# Column 2: Exploring Mysteries of Living: Behavior and Science



**A Los Alamos member of The International Behaviorology Institute**

***Why these Columns?*** Because human behavior causes global problems, and solving these problems requires changes in human behavior… So *everyone* benefits from knowing something about the natural science of human behavior (called behaviorology) that these columns relate. Having first appeared as newspaper columns, these columns began appearing on **BehaviorInfo.com** starting in 2020.

Living on the edge of a small town, I write this as a bright February sun illuminates nearby farm fields already devoid of snow. Deer pass through the unfenced yards between well–spaced homes in the twilight hours of morning and evening, tasting everything on their way to or from an undeveloped area at the center of the next block. One or another dog is always pulling an owner down the street. The resplendent view and clean air invite one to take a walk even without a pet, but a short distance in the stiff breeze, with the temperature below freezing, quickly compels a return to the warm side of the window with a cup of hot cocoa in hand.

That is no idle scene. After each column, you may be able to return to this scenario and count the increasing number of our topics that make cameo appearances in this event snapshot.

The focus now is on some premises of the science that we cover, the natural science of human nature and human behavior that we now call behaviorology. Actually, it is the science of the behavior of all animals. Many lines of development built this science over the last 100 years. Later columns consider not only many of the contingency relations that determine behavior, but also the contingency engineering available to help humanity solve its problems.

"Contingencies" refer to functional relations between variables, and soon get covered in their own column. Some of the scientific answers that this discipline supplies for some of our ancient questions will also receive coverage in future columns.

Consider now the general notion of science, and what is perhaps a most basic and yet seldom acknowledged characteristic of science. This characteristic only began to demand attention in the last several decades, especially with the rise of the natural science of behavior. What is this characteristic? It is behavior itself.

Science provides the foundations for a broad range of both beneficial and occasionally damaging products for humanity. The news media keep scientific and engineering developments in the public eye, although sometimes they focus excess attention on occasional disputes, sometimes physical, over who reached some milestone first, or the luckily even more rare occurrence of data faking.

Why do such things happen? All of these things, good and bad developments, and squabbles, and faking, all happen because they all share the fundamental characteristic of all science that demands our attention: *Science is behavior.* Those things happening become less surprising and more comprehensible as familiarity with behavior, and the variables responsible for it, increases.

Consider science as behavior more specifically. Science is the work–related thoughts, emotions, feelings, and muscle movements, all of which are behaviors, of those whom we call scientists, which includes me and maybe you and also the applied scientists we call engineers. All these behaviors occur under control of the same sorts of "causes," or more technically, "functional independent variables" that affect the behaviors of everyone else as well, including other animals.

Recognizing the nature of science as behavior helps us examine some aspects and constraints not only of scientific endeavors but also of any and all human endeavors, from the most mundane to the truly grand.

As with all behaving organisms, scientists are organisms whose behavior is entirely natural. That means it is neither magical nor spontaneous. Instead it occurs due to real, measurable variables. Nature contains a wide range of variables that naturally affect behavior in ways that scientific behaviors can discover and apply for humanity's benefit.

Scientific behaviors include analyzing phenomena, experimentally if possible, and both disseminating findings and developing them into practical products or procedures. Scientific behaviors also include respecting naturalism, which is the name of the assumptions behind science, the name of the general philosophy of science of the natural sciences. These assumptions interact with science, including with research methods, in a quality controlling manner.

For example, one reason for some interplay, between philosophy of science and research methods, shows up in the assumptions about why variability occurs in experimental data. The term "variability" refers to the fact that repeated measurements of events seldom produce identical data points. The measured amounts vary. Behaviorologists find that different, and unequal, assumptions about the source of the variability tend to come with different methodologies, especially for studying behavior.

On the one hand, behaviorologists see some researchers, especially from non–natural disciplines interested in behavior, assuming that observed variability arises from the fanciful and spontaneous actions of some supposed inner agents that they have posited as causing a behavior of concern, for example a psyche. The magical status of the resulting variability prevents access to it. Thus, one cannot reduce this variability.

The most commonly accepted method to deal with variability that one cannot reduce involves using a group statistical design of one sort or another. In these methods the

mathematical manipulation of the data supposedly spreads out the variability across a large number of randomly selected subjects so that the variability can be "ignored."

On the other hand, for behaviorologists, those putative inner agents cannot be taken as the source of observed variability, because behaviorologists, as natural scientists, cannot grant status to inner agents deemed magical or mystical. This means that variability must stem from something else. Whatever that is, can a different methodology deal with it, perhaps by reducing it? Yes.

Starting with their early experimental work in the 1930s, behaviorologists identify a different source for variability, one related to how thoroughly, or not, we exert experimental control over any functional variables related to a behavior under study. We began working with handfuls of subjects, three to six “per experiment.” Actually three subjects would really be three experiments, as we consider the behavior of each subject individually, because the behavior we study is primarily a phenomenon of individual organisms.

If our experimental arrangements actually controlled every variable relevant to the behavior of concern, no variability would occur. All the measurements would be the same, and the results would match predictions. But this never really occurs, because we can rarely, if ever, control all the variables. So the measurements always vary and predictions are always off by some amount. These amounts indicate the variability, which we thus see as arising from the effects of the variables over which we did not exert experimental control.

This kind of variability is not mysterious. It derives from the incompleteness of our control over functional variables. The variability is larger when we control only a few of the relevant variables, leading to greater measured differences between predictions and outcomes. On the other hand, the variability is smaller when we control more of the relevant variables, leading to smaller measured differences between predictions and outcomes. This means we can reduce variability by taking more of the functional variables into account. Other natural sciences experience similar considerations.

Realistically, however, economics must enter this picture, because taking variables into account is expensive, not just in terms of energy and some other resources, but in terms of funding. Generally, the greater the number of variables measured, and either held steady or altered, the higher the associated monetary expenses. As the importance of the experimental question increases, we must bear more of these costs to take more of the relevant variables into account to answer the experimental question more thoroughly. This reduces variability and increases the success of prediction, control, interpretation, and application, which in some important ways justifies the increased funds society provides to cover the expenses.

Conversely, for less important questions, with control being costly, we settle for controlling fewer variables and so must tolerate more variability along with associated reductions in the accuracy of prediction, and so on. After all, events are still lawful and orderly. We must, of course, be careful not to let costs determine the importance of the experimental questions.

Still, the point is that the source of variability resides in the functional variables that are not taken into account. Said another way, the source of variability resides in the amount

of residual ignorance we must tolerate from affording a decreased amount of experimental control over all the variables related to the events under study.

How does variability affect the selection of experimental methodology? As mentioned, others select methodology that includes group statistical designs to deal with variability from presumed inner–agent spontaneous causes. For behaviorologists, no need exists to smooth out variability from discredited capricious inner agents across subjects in groups. And in any case such group studies tell us little about the behavior of the individuals in those groups; their individual behavior is an important focus.

Instead we adopt the methods that most effectively control, for a given amount of research funds, the most variables affecting a single subject, with three to six subjects studied, thereby providing a built–in minimal level of replication, reliability, and generality for the results. Since the single–subject designs that we adopted early on meet these requirements quite well, we continue to emphasize them in the natural science of behavior.

Mostly through these kinds of methodology, behaviorologists work to discern and apply the variables of which behavior is a function. These variables generally reside in an organism's species history, personal history, current situation and, particularly for people, the socio–cultural setting, all sources of material for future columns.

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