Extinction-induced response resurgence: A selective review

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Resurgence refers to the recovery of previously extinguished responding when a recently reinforced response is extinguished. Although the topic of resurgence has received limited experimental attention, there recently have been an increased number of investigations involving the topic. This increased experimental attention also has been accompanied by conceptual analysis. This increased interest in resurgence by both basic and applied behavior analysts is noteworthy because the topic relates to several different areas in and outside behavior analysis. This paper is a brief and selective review of resurgence, and its aim is to illustrate the importance of continuing to investigate the topic. More specifically, the role of resurgence in understanding topics such as behavioral history, drug relapse, severe problem behavior, communication disorders, and cognition, is described.
Keywords: Behavioral history, extinction, reinforcement, resurgence, review

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Resurgence refers to the recovery of previously extinguished responding when a recently reinforced response is extinguished (e.g., Epstein, 1983, 1985). Figure 1 illustrates resurgence using hypothetical data. In the first condition, only Response A is reinforced. Response A is extinguished in the second condition concurrent with the reinforcement of Response B. Response B is extinguished in the third condition, and the subsequent recovery of Response A is resurgence. The degree of recovery of Response A can be compared to a different (control) response that never was reinforced (Response C). Measuring Response C in this third condition serves as a measure of extinction-induced response variability (e.g., Antonitis, 1951). Thus, resurgence provides a more refined characterization of extinction-induced behavior. That is, responses predicted to occur in extinction are those responses that previously were reinforced under comparable stimulus conditions.

Although resurgence and related extinction-induced phenomena were investigated in the 1970s (e.g., Mulick, Leitenberg, & Rawson, 1976; Pacitti, & Smith, 1977; Rawson, Leitenberg, Mulick, & Lefebvre, 1977), as well as earlier (see Epstein, 1985), Epstein (1983, 1985) usually is viewed as being the most forceful commentator regarding the utility of understanding the determinants and consequences of resurgence (see also Epstein & Skinner, 1980). Epstein argued that resurgence provides behavior analysts with a more descriptive means of understanding findings sometimes attributed to Freud's concept of *regression*. For Freud, regression involved an individual *regressing* to previously demonstrated behavior considered acceptable earlier in the individual's development. In addition to linking resurgence and regression, Epstein also summarized much of the experimental findings related to resurgence. The aim of the present paper, therefore, is to describe more recent experimental findings related to resurgence. By showing the relevance of the topic to a variety of topics in and outside behavior analysis (behavioral history, drug relapse, severe problem behavior, communication disorders, and cognition), this paper urges both basic and applied behavior analysts to continue the analysis of resurgence.

Behavioral history

Appealing to the behavioral history of an organism often provides behavior analysts with a means of explaining complex behavior (e.g., Barrett, 1986; Doughty, Cirino, Mayfield, da Silva, Okouchi, & Lattal, 2005; Lattal, & Neef, 1996; Tatham, & Wanchisen, 1998; Wanchisen, & Tatham, 1991). Broadly speaking, resurgence is a behavioral-history effect in that current behavior only can be understood by appealing to contingencies of reinforcement exposed to the organism previously. A primary issue,

therefore, in the study of resurgence is: what are the necessary and sufficient conditions to produce resurgence, in terms of both past experiences and current environmental conditions?

Lieving and Lattal (2003) addressed the question posed above across several experiments. In one experiment, key pecking of pigeons was reinforced via grain delivery in the first condition. In the second condition, key pecking was extinguished concurrent with the reinforcement of treadle pressing (also via grain delivery). In the third condition, treadle pressing was extinguished, and the resurgence of key pecking was measured. By repeating these three conditions, and consistently observing key-peck resurgence in the third condition, it was confirmed that resurgence is a general and replicable finding. In two subsequent experiments, the necessity of extinguishing treadle pressing in producing key-peck resurgence was investigated. In one experiment, instead of arranging extinction in the third condition, food delivery was made response independent. Not only was key-peck resurgence absent in this condition, but in a subsequent condition key pecking resurged when extinction replaced the response-independent, food-delivery schedule. These latter results suggest that resurgence necessitates a prior reinforcement history and the *extinction* of a more recently reinforced response. In a final experiment, the issue of whether *local periods of nonreinforcement* (i.e., conditions *approximating* extinction) resulted in resurgence of key pecking was addressed. In the third condition of this experiment, the reinforcement schedule maintaining treadle pressing was made *leaner*. Resurgence of key pecking occurred, though it was limited in amount. These results have compelled investigators to investigate the necessity of *complete* extinction in producing resurgence (Doughty & Reed, 2007; see below under *Summary and conclusions*).

