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Behavioral History: A Definition and Some Common Findings from Two Areas of Research

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Behavioral history research includes studies that (a) permit assessment of a prior experimental condition on a subsequent one, (b) show either short-lived or permanent effects, and (c) produce effects that are observable in ongoing behavior or that may be unobservable until special test conditions are introduced. We review experiments within both the conventional experimental analysis of behavior and behavioral pharmacology in order to identify commonalities and differences in the outcomes of conceptually similar experiments. We suggest that a deeper understanding of the necessary and sufficient conditions for producing history effects will emerge from these complementary research efforts.

Key words: behavioral history, behavioral pharmacology, fixed-interval schedule, human/animal differences, punishment, shock postponement, cocaine

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Behavioral history research has been developing in an unsystematic fashion. It is not clear what is meant when the term is used, and much of what is known about behavioral history seems to be the result of serendipitous discovery rather than systematic research. Our understanding could be advanced if there were greater consensus regarding the definition of behavioral history and if the topic were explored through programmatic research. We attempt to clarify the use of this term and then discuss two areas of systematic behavioral history research. We hope that this effort will occasion programmatic research into other behavioral history effects, such that a broader understanding of behavioral history develops.

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Defining the term *behavioral history* is surprisingly difficult (Wanchisen, 1990). In some sense, *all* of operant conditioning is a study of history effects. For example, it is unlikely that behavior would be maintained under a high-value fixed-ratio (FR) schedule in the absence of a history of responding under lower ratio (shaping) parameters. It could also be argued that every presentation of a multiple schedule component serves as a history for all subsequent components. A similar position could be taken regarding studies in which parametric manipulations are conducted (e.g., concurrent choice procedures). The term is also sometimes invoked in discussion sections of empirical papers as an explanation for individual differences; unfortunately, such assertions are often based more on conjecture than on empirical evidence.

The term *behavioral history* should be reserved for a more specified use in order to avoid confusion. Definitions of the term have occasionally been offered; for example, Freeman and Lattal (1992) state that behavioral history effects refer to instances in which the control exerted by current contingencies is influenced by previous contingencies. Expanding this preliminary definition may begin to organize the research done in behavioral history. We suggest that the following three attributes identify and classify behavioral history research:

The research design must permit assessment of the effects of an experimental condition on a subsequent experimental condition. A clearly identifiable history phase must precede a test phase in which the history phase's effects are assessed. This test phase should be compared to a test phase that was *not* preceded by the critical historical manipulation. This general design sometimes occurs within the context of between-groups experimental designs. For example, in errorless discrimination, subjects are exposed to a history phase in which stimuli are systematically faded. A test phase is subsequently conducted, and the results obtained with these subjects are compared to those obtained with subjects who did not undergo an errorless training procedure. Behavioral history effects can be assessed using a within-subject ABA design, with B serving as the putative history phase and A serving as the prehistory baseline for comparison to the second A (e.g., Barrett, 1977; Freeman & Lattal, 1992).

History effects may be either short-lived or permanent. Some behavioral history manipulations produce only temporary effects on subsequent behavior by influencing transition states. A *transition state* is defined as behavior that has not yet reached a steady state following a change in contingencies; Sidman (1960) identified schedule history as a determinant of transition states (e.g., the prior schedule might affect the duration of the transition). Many behavioral history experiments have studied the effects of manipulations on transition states. Some studies have shown qualitative effects on transition states, such as when response patterning is temporarily affected by behavioral history (e.g., Wanchisen, Tatham, & Mooney, 1989). Behavioral history has also been shown to sometimes produce quantitative effects on schedule transitions. For example, the number of sessions until the rate of fixed-interval (FI) responding of rats converged on control rates depended on the parameters of the differential-reinforcement-of-low-rate (DRL) schedule under which they had previously been trained (Tatham, Wanchisen, & Yasenchack, 1993).

Although many behavioral history effects may be transient, there are also examples of behavioral history manipulations that alter the steady-state characteristics of subsequent behavior. The permanence of some behavioral history effects is illustrated by a recent study from one of our laboratories. Separate groups of rats were trained under DRL or FR schedules and were then tested under an FR contingency. The responding of rats in all groups achieved a steady state, yet the response rate differed as a function of history, with the DRL history rats responding at a markedly lower rate than those with an FR history (Wanchisen, Sutphin, Balogh, & Tatham, 1998). Given that behavior during the test phase achieved a steady state, it is reasonable to argue that the effects of the behavioral history manipulation were permanent.

