles, four evaluated non-clinical target responses, and six evaluated problem behavior as the target response.

Most articles evaluated specific tactics for training multiple alternative responses and assessed resurgence during or following training. Although all tactics evaluated had clinical utility, only three studies (Diaz Salvat et al., 2020; Lambert et al., 2015; Lambert et al., 2017) directly evaluated expanded-operant treatments as a strategy for relapse mitigation by comparing resurgence following a traditional treatment approach with one alternative response to at least one type of expanded-operant treatment. Given the brevity and purpose of our review, we will provide a brief overview of the other six articles and then focus on the three papers that directly tested the impact of operant expansion on resurgence.

Two studies evaluated the use of lag schedules to teach multiple alternative responses (Adami et al., 2017; Falcomata et al., 2018). Adami et al. (2017) and Falcomata et al. (2018) both programmed lag schedules of reinforcement for multiple alternative responses to promote mand variability during functional communication training (FCT). Although these studies did not directly evaluate the use of lag schedules as a resurgence-mitigation strategy, results revealed that resurgence of target responding did not consistently occur either when alternative responses contacted extinction, or when lag parameters increased across conditions. Thus, the results of these studies suggest that the use of lag schedules during FCT could be a possible resurgence-mitigation strategy.

One study evaluated concurrent training procedures to teach multiple alternative responses (Meuthing et al., 2018). The purpose of Meuthing et al. (2018) was to evaluate the effects of delays to reinforcement on the variability of four alternative responses during FCT with children who engaged in problem behavior. Meuthing et al. observed mand variability and an initial increase in problem behavior during delays to reinforcement. Although the authors observed initial increases in problem behavior with all participants when they introduced delays to reinforcement, they did not consistently observe resurgence when reintroducing later delays. Like Adami et al. (2017) and Falcomata et al. (2018), the findings of Meuthing et al. suggest that increased numbers of alternative responses during FCT

can reduce the resurgence of problem behavior. As Meuthing et al. did not incorporate lag-schedule requirements into their experimental preparations, their results appear to suggest that increasing response variability may be unnecessary beyond simply reinforcing multiple alternative responses.

Lambert et al. (2020) compared two identical serial-training procedures (i.e., sequentially training, reinforcing, and then extinguishing multiple alternative responses) in a two-component multiple schedule after programming a long baseline history of reinforcement (i.e., more than 400 sessions across up to 11 months) in one component and a short baseline history of reinforcement (i.e., a few sessions in a single day) in the other component. Despite dramatic differences in baseline history, no within-participant differences emerged, and outcomes varied across participants with two participants producing recency effects (i.e., resurgence was largest for the most recently trained alternative response) and the other producing primacy effects (i.e., resurgence was largest for problem behavior). Lambert et al. directly evaluated the resurgence of problem behavior following serial training but did not measure resurgence following a comparison condition in which they trained a single alternative response. Therefore, the results do not provide evidence that serial-response training better mitigates resurgence relative to single-response training, rather, they reveal that duration of baseline exposure did not impact the relative magnitude of resurgence.

Schmitz et al. (2019) compared the use of lag schedules and serial training using a traditional resurgence paradigm. That is, Schmitz et al. conducted two, three-phase resurgence evaluations during which they delivered reinforcement for target behavior during Phase 1, used either serial-training procedures or lag schedules to deliver reinforcement for four alternative responses during Phase 2, and implemented extinction for both target and alternative responding during Phase 3. The authors observed resurgence of problem behavior in Phase 3 following both serial- and lag-training procedures. Thus, in terms of resurgence mitigation, there does not appear to be strong advantages to introducing alternatives serially or through lag-schedule requirements. However, although Schmitz et al. directly evaluated the resurgence of problem behavior, they did not include a more traditional comparison condition in which they trained a single alternative response. Thus, the results do not speak to whether serial- or lag-training procedures better mitigate resurgence relative to single-response training.

Two studies taught multiple alternative responses in a sequential fashion but did not directly evaluate the procedure as a strategy for relapse mitigation by comparing resurgence following sequential- and single-training procedures (Gratz et al., 2018; Lattal et al., 2019). Gratz et al. (2018) trained two functional communication responses (FCRs) and evaluated the resurgence of problem behavior and FCRs by sequentially reinforcing problem behavior and one FCR before placing all responses on extinction and then sequentially reinforcing problem behavior and the second FCR before placing all responses on extinction again. Results revealed resurgence of problem behavior for all participants and resurgence of an FCR for one participant. Lattal et al. (2019) evaluated hierarchical resurgence with pigeons by sequentially training and then extinguishing two target key-peck responses. Lattal et al. delivered reinforcement for a third alternative key-peck response when they programmed extinction for the second-trained target response. When they placed the third

response on extinction, they observed resurgence of the second-trained response. In the instances that Lattal et al. observed resurgence of the first-trained response following resurgence of the second-trained response, it occurred at a lesser-magnitude than that of the second-trained response. These results provide further support for research evaluating the possible resurgence-mitigating effects of training multiple alternative responses in serial, or sequential, fashion.

Table 1 lists the three studies that directly evaluated expanded-operant treatments as a strategy for relapse mitigation by comparing resurgence following a traditional treatment approach with one alternative response to at least one type of expanded-operant treatment. All three studies evaluated serial-response training as the expanded-operant treatment approach. Lambert et al. (2015) was the first study to make a direct comparison between approaches by targeting analogue responses to problem behavior. Lambert et al. employed a two-component multiple schedule to compare the effects of training three alternative responses serially compared to the training of one. For all three participants, resurgence was lower following serial training than following single-alternative training. Additionally, following serial training, the magnitude of target-response resurgence was consistently smallest relative to that of the subsequently trained alternatives. Lambert et al. observed a recency effect for two of the three cases, similar to the findings of Lattal et al. (2019).

