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Explanation Is Not Description

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The point of this article is indicated by the title: Explanation and description are different activities. For example, although both are essential features of natural science, their roles are different, they have different purposes, and they are evaluated on different grounds. Consequently the ways in which they can be problematic are different. The arguments leading to these conclusions and examples of problematic explanations are given in this article.

Distinctions Between Description and Explanation

Novak (1996) said, "Description means 'to delineate' or 'give an account of'" (p. 21) and explanation means "to make clear a cause or reason" (p. 22). The reference to reasons as well as causes in the definition of explanation is consistent with ancient and modern usages. Aristotle used the Greek word *aitia* when he discussed causes; this word refers to cause in the legalistic sense of "guilty of" or "responsible for" (translator's note in Aristotle, 1929, pp. 126-127) rather than the modern scientific sense of "unmediated producer of." For example, if a person is shot and dies, the unmediated cause of death might be systemic shock, and one reason for this cause might be loss of blood, and one reason for the loss of blood might be a bullet wound, and one reason for the bullet wound might be someone's shooting a gun toward the victim, and one reason for this shooting might be "malice aforethought." In other words, an Aristotelian type of explanation can include reasons as well as unmediated causes.

Adults and children as young as 5 years old, but not 3 years old, invoke causes and reasons in explanations, but they tend to invoke them in different domains--respectively, physical and social domains (Kalish, 1998). Day (1976/1992, p. 122), however, seems to have implicitly acknowledged reasons as well as causes in explanations within the physical domain; he argued that reinforcement history is a causal variable and that "Relations of behavior to the present antecedent environment are of a controlling, not a causal kind." If I understand his distinction, it means that controlling variables are *reasons* for rather than *causes* of occurrences of the behavior.

Aristotle pointed out that explanation requires theory because experience teaches only *that* or *how* and theory reveals *why* (*Metaphysics*, Bk. 1, chap. 1 [981a 13 - 981b 9]). For example, he said: "It is the physician's business to know that circular wounds heal more slowly, the geometer's to know the reason why" (*Posterior Analytics*, Bk. 1, chap. 13 [79a 14-16]; quoted from Aristotle, 1952, p. 108). He was illustrating the difference between what he called (a) "natural philosophers" or "empirical observers," who deal with "facts," and (b) "scientists," who deal with "reasoned facts" or explanations (op. cit. [respectively 79a 12, 3; 78b 32]; 1952, p. 108). Toulmin (1953, pp. 44-56) made the same distinction, which he called "descriptive science" versus "explanatory science."

Natural *history* is a descriptive science and natural *science* is an explanatory science. Behavior analysis is a natural science, differing from others in subject-matter, not in aims. The aims of both natural history and natural science include identifying and describing regularities, but like all descriptive sciences, natural history stops at description and therefore it is "mere bug-hunting," as Toulmin said (1953, p. 54). The aims of natural science go beyond description to explanation of the regularities (e.g., Bergmann, 1957, p. 79; James, 1907/1981, pp. 30- 32; Marx, 1951, pp. 5, 6; Pepper, 1966, pp. 265-266; Skinner, 1931, 1953, pp. 13, 15-16; Spiker, 1986; Toulmin, 1953, pp. 44-56). To paraphrase Kant's famous aphorism, explanations without facts (descriptions) are empty, and facts without explanations are blind (Kant's aphorism can be found near the beginning of the *Transcendental Logic*, Kant, 1787/1965, p. 93).

According to this distinction, explanation is different from description: "Description tells us what is there, explanation why it is there" and "Science explains by laws what the scientist first describes by individual fact" (Bergmann, 1957, p. 79). This is the received opinion, advocated by, for example, mechanists such as Bergmann (1957, pp. 75-83) and Toulmin (1953, pp. 44-56) and contextualists such as James (1907/1981, p. 82) and Pepper (1966, pp. 264-265). The distinction seems to be inconsistent with an alternative opinion, that explanation is the same as description, which is advocated by radical empiricists such as Ernst Mach (1914, pp. 337-338), Kantor (1953, p. 34), and Skinner (1931). For example, Kantor (ibid.) said that explanations generally "constitute elaborate descriptions" and Skinner (1931, p. 446) said that description and explanation are "essentially identical activities" and that "the full description of an event is taken to include a description of its functional relationship with antecedent events." However, these elaborate or full descriptions are what others call explanations and therefore the distinction is preserved. To be really elaborate or full, a description must refer to more than the outcome of a specific experimental analysis, and therefore it becomes explanatory. It becomes explanatory because it goes beyond the question answered by description--"What happens?"--to the question answered by explanation--"Why does it happen?" (Bergmann, 1957, p. 79).

A final point in this section is that explanations are theory-based and therefore are "constructions," but descriptions are also constructions (Kantor, 1953, p. 34). Theory influences description (Skinner, 1953, chap. 1, e.g., pp. 9-10) because, as Popper (1966, p. 260) said, "all scientific descriptions of facts are highly selective, [and] they always depend on theory." Examples of this selectivity in behavior analysis are emphasis on frequency of occurrence rather than force, magnitude, and other characteristics of operant behavior and definition of operants as response classes, which usually requires ignoring topographical variations.

Types of Explanation

Kaplan (1964, p. 298) identified two types of explanation. One is deductive, or syllogistic: A phenomenon is explained when it is shown to be deducible from premises. One of the premises--the one identified in formal logic as the major premise--is functionally a theory (Reese, 1989). The other type of explanation involves identification of a pattern or network of facts (Kaplan, ibid.; Overton, 1991, 1998): A phenomenon is explained by a persuasive demonstration or argument that it fits into the network. The network constitutes what Kaplan (ibid.) called a "concatenated" theory. The theory in either type of explanation must be at least the inductive kind, which is a theory in which the constructs are induced or abstracted directly from data (Marx, 1976). This is the kind of theory behavior analysts find acceptable because it refers to a level not much different from the level of observation. Examples of theoretical concepts in this kind of theory include "private event," "response class," "operant," and "relational frame." Higher-level theories include concepts further removed from the level of observation; examples are "drive," "cognitive process," "intelligence," and "heritability."

Deductive explanations are ideal for hypothetico-deductive theories, which are usually associated with the mechanistic world view. Pattern explanations and concatenated theories are usually associated either with the organic world view, as in Piaget's brand of cognitivism (e.g., Piaget, 1983; Piaget & Inhelder, 1966/1969), or with the contextualistic world view, as in Kantor's interbehaviorism (e.g., Kantor & Smith, 1975) and in behavior analysis (e.g., Hayes, Hayes, & Reese, 1988; Morris, 1988). The type of explanation admired by most behavior analysts refers to empirically demonstrated "functional relations" rather than intervening variables or inferred causes (Bijou, 1979; Day, 1976/1992; Delprato, 1986; Marx, 1951; Moore, 1990; Skinner, 1931), but these explanations are still based on theory. The theory is usually concatenated and the explanations are usually the pattern type, consistently with Moore's (1990) argument that in behavior analysis, an explanation is a verbal behavior, not an exercise in logic.