However, there is some resistance to acknowledging that some history effects go beyond transitional levels. Perhaps some behavior analysts hold the opinion that the behavior-analytic perspective is inconsistent with the notion that prior history can continue to exert influence in the present. Instead, there may be the assumption that current contingencies should override control by historical contingencies if the organism remains in extended contact with the current environment. In fact, much of behavior modification is based on this assumption (see Kazdin, 1994) to avoid the difficulties inherent in other therapeutic approaches in which the influence of the past is assumed (like psychoanalysis). Although these viewpoints may be philosophically appealing to some behavior analysts, it is difficult to justify this perspective in light of the potent, lasting effects that behavioral history can play in determining current behavior.

History effects may be observed in ongoing behavior or may be unobserved until revealed by additional manipulations. Many behavioral history effects are directly observable in ongoing baseline behavior; that is, no special manipulations are required to observe the effect following the critical history. This type of effect is exemplified by schedule history experiments in which the rate or patterning of responding under a schedule of reinforcement differs before and after training under a different schedule. However, behavioral history effects that are observable in ongoing behavior extend beyond experiments on history-induced alterations in response rate or response patterning. For example, some behavioral histories alter the extent to which an event functions as a reinforcer. Response-contingent shock is a punisher that will suppress responding maintained by events such as food (recently reviewed by Baron, 1991) or cocaine delivery (Grove & Schuster, 1974). However, Kelleher and Morse (1968b) demonstrated that the lever pressing of squirrel monkeys could be maintained on FI schedules of shock presentation, given an appropriate reinforcement history. The monkeys were initially trained on a food-reinforced multiple variable-interval (VI) extinction schedule in which every response during the last minute of the VI component produced a shock. The VI schedule was subsequently discontinued, but every response during the last minute of the component continued to produce a shock. Despite the removal of food, responding was well maintained, with a positively accelerated pattern of responding through the delivery of the first shock during the component. Behavioral history also plays a role in determining the reinforcing efficacy of some drugs. For example, intravenous injections of MK 801 (a phencyclidine-like drug) are not effective in reinforcing the lever pressing of rhesus monkeys unless the monkeys have a history of lever pressing maintained by phencyclidine injections. The history effect appears to be pharmacologically specific, because rhesus monkeys with a history of cocaine self-administration do not self-administer MK 801 (Beardsley, Hayes, & Balster, 1990).

Some behavioral histories can alter the effects of drugs on schedule-controlled responding without producing any detectable alteration in behavior under baseline (nondrug) conditions. This type of history effect has sometimes been called a *latent* history effect (Egli & Thompson, 1989). An excellent example of this type of effect is provided by an experiment in which morphine initially decreased responding maintained by shock postponement. The monkeys were then given a history of responding maintained by shock presentation. Next, the effects of morphine on responding maintained by shock postponement were redetermined. Morphine now *increased* responding under this schedule, even though response rates were similar under baseline conditions before and after the critical history (Barrett & Stanley, 1983). Another example of this type of history effect is the demonstration that *d*-amphetamine initially decreases punished lever pressing but increases punished responding following a history of shock postponement (Barrett, 1977). Similar to the preceding study, response rates and patterns were comparable before and after training under the critical historical condition; the effect of the behavioral history was observable only when *d*-amphetamine was administered.

Behavioral history effects that are not apparent under baseline conditions have also been found in research on errorless discrimination (Terrace, 1962). Errorless discrimination training employs initial training conditions in which the stimuli are widely separated along the to-be-discriminated continuum. After acquisition of the discrimination, the stimuli are then made gradually more similar along the relevant dimension. An important feature of this procedure is that changes are made so gradually that few nonreinforced responses are emitted. In contrast, conventional discrimination training procedures usually consist of initiating training with the stimulus parameters set to their terminal values.

Terrace (1962) compared the effects of chlorpromazine and imipramine on responding in pigeons trained with conventional versus errorless procedures. Sessions consisted of brief stimulus presentations that terminated when either a key was pecked or 5 s elapsed. During one stimulus (S+), a single peck produced reinforcers. In the presence of the alternate stimulus (S−), pecks terminated trials without reinforcement. Pigeons trained with the conventional procedure emitted many more responses early in training in the presence of S−, but both groups attained nearly comparable high levels of stimulus control prior to the initiation of test sessions with drugs. However, presession administration of chlorpromazine and imipramine dramatically increased the incidence of responding in the presence of the S− among pigeons trained with the conventional procedure. Neither pigeon in this group emitted more than eight responses during S− during any session preceding a drug test. However, both pigeons emitted more than 2,500 responses in the presence of S− when a peak rate-enhancing dose of imipramine was administered. Increases with both drugs occurred across a 17-fold range of doses. In contrast, birds treated with imipramine and trained with the errorless procedure *never* responded during S− across the same range of doses. This demonstrates the profound influence that behavioral history can play on the effects of drugs on discriminative behavior.

