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A Rodent for your Thoughts: The Animal Model Strategy in Psychology

by Kenneth Shapiro

In the previous essay, I described how psychology turned the rat white - how, in constructing a laboratory-based science, psychologists transformed animals of species such as *Norvegicus rattus* into the newly constructed category of "laboratory animals" to fit the requirements of an objective, experimentalist research enterprise. In doing so, they reduced these animals to instruments within a highly technologized laboratory space - attempting to rob them of their individual, species-specific, and even animal nature.

In this second of three essays, I describe how the early modern psychologists adopted the strategy of further transforming rats and other species into models of human thought, feeling, and behavior, and, particularly, of disorders of these - in effect taking "a rodent for your thoughts." In the third essay I will provide a critique and empirically-based evaluation of animal model research. Here I indicate what the model strategy in the biomedical sciences, properly understood, is intended to achieve and how, by contrast, particular models are presented to the public and funding agencies. Finally, I describe how they are utilized in psychology.

The concept of a model in science

Models are analogies. By definition, a model is analogous to but not identical with the actual object of study. If it were identical, it would be that thing itself and precisely not a model. But why do scientists develop models instead of directly investigating the object of study? Is not direct observation a foundational desideratum of

objective science? Scientists turn to the construction of analogies when the object of study is inaccessible (stars) or too complex (the human brain) or too uncontrollable to vary one or two features at a time, as is required in the experimental method, or when there are ethical constraints on direct study of the object under investigation.

However, these occasioning circumstances are not critical to understanding the models approach in science. A primary function of a model is as a device, called a heuristic, that helps the investigator to think about and generate new hypotheses about the actual object of study. This generative or heuristic function does not require the model to duplicate the object of study in every feature. Variations on a theme and even clear differences can be informative. It is important to understand, then, that the value of any insights gained from a model cannot be judged simply by examining the degree to which that model duplicates features of the actual object of study. But this also means that, ultimately, any new insights suggested by a model are only hypotheses. For them to be new understanding, they must be validated in the original, in every instance.

It follows that a critique of animal model research that is limited to the specification of differences between the model and the original is a preliminary and, actually, weak critique. On the other hand, it also follows that any defense of a model that is limited to the specification of similarities is a preliminary and weak defense.

The real question is: Did the model have any heuristic value, that is did it generate any new understanding in the original; and, in the instance of the study of disorders, did any beneficial intervention or treatment result from this understanding? In the third

essay I will describe ways of answering this question scientifically, that is systematically and empirically.

Unfortunately, many proponents and some detractors of animal-based research fail to understand the need for, let alone provide the requisite data resulting from, such scrutiny. Both in whitepapers emanating from their professional organizations and in presentations to the popular press, advocates of the use of animal models clearly attempt to convey the notion that a model is the disease "in every respect"ⁱ or at least hosts an entity that is. One result is the continual publication of news items claiming to announce a breakthrough, the discovery of a model of a particular disease afflicting humans - wherein the model is taken as an exact duplication of, or a re-presentation of the disease itself.

As indicated by the definition of a model, this claim is misleading and inflated. No model can be identical with that which is being modeled. More particularly, in the case of a disease, no disease can be identical in different species: even one resulting from a bacterial germ is conditioned and shaped by the particular host organism. This is even more clearly the case for the modern major killer diseases, which are more complex in their etiology than were the infectious diseases such as tuberculosis - for which science first developed animal models by simply inoculating animals with the tuberculosis-inducing bacteria. For example, tumor formation and cancer generally in a rat is necessarily different from that in a human being or, for that matter, in a mouse.

Animal models in psychology

When we turn to models of psychological disorders, the differences between the model and that which is modeled are more striking. Any claim of duplication "in every respect" is more far-fetched. For example, while nonhuman animals do get depressed and while some of the physiological processes accompanying or even underlying their depression may be analogous to those in humans, this disorder, like all other psychological disorders, is also shaped and conditioned by the meanings it is given in a particular cultural context.

A recently published bibliography of "animal models of human pathology," which lists over 2500 abstracts of studies,ⁱⁱ demonstrates that psychologists have attempted to develop an animal model for virtually every known problem in the human condition that has even a remotely psychological cast. To illustrate the animal model strategy in psychology, I will describe one of many models developed for bulimia anorexia, an eating disorder that has reached near epidemic levels in the last two decades.

High levels of incidence of the disorder are found among women, and particularly women in urbanized (and highly commercialized) cultures and subcultures such as college campuses in the United States.ⁱⁱⁱ According to the diagnostic system most employed by mental health providers and the insurance industry,^{iv} the essential features of bulimia are:

... recurrent episodes of binge eating (rapid consumption of a large amount of food in a discrete period of time); a feeling of lack of control over eating behavior during the eating binges; self-induced vomiting, use of laxatives or diuretics, strict

diETING or fasting, or vigorous exercise in order to prevent weight gain; and persistent overconcern with body shape and weight (pp. 545-550).

