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DRIVERS OF BEHAVIOR: COMMENTS ON T. L. SMITH'S "SELECTION BY CONSEQUENCES IN THE ONTOGENY OF BEHAVIOR: THE PROBLEM OF THE FIRST INSTANCE"

William M. Baum[1]
University of California, Davis

ABSTRACT

Every Darwinian process consists of variation in a pool or population, recurrence of variants in the population, and selection as differential recurrence of variants. The members in the population vary in some property that functions to serve recurrence, and if some variant functions to serve greater recurrence, that variant increases in the population across time. This characterization applies to biological evolution, cultural evolution, and behavioral evolution. Contrary to Smith (2019), whether variation is qualitative or quantitative is of little moment. Selection is passive relative to variation and cannot be said to produce variation. Contrary to Smith, Skinner probably made no such assumption, but rather just took variation in behavior for granted, as inherent. In shaping, or behavioral evolution, recurrence occurs because activities are induced by phylogenetically important events (PIE). The concept of induction has broader explanatory power than the concept of reinforcement, because induction accounts for both non-operant and operant activities. Coupled with covariance between an activity and a PIE, induction removes the problem of the "first instance" that concerned Skinner and now concerns Smith.

Key terms: Behavioral evolution, shaping, Darwinian process, ontological individual, selection, induction

[1] Address correspondence to William M. Baum, 611 Mason #504, San Francisco, CA 94108. Email: billybaum94108@gmail.com

Every Darwinian evolutionary process, whether natural selection, cultural selection, or behavioral selection, consists of three parts: a) variation of a property across individuals in a population or pool; b) recurrence of the property from one time to another; and c) selection of certain variants of the property. The Price equation captures the process by stating that if the covariance of the property with fitness across individuals from Time 1 to Time 2 is greater than zero, then the property increases in the population (Baum, 2017b; Price, 1970, 1972).

A number of terms in the above definition require comment. Any *property* may be subject to evolution, but "property" may be defined in various ways, and we will need to discuss how to define property below. A *population* may consist of organisms, cultural practices, or the activities of an organism, which will most interest us here. It is most accurately defined as a lineage, an evolutionary history common to all members (Ghiselin, 1997). *Recurrence* from one time to another results from reproduction in natural selection, from imitation and rule-governance in cultural selection, and from induction in behavioral evolution (Baum, 2017a, 2017b). *Selection* is a bit of a misnomer, because it results simply from differential recurrence. In natural selection, if individuals with a certain level of a property leave more offspring with a similar level of the property, the mean level of the property in the population increases. In cultural evolution, if a variant of a practice is copied more often than its competitors, the frequency of that variant increases in the pool of cultural practices. In behavioral evolution, if a variant of an activity is induced more often than its competitors, the frequency of that variant increases in the population of activities occurring in an individual organism (Baum, 2012, 2017b, 2018b).

What should we mean by "property?" Price (1970, 1972) took a broad view, considering property to be anything that might vary across members of a population. Biologists often take property to mean a physical characteristic of an organism, like height or coat color. If evolution is a process, however, then its parts are also processes, and recurrence counts as a process. Recurrence serves a function, such as surviving, but ultimately serves reproducing. The property that recurs serves a function, and thus may always be defined functionally. For example, the height of a giraffe's neck serves the function of gaining access to food high off the ground. Selection for catching speedy antelopes results in selection of cheetahs' strong legs. Terns' flying east serves the function of reaching the coast of Europe. The physical properties that recur are not advantageous in themselves, but because they serve functions that make recurrence more likely.

Evolution depends on variation. If a property is invariant within a population, or if variation in a property fails to covary with recurrence, evolution cannot occur. Evolution depends on the existence of novel variants in the population. In natural selection, mutation and immigration introduce novel variants into the population, but the novel variants need not be recently introduced; they may only be expressed when recombination puts them into combination with other variants or when the environment changes to favor them. In cultural evolution and behavioral evolution, novel variants occur due to accident and error. Only variants that recur relatively more often may be said to be selected.