More recently, Ator and Griffiths (1993) trained baboons on an intravenous midazolam versus saline discrimination in which food was used to reinforce pressing one lever following saline infusions and pressing the alternate lever following midazolam administration. After the discrimination was acquired, test sessions were conducted using doses of midazolam lower than the training dose, and responding on either lever was reinforced. In this fashion the researchers determined the lowest dose of midazolam that would occasion responding predominantly on the midazolam lever. In the next phase the baboons were given an opportunity to self-administer midazolam, and this phase was followed by a redetermination of the drug-discrimination generalization gradient. Following the self-administration history, a much lower dose of midazolam occasioned responding on the midazolam lever, indicating enhanced sensitivity to the discriminative stimulus effects of midazolam. The possibility that the increased sensitivity to midazolam resulted from mere pharmacological exposure to midazolam during the self-administration phase was ruled out during subsequent conditions. This was accomplished by exposing the baboons to a noncontingent series of midazolam infusions yoked to their intake pattern during the self-administration phase. Next, the midazolam discrimination gradient was redetermined. The new dose–response curve showed that a much higher dose, relative to the initial dose–response curve, was now needed to occasion midazolam-lever responding. This indicates that noncontingent exposure to midazolam decreased sensitivity to midazolam, in contrast to the increases in sensitivity observed following midazolam self-administration. Taken together, these results show that behavioral history can either increase or decrease the threshold for discriminating a stimulus.

In summary, we suggest that the three dimensions listed above are necessary in a definition of *behavioral history*. This may help to clarify the research area and may offer an organizational structure to it.

COMMON THEMES IN BEHAVIORAL HISTORY RESEARCH

The previous section included examples of the broad range of behavioral history phenomena that have been discovered, and it is clear that history can influence behavior under a wide range of circumstances. It is also apparent that behavioral history research has made considerable contributions to our understanding of the fundamental determinants of behavior. In particular, behavioral history may be an important clue for understanding and addressing the issue of individual differences. Behavior analysis typically focuses on current environmental contingencies as the primary determinant of behavior. Behavioral history research, however, has shown that a given set of environmental contingencies can have radically different effects depending upon the experimental history of the subjects. As the experimental analysis of behavior continues to evolve, it will become increasingly important to expand our understanding of historical influences on behavior and to identify behavioral circumstances that are sensitive to control by an individual's prior experience (Wanchisen & Tatham, 1991).

Several papers have provided comprehensive reviews of the role of history as a determinant of the behavioral effects of drugs (Barrett & Witkin, 1986; Nader, Tatham, & Barrett, 1992). Comparable reviews of the role of behavioral history as a determinant of schedule-controlled behavior do not appear to exist (but see Wanchisen, 1990). We are also unaware of any systematic attempts to compare the effects of behavioral history in both drug and nondrug experimental domains. This paper highlights two research programs (conducted across laboratories and investigators) that have been systematically exploring behavioral history. We have admittedly excluded several areas of research that have yielded important information about behavioral history conditioning (e.g., learning sets, learned helplessness). These omissions reflect the limited scope of this paper and are not a commentary on the value or quality of the excluded research.

Two of the most widely studied behavioral history effects are based on rather different phenomena. One of the phenomena that will be applied to the present analysis will be referred to as the FI effect, whereas the other phenomenon will be called the punishment effect. The FI effect was originally reported by Weiner (1964), who described a series of experiments in which human button pressing was reinforced by point presentation. Several subjects were initially trained on a DRL 20-s schedule, in which responses occurring at least 20 s following the preceding response produced points. Other subjects were initially trained on an FR 40 schedule, in which points were delivered following 40 responses. Both groups of subjects were then placed on an FI 10-s schedule. Subjects with an FR history responded at far greater rates on the FI 10-s schedule than did subjects with initial DRL histories. These differences persisted for the remaining 20 sessions of the experiment. The general finding that a history of FR responding leads to persistently higher response rates on FI schedules, relative to a history of DRL responding, is the prototypical outcome in studies of the FI effect. The FI effect has been extensively replicated, first in humans (Weiner, 1969) and subsequently in several other species (Freeman & Lattal, 1992; Johnson, Bickel, Higgins, & Morris, 1991). In the present paradigm, history effects are immediate and apparent in the sense that no special conditions are required for observing the effects of the history (but see Baron & Leinenweber, 1995).