The sham feeding model of bulimia

In sham or mock feeding, surgery is performed on an animal to produce a fistula, a tube-like passage from an interior cavity to the surface of the body. These holes are made in the stomach (gastric fistula), the esophagus (a canal above the stomach), or, in some experiments, both. Sham feeding has been used on rats, the predominantly utilized species, as well as on dogs, monkeys, and rabbits.

In a typical sham feeding experiment, following anesthesia, a stainless steel tube (cannula) is sutured into the stomach of a rat. Coming out of the muscle wall of the stomach, the tube emerges on the back of the animal, under the shoulder. This tube is connected to a needle tube that is cemented to a fiberglass screen that provides anchoring under the skin. The tube is fitted with a screw or cap so that it may be opened or closed. The needle tube is connected to a plastic tube which extends up through a hole in the ceiling of the animal's testing cage. This tube can be connected to a syringe to draw out ingested foodstuffs.

Sham feeding grossly mimics the bulimic behavior of bingeing and purging: in both food is ingested without being fully digested. It has been found that, even after the fistula has been closed, animals subjected to sham feeding eat more and with shorter intervals between meals. such initial findings and the analogy that both bulimia and

sham feeding involve "eating without calories" provide the basis for asserting that sham feeding is a model of bulimia.

Based on this rough analogy, a more or less inexhaustible set of variables become fair game for further study, as a large number of variables affect appetite and food intake. Using the sham feed model, subsequent research explores the considerable complexities of eating behavior - in the mouth, chewing and taste, orosensory experience; in the gut, absorption, satiation; in the brain, neurotransmitters, effects of pleasure, stress.

General characteristics of animal models in psychology

While an empirical assessment and a consideration of the ethics involved awaits the final installment, certain general characteristics of the animal model strategy in psychology can be drawn from my investigation of models of eating disorders, only one of which is suggested here:

1. Models are typically built on a rough analogy that features one or two parameters of the disorder of interest. They are far from duplicative "in all respects."

2. Animal model research builds or feeds on itself. There are many models of bulimia, and each produces variables that are then studied in relation to each other and many other variables already in the literature - studies on food preference, tastiness, food deprivation, stress, recreational and pharmacological drugs, physiological mechanisms through brain stimulation and lesioning... In this sense the enterprise is ingrown. I will document the lack of reciprocal interaction between the clinic and the laboratory in the final installment.

3. While demographic and epidemiological evidence strongly indicates the cultural basis of this disorder (e.g., "the thin culture"), lab-based animal model research strongly biases toward the exploration of physiological mechanisms as the cause of the disorder rather than value conflicts, issues of self-image, and other sociopsychological factors. These latter phenomena are more difficult to even roughly analogize in the laboratory and with nonhuman animals. The former are more readily manipulated, controlled, and measured - considerations that are critical to the experimental method and its further development, the animal model strategy.

4. Following from this emphasis on physiological rather than psychological discourse, investigators focus their search for effective interventions on the discovery of pharmacological treatments - in effect, a silver bullet that will "cure" this complex, culturally-embedded behavior. While in principle a culturally-based disorder can be controlled pharmacologically, the search for drug-based intervention here is dictated by the constraints and predilections of lab-based animal research, rather than by careful consideration of the phenomenon as seen in the clinic and family.

5. Another feature of this experimentalist enterprise is the value placed on the use of sophisticated technology. The development of metabolic chambers, wire implants, micro-lesioning, computer-based devices for long-term recording of neural and metabolic events all become preoccupying concerns of the investigator. This further distracts the investigator from study of the cultural, symbolic, and family-based variables that most clinicians believe are critical to the understanding and effective treatment of eating disorders.

6. Finally, this research typically involves considerable distress and harm. This is the case because the disorders modeled are themselves distressing, often involving considerable anxiety and depression; and because the focus on physiological variables often involves invasive procedures.

References

ⁱ This phrase is taken from a white paper produced by the American Medical Association in defense of animal research (AMA, March, 1988, *Use of animals in biomedical research: The challenge and response*).

ⁱⁱ Overmier, J. B. and Burke, P. D. (Eds.). (1992). *Animal models of human pathology: A bibliography of a quarter century of behavioral research, 1967-1992*. Washington, DC: American Psychological Association.

ⁱⁱⁱ Vandereycken W. & Hoek, H. W. (1992). Are eating disorders culture-bound syndromes? In K. A. Halmi (Ed.), *Psychobiology and treatment of anorexia nervosa and bulimia nervosa* (pp. 19-36). Washington, DC: American Psychiatric Press.

^{iv} *The Diagnostic and Statistical Manual of Mental Disorders* (4th ed., 1994), known as the DSM-IV, is produced and published by the American Psychiatric Association in Washington DC.