However, when Lambert et al. (2017) extended this analysis to problem behavior, the findings were inconsistent, with only one of two participants showing less resurgence of problem behavior following serial training. Further, the researchers observed primacy effects, not recency effects, for both participants—the most distally reinforced and extinguished response in the serial-training preparation (i.e., problem behavior) resurged most. Taken together, results of the two evaluations by Lambert and colleagues present conflicting evidence for the effects of serial-response training in mitigating resurgence.

Diaz Salvat et al. (2020) recently conducted a series of three translational experiments to evaluate serial- versus single-response training while controlling for the number of response alternatives across comparison conditions. Results of Experiment 1 replicated the findings of Lambert et al. (2015) in that resurgence was lower following serial training. However, Experiment 2 revealed no differences in resurgence when varying the training type and holding constant the number of response alternatives, and Experiment 3 showed less resurgence following a condition with more response alternatives but an identical reinforcement schedule. Taken as a whole, the findings of Diaz Salvat et al. suggest that providing multiple response alternatives, without necessarily providing a recent history of reinforcement (serial or otherwise) for those alternatives, helps to mitigate resurgence. Thus, response competition appears to be an important predictor of resurgence mitigation when using expanded-operant treatments.

Discussion

Results of our brief review highlight several important points for discussion. First, although the general strategy of expanding the operant by training multiple alternative responses has received considerable attention, only three studies have evaluated the core prediction of

whether this strategy mitigates resurgence, despite a focus on resurgence by many of the studies reviewed. Second, of those few studies that evaluated this core prediction directly, most enrolled a small number of participants, and their collective findings were mixed.

These findings establish a few targeted areas for future research and some considerations for that work. First, the field would benefit from the publication of well-controlled studies that compare relapse following expanded-operant and traditional treatments directly. Priority should be given to studies that include multiple subjects or participants. Second, in those studies showing better relapse mitigation following expanded-operant treatments, a necessary next step is clarifying whether response competition alone accounted for the findings (e.g., Diaz Salvat et al., 2020). Third, also desirable are basic studies that uncover the mechanism(s) responsible for recency effects over primacy effects (cf. Lattal et al., 2019), as this pattern of responding could be an important predictor of relapse mitigation. Fourth, other assumptions made by research on expanded-operant treatments should be more directly explored. For example, the degree to which varied requests increase the likelihood that alternative responding will produce reinforcement in applied settings. Finally, publication outlets should encourage the timely publication of well-controlled investigations on this topic that report null findings (e.g., Greer et al., 2020; Lambert et al., 2017; Lambert et al., 2020).

Future research should proceed by heeding a few considerations. First, within-subject designs should include carefully developed control procedures for evaluating resurgence following expanded-operant treatments. Controls should rule out possibilities of carryover effects while also accounting for other variables known or suspected to affect relapse (e.g., response and reinforcement rate differences, time spent in each phase, repeated relapse testing [cf. Shahan & Craig, 2017]). Second, within-subject designs may not always be best for the experimental question at hand, and when appropriate (e.g., evaluating history effects), researchers should consider properly controlled randomized group designs.

Third, regardless of experimental design, selecting topographically similar response alternatives can be advantageous, as they equate response effort and may better control for factors that can bias responding, thus confounding the effects of the expanded operant alone. Researchers should also consider theoretical models of resurgence when developing future studies evaluating expanded-operant treatments. For example, although topographically similar response alternatives better equate response effort, Resurgence as Choice suggests that manipulating response effort in favor of the alternative response can be a useful tactic for mitigating resurgence (Greer & Shahan, 2019).

It is worth noting that although our search included all forms of expanded-operant treatments that measured resurgence, the three articles that we focused on happened to use serial-response training procedures. Thus, the implications of these findings do not speak to the larger strategy of expanded-operant treatments for mitigating resurgence in general, rather to the serial-training tactic specifically. As more studies on expanded-operant treatments for resurgence become available, future research should summarize the findings of each particular strategy, as well as the approach more generally.

Given the mixed findings of the effects of serial-training treatments on relapse mitigation, it is worth noting at least a few other strategies that have shown promise. These include combined, consequent-based refinements of DRA-based interventions (e.g., Fisher 2018), as well as stimulus-control manipulations that bring alternative responding under the discriminative control of the stimuli from a multiple schedule (e.g., Fuhrman et al., 2016; Fisher et al., 2019). Less-promising tactics for relapse mitigation include single, consequent-based refinements of DRA-based interventions (e.g., baseline reinforcement rate; Fisher, Saini et al., 2018; Lambert et al., 2016) and extended time in treatment (e.g., Greer et al., 2020; Nall et al., 2018).

In conclusion, research on variations of expanded-operant treatments has received considerable attention over the past few years. Increased interest in this topic is justified, as these treatments can result in several desirable outcomes clinically. Although their effects on relapse mitigation are mixed, clinicians might use expanded-operant treatments for a variety of other reasons, including to increase individuals' repertoires of appropriate responses, increase the variability of alternative responding, and increase the likelihood that an appropriate response will contact reinforcement under natural periods of extinction. As such, our field will benefit from well-controlled research examining how expanded-operant treatments may also be a tactic for relapse mitigation.

Funding:

Grants #2R01HD079113, #5R01HD083214, and #5R01HD093734 from The National Institute of Child Health and Human Development provided partial support for this work.

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Table 1.

Resurgence Experiments Included

Experiment	Type	Training Procedures	Outcomes
Diaz-Salvat et al. (2020)	Translational	Serial	Less resurgence in conditions with more response options
Lambert et al. (2015)	Translational	Serial	Less resurgence following serial training
Lambert et al. (2017)	Applied	Serial	Inconsistent effects on resurgence