The punishment effect is exemplified by a seminal experiment by Barrett (1977) in which the effects of *d*-amphetamine on punished responding was determined in squirrel monkeys with and without prior histories of responding maintained by shock postponement. In this experiment, lever pressing was maintained on an FI 5-min schedule of food presentation. In addition, every 30th press also produced a mild tail shock. The punishment contingency reduced the rate of responding to approximately 25% to 30% of the rate prior to the introduction of punishment. Occasional tests were conducted in which *d*-amphetamine was injected prior to the experimental session. Two monkeys were studied who did not have a history of responding on a shock-postponement schedule. Lower doses of *d*-amphetamine had no effect on the response rate of these 2 monkeys, and higher doses decreased their responding. Two other monkeys were trained for approximately 1 month on a shock-postponement schedule in which every response postponed shock for 25 s, and shocks occurred every 5 s in the absence of responding. All shocks could be avoided by responding at least once every 5 s. These monkeys were subsequently tested with *d*-amphetamine on the punishment schedule. In contrast to the effects obtained in the monkeys without a history of shock postponement, their punished responding was increased by several doses of *d*-amphetamine. Subsequently, the monkeys without shock-postponement histories were trained on the shock-postponement schedule and were then retested on the punishment schedule. The punished responding of these monkeys was now also increased by *d*-amphetamine. The same paper also demonstrated this phenomenon on a within-subject basis.

The changes in the effects of *d*-amphetamine on punished responding produced by a history of shock postponement are not attributable to rate dependency. Rate-dependent drug effects are those that depend upon the rate of responding during nondrug baseline sessions (Dews, 1958; Kelleher & Morse, 1968a). Rate dependency cannot account for the punishment effect, because the rate of punished responding is not systematically affected by the critical shock-postponement history (Barrett, 1977; Tatham & Barrett, 1993).

The Role of Specific Contingencies

Within the FI paradigm, several experiments have been conducted in which rate of reinforcement has been held relatively constant across groups of subjects trained on different schedules and subsequently tested on the same schedule. For example, Urbain, Poling, Millam, and Thompson (1978) trained separate groups of rats on either DRL 11-s or FR 40 schedules that resulted in comparable obtained rates of reinforcement and similar numbers of reinforcers per session. When subsequently tested on an FI 15-s schedule, a clear dissociation across the groups in response rates persisted for approximately 90 sessions.

A closely related finding has been obtained in a somewhat different fashion with the punishment effect. Rather than varying the contingencies whereby shock could be avoided while holding the rate of shock occurrence constant, Barrett and Witkin (1986) manipulated the controllability of shock during the history phase. As expected, the punished lever pressing of 2 squirrel monkeys was initially decreased by higher doses of *d*-amphetamine. After the initial punishment phase, 1 subject (the "avoidance" monkey) was trained for several weeks on a shock-postponement schedule. The 2nd subject (the "yoked" monkey) received a shock whenever the avoidance monkey failed to postpone a shock. The punishment schedule was then reinstituted and the effects of *d*-amphetamine were redetermined. Whereas the punished responding of the yoked monkey continued to be unaffected or decreased by *d*-amphetamine, the avoidance monkey displayed the usual effect of training on the shock-postponement schedule—several doses now increased punished responding. This clearly indicates that mere exposure to shock does not reverse the effects of *d*-amphetamine on punished responding. This also demonstrates that a given rate of occurrence of a critical event is not a sufficient condition for producing a history-based alteration in the effects of *d*-amphetamine.

To summarize, the rate of reinforcement during the history phase of FI effect experiments does not lead to a unitary effect on FI performance, independent of the schedule under which the food is earned. The particular contingencies arranged during the history phase appear to account for the characteristics of performance during subsequent exposure to an FI schedule. Similarly, the mere occurrence of shock at a given rate during the history phase of punishment effect experiments is not sufficient to alter the effects of *d*-amphetamine on punished responding; an operant avoidance contingency appears to be critical.

The Identity of the Reinforcing and Aversive Events During History and Test Contingencies

Perhaps it is possible to obtain the FI effect even if responding produces different reinforcers during the history and test conditions. A related issue is whether the punishment effect could be obtained if different aversive stimuli were used to punish responding and maintain avoidance responding during the test and history phases, respectively. In other words, a history with a particular type of contingency may be more important than the reinforcers or aversive stimuli scheduled by the contingency. This issue has been addressed in both paradigms.