Drug relapse

The clinical significance of analyzing resurgence, if not clear already, is illustrated well by *naming* Response A and Response B. That is, by suggesting that Response A can represent drug taking and Response B a therapeutically established alternative response, it is obvious that resurgence sometimes is undesirable from a therapeutic standpoint. Podlesnik, Jimenez-Gomez, and Shahan (2006) used resurgence as a model of clinical relapse in the context of *drug seeking* (i.e., an operant response maintained by alcohol reinforcement).

Podlesnik et al. (2006) first reinforced right-lever pressing of rats with alcohol administration. In a second condition, not only was right-lever pressing extinguished, but chain pulling was reinforced with food pellets. In the final condition, when food-pellet delivery was discontinued, and chain pulling decreased, there was a resurgence of right-lever pressing despite the absence of alcohol administration. The recovery of right-lever pressing is described appropriately as resurgence because there was minimal responding to the left (control) lever in this final (extinction) condition. Resurgence was observed by Podlesnik et al. despite a difference in procedure compared to Lieving and Lattal (2003). In Lieving and Lattal, grain delivery was the reinforcer across all conditions, whereas in Podlesnik et al., different reinforcers (i.e., alcohol and food) maintained the different responses (i.e., lever pressing and chain pulling).

In proposing their animal model of relapse, Podlesnik et al. (2006) noted that food-maintained chain pulling may be analogous to therapeutically established alternative environment-behavior relations. These latter relations may be drug treatment, the establishment of healthier family relationships, friendships, and/or employment opportunities. The cessation of food-pellet delivery may be discontinued treatment, family strife, divorce, and/or unemployment.

Severe problem behavior

A considerable number of applied behavior analysts treat problem behavior in individuals with intellectual disabilities. Because applied behavior analysts often are not requested to treat problem

behavior until it becomes severe, they necessarily must acknowledge and combat the behavioral history of their clients (e.g., Progar et al., 2001). Lieving, Hagopian, Long, and O'Conner (2004) reported one way resurgence can be considered when assessing severe problem behavior.

Lieving et al. (2004) studied two participants, a 7-year-old girl (Christine) diagnosed with moderate to severe intellectual disabilities who engaged in disruption, aggression, and self injury, and one 9-year-old boy (Sam) diagnosed with mild intellectual disabilities (as well as other disorders) who engaged in disruption, dangerous acts, inappropriate language, and aggression. For both participants, it was hypothesized at the start of the study that the specific problem-behavior topographies listed above made up a response-class hierarchy of aggression maintained by positive reinforcement in the form of tangibles. Lieving et al. began the study by reinforcing any form of aggression. Extinction then was implemented across conditions for one specific response topography after another, while the occurrence of all these topographies was measured. For example, Sam first was exposed to extinction of disruption, then extinction of disruption and dangerous acts, and finally extinction of disruption, dangerous acts and cursing. Both participants exhibited resurgence at various times across conditions by emitting a different form of aggression after being exposed to extinction for some other form of aggression.

Lieving et al. (2004) did not report the eventual treatment they implemented for these two participants. However, their results force practitioners to consider carefully the role resurgence may play in the *assessment* of severe problem behavior. Furthermore, in linking Lieving et al. and Podlesnik et al. (2006), practitioners also must consider resurgence when establishing *treatment* effects that will persist best outside the clinic setting. That is, it is desirable to prevent problem behavior from resurging upon the client's return to the target setting (i.e., after the problem behavior has been eliminated in the clinic).

Communication disorders

In keeping with the notion that effective treatment must be resilient to conditions that promote the resurgence of undesirable behavior, discussed next is the role resurgence may have in understanding communication breakdowns and problem behavior in individuals with communication disorders (e.g., Halle, Brady, & Drasgow, 2004).

