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Review

Why behavior change is difficult to sustain☆

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ABSTRACT

Unhealthy behavior is responsible for much human disease, and a common goal of contemporary preventive medicine is therefore to encourage behavior change. However, while behavior change often seems easy in the short run, it can be difficult to sustain. This article provides a selective review of research from the basic learning and behavior laboratory that provides some insight into why. The research suggests that methods used to create behavior change (including extinction, counterconditioning, punishment, reinforcement of alternative behavior, and abstinence reinforcement) tend to inhibit, rather than erase, the original behavior. Importantly, the inhibition, and thus behavior change more generally, is often specific to the "context" in which it is learned. In support of this view, the article discusses a number of lapse and relapse phenomena that occur after behavior has been changed (renewal, spontaneous recovery, reinstatement, rapid reacquisition, and resurgence). The findings suggest that changing a behavior can be an inherently unstable and unsteady process; frequent lapses should be expected. In the long run, behavior-change therapies might benefit from paying attention to the context in which behavior change occurs.

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Behavior causes a surprising amount of human disease. For example, an estimated 40% of premature deaths in the U.S. can be attributed to unhealthy behaviors, such as smoking and inactivity (e.g., Schroeder, 2007). Eliminating such behaviors, and replacing them with healthier ones, is therefore one of the most important strategies for improving U.S. population health. But a persistent challenge to the field is that sustaining behavior change is not easy. Classic data suggest that roughly 70% of individuals who successfully quit illicit drug use, cigarette smoking, or problem drinking return to their old behaviors within a year (Hunt et al., 1971). More recent data suggest similar outcomes (e.g., Hughes et al., 2004; Kirshenbaum et al., 2009). Even patients who enter an incentive-based "contingency-management" treatment that explicitly reinforces healthy behavior with vouchers or prizes (e.g., Fisher et al., 2011; Higgins et al., 2008, 2012) often return to their unwanted behaviors over time. That is, once contingency management stops, and the reinforcers are discontinued, many individuals return to the original behavior (e.g., John et al., 2011; Silverman et al., 2012). Despite the fact that contingency management is one of the most successful behavioral intervention strategies, for the case of drug dependence, "the development of more enduring solutions to sustain abstinence over years and lifetimes is perhaps the greatest challenge facing the substance abuse treatment research community today" (Silverman et al., 2012, p. S47).

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The purpose of the present article is to present some research from the basic behavioral laboratory that might shed light on why it is so difficult to sustain behavior change. The issue has been discussed in other papers (e.g., Bouton, 2000, 2002); the current article focuses on behavior change in general with an emphasis on recent work addressing instrumental (operant) learning. Roughly three decades of basic research on behavior change suggests two main conclusions. First, changing or replacing an old behavior with a new behavior does not erase the original one. Second, behavior change can be remarkably specific to the "context" in which it occurs. Both of these features of behavior change appear to be general across different treatment strategies for creating change. They might provide some insight into why behavior change can be so difficult to maintain.

Behavior change is not erasure

Behavior change can be studied in the laboratory with variations of two well-known behavioral methods. In the first, organisms like rats or pigeons learn to perform specific behaviors (such as pressing a lever or pecking at a disk) to obtain food, water, or drug reinforcers. The study of such *operant conditioning* provides a method that allows behavioral scientists to study how "free" or "voluntary" behavior is influenced by its consequences. In the second method, *Pavlovian or classical conditioning*, the organism learns to associate a signal (such as presentation of a tone or light) with upcoming reinforcers or punishers (e.g., food, water, drugs, or a mild shock). This kind of learning in turn allows the organism to adapt to significant events in the environment by making anticipatory responses in the presence of the signal. Both Pavlovian learning and operant learning are widely represented in human experience and provide the building blocks of many complex behaviors and actions (e.g., Baldwin and Baldwin, 2001).

In either type of learning, behavior change can be studied by altering the relationship between the action or the signal and the reinforcing or punishing outcome. In *extinction*, perhaps the most basic form of behavior change, the strength or rate of the behavior declines when the reinforcing outcome is eliminated. The behavior eventually goes away, and is said to be "extinguished." Extinction is a reliable way to reduce a learned behavior, and it is thought to be the mechanism behind various cognitive behavior therapies that eliminate unwanted behaviors, thoughts, or emotions by repeatedly exposing the patient to the cues or situations that trigger them (e.g., Craske et al., 2008). It is tempting to conclude that extinction erases or destroys the original learning. But the evidence suggests that extinction is best thought of as producing a kind of behavioral *inhibition*. That is, the original behavior is still in the brain or memory system, but is inhibited and ready to return to performance under certain conditions. Learning theorists have long emphasized a distinction between learning and performance. Just because a behavior is not manifest in performance does not mean that its underlying basis is gone. It is potentially available to produce lapse or relapse.