In practice, pattern explanations very often include elements of deductive explanation in the form of sets of statements that look like syllogisms, often beginning with an "If-then" statement. Syllogisms have a legitimate ancillary role in a pattern explanation when they are used to exclude something from the pattern. For example: "If behavior X is mediated by behavior Y, then X will not occur if Y is prevented. X occurred even though Y was prevented; therefore, X is not mediated by Y." This is the valid argument of denying the consequent, or *modus_tollens*. However, a more common use seems to be to show that something fits the pattern. For example: "If behavior X is mediated by behavior Y, then X will not occur if Y is prevented. X did not occur when Y was prevented; therefore, X is mediated by Y." This is an invalid argument, involving the logical fallacy of affirming the consequent, but it is valid if it is interpreted as inductive reasoning rather than as deductive reasoning.

Problematic Explanations

Reductionism. The word "reductionism" usually connotes reduction of one domain to another domain--in psychology, reduction of behavior to physiological processes, of these to chemical processes, and of these to molecular structures (e.g., Teyler, 1975, pp. 5-6). These kinds of reduction have never been accomplished except in small parts of a few domains (e.g., Bergmann, 1957, p.

168; Reese, 1996); but in any case this kind of reductionism is typically rejected in behavior analysis (Bijou, 1979; Reese, 1982; Skinner, 1950). Explanation in behavior analysis is nevertheless reductive (Skinner, 1953, chap. 3) in the sense of reduction of a whole--a behavioral phenomenon--to its parts and their interrelations. If this reduction is accomplished by an experimental analysis, it is interpretable as an explanation of the behavioral phenomenon. If it is accomplished by a conceptual analysis, it is a tentative explanation, that is, an hypothesis.

Behavior analysts typically distrust explanations that refer to a level other than the observational level, and although many of them seem to believe that this distrust has a philosophical basis, none is provided by radical behaviorism or any other version of contextualism. However, the distrust does have an empirical basis: Past experience has shown that when the distrusted type of explanation is used, it may not advance the prediction and control of behavior. However, I think the failures have been attempts to reduce behavior to physiology, chemistry, or physics rather than to inferred behavioral entities such as private events, response classes, or relational frames, which are not at the observational level but are still in the behavioral domain.

Reductions to higher-level concepts will not necessarily fail. As William James (1907/1981) pointed out, theories are ideas and therefore they are not the answers, they are the instruments; they "*become true just in so far as they help us to get into satisfactory relation with other parts of our experience*, to summarize them and get about them by conceptual short-cuts instead of following the interminable succession of particular phenomena. . . . Any idea that will carry us prosperously from any one part of our experience to any other part, linking things satisfactorily, working securely, simplifying, saving labor is true for just so much" (p. 30; his italics; punctuation modified).

For example, Barnes and Roche (1997) pointed out that every individual has a unique behavioral history and therefore the explanation of each individual's behavior is unique. However, each of these explanations fits the pattern type, and the unique networks of facts overlap because all of them contain certain universal principles about stimulus functions, response functions, stimulus-response relations, and so on. Also, some universals will be found even in the networks of individuals of different species, such as pigeons and rats in research on the effects of changeover delays on matching (as can be seen in a brief review by Shahan & Lattal, 1998). If these overlaps did not occur, every explanation would be a truly unique *description* and behavior analysis would be a bug-hunting natural history rather than a natural science.

Limited scope. Many explanations in psychology are like one-pony circuses--small and with only one focus of attention. Theorizing starts with a felt need to explain a particular set of facts, but if the theory explains only these facts and has no other implications, it is a one-pony circus. An example is the innate "language-acquisition device" that Chomsky postulated to explain known and suspected facts about language development (1965, pp. 30-37, 1986, p. 3). This device seems to have no implications beyond the facts it was intended to explain, but one of these implications--that language development has an innate basis--has forestalled mainstream linguistic research on environmental mechanisms, which other research (e.g., Moerk, 1989, 1996) has shown are important in language development.

By analogy to Chomsky's language-acquisition device, the capacity for operant conditioning, which Skinner (1974, chap. 3) speculated evolved through natural selection, could be called an innate "operant-conditioning device." It is a one-pony circus because it explains why operant conditioning is possible and it has no implications beyond the facts of operant conditioning. In fact, its only implications seem to be that the conditions under which operant conditioning occurs may be species specific but in any case are innately given and therefore the laws of operant conditioning are attributable to natural selection and are otherwise unexplainable. These implications seem not to have forestalled experimental and conceptual attempts to explain the laws, such as attempts to explain the reinforcing function (e.g., Catania, 1992, pp. 192-194), stimulus equivalence (e.g., Hayes, 1994), and the matching law (e.g., Shahan & Lattal, 1998).

Excessive speculation. The sexes tend to segregate during childhood, and Maccoby and Jacklin (1987) briefly discussed an unpublished sociobiological explanation that was suggested in a discussion group at Stanford University. The explanation was that incest generally does not promote adaptation, and therefore a genetic basis for avoiding incest might have emerged during evolution. This effect could be produced by a mechanism that suppresses sexual attraction to members of the opposite sex with whom one interacted closely as a child, but the mechanism would also have an undesirable effect unless it or an associated mechanism induced children not to interact closely with members of the opposite sex who at maturity would be biologically appropriate sex partners. Any mechanism that had the latter effect would tend to segregate the sexes during childhood.

Maccoby and Jacklin questioned this sociobiological explanation on the ground that the outcomes of the hypothetical mechanism(s) appear not to be universal among human cultures. However, the part about suppression of sexual attraction to persons who were childhood intimates is supported by the fact that biologically unrelated age-peer Israelis raised in the same kibbutz seldom intermarry (e.g., Bettelheim, 1969, pp. 237-238) even though they are appropriate sex partners from a biological standpoint. Thus, the social intimacy that is characteristic of the kibbutz makes biologically eligible sex partners psychologically ineligible. Nevertheless, this outcome does not support the hypothetical mechanism noted above because this mechanism implies that the sexes segregate during childhood, yet the children in the kibbutz do not segregate by sex. Because the hypothetical mechanism does not have all the effects it should have, the psychological ineligibility of same-age kibbutzniks can be attributed to socialization (Bettelheim, ibid.) at least as plausibly as to the hypothetical mechanism. (I am indebted to Jacob L. Gewirtz for directing me to the Bettelheim reference in a personal communication, February 8, 1994.)

A further consideration is that if evolution had given the incest taboo a biological basis in humans, the incest taboo would presumably not need to be stated. In fact, if the incest taboo had a biological basis in humans, human incest would presumably not be as prevalent as it is. More likely, then, the incest taboo has a social rather than biological basis. This explanation also explains why certain male homosexual relations, which were institutionalized in some New Guinea tribes, were subject to incest taboos that forbade relations between males who were close kin (Williams, 1936, pp. 158, 204, 309).

