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FURTHER THOUGHTS ON SKINNER'S SELECTIONISM

MÁS PENSAMIENTOS SOBRE EL SELECCIONISMO DE SKINNER

David C. Palmer
Smith College

Farmer Brown raises border collies and enters them every year at sheep herding competitions. Following the practice of millennia of animal breeders before him, he mates his best males with his best females, hoping to produce a pup that will someday win the blue ribbon in the county trials. His neighbor, Farmer Jones, thinks Brown is wasting his time: all border collies have a herding instinct; that's what makes them border collies. Some are better at herding than others, and some are worse, but they all average out.

Is Farmer Brown a selectionist? He has never given any thought to the matter. He knows nothing of genetics, evolutionary theory, a science of learning, or the differential selection of cultural practices. But his actual practice of capitalizing on successive cycles of variation and selection to shift the typical value of a trait surely falls within a selectionist framework. (Darwin drew heavily from the observations of animal breeders like Farmer Brown.) In contrast, Farmer Jones attributes the behavior of his dogs to some quality that defines the breed; he sees any variability among dogs as mere chance deviations from the norm.

Farmer Brown and Farmer Jones are elementary representatives of selectionism and essentialism, respectively, two contrasting views of nature whose threads implicitly pervade both philosophy and science even today (Palmer & Donahoe, 1992). To a selectionist, variability is fundamental—there is no ideal type—but

Correspondence concerning this article should be addressed to the author at dcpalmer@smith.edu.

to an essentialist variability is a nuisance that hides the true nature of things. Early in his scientific career Skinner, like Farmer Brown, apparently gave no thought to selectionism, as an explicit intellectual position, but both his actual practice and his corresponding conceptual analyses set him firmly on the selectionist side of this divide. Like all products of selection processes, Skinner's mature position did not spring into being in one jump but developed over time. Just as it is a futile exercise to try to find a sharp boundary between two species—any apparent discontinuities arise from the absence of intermediate forms in the fossil record—it may not be possible to specify a point when Skinner became a fully-fledged selectionist. Nevertheless, the course of his intellectual development is of considerable interest. Although I might quibble about their criteria for what it means to be a selectionist, Leão and Neto (2018) have done an admirable job of identifying the emerging strands of this theme in Skinner's work during the first two decades of his professional development.

Why the Status of Behavior Analysis as a Selectionist Science Matters

The reason that we are interested in the role of selectionism in Skinner's science is that selectionist accounts of complexity in nature are extraordinarily parsimonious and powerful. Darwin showed that all of the nearly unlimited and exquisitely complex examples of biological adaptations could be explained as the outcome of a few simple and well known natural processes. His account is both beautiful and persuasive. An analogous process of variation and selection can be seen in the shaping of behavior by successive approximations. This analogy suggests that shaping might be an equally powerful and comprehensive explanation for behavioral adaptations. One reason for urging this point is that the adequacy of behavioral principles to explain complex behavior has long been in dispute. The challenges began in Watson's day and reached a crescendo in the middle decades of the 20th century (e.g., Chomsky, 1959, 1971; Fodor, 1975; Dennett, 1978, among many others). The analogy of shaping to evolution by natural selection suggests that Skinner's critics were wrong. At least in principle, shaping can explain a virtually unlimited range of behavioral phenomena.

Following Dawkins (1986), I have illustrated this point with a computer simulation. The program generates a string of random letters, which for our purposes we can call "response elements," say, speech sounds, words, or elementary movements. The program reproduces the string with occasional random variations and selects the "best" string as the parent of future cycles of variation and selection, analogous

to reinforcing a particular behavioral variant. The program will eventually converge on any target string the user chooses—as of course it must—be it the Gettysburg Address, Hamlet's soliloquy, or the Code of Hammurabi. In principle, such a selection process is capable of simulating any behavior that can be represented by a string of symbols. There are no limits to the "sample space" of potential behavioral permutations that a selectionist model can explain.

