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The Relationship between Systems Theory and Behavior Analysis

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Western Michigan University

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THE RELATIONSHIP BETWEEN SYSTEMS
THEORY AND BEHAVIOR ANALYSIS

by

Michael B. Oberlin

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in partial fulfillment of the
requirements for the
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THE RELATIONSHIP BETWEEN SYSTEMS THEORY AND BEHAVIOR ANALYSIS

Michael B. Oberlin, Ph.D.
Western Michigan University, 1983

This paper provides a conceptual framework which clarifies the relationship between General Systems Theory and Behavior Analysis. This framework is supplied by a theoretical notion borrowed from Simon (1962), the notion of "dynamics of interaction." "Interaction" refers to interaction between the units of analysis of science, e.g., in the analysis of behavior, stimuli, responses, and consequences in economics, units of supply and demand. The paradigm of Behavior Analysis is seen to accommodate a "higher-frequency dynamics" found in subsystems; and General Systems Theory, along with disciplines like Economics and Organizational Analysis, accommodates a "lower-frequency dynamics" found in systems. Argument is based on the observation that the average duration of interaction, and interval between interactions, is greater at the level of organizations, for example, than that of the individual organism. The implication for the applied behavior analysts is that, in their efforts to design enduring behavior change programs, they must also attend to the low-frequency dynamics which form the context for these programs.
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Michael B. Oberlin
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CHAPTER I

INTRODUCTION

There is an increase in the number of articles on Systems Theory published in Behavior Analysis journals. Systems Theory topics have been included in recent Applied Behavior Analysis convention programs, and Systems Analysis is now frequently discussed by behavior therapists. Yet, many individuals in the field of Applied Behavior Analysis still are uncertain about how to view Systems Theory. Questions which arise include the following: What is Systems Analysis, and what is its relationship to Behavior Analysis? What role does Systems Analysis play in the management of behavior? Do Systems Analysis and Behavior Analysis offer competing explanations of the behavior of organisms, or is the knowledge they provide somehow complementary? These are important questions. Answers to these questions will tell us more about the nature of problems that each discipline is equipped to handle. The author attempts to provide these answers in the following paper.

The thesis of this paper is that Systems Theory and Behavior Analysis (BA) complement one another; that each adds a needed set of tools to the other's repertoire. This thesis is not novel. A conference of leading behavior analysts and systems analysts, and the book that resulted from this conference (Harshbarger & Whaley, 1974), addressed the topic of the integration of the two areas.

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What is novel about this paper is that it provides a conceptual framework which clarifies the relationship between Systems Theory and BA. Whenever we have a difference in perspective as large as we do between these two disciplines, it becomes difficult to discuss the nature of one in the terms available in the other. As Kuhn (1970) has argued, a difference in paradigms exists which creates a barrier to communication. One solution is to employ concepts that are independent of the two paradigms. This is what the author has done. This conceptual framework is supplied by a theoretical notion borrowed from Simon (1962), the notion of "dynamics of interaction." The author will argue that the paradigm used for BA accommodates a "higher frequency dynamics" found in subsystems; and that of Systems Analysis (SA) a "lower frequency dynamics," the dynamics of extended time frames and complexes of variables found in systems. This notion of dynamics of interaction integrates the discussion of SA and BA, and serves as a dimension along which these and other areas of inquiry can be compared. Working within this framework has made it possible to provide a comprehensive description of the role of SA and BA, at both the practical and theoretical levels.

The problem facing the behavior analyst is a problem that faces many trained professionals. As professionals we have learned to recognize areas where our methods are effective—what we have not learned nearly as well are the limitations of our methods. The latter is especially problematic. The surgeon is trained to see surgical solutions to problems, the behavior analyst to see problems as faulty contingencies—both find it difficult not to phrase...
solutions in these terms. Yet, in managing the behavior of organisms, the behavior analyst encounters problems not amenable to current behavioral technology. BA, for example, defines the kinds of contingencies that must be present to maintain behavior, but gives little direction in managing the system level variables that generate these contingencies. The behavior analyst also finds the contingency insufficient in orchestrating the behavior of large numbers of organisms. For these problems the behavior analyst is poorly equipped. It is the recognition that BA is unable to deal effectively with these important problems that has led behavior analysts to Systems Analysis.

One important consequence of studying Systems Theory is that one becomes conscious of the incompleteness of vision of any one field of science, and the necessity for consultation across disciplines. The behavior analyst has been telling the physiologist for decades that he must move outside the organism's skin to fully understand muscle action (Skinner, 1974)—the message from Systems Theory to BA is that BA must now expand its field of vision. Setting up an effective behavioral program requires more than skills in BA. The applied behavior analyst must acquire a repertoire in organizational theory, administration, management, marketing, and other areas; the experimental behavior analyst must acquire a repertoire in laboratory management, computer technology, data analysis, and other specialties.

It is just in those areas where BA performs most poorly that the tools of Systems Theory fit best. This is in the area of
complexes of variables and extended time frames—the level of description that might be referred to as "system." Systems concepts enable the behavior analyst to understand the other levels of organization which form the context for their Behavior Analysis. BA, for example, can help in the selection of training material and designing classroom contingencies so that learning occurs, but BA does not help in analyzing the organization to determine the best training objectives, or in designing a training department so that it adapts to the changing needs of the organization. This requires Systems Analysis. Systems Theory facilitates the orchestration of these variables; variables effecting the long-range viability of behavioral interventions.

A problem which belongs in this area, a recurring problem for the behavior analyst is that of maintenance. How can longevity be designed into behavioral systems? Too often, behavior analysts return to find token economies and classroom contingencies only a semblance of the procedures they first implemented. This paper suggests how Systems Theory may offer solutions to these and other problems facing the behavior analyst.

The author will provide a description of the role of BA and the role of Systems Theory in the management of behavior. Throughout this paper it is contended that these two areas complement one another; that an understanding of both is necessary to effectively predict and control behavior outside the laboratory. Although much of this paper may be considered a theoretical analysis, it is the author's hope that it will, like all good theoretical papers, impact
more than just the reader's verbal behavior, and will facilitate the actual use of the tools of SA and BA as well.
CHAPTER II

WHAT IS SYSTEMS ANALYSIS?
AN OVERVIEW

Initially, it will be necessary to clarify the meaning of the term "system." "System" has been defined variously as: "a set of interacting units with relationships among them" (Miller, 1978, p. 298); "a set of elements connected together which form a whole" (Checkland, 1981, p. 3); and "a complex of interacting elements" (Bertalanffy, 1968, p. 55).

From these definitions, "interaction" appears a key characteristic of systems. Components are said to form a system when, by their mutual interaction, a set of variables is kept in equilibrium. The components of the human body work together to maintain body temperature and blood-sugar levels within the narrow range necessary for survival. Similarly, the individuals in a business organization interact in ways which they hope will maintain the level of profit and return on investment necessary for that system's survival.

The word "system" also implies boundedness; some interface separating system from environment. The speaker must designate this boundary, since the term itself refers to any level or span of organization. Its reference, in fact, varies with the focus of discussion. If discussion is centered on the individual organs, for example, that conventionally would be designated the system. The circulatory, digestive, and nervous systems might then be described
as subsystems, and the community in which the individual lives as the suprasystem.

In addition to specifying the level or span of reference of this term, it is necessary to further specify the aspects of the systems one is interested in analyzing. A system model might be used to describe an individual's physiological, psychological, or economic functioning, for example. The point is that the speaker must supply as much added clarification as a particular discussion demands (Beer, 1979). This brief explanation of the term "system" will serve the purpose at this time—the rest of this paper wrestles with providing a more adequate understanding of systems concepts in relation to BA.

Anyone trying to acquaint themselves with the area of Systems Analysis is struck by the diversity of approaches heralded under this name. One may encounter the precise model building of Forrester (1969); or encounter Boulding (1968), or Bertalanffy (1975), entertaining metaphorical notions of "system growth," "death," and "negentropy." There appears a spectrum of approaches to Systems Analysis.

The range of topics in the systems literature is as diverse as the professions of its contributors. Biologists, economists, psychologists, and educators all can be found advocating systems approaches. What is Systems Theory that it can contain this diversity? The definition proposed here is: Systems Theory is an attempt to describe individuals and their interrelationships, through
model building or other theoretical analysis.¹

If this broad definition is employed, each scientific discipline should, in fact, be viewed as a special case of Systems Analysis. The neuro-chemist fashions a model of the major chemicals and relationships occurring at the level of the neuron, the behavior analyst works with the three term contingency in analyzing the behavior of the individual organism, and the organizational analyst constructs an information flow chart to understand the relationship between departments—each scientist attempts to describe behavior at a chosen level of organization. A special view of science results from this formulation. The collection of scientific disciplines appears as a strata of descriptions, with various fields concentrating on different levels of organization. At the suborganic level there are fields such as Quantum Physics, Physical and Organic Chemistry, and Molecular Biology; at the organic level, Zoology, Physical Anthropology, and Behavioral Psychology; and at the supra-organic level, Ecology, Sociology, Organization Theory, and Economics. Figure 1 describes such strata.