Conclusion

A description is right or wrong depending on whether it is or is not an accurate description of the phenomenon purportedly described, regardless of how "accuracy" is assessed. In contrast, the criteria determining whether an explanation is right or wrong depend on the type of explanation being used. The truth of a deductive type of explanation depends on (a) the truth of the theory serving as the major premise in the syllogism from which the to-be-explained phenomenon was deduced and (b) the validity of the syllogism. The truth of a pattern type of explanation depends on (a) the scope and cohesiveness of the theoretical network of facts that the to- be-explained phenomenon is argued to be consistent with and (b) the persuasiveness of the argument. This difference, and others discussed in the article, demonstrate that description and explanation are different activities.

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Author's Note

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Causal Analysis in Modern Developmental Psychobiology: Important Lessons for Behavior Analysis

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Kuo's radical ideas about instinct, evolution, and development reveal a set of conceptual arguments and, especially, recommendations for causal analysis that are highly compatible with those held by behavior analysts in the tradition of B.F. Skinner. It is proposed that if behavior analysis is to take on a full examination of development, we will need a model for ontogeny that prompts us to uncover the mechanisms by which individuals come to display characteristics typical of their species; the mechanisms of the epigenesis of behavior. Broadly conceived, this is the task of a truly causal developmental analysis.

When John B. Watson and other early behaviorists proposed the foundation for a scientific account of human and animal activities, they did so by addressing the most pressing methodological and philosophical issues of their time: Namely, (a) reliance on introspection as a primary methodology, and (b) the notion that the mind is the source of adaptive activity and is equipped, through evolution, to direct pre-adapted emotions, thoughts, and performances (e.g., Guthrie, 1930; Watson, 1930). These early behaviorists spawned a revolution in American psychology by defining the methods and the subject matter of our science. They also challenged the prevailing notion that virtually every complex adaptive activity could be tidily attributed to an inborn instinct (Hilgard & Bower, 1966, pp 75-76).

Kuo's Ideas on the Causes of Development

Zing-Yang Kuo was a young contemporary of Watson's who was sympathetic to the aims of the early learning theorists in developing an objective, experimental, and especially "investigative" science. However, he felt that the field would not be relieved of the sticky nature-nuture problem by simply demonstrating the role of conditioning or learning in behavioral development. In fact, although he was closely identified with environmentalism, Kuo was equally critical of the nativist ethologists and of learning theorists for their approaches to understanding species specific performance (Kuo, 1967; 1970).

An examination of Kuo's radical ideas about instinct, evolution, and development reveals a set of conceptual arguments and, especially, recommendations for causal analysis that are highly compatible with those held by behavior analysts in the tradition of B.F. Skinner (e.g., Skinner 1966; 1969; 1974; 1975a). Despite this compatibility, historically behavior analysis has not included a model of individual development and evolution that incorporates the thinking of Kuo or his intellectual descendants.

My purpose is to review some of that thinking, paying particular attention to ideas about good and poor explanations for behavioral development. I will follow a few of my colleagues in behavior analysis, especially Bryan Midgley and Ed Morris at the University of Kansas-Lawrence, in suggesting that the developmental psychobiology tradition has generated systems for thinking about the causes of development that resonate with the fundamental tenets of behavior analysis (Midgley & Morris, 1992; Midgley, 1997). If behavior analysis is to take on a full examination of development, we will need such a model for ontogeny: One that prompts us to uncover the mechanisms by which individuals come to display characteristics typical of their species; the mechanisms of the epigenesis of behavior. Broadly conceived, this is the task of a truly causal developmental analysis.

In 1921, when he was still an undergraduate student, Zing-Yang Kuo published an article titled "Giving up Instincts in Psychology" and thereafter stood out as an insightful and challenging participant in the nature-nurture debate (Kuo, 1921; see Gottlieb, 1976 for a brief biography of Kuo). In his last publication, in 1970, he said:

> The chief objective of the epigenetic behaviorist is to seek order out of [such] complex behavioral phenomena in order to formulate laws of behavior without resorting to vitalism either implicitly or explicitly. (Kuo, 1970, p 25)

Kuo was concerned with combating the same types of non-explanation that bothered Watson, and later Skinner, particularly concepts that were substitutes for true causal analysis. It is this core argument about the nature of adequate explanations for behavior that will be most familiar to behavior analysts. For example, Kuo argued that the more we learned about the causes of behavioral development, the less we would rely on mental concepts and other empty explanations (Kuo, 1970; p. 4): "To call an acquired trend of action an instinct is simply to confess our ignorance of the history of its development." (Kuo, 1921, p. 650)

Another aspect of Kuo's arguments about explanation that will sound familiar to behavior analysts is his preference for those that lead to investigation--and especially to manipulable variables (Gottlieb, 1976, p. xiii). Kuo conducted a series of studies in which he attempted to change typical developmental outcomes (such as aggression of cats towards rats) by systematically varying rearing conditions (Kuo, 1970, p.63-65). His approach to causal analysis was to vary specific environmental events in ontogeny in order to look for related variations in behavioral development--he attempted to predict and control the behavioral outcomes of development. Kuo assailed the concept of instinct especially for directing attention away from this kind of analysis of causal events occurring during individual development:

> [Kuo's] attack was based on the insight that the use of instinct as an explanatory concept was harmful to a genuine understanding of behavior because it made the analysis of development superfluous, and therefore, unnecessary. (Gottlieb, 1976, p xiii)

In other words, when a response in question is attributed to instinct, and therefore to the evolution of the species, questions about the mechanisms by which it arises during an individual's development are circumvented. Kuo said that any explanation for the presence of behavior which ignored the ontogeny of that behavior in the individual was no explanation at all (Kuo, 1970):

> To assume any inborn tendency is to assume an *a priori* relation between the organism and stimulating objects; for every behavior is an interaction between the organism and its surrounding objects. Such an assumption is no less objectionable than the theory of innate ideas. (Kuo, 1921, p 650).

For developmental psychobiologists, then, the appearance of a match between the behavior of the organism and its environment (in the absence of so-called relevant experience) demands a causal analysis of the events responsible for that behavior appearing in the individual. They refuse to simply celebrate the actions of a fortuitous genetic and neural endowment, but instead set out to uncover the structural and experiential history of the organism that precedes the appearance of an adaptive response. It is useful to note that the same argument is made for the development of the morphology of the organism (through embryogenesis).

This is a radical departure from an approach in which the appearance of an adaptive response in the absence of obviously relevant experience is credited to the genetic endowment of the organism, or as in behavior analysis, to the selection contingencies for the species that determine that endowment (Midgley & Morris, in press). For example, chicks begin pecking at small objects very shortly after hatching, obviously having had no similar experiences inside the egg. The traditional developmentalist, and behavior analyst, once satisfied that pecking does arise in the absence of extra-egg environmental input, both attribute the performance to maturation of the nervous system and other related morphology, a largely passive process of growth directed by the genes in which the stimulating environment plays no important part.