The role of specific reinforcers in the history and test phases of FI effect experiments has been examined in a pair of recently reported experiments. Nader and Reboussin (1994) demonstrated that the FI effect could be obtained with cocaine as the reinforcer in both the history and test phases. Rhesus monkeys were initially trained on an FI 5-min schedule in which reinforcers consisted of infusion of 30 μg/kg/injection of cocaine. The monkeys were subsequently trained on either a DRL 30-s or FR 50 schedule of cocaine reinforcement for 65 sessions. The FI schedule of cocaine reinforcement was reinstated and a history effect was observed; monkeys with DRL histories responded for at least 60 sessions at significantly lower rates than did monkeys with FR histories.

A second experiment demonstrated that comparable effects could be obtained when different reinforcers were used during the history and test phases. Nader and Bowen (1995) randomly assigned experimentally naive monkeys to either a DRL 30-s or an FR 50 group and reinforced responding with 1-g food pellets. After 65 sessions, the history phase was discontinued and all monkeys were trained on an FI 5-min schedule of cocaine reinforcement (30 μg/kg/injection). Despite the use of different reinforcers in the history and test phases, the results were comparable to those obtained when the same reinforcer was used in both experimental phases—monkeys with a history of food-maintained DRL responding lever pressed on the FI schedule of cocaine reinforcement at a rate significantly below the rates of FR trained monkeys.

A comparable experiment with the punishment effect was conducted in one of our laboratories (the first author in collaboration with James E. Barrett and Matthew Roden). An FR 10 schedule of intravenous injection of histamine (300 μg/kg/injection) was used to punish the food-maintained FI 5-min responding of a squirrel monkey. As expected, presession intramuscular injection of *d*-amphetamine produced no effect at lower doses and decreased responding at higher doses. Following a phase during which responding postponed shock delivery, the effects of *d*-amphetamine on punished responding were redetermined. In contrast to the initial phase of the experiment, responding was now increased by *d*-amphetamine at several doses. This suggests that the postponed event need not be the same as the punishing event in order to reverse the effects of amphetamine on punished responding. Collectively, these results suggest that in both paradigms, the contingencies during the history and test phases are more important than the particular reinforcing or aversive events they arrange.

Generalization Across Response Topographies

An important issue regarding behavioral history effects is the extent to which behavioral history generalizes across response topographies. If behavioral histories acquired with one response topography affect only similar response topographies, then the extent to which ongoing behavior is affected by behavioral history may be rather limited. In contrast, if behavioral history acquired in one situation with a particular response affects responses with distinctly different topographies, then the role of behavioral history as a determinant of behavior is potentially much larger.

This issue has not been addressed within the domain of the FI effect, but several relevant experiments have been conducted with the punishment effect. In one experiment, it was initially determined that *d*-amphetamine decreased or had no effect on the punished *lever pressing* of squirrel monkeys. The monkeys were then trained on a procedure in which *chain pulling* postponed shock. Following this history, *d*-amphetamine increased the punished *lever pressing* of each monkey at one or more doses (Tatham, Gyorda, & Barrett, 1993). A similar pattern of generalization across chain pulling and lever pressing was also reported under a different behavioral history paradigm (Barrett & Stanley, 1983). It might be argued that there is some topographical overlap in chain pulling and lever pressing that could account for generalization of the effects of the shock-postponement history. However, this finding has been corroborated in pigeons with key pecking as the punished response and treadle pressing as the shock-postponement response (Tatham, Gyorda, & Barrett, 1994).

Generality Across Species

The significance of behavioral history as a determinant of behavior would be relatively minor if history effects were due largely to the vagaries of individual species. For example, the significance of shock-maintained behavior to understanding control by aversive events may be limited by the fact that the phenomenon has been demonstrated only in nonhuman primates. In contrast, the occurrence of a given behavioral history phenomenon in multiple species increases confidence in the likelihood that history controls behavior in a general fashion in the same sense that FR schedules control behavior in a more or less comparable fashion across species.

There is considerable evidence that both of the prototypical history phenomena occur in multiple species. The FI effect has been demonstrated in humans under schedules of point-reinforced button pressing (Weiner, 1969), with rats lever pressing for food pellets (Johnson et al., 1991; Urbain et al., 1978; Wanchisen et al., 1989), pigeons key pecking for food (Freeman & Lattal, 1992), and rhesus monkeys pressing for intravenous cocaine infusions (Nader & Reboussin, 1994). The punishment effect was initially demonstrated with squirrel monkeys (Barrett, 1977) and has been recently demonstrated with pigeons (Tatham et al., 1994).