Broadening the definition of Systems Analysis to include established scientific disciplines is most useful. This formulation enables one to put BA and other scientific disciplines, as well as General Systems Theory (GST), the subject of the next section, in perspective.

¹The author uses the term "individual" as Boulding (1968) does, to mean basic units of study, e.g., atoms, cells, organisms, families, species, as well as dollars, and units of supply and demand.
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Figure 1. Levels of description in science.
What people generally think of as Systems Analysis owes much to the endeavors of a group called the General Systems theorists. This group represents a new breed of less restrained, more ambitious scientists; people like Boulding and Bertalanffy.

While recognizing the integrity of the individual sciences, these theorists were struck by the similarities in the theoretical constructs of different disciplines. This led them to try to develop simple models which would describe these similarities, viz., these basic patterns discovered at the various levels of scientific description. It was an exercise in the Systems Analysis of systems.

The three term contingency, Stimulus-Response-Consequence (SRC), can be thought of as a model aiding in the prediction of responses. This model is applied at one level, to the behavior of the individual organism. In contrast, the General Systems model, to be introduced in Chapter III, describes interaction among individuals at any level of description. This model can be applied at the level of the individual organism, i.e., the level of BA, or a higher level, the level of the family, for example. If the GST model is applied to this living organism as a system, responses become the individuals, and the role of the systems model is in explaining interactions between responses and the environment. It will be seen later that, when applied at the level of BA, the general systems model and the three term contingency are very similar. This, of course, is what should be expected, if the basic tenet of GST (that of the isomorphism of interactional patterns at different organizational levels)
is valid; and if the model is accurate in depicting these patterns.\textsuperscript{2}

In the next chapter, this paper will set the background and discuss some of the ideas of a few of the more important General Systems theorists. Chapter III will then examine a simple General Systems model in detail. The ideas touched on in the overview in this section will become clearer in succeeding chapters.

\textsuperscript{2}In fact, much confusion about SA among behavioral scientists arises because SA is encountered at the level of the individual organism. At this level, both SA and BA produce similar descriptions and similar recommendations. To the behavior analyst, Systems Analysis appears to be offering a rival account of behavior, and nothing more.
CHAPTER III

GENERAL SYSTEMS THEORY AND THE EXPERIMENTAL
ANALYSIS OF BEHAVIOR: DIFFERENT
ORIENTATIONS TO SCIENCE

Describing the Theoretical Foundations of General
Systems Theory and the Experimental
Analysis of Behavior

A basic understanding of the theoretical orientation of General
Systems Theory makes it clear how the systems view of the world pro­
vides a perspective different from that of the Experimental Analysis
of Behavior (EAB) and Applied Behavior Analysis (ABA).

All of science is a search for simplicity (Rapoport, 1966). The physiologist seeks order underlying the diverse organic phenome­
non he encounters, the physician searches for simple characteristics
by which pathogens may be grouped and better understood, and the
experimental psychologist simplifies complex behavior by relating it
to predictable environmental events. General Systems Theory also
seeks simplification. It does this by discovering repeating pat­
terns of organization. Its goal is to find the fundamental organi­
zational features shared by all natural systems.

This emphasis of Systems Theory on general structure contrasts
with an experimental approach. In the experimental analysis of be­
havior, complexity is reduced by dissecting what Lazlo (1972) called
"complex wholes," until the number of variables controlling the dis­
sected unit becomes manageable. At this point, variables can be

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experimentally manipulated to illuminate the important relations.

Most of scientific progress resulted from a methodology which devised laws applicable to complex behavior by examining the details of isolated simple behavior. The operant conditioning chamber permitted the study of a simple response under conditions sufficiently controlled that important relations between the behavior and the controlling variables could be discovered (Skinner, 1938). Similarly, the isolation of single cells in medical research permitted the elucidation of their function. By isolating the subject, manipulating a single variable, and recording quantifiable changes in the individual's response, additions have gradually been made to the knowledge of these subjects.

General Systems Theory broke from this traditional, atomistic methodology. In contrast to the study of the single organism in its austere chamber, General Systems Theory arose from observations of organisms in complex intercourse with their environments. Physicians, biologists, economists, and scientists from a diversity of other fields compared notes and noticed that the patterns of interaction among the individuals in each of the disciplines bore striking similarities; the way cells interacted could be described in ways very much like the way different species interacted, which was similar to descriptions of the way business organizations interacted. Principles governing interaction among individuals at all levels in the strata appeared surprisingly similar. In light of the ubiquity of these patterns, scientists began to question whether their own fields were really achieving the "optimum level of generality"
(Boulding, 1968), and whether or not some general theory of interaction might not be possible. This thinking marked the genesis of General Systems Theory.

Introducing Some System Concepts

Where experimental behavior analysts had discovered principles governing the behavior of the individual organism, General Systems Theory sought an explanation for the orderly relations characteristic of individuals interrelated within a system. This search resulted in the discovery of a number of features that appear common to all living systems. In a monumental work Miller (1978) identified 19 functions, showing how they can be found in processes such as "ingestion," and in what he termed "distribution," "conversion," and "extrusion." These processes refer to, respectively: bringing matter/energy into the system, spreading this matter/energy around to sites where it can be utilized, converting raw input into more usable forms, and removing unwanted waste products.

In addition to these matter/energy processing functions, Miller identified subsystems whose function was to process information. These included "transducers" to receive the information, "decoders" to convert it to a form interpretable by the system, "associators" to link the information to related information or system functions, and "memory" subsystems that enable living systems to learn from experience.

That all living systems share these common features shouldn't surprise anyone. Organisms are shaped by their environments, and

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creatures on this planet face an environment which places similar basic demands on them all. At one level, the general environment is varied enough to necessitate diversity in species' adaptions to particular niches, but at another, similar enough in its demands that successful organisms are expected to share certain broad organizational features. For example, environments are similar in that they are not stable but changing. This puts particular demands on living systems; in order to survive in a changing environment, organisms must be able to sense these changes and adapt accordingly. Hence, each organism has some way of monitoring the environment; some systems for sensing important changes and enabling it to make necessary adjustments. The system literature refers to these as external feedback systems.

The environment in which humans developed shared other characteristics besides instability. There was often a scarcity of resources, for example. As a result, all species evolved efficient processing systems, i.e., means for digesting food, extracting nutrients, and storing energy.

The efficient functioning of these complex physiological systems, in turn, required that internal conditions be carefully controlled. Hence, in addition to systems for monitoring changes in the external environment, all organisms have highly developed internal monitoring and control equipment. When body temperature is reduced, the body shivers to warm itself; when bodies become dehydrated, people seek out water. There are a thousand such examples of these internal feedback systems operating within every organism.
Miller (1978) and other General Systems theorists have attempted to identify these basic subsystems and organizational features of living systems. Their theories are elegant in that they apply no matter what level of system is being considering. Their models serve to describe the essential components at work in the functioning of an organization, a department within an organization, an individual, or a part of that individual, an organ—for example.

Underlying these models are the notions of "open system" first advanced by Bertalanffy (1950), "homeostasis" (Cannon, 1932), and "adaptive system" (Katz & Kahn, 1966). Bertalanffy (1950) argued that living systems were unique because they maintained steady states despite a constant through-put of materials and change in components.

From the physical point of view, the characteristic state of the living organism is that of an open system. A system is closed if no material enters or leaves it; it is open if there is import and export and, therefore, change of the components. Living systems are open systems, maintaining themselves in exchange of material with environment, and in continuous building up and breaking down of their components. (p. 23)

Cannon's (1932) concept of "homeostasis" complemented this picture. Living systems take in material, utilize information, and expend energy in order to maintain a set of variables within the narrow range necessary for survival. The physician monitors fluctuations in these variables, e.g., fluctuations in body temperature, blood-glucose and ketone levels, white blood cell count, and a host of others requiring very sophisticated monitoring equipment. Similar homeostatic processes are found at the supraorganic level. The
business analyst, for example, keeps close watch on sales volume and interest and investment rates, knowing that these must remain within certain limits if his business is to prosper.

The idea of "adaptive system" completed this picture. Systems are not static but change in response to changes in the environment. Through natural selection, a species adapts; the individual organism adapts through operant learning. For the genus Homo, a complex form of adaptation included learning to utilize vocal and written stimuli for communication. Business has analogous methods of adapting to changing environments. For example, information on a fluctuation in the price of supplies, a change in import levies, or a move by competitors will trigger changes in a company's policies.

These three concepts: that of "open system," "homeostasis," and "adaptation," are at the foundation of all systems thought. These ideas supplied a context within which scientists could begin to grapple with the complexity of systems.

We now see that the perspective that arises from the holistic systems approach is markedly different from that of the EAB and ABA. BA centers on one level of organization, the level of the individual organism. Like a camera focusing in close, it captures detail—but its field of view is narrow and much of the background is blurred. Indeed, the function of the laboratory is to remove most of this background from the picture; distracting visual and auditory stimuli are eliminated, and lighting, temperature, and feeding schedules are kept constant.

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In contrast, GST approaches many different levels of organization; sometimes the level of the individual, but much more often it directs itself to higher levels involving many individuals, e.g., classrooms, school systems, and corporations. SA focuses out to broaden its field of view and take in more background. In doing this, it temporarily sacrifices detail about the variables controlling the individual.