> As far as innate behavior goes, then, in this view the genes provide an essential controlling or determinative impetus to the development of the nervous system, including peripheral sense organs and muscles. In a word, genes are thought to somehow be at the base of neural maturation, which in turn leads to the manifestation of innate behavior. (Gottlieb, 1976c., p. 239)

In contrast, Kuo and others adopted the conceptual stance that a full explanation of the development of a response requires an analysis of the local causes of development, including reference to the morphology and physiology of the organism as well as current physiological and environmental events (such as hormonal states and eliciting stimuli). Kuo himself is well known for having developed techniques for removing the top of chicken's eggs late in their development in order to view and record behavioral, neuromuscular, and stimulative events occurring before hatching. In the case of pecking, for instance, the head rests directly on top of the heart late in embryogenesis. If the chick's head is displaced in such a way that it does not receive the "typical" rhythmic stimulative experiences from resting on the heart, lunging and pecking shortly after hatching are affected:

> Kuo believed it was useful to regard all behavior as being acquired during individual development--in this way, one is forced to come to grips with an analysis of the anatomico-physiological maturational events, as well as the environmental contingencies, which determine behavior. From an ontogenetic viewpoint, all behavior has to be "acquired" during development-unless, that is, one cares to make a case for preformation. (Gottlieb, 1976, xv.)

Kuo's studies of prenatal development of chicks is instructive in another way. Notice that in this example, the prenatal "experience" that is thought to play a causal role in the appearance of pecking is self-stimulative, not dependent on the extra-egg environment. And that self-stimulaton is largely a consequence of the structural features of the organism such as the heart, the way the head and neck are positioned at this point in development, etc. Developmental psychobiologists have been particularly concerned with the role of self-produced stimulation in their causal models. In their formulations, it has been important to distinguish between behavior that appears to be completely autogenous from that which has identifiable experiential causes, even if some of those causes are contained within the skin of the organism and arise as a direct result of organismic structures (structures which, not incidentally, have their own analyzable developmental histories).

Other Metatheoretical Conceptions by Developmental Psychobiologists

Much of this conceptual concern about the role of self-produced stimulation arose in the field of experimental embryology--which clearly overlaps with the study of early behavior and the development of the sensory systems. In the late 1800's, science had only recently rejected the idea that the entire structure of the individual was present, albeit in a tiny form, in the fertilized egg. Later studies of the conditions under which the first movements of embryos arise revealed that in some cases, movement or sensory function preceded all afferent input (e.g., Oppenheim, 1963; Hamburger, 1973, Hubel & Weisel, 1963). In other words, some movement and sensory function can be entirely autogenous and not dependent on any extra-organism stimulation.

For developmental psychobiologists, a full causal picture of behavioral development would explain the genesis of both behavior dependent on endogenous stimulation and behavior that is autogenous. The level of biochemical "experience and context" for migrating neurons, for example, is part of a causal description of how behavior develops--although developmental psychobiology generally leaves questions about the chemical and structural determinants of early neural proliferation and migration, for example, to the embryologists. However, they do take a unique view of the role of those autogenous responses and sensory capacities in causing subsequent development. When the organisms own spontaneous movements affect subsequent structural and behavioral development, they become causal experiential variables:

> . . . experience involves sensory or motor function whether evoked or spontaneous. . .spontaneous (as well as evoked) neural activity may play an important role in neural maturation and behavioral development. (Gottlieb, 1976b., p. 27)

If stimulative factors, which operate through the functioning sensory system can be determinants of structural development, then the typical "structure causes function" notion of development is turned around. Now function is seen as causing structure. In fact, acknowledgement and analysis of the bidirectional relationship between structure and function, or structure and behavior is a hallmark of developmental psychobiology (see Oyama, 1985 for a discussion of the structure-function relationship and Midgley & Morris, 1992 for a review of her book from the point of view of behavior analysis).

In this way of thinking, everything about the organism has to be "acquired" or constructed during ontogeny--morphology, physiology and behavior. Structure and behavior, sensory, and motor functioning have a bidirectional causal relationship. When everything about the organism is seen as being acquired, and when the structure of the organism is affected by its own developing functions, it becomes necessary to consider the acquisition of structure and function as probabilistic and influenced by a sequence of environment-organism interactions, not as predetermined and invariant:

> One viewpoint holds that behavioral epigenesis is predetermined by invariant organic factors of growth and differentiation (particularly neural maturation), and the other main viewpoint holds that the sequence and outcome of prenatal behavior is probabilistically determined by the critical operation of various endogenous and exogenous stimulative factors. (Gottlieb, 1970; p. 111)

But what can this kind of reconceptualization of ontogeny and its determinants do for behavior analysis? In the long run, this perspective would allow behavior analysis to adopt a conceptually consistent view of development--one which highlights the "hows" of behavioral development (Anastasi, 1958); just as the existing system of explanation in behavior analysis focusses on the "how's" of behavior maintenance and change (e.g., Skinner, 1966). In this sense it could set the stage for a "downward extension" of the existing explanatory concepts in behavior analysis into prenatal or pre-operant models of influence on the organism which are necessary for a thorough and systematic behavior analysis of development.

Admittedly, a full introduction to this perspective and its relationship to behavior analysis requires a considerably more detailed review and exposition than I have presented here. An examination of how behavior analysis and developmental psychobiology view the reciprocal interaction between structure and function in the development of behavior, for example, would certainly be in order (this is one topic I'll defer to a subsequent paper). There are several other steps one might take or "chapters" one might write about this relationship (Midgely & Morris, 1998). For example, I have not introduced the conceptual and empirical work of researchers and writers who have championed and extended the psychobiological perspective (e.g., Lehrman, 1953; Schneirla, 1972; Gottlieb, 1976b, Oyama, 1985; Thelen, 1993), nor the few examples of behavior analytic work that I view as explicitly compatible with it (e.g., Schusterman & Kastak, 1998). I expect that discussions of the relevance of psychobiology and developmental systems to behavior analysis will continue and will generate these and many more such "chapters" to the benefit of behavior analysis.

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Learning and Growth: Developmental Changes in Behavior

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Any scientific approach to the understanding of developmental change must assume that developmental outcomes are determined by many factors, including: 1) species-specific, biologically-based perceptual and behavioral capacities (prescribed by the morphology of the species), 2) individual biologically-based perceptual and behavioral capacities (prescribed by variability in morphology within the species), 3) maturational growth, 4) a history of interactions with the environment, and 5) current task demands. However, the assumption of determination does not imply the ability to predict outcome or patterns of change for any given instance (Marr, 1996), which suggests significant modifications to current theoretical, methodological, and statistical practices in developmental science. In particular, the utility of an ecological, dynamic systems approach for exploring change will be proposed as appropriate for conceptualizing development.

