Is Variability an Operant? Introductory Remarks

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The following article by Barba (2012a) addresses Neuringer's proposal that variability is an operant dimension of behavior, that is, that variability can be reinforced, extinguished, and brought under stimulus control, just like any other response property (e.g., Denney & Neuringer, 1998; Morgan & Neuringer, 1990; Neuringer, 1986, 2009; Page & Neuringer, 1985). Barba confines his argument to methodological considerations: He points out that the measures that have been used to assess Neuringer's proposal have been indirect and do not resolve the question one way or the other. Specifically, he argues that, in the relevant studies, the response properties on which reinforcement was contingent were not the same as the properties that were used as measures of variability. Thus, he holds that Neuringer's proposal remains in doubt until this methodological discrepancy is addressed.

Neuringer has supported his proposal with a long program of research over several decades, with pigeons, rats, and college students. In every case, variability in behavior increased when reinforcement contingencies were applied. This empirical finding is not in doubt. Moreover, it has practical applications, particularly for populations in which behavioral variability is limited. However, although the empirical findings appear to be robust, Neuringer's interpretation of them has been controversial on grounds other than those offered by Barba. As Holth (2012a) pointed out,

instances is problematic because such a class would have no defining criteria to permit the counting of instances, or even to specify where an instance of novel behavior starts or ends. (p. 88)

Thus, although the data show variability in behavior, it isn't clear what the units of analysis are. Most studies of variability have investigated sequences of behavior, in which variability is found in patterns of elementary responses that are not, themselves, novel. (Exceptions include studies of extinction, e.g., Antonitis, 1951; Notterman, 1959; and studies of variations in response topography, e.g., Pryor, Haag, & O'Reilly, 1969; but see Holth, 2012a, for an alternative view.) Can variability in the sequencing of elementary units be considered a dimension of operant behavior, or is a more fundamental interpretation possible? This problem is not unique to Neuringer's proposal. Generalized operants raise the same problem and occasion an analogous controversy. Because Barba's paper, and the topic of variability-as-operant generally, evoked a wide range of thoughtful remarks from the reviewers, we solicited commentaries from five experts on the conceptual foundations of behavior. Their articles offer the reader a wide range of opinions on Barba's target article, Neuringer's proposal, and some of the fundamental conceptual topics that are raised by the controversy. Neuringer (2012) ably defends his proposal on conceptual, methodological, and empirical grounds, and Holth (2012b), with reference to his own work on the topic, offers a contrary opinion on the same grounds. Machado and Tonneau (2012) challenge the premise of Barba's argument, but they offer an interpretation of the research on variability in

Conceptually, the idea of an operant class that consists of, or includes, all sorts of novel

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terms of differential extinction and reinforcement that does not require that variability itself be an operant. Marr (2012) points out that variability should not be confused with randomness and raises questions, challenging to all points of view, about how a science of behavior can decide on units of analysis, dependent variables, and levels of analysis with such a slippery topic. Barba (2012b) concludes the set by responding to the other commentaries and returning to his suggestion that questions about the operant nature of variability can be answered only when dependent variables and reinforcement criteria are the same.

In approaching the set of articles, perhaps the reader will find it helpful to consider some hypothetical cases. How, in general, do we decide whether something is an operant? How do we settle on a definition? The question is as old as behavior analysis itself. In "The Generic Nature of the Concepts of Stimulus and Response," Skinner (1935) wrestled with the question and offered an empirical solution: Define your units in such a way that the relation between behavior and its controlling variables, so defined, is most orderly. This requires exhaustive parametric research, and in practice, most researchers simply use well-tested experimental procedures or leave the matter of conceptual units to common sense. But consider the following cases:

- (a) A research team reinforces "weight loss." They can measure it precisely, and they discover that it is sensitive to reinforcement, punishment, and extinction procedures, and that it can be brought under stimulus control. In this case the dependent variable, as measured, is not behavior at all but an outcome of behavior. Following Skinner's maxim, they would vary their definitions and presumably discover that even more variance could be accounted

for by studying the behavior that mediates weight loss and the many conditioned reinforcers that attend such a complicated set of events.

- (b) A research team reinforces rapid heart beats. They too find that it is sensitive to the full range of behavioral procedures. Moreover, unlike the first team's dependent variable, theirs is behavior. But continued investigation reveals that the experimental subjects get up and run around when the contingency is in effect. When running is controlled for, the remaining effect on heart rate is absent, or very weak.

The point of these implausible scenarios is that the sensitivity of a variable to behavioral procedures is not, by itself, sufficient for us to determine that something is an operant if there are other behavioral events that mediate that sensitivity. Might variability be mediated in some analogous way? One possibility, noted by Neuringer himself, is that variable behavior might be "strategic." An experimental subject who is aware that his behavior is reinforced on a Lag 4 schedule could obtain every reinforcer by repeatedly cycling through the same four responses. An experimental subject asked to generate random numerals might recite telephone numbers, birth dates, time of day, mathematical constants, and so on. Strategic behavior of that sort might be possible for verbal adults, but it is implausible in pigeons and rats. However, a program of research by Machado has investigated the effect of local contingencies on variability and has shown, among other things, that differential reinforcement of various rates of switching behavior affects measures of variability in systematic ways (e.g., Machado, 1989, 1997).

The foregoing remarks are intended to illustrate the formidable problem of determining when something

is an operant, particularly when it is an atypical case. Perhaps the concept of the operant, like other natural categories, has fuzzy boundaries, and at those boundaries we may have to make do with a degree of uncertainty. Whatever the resolution of the claim that variability is an operant may be, variability is of fundamental importance to a science of behavior, just as it is to evolutionary biology. Repeated cycles of variation and selection offer a powerful and parsimonious explanation of both biological and behavioral adaptations to changing contingencies. Both evolution and shaping illustrate differential selection of some candidates from pools of variants (Pringle, 1951; Skinner, 1953, 1981). The scope of such accounts is limited by the selection contingencies themselves (not all programs of contingencies occur in nature) but a second constraint is imposed by sources of variation, because without variation, neither evolution nor shaping could occur. Ultimately, variation is the origin of all behavior.

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