The thesis of this paper is that GST and BA complement one another, and that both are essential for a full understanding of the variables controlling behavior. BA puts meat on the bones, i.e., fits some of the missing details into the general schema of the individual provided by GST. In turn, by providing the general schema, GST assures that behavioral intervention is viewed in its proper context.
CHAPTER IV

A PRIMER IN SYSTEMS ANALYSIS

The Total Performance System Model

It will be useful to have a method for conceptualizing GST similar to the SRC paradigm of BA. Brethower (1982) has developed a very general model which contains the major elements and relationships inherent in a systems view of organizations. He called this model the Total Performance System (TPS). In this and the following section, this conceptual tool is employed in describing some basic systems concepts.

In Brethower's model (see Figure 2), an organism is viewed as a processing system that takes in material, utilizes information, and outputs some kind of product. To illustrate these functions, an elementary school classroom can be used as a processing system. The classroom fits the model of an open system discussed in the previous chapter; inputs would include the salary paid to the teacher, the teacher's time, teaching materials, and the students (each coming in with particular skill deficiencies); output would be the "knowledge learned," measured by the number of educational objectives accomplished each week. The idea of homeostasis is also implicit in this model; the amount of learning, and the level of reinforcement necessary to sustain teacher and student academic behavior, must be maintained at certain levels if the classroom is to
function successfully.

![Diagram of the total performance system]

Figure 2. The total performance system.

Information on how well the classroom (the processing system) is maintaining these levels would be an example of Internal Feedback, or Processing System Feedback.

The rectangle labeled Receiving System in Figure 2 represents the immediate environment on which the processing system must depend for its resources. In order to anticipate changes crucial to system survival, the classroom must monitor its effect on this environment. In the TPS model, this important function is indicated by Receiving System Feedback, also termed External Feedback. This information might include data on students' performance in related courses and in their classrooms the next year, a sample of parental opinion of teacher performance, as well as students' employment records. Receiving system feedback is useful in evaluating the classroom's
impact on variables crucial to its long term survival. This information is also useful in alerting the processing system to important changes in the environment, changes that might disrupt its homeostasis. In the example used here, this could include information on school budget cuts, legislated changes in teacher liability, or proposed changes in accountability practices. Monitoring this information enables the processing system to be adaptive.

The TPS model depicts the major organizational features identified by the General Systems Theorists. It provides a simple representation, in this case, a visual representation, of the very basic components and functions that are found in all systems. This model serves the system designer as a kind of checklist. Knowing that every system must contain components to handle each of these functions, he can refer to it while designing or trouble-shooting programs. In a later section this paper examines a chronic problem facing the behavior analyst that results from a failure to consider certain of these essential system functions.

**New Developments in SA: Filling in the Model**

The systems literature is beginning to flesh-in important aspects of the TPS model. Research is clarifying the nature of receiving system feedback, for example. It has been discovered that different properties of information like its timeliness, reliability, or coverage, may be suited to particular types of processing and receiving systems. For example, when environmental changes that are critical to a system's survival occur quickly, quick acting
information and adjustment systems are demanded. To illustrate this, when exposed to high temperatures, it is crucial that the human body quickly sense and respond to rising body temperatures, activating sweat glands and slowing metabolic rate before any damage occurs. The heat sensing information system must be capable of immediately detecting and relaying information on body temperature to equally quick acting cooling systems. On the other hand, the information system that tells the body to produce melanin as a result of exposure to sun during the summer months needn't respond so quickly. Damage to the body from the sun's ultraviolet rays will not occur as quickly and is usually not as serious as is damage from overheating.

The new systems literature is also helping us to understand qualities like system flexibility and stability (Cook, 1980), and is directing our efforts to engineer these characteristics. Knowing how a particular system will be dependent upon its environment and how quickly that environment can be expected to change, a system designer can construct a system that flexes in the right places, and with sufficient rapidity to be adaptive. For example, a clothing design and manufacturing company may benefit by responding immediately, to fads occurring as abruptly as the release of a successful movie. This company's success depends on accurate predictions of buyers' preferences and on a flexible, responsive design department. Those responsible for product development must decide on strategic predictors of trends, and establish an ongoing network for monitoring these predictors and dispensing information. Promptness is
crucial in these departments. For the marketing and basic manu-
facturing processes, on the other hand, flexibility is not as important.
The availability of raw materials like cotton and wool does not
fluctuate as much as do customers' preferences, and basic manu-
facturing processes which are functioning well are probably best left
undisturbed.

System theorists are attempting to construct models to simulate
these situations, so that optimal ways of monitoring the environment
and facilitating information flow and decision making can be dis-
covered. Their efforts are producing insights valuable to the
applied behavior analyst. This knowledge can help the behavior
analyst design programs which are not only behaviorally sound, but
are sound from a larger system standpoint as well.

The preceding sections of this paper have introduced the reader
to the fields of SA and BA. We can now move on to the goal of
analyzing the relationship and charting the domain of these disci-
plines.
Science Viewed as a Hierarchy of Descriptions

Science consists of hierarchies of levels of description (Lazlo, 1972). Chapter I indicated that each discipline describes a particular level of organization, or span of subject matter. Physiology, Psychology, and Ecology, for example, describe the functioning of the cell, the individual, and the ecosystem.

This stratification of levels of description enables science to deal with the problem of complexity. By centering attention on one level the different disciplines divide up the universe into manageable fields of study. The explanations formulated at each level thus remain comprehensible. Imagine trying to explain the behavioral phenomenon of extinction from the level of quanta. More realistically, one can see the difficulties the physiologist faces in his efforts to explain similar events.

Boulding (1968) referred to levels of description lower in this hierarchy as "theories of the individual," and those higher as "theories of interaction." What this means is that, viewed from their

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3 The span of a discipline is, again, a matter of which units of nature (which individuals, to employ Boulding's term) the discipline chooses to focus on. Ornithology and herpathology, for example, lie at the same level of description, but span different individuals.
higher vantage point, levels higher in the hierarchy concern themselves with the interaction among individuals in the lower levels. High and low here are relative measures, not absolute. Viewed from one level, Biology, for example, presents a theory of the individual—Ecology, a theory of the interaction among biological units. Viewed from the level of Cellular Biology, however, Animal Biology is a theory of interaction, and Cellular Biology a theory of the individual.

This applies to Behavioral Psychology as well. Viewed from its own level, Behavioral Psychology presents a theory of the individual; viewed from the level of the physiologist, it is a theory of interaction—it all depends on the basic units of study. This is the theoretically correct use of "Systems Analysis." Any theory of interaction is a System Analysis, since it studies individuals in interaction and it is "individuals in interaction" that defines a system.

This distinction between "theories of interaction" and "theories of the individual" helps understand the role of General Systems Theory and BA. BA focuses on the variables controlling the behavior of the individual living organism; BA is relegated to one level in their hierarchy. In contrast, General Systems Theory presents a grand theory of interaction applicable at all levels. General Systems Theory distills from the many separate theories of interaction a general theory of interaction. It attempts to discover the main variables governing interaction among individuals in
the broad sense in which Boulding used the term, to mean basic units of study of any science.

High- and Low-Frequency Dynamics

Simon (1962) employed a distinction which helps explain more about the nature of "theories of interaction" and "theories of the individual." In his article "The Architecture of Complexity," Simon distinguished between "high-frequency dynamics," which he contended operate in subsystems, and "lower-frequency dynamics," which operate at the system level. Theories of interaction are theories about systems, and according to Simon are concerned with the low frequency dynamics governing this higher level of analysis. Theories of the individual, in turn, concern the behavior of the individuals within these systems and the high-frequency dynamics which govern this behavior.

Simon's argument is based on the fact that "there are generally limits on the simultaneous interaction of large numbers of subsystems" (p. 476). An individual's capacity to process stimuli is limited; just so many contingencies can control responding. Simon stated that "apart from requirements of direct interactions, most roles impose tasks and responsibilities that are time consuming. One cannot, for example, enact the role of 'friend' with large numbers of other people" (p. 477). As a result, contingencies associated with personal welfare, family, and close friends (what Simon called intracomponent linkages) control most of an individual's behavior. Intercomponent linkages, involving an individual and his
neighbors, for example, are left with only the possibility of exerting weak control. The same conditions exist within a company. Interactions within a department are often more important and occur more frequently than interactions between departments.