Communication breakdowns occur when speakers (for example, young children with limited communicative repertoires) initiate communication but do not receive their requested consequences. Halle et al. (2004) describe *repairs* as the subsequent responses of speakers following these breakdowns, and the function of these repairs is to procure the requested consequence. Halle et al. classify three types of communication breakdowns and note their varying effects on repair frequency. *Requests for clarification* reliably occasion repair attempts in the form of a slightly different response topography. *Nonacknowledgements* do not occasion repairs reliably in that the speaker does not receive a response from the listener. That being said, requesting may persist if maintained by valuable consequences. Finally, *topic shifts* are when listeners attempt to manipulate the speakers' attention to a different subject, and children have been shown to repair least frequently to these breakdowns. That being said, the reliability of this latter effect depends on a variety of variables (e.g., reinforcement factors correlated with the initial request as well as with the changed-to topic).

Halle et al. (2004) also classify two different types of repairs, repetitions and modifications. In a repetition, the response of the speaker is an exact replica of the original communication attempt, and in a modification, the response is different from the original attempt. Three modifications were described: additions, in which the original attempt is augmented in some way; reductions, in which something present in the original attempt is removed; and substitutions, in which the original attempt is changed considerably. Observing the occurrence of a desirable repair on the behalf of the child is important because in the absence of such a repair problem behavior may occur. It seems reasonable to suggest that

the emission of problem behavior following a communication breakdown is the result of that behavior being reinforced in the history of the organism (i.e., the resurgence of problem behavior following the extinction of an appropriate communication attempt). It, therefore, is imperative that practitioners arrange conditions to maximize the probability of observing *effective* repairs. Halle et al. describe well the reinforcement factors responsible for establishing persistent repairs in the face of breakdowns.

Cognition

An essential aspect of cognitive therapy is the instruction from the therapist to the client to *refrain* from thinking about the targeted problem (e.g., the obsession in obsessive-compulsive disorder). These instructions sometimes include the establishment of an alternative response (i.e., the client is told to think of X instead of Y, where Y is the targeted problem). If the recurrence of the targeted thought is problematic, then effective treatment must reduce its probability of occurrence (i.e., its resurgence under *unwanted* circumstances). Several cognition studies with non-clinical populations, usually college students, have sought to examine the conditions under which people are more or less successful at effective thought suppression.

Wegner, Schneider, Carter, and White (1987) studied the so-called *paradoxical effects of thought suppression*. The focus was on why, when attempting to suppress a particular thought, the content of this thought tends to recur at relatively high levels. In Phase 1, one group of students was asked to relay a stream of consciousness into a tape recording in several 5-min periods. After a number of sessions, the students were asked to continue reporting these streams but to *abstain from thinking of a white bear*. They were told to ring a bell if they thought of a white bear. The students supposedly found it extremely difficult to suppress white-bear thoughts. In Phase 2, the same students were asked to report their streams of consciousness as they had done *before* the request was given to suppress white-bear thoughts. Students supposedly still showed a white-bear preoccupation. With a different group of students, Wegner et al. repeated the aforementioned procedures; however, these students were told in Phase 2 to think of a *red Volkswagen* if white-bear thoughts arose. Although white-bear thoughts supposedly were present in this group of students as well, they were significantly less likely than the first group of students to think about the white bear. Evidently, the establishment of a specific alternative response reduced the recurrence of the unwanted thought.

Although the differences between Wegner et al. (1987) and the studies discussed above are too numerous to list, it nevertheless may be noteworthy to consider the results of Wegner et al. in terms of behavioral resurgence. That is, when placed in a stimulus context previously correlated with a target response, there are times when that discriminative context occasions the target response, as opposed to some alternative, more recently learned response. Wegner et al. describe their results in the following way, "some reminder occurs, [which] in a moment of weakness, the person gives rise to the rumination [of the formerly suppressed thought]." In the context of behavioral work involving resurgence, some investigators (e.g., Doughty, da Silva, & Lattal, 2007) have analyzed the conditions that promote *better* this response recurrence.