Developmental outcomes can be described as relatively stable patterns emitted by an individual when the following components come to be organized in new ways: 1) species-specific, biologically-based perceptual and behavioral capacities (prescribed by the morphology of the species), 2) individual biologically-based perceptual and behavioral capacities (prescribed by variability in morphology within the species), 3) maturational growth, 4) a history of interactions with the environment, and 5) current task demands. Any scientific approach to the understanding of developmental change must assume that developmental outcomes are *determined* by these factors. However, the assumption of determination does not imply the ability to predict outcome or patterns of change for any given instance (Marr, 1996), which suggests significant modifications to current theoretical, methodological, and statistical practices in developmental science. In particular, the utility of an ecological, dynamic systems approach for exploring change will be proposed as appropriate for conceptualizing development. In addition, it will be argued that this new metatheory provides an excellent base for integrating behavior analytic and non-behavior analytic developmental approaches. An example of such an integration is the new textbook, "Developmental Psychology: Dynamic Systems and Behavior Analysis," written by Gary Novak (1997). Here, I, a developmental scientist who was not trained formally in behavior analysis, would like to further promote such an integration.

Applying Dynamical Systems Assumptions

A dynamical analysis involves understanding a pattern of changes over time in a particular variable that is well-defined and observable (Thelen & Smith, 1994), and it can be conducted through multiple methods, including various quantitative mathematical and statistical procedures (Barton, 1994). Key conceptual features of dynamic systems theory, however, entail methodological approaches that are more qualitative in nature (Haynes, Blaine, & Meyer, 1995), and hence provide a starting place for thinking in new ways about investigating behavioral development. First, the idea that continuous changes in certain components of a system can lead to sudden state changes provides us with a mechanism for transitions to novel forms (or stages) (Barton, 1994; Rosales-Ruiz & Baer, 1996). This suggests the need for a large number of observations of the system just prior to the time of change and a search for high levels of behavioral variability in the system at the time of change (Siegler, 1996).

Second, dynamical systems are seen as self-organizing in that stable, new structures or patterns emerge in open systems (ones that exchange energy) without necessarily being specified by external, environmental constraints. An example of self-organization comes from the footfall pattern, or gait, of a horse, as increases in the energy being expended toward forward locomotion, result in dramatic changes in the form of the locomotion. These changes are in large part determined by the anatomical structure of the horse which constrain possible outcomes (Thelen, 1995). Dynamical systems therefore involve both stability and flexibility, and are susceptible to restructuring with small perturbations in various aspects of the system. Thus, strategies for examining dynamic systems should entail a focus on the conditions that invoke transitions, and the importance of variability at the local level (i.e., the importance of task demands and performance) are highlighted (Eckerman, 1993; Kelso, 1995; Siegler, 1996; van Geert, 1994).

This perspective has obvious applicability across the natural sciences, and has been guiding theory and research in biology, physics, and chemistry (e.g., see Baskin & Mittenthal, 1992, Gleick, 1987, and Haken, 1983, for reviews). It has also appealed to a number of developmental psychologists (e.g., Eckerman, 1993; Fogel, 1990; Fogel & Thelen, 1991; Smith & Thelen, 1993; Thelen & Smith, 1994), as well as behavior analysts (see the Special Issue on Behavior Dynamics, May 1992, JEAB). Critically, these investigations challenge some aspects of traditional scientific methods. While the perspective is deterministic, because of a focus on the complexity of the interactions of the causal mechanisms (e.g., non-linear, non-additive effects, feedback loops), dynamic systems are extremely sensitive to initial conditions. Even with attention focused on critical historical values of target behaviors and causal factors (Heiby, 1995a; 1995b), prediction and control are difficult, and may be unreasonably stringent criteria for experimental analyses.

Applying a dynamic systems approach means taking changes in performance over time very seriously, a fact which forms the basis for the suggestion that the theory provides an opportunity for greatly expanded discourse between developmental psychology and behavior analysis. Developmental scientists are increasingly focused on the importance of variability to ontogenetic change, and the traditional focus on competence, rather than performance, is being strongly criticized (e.g., Sophian, 1997). In fact, variability in behavior is being stressed as the most critical characteristic of an immature organism to consider when describing development (Siegler, 1996). Variability across organisms and environments is not noise but is the source of data that yields the best descriptions of behavior and development over time, and incorporates the notions of changes in behavioral probabilities, novelty, and fluency (Sidman, 1960; Siegler & Crowley, 1991). That is, in addition to increasing our understanding of the behaviors that are developing, a focus on changes in performance is critical to describing the process by which new behaviors emerge and are maintained.

Variability. Interpreting variability as essential to development entails a discussion of selectionist accounts of behavior change (Baum, 1995). Accounts of change that appeal to age or maturation as an independent variable are problematic as experience is seen as the "true" causal mechanism (Bronfenbrenner & Ceci, 1994; Chi & Ceci, 1987; Cohen & Siegel, 1991; Landau & Gleitman, 1985; Rogoff, 1990). Critical, however, to a perspective that emphasizes experience or history is the notion that stimulus control can not restricted to momentary cause (Rachlin, 1994; Staddon, 1993). An emphasis on contextual variables, or setting events, at all levels is central to the importance of differential experience to developmental outcomes (Baer, 1997; Bijou, 1996; Paniagua, 1997). The consideration of 4- and higher-term contingencies and complex antecedent discriminative stimuli, both historically and currently, is necessary (Pelaez-Nogueras & Gewirtz, 1997). And for the analysis of human behavior, contextual events at the level of culture must also be examined. Cultural learning is being heavily emphasized in both the developmental (e.g., Montgomery, 1997; Tomasello, Kruger, & Ratner, 1993) and behavior analytic literatures (e.g., Glenn, 1991; Lamal, 1991; Malagodi, 1986).

Recognizing the etiologity of reinforcers. A thorough understanding of what is reinforcing to the organism is also critical to selectionist approaches. Mainstream developmental psychology has assumed that human behavior can be maintained by phenomena like perceptual stimulus changes, movement relative to the external environment, the successful manipulation of objects, and proprioceptive feedback. For example, while many developmental psychologists reject the "mentalism" inherent in Piaget's theory of cognitive development, his observations with respect to the enormous amount of independent, variable, manipulative, exploratory "play" behavior in the developing human have been replicated consistently (see Flavell, Miller, & Miller, 1992). These types of reinforcers come under the category of ecological or automatic reinforcers in the behavior analytic literature (Bijou & Baer, 1965; Bijou, 1995; Malcuit & Pomerleau, 1996; Vaughn & Michael, 1982), but have not received very much attention. Developmental scientists have also assumed the strong effects of social stimuli as reinforcers for human infants (Redd, Winston, & Morris, 1977). Current behavior analytic work is systematically manipulating some of these stimuli (e.g., touch, vocalizations, facial expressions, and imitation) (e.g., Gewirtz & Pelaez-Nogueras, 1998; Pelaez-No gueras, Gewirtz, Field, Cigales, Malphurs, Clasky, & Sanchez, 1996) in order to further our understanding of species-typical reinforcers and how they function.