Simon went on to say that "this fact—that intracomponent linkages are stronger than intercomponent linkages—has the effect of separating the high-frequency dynamics of a hierarchy—involving the internal structure of the components—from the low-frequency dynamics—involving interaction among components" (p. 477). This separation of high- and low-frequency dynamics has important consequences for the description of systems. As a consequence, it becomes possible to explain the behavior of groups composed of many individuals without looking at contingencies controlling each individual. The disciplines of Economics and Organizational Analysis, for example (disciplines concerned with higher levels of systems), are able to formulate jobs governing these larger systems without reference to variables controlling the individuals composing these systems. The event classes in these higher level disciplines accommodate the lower-frequency dynamics involving interactions between subsystems, i.e., of levels higher in the system hierarchy—the high-frequency dynamics governing the behavior of the individual can be temporarily ignored. In the next section examples are provided of high- and low-frequency dynamics. These ideas of Simon's continue to be used to clarify the roles of BA and GST, as well as the other fields of science.
Examples of the Application of Systems Analysis and Behavior Analysis

Every analysis begins by segmenting the continuum of experience into event classes. In BA these classes are antecedent stimulus, response, and consequence, and are linked together into a unit called the contingency. This fine-grain unit of analysis reveals the subtle interactions between responses and the environment that are necessary to understand the behavior of the individual organism. As Simon would state, the contingency reveals the high-frequency dynamics governing behavior within these subsystems.

In GST, in contrast, the continuum of experience is broken into energy inputs, information inputs, outputs and processing system, and receiving system feedback. These response classes reveal the lower-frequency dynamics of interaction between many individuals. Segmenting events along these fracture lines enables one to understand the dynamics of system behavior. A convenient unit of analysis for GST, containing the major elements and relationships inherent in a systems view of organization, was discussed in an earlier section. This unit, the TPS, appeared in Figure 2. In the section that follows, the author attempts to illustrate this notion of high- and low-frequency dynamics by comparing the professional behavior of a behavior analyst in a hypothetical setting, with that of a more system oriented individual—some families with GST, and the importance of multiple levels of analysis. The individual will be referred to as a "performance analyst."

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The Application of Behavior Analysis

The example concerns a firm that designs and manufactures women's clothing. In this example, one can best imagine the behavior analyst narrowing his focus to individuals within one department of the company, the design department, for example. Here, one goal might be to discover ways of arranging stimulus materials to optimize the creative behavior of each designer. To do this, the behavior analyst could observe the behavior of the top designer. He might note the neat appearance of design instruments and great number and diversity of materials used as sources for design ideas, and the orderly method by which the designer peruses these materials, and keeps note of potential design ideas. Record would be made that this individual shuffles his preliminary sketches to form different combinations of blouses, pants, shawls, etc., and that he uses fully detailed color drawings, and actual samples of material in making his final design decisions. Also that the top designer exchanges preliminary ideas with other designers.

In addition, the behavior analyst would be looking at the contingencies of reinforcement operating within this department. He might note that little extrinsic reinforcement is available in this setting; that a designer hears from his supervisor only when he doesn't produce enough. In fact, individuals within the department might actually discourage others from working above the minimum level. The BA could discover that finishing an assignment quickly only means that another assignment is given; and that, although a
purported incentive system is in effect, bonuses are awarded to everyone regardless of performance. Observing in the section of the building not frequented by the supervisor, the BA might also observe that the allotted 15-minute breaks often extend to 30 minutes, and that newspapers instead of design pads sometimes cover the drawing tables.

The Application of Systems Theory: Performance Analysis

In comparison, the performance analyst would analyze the design department as a processing system. Contingencies controlling the behavior of the individual would be overlooked temporarily as the performance analyst focused on, for example, the department's output. Here he would examine the fashion ideas produced by the designers. How does the manufacturing department react to these ideas? How does the buying public rate these fashions? Do they sell? The performance analyst might discover that, because of the kinds of designs coming from the design department, the manufacturing department has difficulty converting these ideas into actual salable products. It might be that designers often recommend intricately stitched patterns that are not within the capacity of the manufacturing department's equipment, or recommend sewing wool products in ways which weaken the material too greatly. The designers may design products to be manufactured in silk, and silk may be exorbitantly expensive, or too difficult a material to produce to standard.
The performance analyst would also examine the company's sales figures. The success of the department is ultimately measured by how well its designs sell. By examining information on sales, the performance analyst might discover that this department is not adapting to changes in its market. The company's success may depend upon the accurate predictions of consumer preferences, and the ability to flex and respond to this information—preferences may change as abruptly as the release of a successful movie.

Many other important concerns that ultimately affect the behavior of the individual organism appear in the analysis at higher levels. The performance analyst might analyze interactions between the design and manufacturing company, and the budget clothing industry; or analyze the resurgence of housewives sewing clothes within the home, and its effect on sales; or the effect of increasing unemployment. The areas of Marketing and Economics represent Systems Analyses of these variables. An analysis at this level could indicate that the most expensive fashion clothing lines remain strong, but that the less expensive lines are losing sales to bargain priced budget store clothing. A change in pricing policy might be recommended, raising the prices and changing advertising of these less expensive lines—and not trying to compete with the chain stores.

Discussion of the Examples

Comparing these examples of BA and Performance Analysis, it becomes clear what Simon (1962) meant by high- and low-frequency
dynamics. In analyzing the behavior of the individual organism, the behavior analysts attend to the rapid changes in environment which momentarily evoke first this behavior, and then that. He observed the employees' behavior around one staff member, and how it changes when another enters, or when a supervisor enters. Here concern is with the rapid-fire exchanges between organism and environment that comprise a contingency. These are the high-frequency dynamics of which Simon spoke.

In comparison, turning to a level of analysis yet above BA, the dynamics of organization-environment interaction alter. Here concern is with larger event classes, and with relations occurring over a longer period of time. The example related a decline in dress sales to dress making in the home. Here the two event classes involved the complex behavior of systems; the event of a decline in sales by the dress making company, and the event occurring in the receiving system, an increase in dresses being made in the home. This is an example of low-frequency dynamics. These events occur over a longer period of time—the dynamics of interaction here is of a much lower frequency than those involving the responses of individual organisms.

The preceding examples illustrate how analysis can proceed at different levels of organization. One can analyze the behavior of individuals, as the behavior analyst did when he focused on variables operating within the design department; or move to a higher level of description, and discover contingencies that apply to the design department directly—to that level of organization. Carrying
on analysis at a higher level enables one to observe variables outside the range of behavior analysis.

These system level variables are critical in determining the long-range functioning of lower level subsystems. System level problems eventually impact lower levels. For example, if the board of directors of the dress making company does nothing to counter the trend toward home dress making and consequent erosion of sales, the impact may be in the form of layoffs and pay cuts, or even the total dissolution of the system.

The Complementary Roles of Performance Analysis and Behavior Analysis

The "Introduction" to this paper stated an intention: that of showing that skill in both BA and analysis at higher levels is effective with behavior. Rather than immediately stating an explicit argument, the author began setting forth the groundwork in the section on the hierarchical nature of descriptions. The argument, the reader later learned, was based on the assumption that a full understanding of behavior required analysis at all the levels in this hierarchy. The paper described how BA operates on one level; the level describing the interaction of the responses of individual organisms with the environment. GST, in turn, described interaction among individuals at all levels in the hierarchy: the level of responses, as in BA; the level of a system of organisms, as in the design department example; and of a system of systems, all the clothing manufacturing and design companies, for example. The preceding
example showed that many of the concerns that appear in a higher level of analysis are unobservable at the level of BA. Beer (1979) spoke of these higher levels as being "preconditioned by a different level of organization" (p. 68).

The fine-grain behavioral unit of analysis encourages a narrow perspective. Attention is directed to the particular behavior of individuals, and not the long-range consequences (what might be called performance outcomes) that affect the larger systems' functioning. This was seen in the example. Analysis of the design department output as input into the manufacturing department indicated that designers needed to be aware of certain design restrictions. The perspective of BA centered on the behavior of individuals would not have produced this observation. The behavior analyst would tell how to design a training program to teach these needed skills, but not that such a training program was needed in the first place. Similarly, as a result of comparison of sales figures with those of other companies, Performance Analysis indicated that individuals in the design department were not adequately predicting fashion trends. If it was decided that they begin attending more fashion shows, behavior analysts could tell how to arrange contingencies to insure this attendance, but not why this attendance is desirable.

The necessity of analysis at various levels in the hierarchy becomes apparent. Operating at a level of description above BA, Performance Analysis helps the behavior analyst link immediate behavior to its long-term consequences. It does this by indicating
system level problems which will ultimately affect individuals at lower levels.

The behavior analyst must always attend to these larger system concerns. To paraphrase Lazlo (1972), high levels of analysis supply the relevant context in which detail (supplied at lower levels) must be comprehended. An analogue is found in the behavior of the writer. In addition to the stylistic flow of one sentence into another, the writer must always have in mind the overall structure of the paper—an idea of how each paragraph is to function as part of the whole. A sentence may be beautifully constructed, yet be a poor choice when viewed in the context of the larger paper. Similarly, a procedure to change an individual may be ingenious and highly effective in the short run, but inappropriate from a larger systems standpoint. Analysis must be performed at these higher levels.

Summary

The previous section can be summarized as follows. BA deals with the high-frequency dynamics governing the behavior of the individual organism. The special analytic tools of BA are designed to describe (a) the specific behavior of individual organisms (b) occurring over short time periods. Because these tools are designed to describe relatively circumscribed events, vis., stimuli, responses, and consequences, they do not aid in the analysis of dynamics of lower orders.
Low-frequency dynamics concern (b) larger, less circumscribed event classes and (b) longer time spans. Fields like Economics, Sociology, and Ecology supply theories of the low-frequency dynamics of specific groups of systems. GST, as it is commonly understood, provides a general model of the low-frequency dynamics of any system.