In the target article, Smith (2019) distinguishes between qualitative and quantitative variation in a property. They differ as to how many genetic loci are involved in the trait. Height, for example, is affected by hundreds of loci, and each may influence height in its own way (Berg et al., 2019). Height may be thought of as a quantitative trait, or continuous, but the continuity is approximate only. No matter the number of loci involved, any variants that recur more often increase in frequency with time. The same may be true of behavior, because activities are composed of parts that are themselves activities. An activity is, ontologically speaking, a process, and as time scale decreases, activities are processes all the way down. Large variations thus may

arise from many small changes in parts. For example, in the evolution of serving a tennis ball, one's first clumsy attempts ultimately give way to a smooth integrated performance. The tennis serve has a unitary quality that makes it an ontological individual (Baum, 2017c, 2018b).

Selection, however, stays independent of variation. Selection is passive in the sense that it only consists of one variant recurring more often over time than competitor variants. In particular, selection cannot produce variation. To say that selection produces variation is logically incorrect, because selection is just differential recurrence. Staddon and Simmelhag (1971) argued that behavioral variation and selection operate each according to its own laws. The laws of variation capture effects of variation in the environment in conjunction with an organism's tendencies toward induction of certain activities. Once, my mentor, R. J. Herrnstein, saw me in the laboratory trying unsuccessfully to train a pigeon to peck a key by successive approximations. The pigeon was bobbing its head in front of the key but never pecking. Herrnstein took hold of the connection to the key light and disconnected and reconnected it, flickering the key light. The pigeon immediately pecked the key. A law of variation was at work.

In the target article, Smith (2019) suggests that Skinner viewed all behavior as varying quantitatively or continuously because Skinner wrote about shaping as capitalizing on the introduction of new variants as the modal behavior shifted. Although Smith concludes that Skinner saw selection as generating new variation, I doubt that Skinner actually believed that. Instead, his account of shaping just seems to take the variation for granted, considering it inherent in behavior, while offering no theory as to how the new variants come about. The problem with cognitive psychology is not that it focuses on qualitative variation instead of quantitative variation in behavior, but that it doesn't deal with behavior at all and hence takes no interest in behavioral evolution or shaping.

Skinner did, however, write about shaping in ways that seem contradictory. The analogy to a sculptor modeling a block of clay suggests that behavior is shaped from "undifferentiated material." The suggestion of "natural lines of fracture" contradicts this, because it indicates that behavior is not "undifferentiated," but rather is inherently differentiated along natural lines. The latter view seems to be more consistent with what we have come to understand about behavior, particularly about the induction of specific activities (Segal, 1972; Staddon & Simmelhag, 1971).

I have argued elsewhere that induction is a more broadly explanatory concept than reinforcement (Baum, 2012, 2018a). Induction accounts for non-operant (adjunctive) activities that are induced by phylogenetically important events (PIE) as a result of natural selection. PIEs are events that affect reproductive success, such as a potential mate, food, predators, and injury; some support reproducing and others threaten reproducing. In addition, when covariance occurs between an activity and a PIE, the activity—traditionally called "operant" activity—comes to be induced by the PIE.

One strength of the concept of induction is that it eliminates the problem that concerns Smith (2019) in the target article, the so-called problem of the "first instance." The "problem" arises out of a fixation on order, the notion that a reinforcer must follow a response to strengthen the response. Induction takes us away from all three propositions included in this notion: a) the concept of discrete response, which is replaced by temporally extended activities defined along the "natural lines of fracture;" b) the concept of response-reinforcer contiguity, which is replaced by correlation or covariance; and c) the concept of strength, which was never clear anyway and simply disappears (Baum, 2012, 2018a, 2018b). When covariance occurs between an activity and a PIE, the covariance may be negative or positive, and, depending on whether the PIE is beneficial or detrimental, the PIE induces activities that either enhance or mitigate the PIE. In a typical

experiment with lever pressing and food, for example, pressing produces food and food induces pressing; a loop is closed that maintains the pressing as long as the covariance continues. The distinction between antecedent and consequence collapses, because, in a loop, no such distinction exists. The food may follow the pressing, but it also precedes the pressing. With the disappearance of the antecedent-consequence distinction, the problem of the "first instance" also disappears.

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