The relevance of physiology and individual differences. A selectionist perspective also implies that while developmental science cannot be reduced to biology (Reese, 1996), physiological products and the neurological substrates of behavior cannot be ignored (Donohoe & Palmer, 1994; Harrison, 1994; Hunziker, Saldana, & Neuringer, 1996; Johnson, 1993; Siegler, 1989). In addition, comparative research (e.g., Sameroff & Suomi, 1996) implies the relevance of both species-specific principles of behavior, and principles that generalize across species, to current developmental science.

Thus, a dynamic systems approach that entails complex change in open systems is being proposed as the best one to account for the key phylogenetic, ontogenetic, and immediate determinants of behavioral development. There will always be the issue of how to conduct experimental analyses involving variables that cannot be manipulated ethically. Developmental psychology has dealt with this through the use of correlational research methodologies, within-subject group designs that capitalize on naturally occurring variability in the multiple determinants of behavior. An illustration follows, one that attempts to place correlational designs within a perspective that incorporates the concepts of both learning and growth: Thompson (1986) proposed that, while "individual variation in emotionality... can shape infants' perceptions of the care-giving environment..." (p. 45), much of the work on early parent-child interaction focused solely on the role of maternal responsivity. However, individual variation in temperament or emotional behavior may interact with the variability observed in parental responsivity or sensitivity. For example, one critical measure of responsivity and sensitivity is latency to attend to infant cries. Individual differences in frequency of crying may have a large influence on how infants learn the contingencies that are operating in this behavioral sequence. Similarly, frequency of gaze aversion on the part of the infant might influence the ability to gain certain kinds of information available in face-to-face interaction with a caregiver through facial expressions and vocalizations. Complicated 4- and higher-ter m contingencies are nowhere more evident than in these interactions and most probably provide the critical environmental setting for skills like imitation.

In addition, variability in infant behavior may have the effect of differential elicitation of caregiver behaviors. Adults are more likely to use reasoning about the consequences of behavior when working on a task with a child with a person orientation (one who looked frequently at the adult's face and was verbally responsive) while being more likely to use power assertion discipline strategies with children low in person orientation (Keller & Bell, 1979; see also Brunk & Henggeler, 1984; Cantor & Gelfand, 1977). Similarly, with children who tended to avoid social contact, in contrast to those who seek out such situations, adults pay less attention, show low physical contact, and interact infrequently (Taylor & Carr, 1992a; 1992b). While these data are correlational, the studies were designed to assess the impact of the child in interactions. Yet another potential child effect is evident in recent findings in the child language literature that suggest adults prefer syllabic vocalizations on the part of a baby (Bloom, D'Odorico, & Beaumont, 1993). That is, these findings show that adults tend to reinforce syllabic vocalizations to a greater degree than they do non-sy llabic vocalizations. Thus, infants who emit more non-syllabic vocalizations may receive less adult attention.

In all of these situations, individual differences in infant characteristics (which are at least partially heritable, as indicated by the growing amount of evidence from the field of behavioral genetics (e.g., Bates & Wachs, 1994, Plomin, 1989; Plomin & Daniels, 1987; Suomi, 1987)) would have the effect of exposing infants to differential amounts and types of information about the social environment. These differences in infant behavior are also likely to be differentially maintained by operant contingencies, thus yielding differential learning. These types of analyses are necessary for identifying the influential determinants inherent in the dynamic system that is the developing human in a species-typical environment (Fogel & Thelen, 1987; Goldfield, 1995).

Conclusion

Developmental psychologists want to describe the process by which behaviors come to appear in the human repertoire that are not observable in the newborn infant. Dynamic systems theory provides a model for conceptualizing the interaction between nature and nurture in producing behavior. It forces us to not just explain organism-behavior causal relations or environment-behavior causal relations, but rather to see behavior as emergent from the organism-environment dynamic system. The model allows us to fully acknowledge species continuities and discontinuities, developmental continuities and discontinuities, and behavioral continuities and discontinuities. Gewirtz and Pelaez-Nogueras (1996) recently defined the study of behavioral development as the study of 1) changes in the complexity of the controlling environment (including the origins of and changes in reinforcers), 2), early experience as containing important determinants of later behavior, and 3) contextual variables and their relation to interactions among stimulus and response functions. My claim here is that much of current research and theory in mainstream developmental is covered by this definition (see Cairns, Elder, & Costello, 1996, for example). If we put together these two branches of research traditions, behavior analysis and developmental psychology, under the guidance of a dynamic systems perspective, I think we might make significant headway on questions concerning developmental change. Paying attention to the key features of the theory is critical, and includes a new meaning for time, a new meaning for variability, and a new respect for individuality (Thelen & Smith, 1993).

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Skills Learning in Behavioral Epigenesis

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Skills learning is a cornerstone of behavioral epigenesis from a behavioral systems perspective. The characteristics of skills and their development are described. Examples of the skills learning paradigm are applied to motor, cognitive, language, and social development. Differences between traditional developmental, behavior analytic, and behavioral systems approaches are described.

Skills learning is a cornerstone of Behavioral Systems Theory (Novak, 1996, 1998). It is the fundamental process by which organized systems of behaviors emerge over time through environmental interaction. This paper describes the characteristics of skills learning as a natural developmental process and describes its relevance to specific developmental domains such as motor, cognitive, language, and social development.

A problem for behavior analysts investigating the development of behavior is that the experimental analysis of behavior focuses on short-run changes in behavior, whereas developmental questions tend to be long-run issues. Furthermore, viewed from outside the field of behavior analysis, the small set of simple, but parsimonious principles valued by behavior analysts, is viewed by traditional developmentalists as being too simple, and thus simplistic. I think skills learning is one way for behavioral developmentalists to address both these issues.

Behavior analysts have long accepted the importance of skills learning in the development of behaviors in applied settings. A recent electronic search of the abstracts of the *Journal of Applied Behavior Analysis* turned up 207 articles involving skills. These articles use learning principles to create skills in a wide-range of applied areas. However, as a natural developmental process, skills learning is virtually unexplored by behavior analysts.

Only recently have behavior analysts recognized the relevance of skills learning to developmental epigenesis (Novak, 1996). For example, Moerk (1993) has laid out an empirically based argument for the development of language as skills learning. Likewise, Novak (1996) has suggested Kurt Fischer's (1980) skills theory of cognitive development as an appropriate model for a behavior analysis of cognitive development.