The impetus of this paper is that both high- and low-frequency dynamics must always be considered. Too often, a person is trained or has experience in analysis at one level, emphasizes that level, and as a result overlooks other important aspects of a situation. Often one finds that chief executive officers skilled in market analysis, organizational analysis, and 5-year projections are out of touch with the worker; or that the behavior analyst skilled in managing the behavior of the individual organism does not have a feel for the organization. On one side are found intricately designed systems which fail at the level of the individual, and on the other, elegant behavioral interventions which have no system to support them. Besides the breadth of vision to direct the larger movements of a system, the greatest system builders retain a respect for, and understanding of, the high-frequency dynamics of human interaction. Carnegie (1937) discovered this in his study of the autobiographies of great men, of empire builders. For example, he learned that John D. Rockefeller, Sr., valued the ability to deal with people "more than any other under the sun," and he told of the great pains Napoleon went to remember people's names.

The BA sees solutions in terms of a rearrangement of contingencies. The problem is that the short-term contingency is a unit of
analysis totally inadequate to describe the dynamics of lower frequencies. The next section identifies a chronic and serious problem that surfaces because of this inadequacy.
CHAPTER VI

PRACTICAL PROBLEMS AND APPLICATIONS

The Problem of Maintenance

Designing systems which will last is a major challenge facing the behavior analyst. Often coming in as outside consultants, various exigencies may prohibit the behavior analysts from monitoring and supporting the programs they have designed. It is crucial then, not only that the initial program be as robust as possible, but that it be designed to anticipate and counter the host of influences which encourage its collapse. The tools of GST, and those of the disciplines concerned with higher levels of analysis, can help the behavior analyst to meet the challenge of maintenance. The following sections indicate how.

Maintenance Problems Resulting from Inadequate Analyses of Context

Some Examples

When behavioral programs fail it is often because their designers analyze only the high-frequency dynamics of the immediate setting, and do not do a thorough analysis of the low-frequency dynamics operating in the larger system. Program design must begin with an analysis of the larger system. A couple of examples will show why this is important.
The first example concerns a high school. In this setting, analyzing low-frequency dynamics may mean looking at the relationship between the school's curriculum and its graduating students' success in finding jobs (low-frequency dynamics often involve interactions between processing and receiving systems). A performance analysis may indicate that students currently lack the vocational skills most-needed in the work place. A curriculum change might be proposed, with learning objectives more job oriented, for example. The behavior analyst will often fail to consider these receiving system variables. In the example, he may be found concentrating only on strengthening the existing curriculum.

Reviewing papers in the *Journal of Applied Behavior Analysis* (JABA) on Behavior Analysis in the classroom, Winett and Winkler (1972) reported that they "were unsuccessful in finding a single study that in any way sought to ask rather fundamental questions about the curriculum" (p. 501). These authors were forced to conclude that "as currently practiced, behavior modification has done very little to change the deplorable state of our schools. If anything, it appears that behavior modifiers have been instruments of the status quo" (p. 501).

Consider another example. The management of an auto company is alarmed because the number of accidents occurring along the assembly line has risen. Several of these individuals propose that a training program be instituted. It would be easy to design such a program. Experience has shown, however, that performance problems need to be more carefully looked into, and that they often turn out
not to require training, but some other solution. This turns out to be the case. New organizational goals have been established which demand an increase in productivity. Safety procedures (that workers are well aware of) are being ignored under supervisors' pressure to speed things up—workers know they are to wear gloves and goggles, but are now discouraged from wearing them because these articles interfere with their work.

The necessity for analysis at higher levels is apparent in this example. Money invested in training employees in safety procedures would not improve safety. The problem is not one of lack of knowledge or insufficient skills. An incentive program which produced fewer accidents but slowed production to unacceptable levels would also not do. Only by carrying on an analysis at higher levels can one determine the proper trade-off between safety and production.

BA tells how to maximize performance within particular sub-systems, but not the level of performance most desirable from the standpoint of the larger system. Systems Theory informs that a system functions best when each subsystem functions, not maximally, but at a level determined by the needs of the larger system. These needs put constraints on the functioning of subsystems. In a manufacturing company, for example, a minimum level of production must be maintained if the company is to survive. Any proposed safety program would be constrained to not reduce productivity below this level. Again, this determination of minimum production levels would require an analysis of the low-frequency dynamics operating in the larger system.
The lesson in both these examples is the same: one must first analyze the lower-frequency dynamics which form the context for the behavioral change procedures—only then can one begin to discuss which procedures can be best integrated into this context.

**Gilbert's Analysis**

Similar pleas to integrate high- and low-frequency dynamics are encountered under different guises in the writings of Odiorne (1970), Goldiamond (1974), Gilbert (1978), and many others. Gilbert presented the most comprehensive description of how to actually go about analyzing low-frequency dynamics and choosing appropriate change procedures. In the appendix to his book, *Human Competence: Engineering Worthy Performance*, Gilbert presented a detailed example of an actual case in which this type of analysis was conducted. An examination of that example follows in the next section.

**Policy Level Analysis**

The example concerns Byron, a manager-performance engineer for a potato chip manufacturing plant. Byron decides to improve his plant's performance, and sets out to determine where changes are needed most. He proceeds with the following analysis, beginning with what Gilbert called policy level analysis. Here Byron sketches the management structure, diagrams work and information flow, and develops a crude budget for a typical potato chip manufacturing plant. He also identifies the four major missions of the company: (a) raw material storage, (b) material processing, (c) packaging,
and (d) shipping. Potential costs and benefits of improving performance in each of these areas are then computed. Byron discovers that the largest cost benefit ratio occurs in packaging, estimating that by concentrating on performance in this area alone the company could save $17,000,000 a year. Further analysis of the packaging department revealed that the greatest potential for improvement lay with the packaging machine operators. After breaking down the likely costs and returns of training these operators, Byron put together his findings to present to top management. The result—a new packaging machine operator training program was instituted saving the company considerable money.

It is instructive to review what occurred during policy level analysis. Byron began by outlining the management structure, diagraming work and information flow, and developing a budget. These are all ways of schematizing the low-frequency dynamics of an organization. Other indices for monitoring low-frequency dynamics include discounted cash flow systems and return on investment (ROI) measures. These are indices of low-frequency dynamics because they provide a measure of overall system performance; and because a single such index describes (a) a complex of interactions (b) occurring over a long period of time and (c) among a variety of subsystems. Compare the usual period for evaluating changes in these low-frequency indices with the much more frequent, sometimes daily, evaluations that occur of individual performance problems.

Byron then identified the major functions of the company and did a cost-benefit analysis of improving performance in each area.
Since benefit is measured in terms of the overall system objectives, cost benefit analysis is one way of insuring the priority of low-frequency dynamics in decision making. Management by objectives (MBO) is another method. After deciding to work in the packaging department, Byron again does a kind of cost benefit analysis to decide which area of packaging to concentrate on.

Gilbert's (1978) example goes into much greater detail. Enough has been presented here to show the major pattern of policy level analysis. A performance analyst begins by sketching out certain low-frequency dynamics of the larger system (using tools of organization and financial analysis), then proceeds to work his way down, trying to determine (through cost benefit analysis and other methods keyed to these low-frequency dynamics) the point of intervention which will provide the greatest benefit to the overall system.

**Strategic Level of Analysis**

After policy level analysis, Gilbert (1978) called the next state the "strategic level." His focus is on creating models of the critical jobs, and determining a general strategy for implementing proposed changes. In the example, policy level analysis determined that improving the performance of packaging machine operators would optimize the performance of the organization. During strategic level analysis, the job itself is analyzed. A job model, often with redefined work responsibilities, is arrived at. In the example Gilbert used in his book, strategic level analysis indicated that packaging machine operators serve both as operators and minor
repairmen. Many of the line shutdowns, it appeared, were due to minor problems with these machines, problems that could easily be diagnosed and repaired "on the spot," by the operators.

In addition to redefining job responsibilities, general plans for carrying out the proposed changes in the work must be arrived at. This would include deciding on the best type of training program, e.g., on the job or simulation training, as well as general decisions about changes in compensation practices and work evaluation criteria.

**Tactical Analysis**

Gilbert (1978) identified a third level of analysis in his example, the tactical level. Here performance analysis is concerned with identifying the actual tasks of individual packaging machine operators, and arranging contingencies so that these tasks are carried out. At this stage the tools of BA are required. For example, knowing the problems that most often occur with packaging machines, the behavior analyst could develop a sequence of tests that operators could perform to identify problems. The behavior analyst could then design on-the-job training that would instruct operators in how to remedy each malfunction. In overview, BA provides the tools for tuning of a system once the larger system components have been assembled and general strategies for implementation have been worked out via performance analysis.

To summarize this section, behavioral programs experience maintenance problems because their designers do not do a thorough
analysis of low-frequency dynamics. To be successful, behavioral programs must be integrated into the context of the larger system. This requires that analysis begin with what Gilbert calls the policy level of analysis. Only after analyzing the larger context can one know which objectives to set for the behavior change program, and only then can one begin to design specific behavior change procedures to meet those objectives.