Discriminative Control Over History

One area in which there appears to be strikingly discordant results between the two paradigms is the extent to which behavioral history may be brought under stimulus control. The data on this issue are conflicting; control over behavioral history has been demonstrated within the FI effect tradition but has not been obtained with the punishment effect.

Two studies have reported stimulus

control over behavioral history. Freeman and Lattal (1992) trained pigeons on alternate sessions with DRL and FR schedules that were accompanied by distinctive chamber liners and key colors correlated with each session type. After response rates were clearly differentiated, the DRL and FR sessions were changed to identical FI sessions. However, the stimuli associated with DRL and FR continued to be presented on alternate days. In the presence of the DRL stimuli, FI response rates were lower than in the presence of the FR stimuli. These results clearly indicate that behavioral history can be brought under stimulus control.

In contrast, stimulus control over behavioral history has not been demonstrated with the punishment effect. Indeed, a variety of arguments may be offered to suggest that the punishment effect is remarkably resistant to stimulus control. The resistance of the punishment effect to stimulus control is illustrated by an experiment in which monkeys were initially trained on a multiple schedule (McKearney & Barrett, 1975). Responding was punished in the presence of one stimulus, whereas responding was not reinforced in the presence of a second stimulus. Initial dose–response determinations indicated that *d*-amphetamine decreased punished responding, as expected. Next, the extinction component was changed to a shock-postponement schedule. Responding in the two components was not only under good stimulus control, but administration of *d*-amphetamine now increased responding. Thus, the shock-postponement schedule altered the effects of the drug on punished responding, despite stimulus control with respect to the performances maintained during the two components. The schedule was then changed to a simple punishment schedule, and *d*-amphetamine continued to increase punished responding. These manipulations demonstrate that the punishment effect occurred despite stimulus control over the responding maintained by the history and test schedules. Other experiments described earlier also point to the resilience of the punishment effect with respect to discriminative control. Specifically, demonstrations of generalization of the effect across operants (Tatham et al., 1993, 1994) and the tentative finding that a shock-postponement history alters the effects of *d*-amphetamine on histamine-punished responding suggest that the punishment effect resists manipulations that might reasonably be expected to eliminate or diminish the effect, if the effect were readily amenable to stimulus control.

CONCLUSION

Behavioral history is a term that has been used loosely for a long time, often to "explain" otherwise inexplicable or idiosyncratic behavior. We have argued that this term should be used in a more disciplined fashion and have identified three dimensions relevant to identifying and classifying behavioral history phenomena. It is our hope that other authors will refine and extend our framework.

We have also attempted to integrate some of the research reported in various areas of behavioral history and suggest some new avenues of study that arise from this integration. Two of the most active areas of behavioral history research, the FI effect and the punishment effect, have been unfolding independently for several decades. Despite the fact that one line of research has been conducted within the domain of the conventional experimental analysis of behavior and the other has been conducted by behavioral pharmacologists, the data gathered within the two spheres are mutually corroborative in many instances. The history effects reviewed in this analysis reflect two rather distinct sets of methodology, and the basic paradigms differ in many regards. Although the FI effect is readily observable in ongoing schedule-controlled responding, the punishment effect is observable only after the administration of psychomotor stimulants. Furthermore, the FI effect is based on schedules of positive reinforcement in both the history and test phases of the paradigm, whereas the punishment effect involves a schedule of positive punishment as the test schedule and a shock-postponement contingency as the critical history. The two phenomena also differ with respect to longevity; the magnitude of the FI effect is typically observed to diminish over time (Tatham et al., 1993; Wanchisen et al., 1989; but cf. Wanchisen et al., 1998), whereas it appears that special procedures are necessary to diminish the punishment effect (Bacotti & McKearney, 1979).

Given that the evidence is mounting that some behavioral history effects are stable, long lasting, and replicable, moving towards integration of at least some of the research is an important step in behavior analysis. The two areas considered here are probably the most thoroughly investigated avenues of behavioral history research, and share similarities in basic theoretical issues while offering diverse experimental preparations. Continued research on these topics may result in the discovery of additional commonalities, and the ultimate goal is to deduce general principles of behavioral history by extending the present approach to all areas in which behavioral history plays a role.

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