Since the 1970s, extinction has been studied extensively with Pavlovian methods. As noted above, when the significant event is no longer presented, anticipatory responses to the signal go away. However, the extinguished response can readily return with any of several experimental manipulations (see Bouton, 2004; Bouton and Woods, 2008, for more extensive discussions). These are summarized in Table 1. In what is probably the most fundamental example, the *renewal effect*, extinguished responding to the signal (the conditioned stimulus or "CS") returns if the CS is simply tested in a different context (e.g., Bouton and Bolles, 1979a, 1979b; Bouton and King, 1983; Bouton and Peck, 1989). (In the animal laboratory, "contexts" are usually provided by the Skinner boxes in which learning and testing occur; they usually differ in their visual, olfactory, tactile, and spatial respects.) In *spontaneous recovery*, the extinguished response can return if the CS is tested again after some time has elapsed after extinction(e.g., Rescorla, 2004). The phenomenon can be viewed as another example of the renewal effect in which extinction is shown to be specific to its *temporal* context (e.g., Bouton, 1988). In *reinstatement* (e.g., Rescorla and Heth, 1975), mere exposure to the significant event (the unconditioned stimulus or "US") again after extinction can make responding return to the CS. Importantly, the reinstating effect of presenting the US alone is also a context effect. For example, in Pavlovian learning, presentation of the US must occur in the context in which testing will take place in order for the response to return (Bouton, 1984; Bouton and Bolles, 1979a, 1979b; Bouton and King, 1983; Bouton and Peck, 1989; see also Westbrook et al., 2002). The picture that emerges is that behavior after extinction is quite sensitive to the current context. When the trigger cue is returned to the acquisition context, when the context is merely changed, or when the context is associated with the reinforcer again, the cue (CS) can readily trigger responding again.

A fourth phenomenon is *rapid reacquisition*. In this case, when CS–US pairings are resumed after extinction, the return of responding can be very rapid (Napier et al., 1992; Ricker and Bouton, 1996). Rapid reacquisition may be especially relevant to behavior change in the natural world, because the US or reinforcer is usually presented whenever a lapsing drug user or over-eater consumes the drug or junk food again. The evidence suggests that reacquisition is rapid because the reinforced trials were part of the "context" of original conditioning (Bouton et al., 2004; Ricker and Bouton, 1996). Thus, when the CS and US are paired again, the organism is returned to the original context, and responding recovers because it is a form of an ABA renewal effect. Once again, performance after extinction depends on context. And the meaning of "context" can be very broad and include not only the physical background, but recent events, mood states, drug states, deprivation states, and time (e.g., see Bouton, 1991, 2002).

It is important to note that what we know about extinction also applies to other Pavlovian behavior-change procedures (Bouton, 1993). For example, in *counterconditioning*, the CS is paired with a new US in Phase 2 instead of simply being presented alone. Here we also find little evidence for erasure and a lot for the role of context. For example, when CS-shock pairings are followed by CS-food pairings, renewal of fear occurs after a context change (Peck and Bouton, 1990), spontaneous recovery occurs after the passage of time (Bouton and Peck, 1992), and reinstatement of fear to the tone occurs if shock is presented alone again (Brooks et al., 1995). Renewal and spontaneous recovery of appetitive behavior can also occur when tone-shock follows tone-food (Bouton and Peck, 1992; Peck and Bouton, 1990). We have also seen renewal and spontaneous recovery after discrimination reversal learning in which tone-shock and light-no shock were followed by tone-no shock and light-shock (Bouton and Brooks, 1993). And when an inhibitory CS that signals "no reinforcer" is converted into an excitor that now signals that the reinforcer will occur, the original inhibitory meaning can return upon return to the original inhibitory conditioning context (Peck, 1995; see also Fiori et al., 1994). All of these findings suggest that extinction can be viewed as a *representative* form of retroactive inhibition in which new learning replaces the old (Bouton, 1993). Learning something new about a stimulus does not necessarily erase the earlier learning. It involves inhibition that is sensitive to context change.

The variety of different lapse and relapse effects suggests that behavior change can be an intrinsically unsteady affair. Given the many possible context changes that can occur in the natural world after a behavior is inhibited, repeated lapses should always be expected. One rule of thumb is that after extinction the signal has had a history of two associations with the US (CS–US learned in conditioning and CS–no US learned in extinction). Its meaning is therefore ambiguous. And like the current meaning of an ambiguous word (or the verbal response it evokes), the current response evoked by the trigger cue depends on the current context. More detailed reviews of extinction in Pavlovian conditioning with an eye toward making it more enduring can be found in Bouton and Woods (2008) and Laborda et al. (2011).