Failure to analyze the larger context of our interventions is one major reason for the lack of success of behavioral programs. Two other reasons for failure are discussed in the next sections.

Maintenance Problems Resulting from Inadequate External Feedback Systems

In addition to broadening the context of analysis, an analysis of low-frequency dynamics entails the informed forecast of potentially important changes in the system's environment. Behavioral programs experience maintenance problems because they are not designed to monitor and adapt the environmental change. The environment is continually changing: new staff are hired, new policies are approved, spending is redistributed, and budget cuts and layoffs occur. Why then design systems as if existing conditions never changed? All too frequently a system remains as originally designed, becomes mismatched with its environment, and ends by being totally scrapped. For example, a token economy which had been functioning very effectively may be discontinued when staff cuts make the existing program unfeasable. Better that programs be designed so that

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these changes are anticipated, and necessary renovations made in the present system.

The behavior analyst's idea of maintenance often consists only in measures to insure the existing reinforcement contingencies remain intact. In a token economy, the behavior analysts will insure that valuable new items are always available for token exchange, establish strict regulations governing dispensation of tokens, and insure that all levels of staff are adequately rewarded for their support of the system. This program might function beautifully until an unanticipated change in the environment (severe budget cuts in the example) made the present system unworkable. If these cuts had been anticipated, the staff might have modified their program so that it remained viable.

External feedback systems must be designed to provide information on any changes that might affect the long-term functioning of a program. In the example, the staff running the token economy must establish a regular channel by which they receive, and then review, information on any new legislation that might affect the program, data on anticipated client enrollments, expected changes in prices of token exchange items, building rental increases, etc. Even in simple systems, information on such important factors often reaches the staff through informal channels, and is too often late and unreliable. This program becomes more serious as the size of the system increases.
Maintenance Problems Resulting from Faulty Internal Feedback Systems

In addition to problems resulting from the failure to analyze lower frequency dynamics, many systems experience maintenance problems because they are not equipped with networks for internal feedback. An internal feedback system furnishes information on whether a program is meeting goals. This information must be evaluated frequently and any necessary changes made in the existing system.

Unlike the previous two problems, this maintenance problem is not directly related to low-frequency dynamics, and is not a problem particular to BA. In fact, since behavior analysts tend to be evaluation-oriented, problems arising from faulty internal feedback systems are less prevalent among behavioral programs than in many other areas, e.g., in educational and industrial training programs. However, because it accounts for so many problems in areas related to BA, and occasionally surfaces yet as a problem in behavioral programs, it is worth including discussion of internal feedback systems in this section on maintenance problems.

There are three components to any internal feedback system. Disregarding any one of these can lead to maintenance problems. Each component is discussed separately below.

Statement of Goals

An internal feedback system implies a clear statement of system and subsystem goals. To paraphrase Broadwell (1975), the single most important measurement of whether any program is going to be a
success is the ability to properly state objectives. Starting with system objectives, subsystem objectives are determined, which in turn determine sub-subsystem objectives. This process has been extensively described in the literature on management by objectives (Odiorne, 1970). Starting with the larger system objectives helps to insure that high-frequency dynamics are integrated with lower-frequency dynamics.

The objectives of the larger system are often expressed in economic terms. Ideally, then, subsystem objectives should also be so expressed. As Odiorne (1970) indicated, "economic values are survival values for the firm" (p. 28). Programs which can justify themselves in economic terms, by showing that they cut selling expense or reduce costs, have a much better chance of surviving. This leads to the second component of an internal feedback system.

**Evaluation**

The second component of an internal feedback system is evaluation. Regrettably, as has often been remarked, evaluation is in the same state as Mark Twain put the weather; everyone is talking about it but no one is doing anything about it. If behavioral programs are to merit survival in times of competition for funds, they must engage in self-evaluation.

Although in its infancy, the control literature on management control systems offers insight in designing evaluation systems. This literature (Beer, 1966; Jerome, 1961; Mockler, 1972) states, for example, that routine information about progress toward

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objectives, feedback about deviations from standards, and data about an increase in grievances or number of accidents should be directed to "the lowest level of decision making for that element" (Newman, 1975, p. 38). In the previous example, information showing that the number of accidents increased significantly in a department should be directed to the supervisor of that department first. His familiarity with the high-frequency dynamics of the department and its employees puts him in the best position to react to this information.

On the other hand, information about a change that might affect a large number of programs often requires the perspective and special tools of higher levels of management, and should be directed to those levels first. An example would be information about a large cut in funds. Higher levels of management, having an overall perspective of the role and contribution of individual programs within the broad plans of the organization (i.e., of the lower-frequency dynamics) will be able to decide how to absorb these cuts with the least damage to the large system, or at least with the least damage to higher levels of management.

Recycling

The third function implied in an internal feedback system is that action be taken to recycle the system. New programs especially will benefit from recycling.

One must understand that all programs put forward . . . have faced validity, which is to say that they look like they are likely to produce the desired results. If a
program did not appear ostensibly plausible it would not generally be undertaken. Yet, we have a multitude of examples of eminently plausible, well-conceived applications of generally-accepted social science theory to the solution of a practical problem, which when subjected to evaluation, prove ineffective. (Levy, 1974, p. 275)

This third component can be thought of as the adjustment phase of the cybernetic control mechanism. To employ the often used example, one (a) sets a thermostat to the temperature desired, (b) the mechanism senses the current room temperature and the discrepancy, and (c) the necessary action is then taken to correct the discrepancy.

Speaking of the recycling phase, Malott (1974) has said "It is probably the case that in a real-world system, the recycling process will be a continuous operation; we never get there, we just get a little closer" (p. 335).

The three components of an internal feedback system function to create a "guided system" (Newman, 1975), one which continually steers itself toward its goals. Properly coupled with external feedback, internal feedback makes a system not only guided, but adaptive as well.

In summary, this section has indicated how SA can aid the behavior analyst in designing behavioral programs which will endure. As stated earlier, this is a major challenge facing the behavior analyst. By aiding in the analysis of low-frequency dynamics operating in the larger system and in integrating the behavioral programs into this context, and by helping the behavior analyst design
effective internal and external feedback systems, SA enables one to reduce program casualties and meet this challenge.
CHAPTER VII

THE CURRENT MOVEMENT TOWARD MORE
SYSTEM ORIENTED APPROACHES

History shows that our intellectual orientation swings gradually between Atomistic and Holistic. As adherence to one approach reveals limitations and weaknesses, sentiment grows toward the other. The 19th and 20th centuries have been periods of intense micro-examination. Nature has been dissected into its more basic components: subatomic particles, molecule, cells, single organisms, etc. This has led to the development of powerful "theories of the individual." But the weaknesses in this approach have become apparent. No atom, cell, or individual organism functions alone. Kantor (1971) has repeatedly and eloquently affirmed this point--each individual is woven into a complex of interrelationships. "Theories of the individual" excise a section of nature, clean it off, and tinker with it in an attempt to understand and in some measure reconstruct its functioning. This gives us success--but success only in the short run. In the long run, to paraphrase Whitehead, nature doesn't come clean.

This paper has suggested that behavioral programs are often inadequate in the long run. The author has argued that behavior analysts are not equipped to analyze the low-frequency dynamics operating within larger systems. In this chapter some actual
examples of inadequate behavioral approaches are presented. 4

Also indicated are areas in which a recognition of the failings of existing behavioral interventions have led to cogent movements toward more systems-oriented, holistic approaches.

An important point that arises is this. Programs exhibit a range of sensitivity to high- and low-frequency dynamics. The best are designed and overseen with a sensitivity to both—the worst, a sensitivity to neither.

The examples presented here range from, in the first example, an extreme case illustrating behavior analysts' nearsighted attention to only very high-frequency dynamics to the praiseworthy efforts of organizational behavior analysts to integrate high- and low-frequency dynamics within business settings.

This section begins with an example that appeared in Archives of General Psychiatry (Brady & Detley, 1961). The example concerned a man diagnosed as blind who recovered his vision after being treated with a behavioral procedure. The article reported how the client had arrived at a hospital blind in both eyes and seeking medical assistance. A medical examination suggested the diagnosis of "hysterical blindness"; no organic cause for vision loss could be found. The authors designed an experiment to test this hypothesis, and at the same time, to help the client recover his vision. The

4 Such examples are difficult to find. The demand for positive results, and the process of editorial review censures most of them from the published literature. The author found a few—the reader is probably aware of others.
procedure involved a difficult temporal discrimination: a single response occurring between 18 and 21 seconds from the beginning of the trial was required before reinforcement would be delivered. Any other response terminated the trial. To see if the client would make use of visual cues, a light bulb was illuminated during the period in which responses would be reinforced.

Results indicated that the subject was able to see the light, even when illumination was reduced so that it was barely visible to a normal viewer. The subject affirmed that he could once again see. Further, he reported a short while later that he was now even able to read small newsprint. This case was reported and widely cited as a successful application of behavioral procedures.