Unfortunately for this line of argument, much human behavior is conspicuously *not* the direct result of shaping; rather, it occurs in final form on its first occasion. The ubiquity of such examples might explain the resistance to behavioral interpretations of complex behavior. Skinner (1966) accounted for the immediate appearance of adaptive behavior by distinguishing between contingency-shaped behavior and rule-governed behavior. If we want to visit a new restaurant, we don't drive at random until we arrive: We ask directions from a friend, consult a map, or follow the instructions of a navigational device. As a result, we might get to our destination in the shortest possible time without having made a single wrong turn. In such cases, variation is not random; it is instructed, either directly or indirectly, by another person. Rules are just one example of the ways in which variation can be guided into an effective form. Imitative behavior, echoic behavior, textual behavior, the reading of musical scores, painting by numbers, Morse code, and semaphore, are all examples of processes of directed variation that short-circuit the shaping process (Palmer, 2012). The first instance of any adaptive behavior must be acquired through cycles of variation and selection, but once acquired by one individual, it can rapidly spread to others through directed variation. Genetic engineering, in which the genome of an organism is explicitly modified in the laboratory, exemplifies directed variation at the phylogenetic level, so in that respect also, the analogy with behavioral selection holds.

Our understanding of the means by which variation can be directed restores the vast explanatory power of selectionist accounts. The analogy between phylogenetic and ontogenetic selection is not perfect, but it need not be so. It is a heuristic that helps us see the potential power and parsimony of a behavioral interpretation of all behavior, human and nonhuman.

Selection at the Cultural Level

In my view, the analogy between phylogenetic selection and cultural selection is much weaker than with behavioral selection. The units of analysis in cultural change

are less distinct than genes or responses. In the competition between small tribes, a particular cultural practice might confer a decisive advantage and so endure over time. All other things being equal, a tribe that practiced hand washing to please the Goddess Idiris might survive an epidemic, and as a result that particular cultural mutation would continue to be passed on across generations. The unit of selection might be fairly clear in such a case. In ancient times tribes presumably cohered genetically, geographically, linguistically, and in their cultural practices.

But today cultural coherence is by no means distinct. On Monday, a Tamil-speaking software engineer hired by a Silicon Valley company develops code that protects computers from a virus; by Tuesday, the program has spread around the world. On Wednesday an Ebola vaccine based on a paper written by a consortium of European biologists begins clinical trials in hopes of preventing a possible future epidemic in Sierra Leone. We can detect the hand of selection at work in such scenarios in that effective programs and vaccines are adopted, while ineffective ones are abandoned, but I don't believe that the concept of cultural selection is helpful in understanding how this happens. It is true that the artifacts and practices of groups of people are adopted or abandoned across different people and generations, but it appears to me that we can understand such effects in terms of directed variation at the level of operant conditioning. Our task is to understand nature, not to insist on fealty to a particular viewpoint. The concept of cultural selection might help us understand some phenomena; in other cases, perhaps we can do without it. If so, nothing is lost. The truth remains that selection processes, in one form or another, appear to be adequate to explain the complexity of the biological world at both the morphological and behavioral levels.

The Essence of Selectionism

The thesis of Palmer and Donahoe's (1992) article was not that Skinner's concept of generic units of analysis (1935) was evidence of an explicit philosophical stance but that it placed him on the selectionist side of the selectionism/essentialism divide. As we pointed out, selection contingencies are like sieves: In order to be selected, some criterion, or a set of multiple criteria, must be met, but elements are otherwise free to vary. For example, to survive a wildfire, an animal needs to keep cool, usually by putting sufficient distance between itself and the flames. It might do so by flying away, by burrowing into the ground, or by outrunning the face of the fire. Within each modality of escape much variability is permitted: There

are many ways of flying, many shapes and sizes of wing, many ratios of body mass to wingspan, etc., that would permit the minimum speed and endurance of flight necessary to outpace the fire. At the level of behavior, there are many topographies of behavior that will open a door or turn a faucet, and there are even more topographies of behavior that will fail to do so. The two classes are distinguished by their consequences. Thus a particular selection contingency is blind to within-class variability, which means that, in principle, in the class of things selected, great heterogeneity is possible. Moreover, a given selection contingency is helpless to engineer homogeneity. One might say that this helplessness is the essence of selectionism. (If nature permitted only one possible way to satisfy a selection contingency, homogeneity might indeed emerge, but that would be an accidental circumstance that has no bearing on our generalization.)