Characteristics of Skills

Zimmerman and Whitehurst (1979) identified seven issues which differentiate structural from functional viewpoints on development. One of these is the significance of skills. According to the authors, structural viewpoints, such as Piaget's theory of cognitive development, emphasize qualitative stages while functional views, such as behavior analysis, see development as in the "accretion of skills" (Zimmerman & Whitehurst, 1979, p. 16). From this perspective, new skills develop from previous ones. The authors cite Gagni as one example of a hierarchical approach to skill development. In such an approach, complex skills are the result of more basic ones. Commons and Rodriguez (1993) provide another hierarchical model from within the behavior analytic framework.

Behavior analysts have long recognized the nonlinearity of behavioral change. While an accretion of skills suggests linearity, this need not be the case. While shaping is defined as the process of reinforcing successive approximations, there is no requirement that the approximations be linear. For example, the steps in shaping an autistic child to emit the word "ball" are not equally spaced. The initial steps may be very small while at the end, there may be a large leaps. Another example is stimulus equivalence which is defined by the sudden emergence of untrained responses to derived relations among stimuli. This type of sudden change parallels the dynamic systems concept called a phase shift. Andronis (1983) and Johnson and Layng (1994, 1996) have described the sudden emergence of qualitatively different skills from those directly trained as "contingency adduction." The term suggests the nonlinear emergence of new skills by the application of contingencies.

Zimmerman and Whitehurst (1979) acknowledge this nonlinearity in skill development which they refer to as "discontinuities" (Zimmerman & Whitehurst, 1979, p. 17). The term "discontinuity" has been often used by traditional developmentalists to describe the stages which they feel characterize development. In the view of Zimmerman and Whitehurst these discontinuities or nonlinearities are seen by functionalists, including behavior analysts, as the result of inability to detect intermediate skills (what Thelen and Ulrich, 1991 call "hidden skills") rather than structurally based stages. Furthermore, Zimmerman and Whitehurst (1979) suggest that such nonlinearities may result from the strong contingencies produced by a newly emergent cognitive skill. Thus, a new skill may be so much more functional that it is very quickly strengthened, while less functional forms are not.

This view is incorporated in contemporary dynamical systems approaches to development (e.g., Novak, 1996, Thelen & Ulrich, 1991). *Phase shifts* describe nonlinear changes from one dynamic attractor state to another. Attractor states or attractors are consistent patterns of responding. In behavior analysis, new functional response classes emerge from organism environment interactions. Initially these attractors are "soft assemblies" of behavior (Thelen & Ulrich, 1991). This suggests that in the early stages of the organization of behavior, there is a great deal of variability and susceptibility to perturbation.

Phase shifts occur through coalescent organization, which is the combination of necessary and sufficient conditions to produce organization or reorganization of behavior (Novak, 1996). Behavior analysts have frequently noted the increased variability and fragility of response classes in the initial phases of skills learning. Recently, Binder (1996), Lindsley (1996), and other behavior analysts have stressed fluency in the development of academic skills, as a way to reduce this fragility. Fluency leads to "hard" or at least harder assemblies and results from overlearning of skills (Dougherty & Johnston, 1996). Dynamical systems theorists find such fluency occurring naturally in developmental epigenesis as skills learning progresses.

As noted earlier, development as the acquisition of skills is a central part of Behavioral Systems Theory (Novak, 1998). There are five important characteristics of skills. First, skills are organized functional response classes. Second, skills develop over long periods of time during which enormous numbers of behavioral trials or learn units occur. Third, skills develop through environmental influences. Consequences, in the form or feedback or other types of reinforcement are among the most important environmental influences for assembling skills. Fourth, the unit of analysis is the four-term contingency. Finally, skills are hierarchical (Kaye, 1979). A corollary of this means that components of skills may be present but undetected prior to being assembled under coalescent organization. Thelen and Ulrich (1991) refer to these undetected components as "hidden skills".

Besides being compatible with behavioral systems theory, a skills learning approach is consistent with observable conditions. Moerk's analysis of the intuitive use of the three-term contingency in mother-child language interactions (Moerk, 1990) is an example of this. In his analysis of mother-child linguistic interactions, Moerk found that mothers employ extraordinarily high frequencies of antecedents and consequences when shaping child verbal behavior.

In the remainder of this paper I shall illustrate how skills theory forms a central notion in theories explaining the development of various important behavioral domains.

Motor Development and Skills

Esther Thelen has placed a great deal of emphasis on skill development in her dynamic systems approach. A skills learning approach is a natural outcome of her early research which focused on motor behavior, particularly bipedal walking (Thelen & Ulrich, 1991). Since motor behaviors are easily observed, the characteristics of change which relate to skills learning is more easily apparent in this domain than others. Thelen and Ulrich (1991) experimentally manipulated environmental conditions in pre-walking infants to uncover the emergence of a hierarchy of walking skills and hidden skills.

Subsequently, Thelen and her associates have extended this skills development approach to other domains, such as cognition (e.g., Thelen & Smith, 1994).

Cognitive Development and Skills

Fischer (1980) considers the term "skill" to be equivalent to Piaget's "scheme" or to Skinner's "operant". He views skills as response sets, or response classes. In his view, skills are systematic variations in behaviors which are under the control of organismic and environmental conditions. Much of Fischer's theory is concerned with the hierarchical structure or organization of these response classes.

In Fischer's view, skills develop in a hierarchy of complexity. He postulated four tiers of development: reflex, sensori-motor, representational, and abstract (although he was reluctant to give reflex the full status of a tier). Each tier consists of qualitatively different organizations of cognitive skills. These tiers roughly translate to Piaget's stages of cognitive development, but Fischer's tiers are not equivalent to the Piagetian stages. The most obvious similarity is the sensori-motor tier where the name is the same in both theories.

Within each of Fischer's tiers are four levels with the same basic structure. It is significant that the fourth level of a lower tier is the same as the first level of the next tier. Thus, the fourth level of the sensorimotor tier is the same skill as the first level of the representational tier.

The first level of each tier is a single operant response set or class. Metaphorically, this level is represented symbolically by a single dot. The second level is a relationship between two response classes which Fischer called a "mapping relationship" and is represented this by a line joining two dots representing two individual response classes. At level 3 are "systems", which are multidirectional relationships between more than two response classes. This is represented by a square comprised of mapped relationships. Finally, level 4 involves a relation which Fischer called "systems of systems" in which systems are related to other systems. This is symbolized by a cube. Recall that this level 4 relationship is the same as the first response class (level 1) of the next tier. Thus, a sensori-motor system of systems is also a simple representational response class.

Language Development and Skills

A third domain to illustrate a skills learning approach is the development of language. Ernst Moerk (1986) has long championed the view that skills learning is emerging as the appropriate paradigm for language acquisition. Like Fischer (1980), Moerk too views skills as behavioral structures which are hierarchically organized. As a skill, language develops gradually over many behavioral trials. Language is taught to the child by the parents, particularly the mother, through an intuitive teaching process employing the three-term contingency (Moerk, 1990).