Three years later, the subject arrived at a hospital using a white cane, tapping the floor and walls—again apparently totally blind. The case reappeared in an article "Experimental Analysis of Hysterical Blindness: A Follow-Up Report and New Experimental Data" (Hanus & Zimmerman, 1965). The subject's clinical improvement had been short-lived. A search of records indicated that he had worked at a clinical rehabilitation center for only 3 months before discharging himself. A vision test conducted 8 months after discharge indicated that he was again blind.

A subsequent reassessment of the client's history indicated clearly that his blindness was functional. The initial study had reported that the first bout of blindness had been preceded by a period in which the client's wife and mother-in-law were more demanding than usual, requiring him "to work nights and weekends at
various chores under their foremanship" (Brady & Detley, 1961, p. 334). This and considerable other evidence disclosed the true nature of his disability.

The preceding example illustrates an extreme case, but this kind of problem still appears in many behavioral interventions. Too often, problems and solutions are narrowly defined. Highly artificial contingencies are arranged to punish or extinguish undesirable behavior—with no effort to teach acceptable alternative responses. In the previous example, the therapists concerned themselves only with the subject's immediate environment. Contingencies were arranged to, in effect, punish the subject for his inappropriate behavior. No effort was made to intervene in such a way that a lasting behavior would occur. Consequently, treatment effects were short-lived. Many behavior analysts can be criticized for their unwillingness to tackle the more deep rooted causes of behavioral problems.

If this is true of some operant procedures, it is an even more powerful criticism of classical conditioning procedures. Reviews of aversion based treatments of alcoholism, for example, have concluded that classical conditioning techniques have little prolonged impact (Costello, 1975; Davidson, 1974; Franks, 1966; Laverty, 1966; Rachman & Teasdale, 1969). The aversion generated during therapy extinguishes soon after the client leaves the laboratory setting.

In a previous section of this paper, similar criticism was leveled against BA in education. Reviewing articles in the Journal of Applied Behavior Analysis (JABA) on BA in the classroom, Winett &
Winkler (1972) concluded, "as currently practiced, behavior modification has done very little to change the deplorable state of our schools. If anything, it appears that behavior modifiers have been instruments of status quo" (p. 501).

In this same article, these authors critized the use of behavior modification in psychiatric hospitals for similar reasons. They argued that, here again, behavior analysts fail to impact the real problems that exist in this area. For example, they contended that token economies have been able to reduce inappropriate behavior on the ward but, to quote the authors,

There is little reliable evidence that token economies have made a significant contribution, relative to other types of programs, to the number of patients who are discharged from chronic wards or to the length of time discharged patients remain in the community. (Winett & Winkler, 1972, p. 501)

Winett and Winkler (1972) went on to argue that:

There is now almost universal agreement that psychiatric hospitals in their present form as total institutions for long-term care are detrimental to the patients in them and should be replaced by smaller community oriented centers of prevention and out-patient therapy. (p. 501)

The predicament of the behavior analyst is apparent. Skills in BA are little help in answering larger questions involving educational curriculum, or of whether psychiatric patients should be institutionalized or moved to outpatient centers. These decisions require a perspective of the functioning of the larger system; of existing financial constraints and of the goals of the community with respect to education and to the treatment of the mentally ill.
These are questions involving low-frequency dynamics. The tools of BA are of little value in this realm.

**Family Therapy and Community Mental Health**

The frequent failures associated with the behavioral treatment model has spurred the development of more system-oriented, broad-spectrum approaches to treatment. Two outgrowths of this have been the birth of Family Therapy (itself an outgrowth of group therapy technique) and of the Community Mental Health approach. Both of these new approaches emphasize the importance of broadening the locus of treatment, and establishing natural systems of support for desired behavior. The influence of SA is evident. Barnard and Corrales (1979) described the impetus for family centered therapy as follows:

Traditionally, therapists have focused on the individual person as the primary locus or site of health or disturbance... A family therapist working only with individual-oriented concepts is particularly handicapped because he most likely misses many interactional patterns that are vital to the understanding of the family and its members, and vital to diagnostic and treatment issues. (p. 3)

Notice the similar emphasis in this description of the Community Mental Health approach.

Community Mental Health can be viewed as an approach in which greater emphasis is placed upon the interrelationships between the individual and the community in which he lives. The patient and his emotional disturbance can no longer be viewed in isolation, but require a broader understanding of the environmental or community factors which may also play a part. (Bindman & Spiegel, 1969, p. 3)
In Behavioral Approaches to Community Psychology, (Nietzel, Winett, MacDonald, & Davidson, 1977), the authors reviewed several areas in which broad-spectrum, system-oriented treatment programs have been successfully applied. This review includes research within school systems, juvenile justice systems, and adult corrections, in social skill training with psychiatric residents, with the aged, the unemployed, and with drug addicts and alcoholics. In each area, the authors reviewed the failures to traditional treatment approaches, as well as the promising results of recent efforts toward more system-oriented programs.

Work in the area of alcohol abuse is representative of the way an especially difficult problem is handled within this new treatment paradigm. Traditional psychotherapeutic approaches have had little success with alcoholic clients (Emrick, 1975; Gerard, Saenger, & Wile, 1962; Hill & Blane, 1967). The claims of Alcoholics Anonymous of 75% abstinence rates are probably greatly exaggerated—high attrition, and self-selection factors inflate the true success rate. In contrast, results of early broad-spectrum approaches are encouraging.

In Behavioral Approaches to Community Psychology (Nietzel et al., 1977), the authors described the development of Community Mental Health approaches to alcoholism along these dimensions:

One important trend has been to select treatment goals that are likely to be supported maximally by the post-treatment environment. . . . A second development has been to bolster the social contingencies which would maintain sobriety in the community. Regulation of familial, legal, social, and vocational consequences of drinking has proven that sobriety can be achieved effectively through the mobilization of resources and deterrents which would reduce the probability of uncontrolled
drinking.

A group of "broad spectrum" behavior therapies have sought to reduce alcohol abuse by establishing new interpersonal behaviors (e.g., assertions), vocational skills, and general problem-solving abilities thought to lessen the probability of uncontrolled drinking. (p. 199)

Nietzel et al. spoke of the "trend to select treatment goals that are likely to be supported by the post-treatment environment" (p. 124). This statement, as well as similar statements by family therapists and community mental health practitioners, indicates a recognition of the role of larger system dynamics in the success of their programs.

In summarizing Community Mental Health and Family Therapy, these new approaches begin to integrate a knowledge of both BA and higher levels of analysis. There is emphasis on the necessity of broadening the scope of behavior change programs. The goal of both of these approaches is to establish a network of mutually supportive positive behavior patterns. This network should extend outside the clinician's office, outside the client's immediate family and circle of friends, and into the larger community.

Community Mental Health and Family Therapy only begin to integrate BA and systems thought. Integrating these areas implies much more than broadening the scope of behavioral interventions. A behavioral program may enlist a client's family and friends, employers, and countless community support systems, and still be completely insensitive to low-frequency dynamics. In fact, viewed from yet a higher level of analysis, the added cost of broad-spectrum, or individualized treatment programs leads one to wonder about their
feasibility. Will funds be available to buy and maintain such potentially expensive programs? This and similar questions would have to be answered before labeling these new programs "good systems approaches." The next section examines a program which does weigh such consideration.

Organizational Behavior Management

The most ambitious and, from a systems standpoint, some of the most praiseworthy of efforts to integrate Behavior Analysis and Systems Theory have risen from attempts to apply behavioral principles within organization—Organizational Behavior Management, as it has come to be called. Behavior analysts working as consultants in business learn quickly that there are things other than reinforcement contingencies to be concerned with. The importance of attending to low-frequency dynamics is especially evident in this setting. Here performance is measured in terms of market share, return on investment (ROI), and the host of indices that appear in the quarterly report. The effect of not attending to low-frequency dynamics is only too apparent; each issue of The Wall Street Journal contains news of another company initiating bankruptcy proceedings.

The work of Gilbert (1978), discussed in Chapter VII, and that of Brethower (1982) and Malott (1974) grew out of the recognition that the technology was needed for integrating high-frequency dynamics and low-frequency dynamics. Gilbert (1978) proposed beginning with what he called policy level analysis, with an analysis of organization goals, and working down to tactical level analysis—
analysis of stimulus materials and reinforcement contingencies.