Skinner (1935/1999) pointed out that reinforcement contingencies permit variability in response topography. For example, a lever can be pressed with a range of forces, postures, and muscle groups, but orderly data can be obtained even so:

> The number of distinguishable acts on the part of the rat which will give the required movement of the lever is indefinite and very large… Now it may be shown that under various circumstances the rate of responding is significant—that is to say, it maintains itself or changes in lawful ways. But the responses which contribute to this total number-per-unit-time are not identical. They are selected at random from the whole class— that is, by circumstances which are independent of the conditions determining the rate. Not only, therefore, are the members of the class all equally elicitable by the stimulation arising from the lever, they are *quantitatively mutually replaceable.* (p. 508, emphasis in the original.)

Furthermore, not only do selection contingencies permit this variability, orderliness is sacrificed if, for any given contingency, the experimenter arbitrarily restricts the range of responses that are tallied in the quantitative analyses:

> If we further limit the response by excluding all examples except those of one given kind (pressing with a certain muscle-group, for example), we destroy our curves by eliminating many instances contributing to them. The set of properties which gives us "pressing the lever" is uniquely determined; specifying either fewer or more will destroy the consistency of the result obtained. (p. 516)

In summary, Skinner was saying that an objective analysis of behavior yields analytical units that are fundamentally variable, reflecting the sieve-like nature of selection contingencies. However, this should not be taken to mean that the reinforcement contingency itself is, by itself, sufficient to specify an appropriate response class. An empirical search for orderly data is still necessary to characterize the response class. Skinner found that "pressing the lever" was an appropriate definition of a response class in his experiments, not because that was the criterion that met the contingency, but because the data, so defined, were orderly. That is to say, a response class must satisfy the reinforcement contingency, but a given class need not exhaust all the possible ways of doing so. As an analogy, there are many ways of fleeing a fire, and many different ways of doing so have indeed evolved, but it would be a mistake to consider the wings of a bird and the legs of a gazelle to be the same evolutionary adaptation. Likewise, a pigeon trained to peck a lever near the floor of a chamber will not therefore press it with its foot, even though both topographies would meet the contingency. A very rare exception would not justify lumping such a response together with lever-pecks in one's analysis, since the two topographies would not be, in Skinner's terms, "quantitatively mutually replaceable." In other words, units of behavior will vary within boundaries permitted by selection contingencies, but they need not embrace the full range of permitted variations. Just as there are multiple evolutionary strategies to meet a given contingency of survival, there might be multiple response classes that would meet a contingency of reinforcement. Defining the parameters of a response class is an empirical matter, not one to be settled by examining apparatus.

Saltations in the Evolution of a Selectionist

I have suggested that "becoming a selectionist" is itself a kind of evolutionary pathway, and that Skinner diverged from the essentialist branch of our intellectual family tree when he implicitly recognized that selection contingencies necessarily permit variability in the class of things selected. He embraced other features of the selectionist position over the next two decades in ways outlined by Leão and Carvalho (2018). But the evolutionary history of biological forms often reveals periods of relative stability interrupted by relatively brief periods of rapid changes in form. An analogous jump in Skinner's development as a selectionist occurred when he explicitly acknowledged the analogy between natural selection, shaping, and the

evolution of cultures. By my reading, *Science and Human Behavior* was his first explicit statement of this general selectionist position:

> We have seen that in certain respects operant reinforcement resembles the natural selection of evolutionary theory. Just as genetic characteristics which arise as mutations are selected or discarded by their consequences, so novel forms of behavior are selected or discarded through reinforcement. There is still a third kind of selection which applies to cultural practices. (1953, p. 430)

Was this jump to an explicit avowal of selectionism contingency-shaped, or might it have been an example of directed variation? Two years before Skinner published *Science and Human Behavior,* the British evolutionary biologist, J. W. S. Pringle,[1] published a paper on the analogy between learning and evolution. Skinner did not cite Pringle, and I know of no evidence that he read his paper, but it is plausible that Pringle's analogy was a topic of discussion among behaviorists at the time Skinner was working on his manuscript. Skinner was so well prepared for this evolutionary step in his position that it might have occurred under control of the natural contingencies of writing a comprehensive summary of the place of a behavioral analysis in science, but it remains a possibility that the step to an explicit avowal of selectionism was an example of directed variation that short-circuited the shaping process. If so, Pringle's paper must take its place in the long history of contingencies that shaped and directed Skinner's personal evolution as an exponent of selectionism.

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[1] Pringle was known to his students, of whom Richard Dawkins was one, as "Laughing John" for his dour personality (Dawkins, 2013).

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