Summary and conclusions

Resurgence is a topic that has not received extensive empirical attention in behavior analysis. That being said, behavior analysts recently have shown an increased interest in the topic. This interest is evidenced in the basic non-human animal laboratory (e.g., Doughty et al., 2007; Doughty & Reed, 2007; Lieving & Lattal, 2003), in the translational non-human animal laboratory (Podlesnik et al., 2006), in the basic human laboratory (e.g., Wilson & Hayes, 1996), and by applied behavior analysts (e.g., Lieving et al., 2004). The topic also has been included in novel conceptual analyses (e.g., Shahan & Chase, 2002). Although the present paper did not include detailed discussion of all these issues (e.g., Shahan & Chase,

2002; Wilson & Hayes, 1996), it did provide a glimpse into some of the areas, both in and outside behavior analysis, related to resurgence.

Regarding resurgence in the basic non-human animal laboratory, the procedures and results of Lieving and Lattal (2003) were presented in detail. This set of experiments was described partly because it analyzed systematically the necessary and sufficient conditions that promote resurgence. An intriguing aspect of these data was that resurgence may not be confined to *complete* extinction. That is, by reducing the rate of reinforcement rate correlated with Response B, these investigators found some, albeit limited, evidence of resurgence. Doughty and Reed (2007) extended Lieving and Lattal by assessing resurgence following a reduction in *reinforcer magnitude* for Response B. Doughty and Reed also found some evidence of resurgence. The conditions necessary to uncover resurgence clearly need to be studied further.

Regarding resurgence in the translational non-human animal laboratory, Podlesnik et al. (2007) introduced the topic to experimental psychologists interested in drug relapse. Because animal models of relapse have focused on extinction-related phenomena other than resurgence (i.e., reinstatement; Doughty, Reed, & Lattal, 2004; Shaham, Shalev, Lu, de Wit, & Stewart, 2003), much work still is needed to assess the utility of resurgence in this area. Similarly, because applied behavior analysts still have not examined resurgence systematically (cf. Lieving et al., 2003), there remains considerable work in this area as well. For example, Doughty et al. (2007) observed that the onset and amount of resurgent key pecking in pigeons depended on how the key pecking was eliminated. The response-elimination techniques studied mirror procedures used by applied behavior analysts to eliminate problem behavior (i.e., extinction, differential reinforcement of *other* behavior, and differential reinforcement of an *alternative* behavior).

Arguably the most intriguing questions still unanswered involving resurgence relate to its ability to provide connections between behavior analysis and other fields of study. Two such fields discussed above were communication disorders (Halle et al., 2004) and cognitive therapy (Wegner et al., 1987). During a time in which behavior analysts sometimes find themselves isolated from other fields of study, resurgence may provide a means of collaboration. More importantly, behavior analysts have much to offer to these fields by showing how behavioral concepts and principles discovered in the non-human animal laboratory extend so well to socially significant human behavior outside the laboratory.

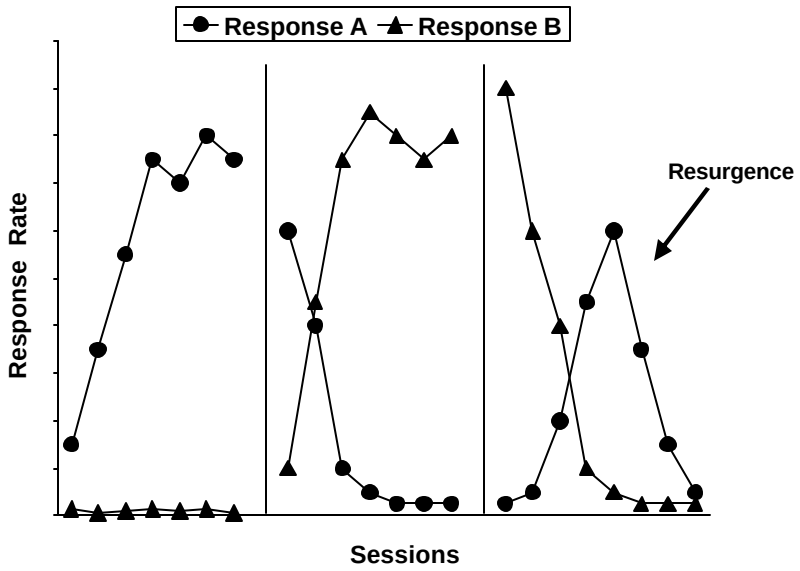

Figure 1. Hypothetical data illustrating resurgence.

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