Brethower (1982) developed the TPS model as a vehicle for this integration. Dickinson (1982) described the role of the TPS model as follows:

The total performance system permits us to examine what kinds of performance changes at the departmental and individual level would be of value to the total organization, and how these changes would impact on other departments and individuals within the organization. By first ascertaining the kinds of outputs that will be valuable to the total organization, one can determine the types of changes that will be required to achieve those outputs. It is then possible to track those desired changes to the smaller systems ascertaining what changes are required at the individual level. (p. 305)

The book Industrial Behavior Modification (O'Brien, Dickinson, & Rosow, 1982) contains several examples of the application of these new management tools. Following is a review of one of these examples. The example concerns a sales improvement project for a furniture store chain conducted by the consulting firm of Edward J. Feeney Associates. The key to the success of this program is the "performance audit." The authors stated at the beginning of the article:

When developing a performance program within any organization, one must identify what are likely to be the most profitable areas of intervention through what is called a "performance audit." The performance audit not only indicates the areas in which the largest potential payoffs exist, but also quantitatively demonstrates to skeptical managers that improvement is needed. (Crawley, Adler, O'Brien, & Duffy, 1982, p. 184)

The "performance audit" has much in common with Gilbert's (1978) analysis, discussed in Chapter VI. Simply stated, a performance audit is an examination of various areas within an organization to determine where payoffs for improving performance will be highest.
In making this determination, the authors stated that two factors must be assessed. For each area identified as having a potentially important performance deficiency, a performance improvement factor (PIF) must first be calculated. This consists of the ratio of the very best level of performance in that particular area to the typical performance level. The larger this ratio, the greater the potential for improvement in that area. The other factor that must be considered is the importance of the improvement, its "worthiness," to use the authors' phrase. As the authors stated: "When taking the goals of an organization into account, the 'worthiness' of the performance goal is measured by assessing the cost of the performance improvement in comparison to the money generated by improved performance" (Crawley et al., 1982, p. 184).

To summarize, the role of the performance audit is (a) to measure opportunity for behavior change and (b) to state this opportunity into economic terms, the language of the firm.

To continue with the example, as a result of the performance audit of the furniture chain store sales program, several areas were identified with large potential for bottom line gains. These areas appear as output in Figure 3, along with other information obtained from the audit. To briefly illustrate how the first entry in this figure, in-house calls, was selected as important, here is a quote from the text:

Archival data suggest that visiting the customer is by far the more profitable approach. When servicing the customer through "in-home calls" (visiting the customer's home), the "close ratio" (ratio of sales to customer contacts) is 60% versus 22% for customers served within the
<table>
<thead>
<tr>
<th>Output</th>
<th>Quantity measure</th>
<th>Typical perf.</th>
<th>Exemplary perf.</th>
<th>&quot;PIO&quot;</th>
<th>Annual cost of solution</th>
<th>Annual net payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In-home calls</td>
<td>rate</td>
<td>.7%</td>
<td>5.0%</td>
<td>4.3%</td>
<td>$2,840</td>
<td>$647,860</td>
</tr>
<tr>
<td>2. Customer name and address obtained</td>
<td>rate</td>
<td>50.0%</td>
<td>94.0%</td>
<td>44.0%</td>
<td>$3,000</td>
<td>$332,172</td>
</tr>
<tr>
<td>3. Referrals obtained</td>
<td>rate</td>
<td>25.0%</td>
<td>96.0%</td>
<td>71.0%</td>
<td>200</td>
<td>282,300</td>
</tr>
</tbody>
</table>

Figure 3. The performance audit.
store. The average sale for in-home calls is $2,700 versus $600 for walk-in sales ... therefore, when computing a performance audit, increasing the frequency of in-home calls would be a profitable area of intervention. (Crawley et al., 1982, p. 185)

Once these economically important "output areas" had been identified, the next phase in the program became to design and implement a performance improvement program that would impact each of these areas. The first step in this process was to target specific behavior changes. It was necessary to identify, for example, what specific behaviors were involved in securing an in-home call, and in insuring that a sale followed from that call. The consultants decided that the best way to do this would be to observe the exemplary performers; the best salespersons in the field. As the authors explained: "The top dollar salespeople were observed during the four months for 1,000 hours, as they worked with actual customers in stores and in homes. Observers took notes based on a stimulus-response analysis of the sales interactions" (Crawley et al., 1982, p. 187).

Once target behaviors had been identified, the second step in developing the performance improvement program became to design and test instructional procedures. It was decided that both store managers and the consultants would serve as on-the-job coaches, instructing individual salespersons in the desired behaviors. This procedure was tested in a single store. Results were dramatic--sales rose 95%. The program had proven its effectiveness.

The next step became to implement the program on a national basis. Baseline data were collected on all 450 sales representatives

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so their progress could later be evaluated. As in the trial program, each salesperson was provided with a coach. These coaches observed the salespersons' performance during actual sales presentations, and provided feedback. The coaches themselves were also intermittently observed and given feedback on their performance. In addition, several tried and true behavioral procedures were implemented, including the setting of measurable goals, and the provision of a variety of reinforcers contingent on meeting these goals.

The program was then put in effect in stores nationwide. The authors presented the results of evaluations that occurred 2 to 3 months after implementation. These data showed that the intervention had impacted each of the areas identified as important in the performance audit. For example, in-house calls were up 75% in one New York location, and customer referrals, another high payoff factor, increased 300% in a Maryland store. In short, the program had proven a huge success.

This example from the organizational behavior management literature illustrates a systematic approach to integrating high- and low-frequency dynamics. The example found a welding of BA with tools for analysis of higher levels of systems, tools like organizational and financial analysis. Like Gilbert’s (1978) "performance engineering model," and Brethower's (1982) "total performance system," the "performance audit" employed by the consulting firm of Feeney Associates guides one toward the design of programs which are sound from the behavioral as well as a larger system perspective. Only when high-frequency dynamics are integrated with low-frequency
dynamics in this manner are the benefits accruing from program change distributed at all levels in the system. This is the essence of good program design.
CHAPTER VIII

WHY ARE GOOD BEHAVIOR ANALYSTS GOOD SYSTEMS ANALYSTS—AND VICE VERSA?

Throughout this paper the argument has been that one must study both high- and low-frequency dynamics to be a really effective agent of change. But aren't these things learned from experience, without actually studying the other disciplines? Can't the behavior analyst simply concentrate more on long-range consequences, for example? The author knows, for example, of several excellent behavior analysts who have had no training in GST. Their behavior has been shaped by contingencies.

Good behavior analysts are good systems analysts. This is expected—we expect contingencies to shape essential skills in experienced practitioners. The seasoned behavior analyst may acquire quite a repertoire of SA skills. In years of work, designing countless procedures, one learns intuitively, i.e., via contingency shaping, what works and what doesn't. The point, however, is that this haphazard teaching process takes a long time, and the resulting repertoires are often incomplete.

Much of the ineffectiveness of systems theorists and behavior analysts can, in fact, be blamed on ignorance of knowledge taken for granted in the other discipline. Contingencies are dense, fumbling teachers. Skinner (1969) spoke of the "tedious process of having behavior shaped by the contingencies" (p. 57). Natural contingencies
cannot be relied on to teach behavioral analysts skills in higher levels of analysis and systems theorists the skills of behavior analysts.

There are many examples in both the systems literature and BA where defective contingencies very often do not shape effective behavior. Behavioral rules concerning extinction indicate that withholding reinforcement for a response will eventually result in the decline and cessation of that response. Left to be shaped by naturally occurring contingencies, simple extinction procedures are often never learned. Likewise, contingencies may never shape up behavior corresponding to the basic system rule that says subsystems are interactive, i.e., that changing one subsystem will cause changes elsewhere in a system.

Not only may these repertoires be incomplete, but because of adventitious reinforcement an unpruned contingency-shaped repertoire may contain behavior that is unproductive. In many cases contingencies adventitiously "convince" an individual of the efficacy of a useless procedure. Some behavior analysts and systems theorists become convinced that particular shaping procedures or management approaches hold the key to behavioral control. Those who advocate a single management style may have come under the control of adventitious reinforcement. Any one prompting procedure or approach to management is not enough—success is due more to an ability to shift styles according to the demands of each situation. Adventitious reinforcement often destroys this flexibility by strengthening a few response patterns that become ritualized and locked in. More
effective response selection is thus inhibited. The constantly authoritarian executive and his counterpart, the individual who never lays down the law, represent examples of inflexible behavior patterns whose strength may in part be accounted for by adventitious reinforcement.

The point is, again, that we cannot leave it to contingencies to shape these skills. The results of relying solely on contingencies is evident; everywhere we find behavior analysts whose treatments never maintain, and systems analysts whose intricately designed systems fail at the level of the individual.
CHAPTER IX

SUMMARY AND CONCLUSION

The author began by posing some questions. What is the role of Systems Theory in the management of behavior? Do Systems Theory and Behavior Analysis offer competing, or somehow complementary explanations of behavior? Many behavior analysts, the author believed, were uncertain about the relationship between the two disciplines.

The paper began with a brief examination of the development of General Systems Theory and the Experimental Analysis of Behavior, in which the theoretic of the two were compared. The perspective of General Systems Theory, arising from a holistic approach to science, was described as markedly different from that of the Experimental Analysis of Behavior and Applied Behavior Analysis.

Rather than offering competing explanations, the author argued that Systems Theory and BA complement one another; BA providing expertise in managing complex contingencies controlling the individual, and GST more often in managing interactions among the many individuals composing a system. Borrowing a distinction from Simon (1962), BA was understood to accommodate "high-frequency dynamics," and GST, along with disciplines like Economics and Organizational Analysis, the dynamics of lower frequencies. It was in the area of low-frequency dynamics that the author argued that BA was deficient. The failure of behavior analysts to analyze the larger context of behavioral programs was suggested as the main source of their
maintenance problems.

In conclusion, if the role of BA has been well described, behavior analysts should recognize areas in which the tools of their discipline are ineffective. If the author has convinced the reader to seek out some of these new tools, the paper must be judged a success.


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