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PROGRESSIVE-RATIO SCHEDULES AND APPLIED BEHAVIOR ANALYSIS

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Establishing appropriate relations between the basic and applied areas of behavior analysis has been of long and persistent interest to me (e.g., Friman & Poling, 1996; Poling, Picker, Grossett, Hall-Johnson, & Holbrook, 1981; Porritt, Van Wagner, & Poling, 2009). Therefore, I read with enthusiasm the collection of articles on progressive-ratio (PR) schedules that appeared in the Summer 2008 issue the *Journal of Applied Behavior Analysis* (*JABA*). For nearly 50 years, since they were first described by Hodos (1961), such schedules have been used in basic research published in the *Journal of the Experimental Analysis of Behavior* and elsewhere to measure what is commonly termed the *strength*, *potency*, or *effectiveness* of scheduled reinforcers. (The three terms appear to be synonymous, and hereafter I will use only *potency*.) The essential logic, reflected in all of the *JABA* articles, is that there is a direct relation between how hard an organism will work for access to an object or activity, as indexed by the largest ratio completed under a PR schedule (the *breaking point*), and the potency of the reinforcer.

It is important to recognize that reinforcer potency is a hypothetical construct, and prominent behavior analysts have argued consistently and compellingly that hypothetical constructs play no useful role in a science of behavior (e.g., Michael, 2004; Skinner, 1938). Unlike, for example, reinforcer delay or magnitude, reinforcer potency is not measured directly, but is instead inferred on the basis of how the scheduled event interacts with ongoing behavior. PR breaking strength is one measure of this interaction, but many others are tenable, including amount of time spent interacting with a reinforcer (think Premack principle), rate of responding engendered by a reinforcer, preference for a reinforcer (think matching equation), demand (in the behavioral economics sense) for a reinforcer, and resistance to disruption of behavior maintained by a reinforcer (behavioral momentum).

Although I will not attempt to review the relevant literature, basic and applied studies (including those published in the *JABA* collection on PR schedules) make it clear that these measures are not necessarily equivalent. As an example, consider cocaine. Acute administrations of the drug reduce self-reported craving for food in humans as well as food intake in humans and nonhumans alike, but they increase PR breaking points at low to moderate doses (Jones, LeSage, Sundby, & Poling, 1995; Sizemore, Cannon, Smith, & Dworkin, 2003; Thompson, 1977). Does the drug increase the reinforcing potency of food and act as an establishing operation (EO), as suggested by PR breaking points, or decrease it and act as an abolishing operation (AO), as suggested by craving and consumption?

As a second example, consider methylphenidate. A PR study with rats indicated that the drug increases breaking points for food reinforcers, suggesting that the drug is an EO (Poncelet, Chermat, Soubrie, & Simon, 1983). This suggestion is inconsistent with results of an experiment by Northup, Fusilier, Swanson, Roane, and Borrero (1997), who studied young people diagnosed with attention

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deficit hyperactivity disorder. These researchers systematically reinforced appropriate responses (completed math problems) with coupons (conditioned reinforcers) that could be exchanged for particular back-up reinforcers. Each time a reinforcer was earned, seven different coupons, each exchangeable for a different reinforcer, were available in a reinforcer selection arrangement. In general, coupons exchangeable for food were selected more often when placebo was given than when methylphenidate was administered, and coupons exchangeable for activities were selected more often in the latter condition than in the former. These findings suggest that the drug acted as an EO for social activities and as an AO for food.

Of course, the effects of drugs on PR responding and other aspects of behavior may reflect a mechanism other than altered reinforcer effectiveness, but the point is clear: PR schedules do not provide an uncontaminated index of the effects of drugs or other independent variables on reinforcer potency. As the examples of cocaine and methylphenidate illustrate, the apparent potency of a reinforcer may depend on the general procedure used to measure it. In addition to the general strategy used to quantify behavior, the specifics of a given procedure also can influence reinforcer potency. Roane (2008) indicated that this appears to be the case with PR schedules, but there are many uninvestigated areas for future research, including (a) how initial schedule value and step size influence findings in applied settings, (b) how response topographies influence results, and (c) whether behavioral economics analyses can be applied profitably to PR findings. In fact, he comments that ''almost any previous study that has examined variables that alter the effectiveness of positive reinforcement could be replicated [in applied settings] using PR schedules'' (p. 159). One can easily envision several lifetimes of research in this vein, especially when comparisons across all of the procedures available for measuring reinforcer potency, as well as within PR schedule variants, are considered and negative reinforcers are added to the mix.

Whether such research would yield much of applied benefit is debatable. My prediction is that it would not. In applied research—at least, when *applied* is defined as proposed in Baer, Wolf, and Risley's (1968) seminal article—the potency of a scheduled reinforcer is important primarily with respect to whether or not that reinforcer can be arranged to improve a socially significant target behavior. How it affects behavior in other circumstances, even in the population of concern (e.g., children with autism), is of value only if (a) this information is easily obtained, so there is little cost for people with special needs; and (b) this information allows applied behavior analysts to predict the clinical utility of the scheduled reinforcer. PR schedules are not an especially quick way to scale reinforcer potency. In addition, exposure to long ratios (as when the breaking point is approached) is known to be aversive (e.g., Dardano, 1973). Therefore, members of protected populations should not be exposed to them unless there are clear offsetting benefits. To date, no such benefits have been demonstrated, and no compelling arguments for their existence have been provided.

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