Instead of the random linguistic environment suggested by psychololinguists, Moerk (1986) suggested that the environment parents provide is ideal for the teaching of language as a skill. Moerk identified four characteristics of this informal skills learning process. These are: 1) mothers repeat sentence types in highly intensive episodes; 2) children respond to the intensity of maternal prompting with large numbers of utterances; 3) mothers provide reinforcing and corrective feedback to the children; and 4) parents modify their language teaching based on the feedback from the child.

As an example of the intensity of the language training, Moerk (1986) estimated that the child Eve in Roger Brown's *A First Language* (1973), would have heard as about 100,000 repetitions per month of each of the major sentence types. This evidence of enormous number of language skills teaching episodes is supported by Hart and Risley's work (1995) in which they estimate that children of professional parents may be exposed to 30 million words by the age of three.

In turn, children respond to their parents' language teaching with the development of language skills. For example, Moerk estimated from Brown's sample that Eve may have produced 500,000 linguistic responses per month. Similarly, the vocabulary development of children in three distinct socio-economic classes was directly related to the amount of language training, including word usage and feedback, by their parents (Hart & Risley, 1995). In sum, Moerk (1986, 1993) and Hart and Risley (1995) make a strong case that language acquisition is a skills learning process.

Antisocial Development and Skills

Finally, a skills learning process may be applied to the development of social development and personality. One example is Patterson's examination of the developmental of antisocial personality (Patterson, Reid, & Dishion, 1992). Gerald Patterson and his associates have for years detailed the development of antisocial behavior in children. Recently they have extended their analysis to include a process from basic training of antisocial skills in the preschool-age child through the development of an antisocial personality in the adult. This process fits the criteria for skills learning model. First, the antisocial behaviors become organized and reorganized over the course of development to the point that in maturity they are considered career antisocial adults with a stable "antisocial trait" (Patterson, et al., 1992, p. 27). At this point the pattern of responding consists of a constellation of highly skillful coercive and antisocial behaviors exist. The consequence is that these individuals are likely to be unemployed, have failing marriages, and are higher risks for substance abuse and for being arrested.

Second, as with other skills, antisocial behavior develops incrementally over a long period of time. The process starts with the learning of coercive behaviors in early childhood and continues into adulthood (Patterson, DeBaryshe, and Ramsey, 1989). It includes a stage during later childhood and adolescence which Patterson and his associates (Patterson, et al., 1992) deem "polishing antisocial skills" (p. 12).

Third, Patterson, et al. stress environmental determinants. Initially these are family based in early childhood, but progress through typically negative interactions involving schools and normal peers. Consistent with the fourth characteristic of skills, Patterson and associates emphasize the importance of contingencies, particularly negative reinforcement in shaping antisocial skills. Finally, antisocial skills are organized hierarchically, with more basic coercive skills in early childhood leading to more complex ones as development progresses.

In summary, skills learning provides an effective paradigm for understanding the incremental yet nonlinear long-run changes that characterize human development. Two final points seem justified. First, it is important to emphasize that the structures which are organized as skills are response-stimulus and response-response relationships, not formal mental structures. This is an important difference between the skills learning model taken in Behavioral Systems Theory and traditional stage theories.

Second, the skills learning model emphasizes the building of highly complex skills from its components. This is the opposite of the task analysis approach employed by behavior analysis in teaching skills. In the latter, skills are deconstructed from a formal or functional analysis of the end skill. Ironically, this latter approach is suggestive of many traditional developmental perspectives which take a "tasks of childhood" approach (e.g., Piaget, Erickson) to development. In these a developmental outcome is identified, but the environmental interactions are never analyzed. In a skills learning approach the necessary and sufficient behavior-environment interactions are identified and the developmental outcome emerges from these.

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Four Dimensions of Rules and Their Correspondence to Rule-Governed Behavior: A Taxonomy

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The taxonomy presented takes into account dimensions of an entire contingency arrangement specified in the rule and how these dimensions relate to the listener's behavior. The classification is made according to rule: (a) explicitness, (b) accuracy, (c) complexity, and (d) source. It is argued that the probability that the listener will behave according to a rule depends on the type of rule provided, the context in which the rule is provided, and listener's history with that or other similar rules. Even though manipulations of other types of rules have been conducted in studies of stimulus equivalence, relational frames, and derived stimulus relations, a systematic study of the differential effects of the proposed 16 types of rules on the listener's behavior is recommended.

Behavior analysts have distinguished rule-gov erned behavior from direct contingency-shaped behavior on the bases of different sets of controlling contingencies (e.g., Galizio, 1979; Reese, 1989; Verplanck, 1992; Zettle & Hayes, 1982). However, the contingency-specifying verbal stimuli (i.e., the rules), whose function is to control behavior and that have function-altering effects (Schlinger & Blakely, 1987) have not been systematically analyzed and classified in terms of *both* form and function. The classification of rules offered here may contribute to an advancement in the structural and functional analysis of rule-governed behavior.

On the Meanings of Rule-Governed Behavior

Rule-governed behavior has been distinguished theoretically and experimentally from behavior that is shaped and maintained by its direct consequences (e.g., Catania, 1985; Catania, Shimoff, & Matthews, 1989; Cerutti, 1989; Hineline & Wanchinsen, 1989; Vaughan, 1989; Zettle & Hayes, 1982). Skinner (1953, 1957, 1966, 1969) distinguished between behavior shaped by direct consequences, naming it contingency-shaped behavior, and behavior controlled by verbal antecedents, naming it rule-governed behavior. In his account, contingency-shaped behavior is maintained by direct consequences and comes under the control of discriminative stimuli. In contrast, rule-governed behavior, is controlled by verbal behavior, and only indirectly maintained by its consequences. In this sense, Skinner (1966) identified rules as contingency-specifying verbal stimuli--as stimuli that specify, either directly or indirectly, consequences for the behavior.

Rules and Rule-Governed Behavior As Useful Concepts

A concept of rule-governed behavior can be useful *if* it accommodates the description of complex behavior that is under the control of contingencies and can be modified by antecedent verbal stimuli (i.e., rules). The primary function of a rule, then, is to influence or guide the behavior of the listener--controlling the listeners' behavior in ways specified by the verbal behavior of the speaker. Such control can include producing *novel* ways of behaving.

Although the control of rules in governing behavior has been demonstrated, the distinction between contingency-shaped behavior and rule-governed behavior, at times, is unclear. Theoretical inconsistencies in the distinction between notions of contingency-shaped and rule-governed behavior have been discussed (e.g., Cerutti, 1989; Peláez-No gueras & Gewirtz, 1995; Ribes, 1992).

We should emphasize that although both are established by consequences, the controlling variables and functional properties of contingency-sha ped and rule-governed behavior differ. The particular functions of verbal stimuli, as controlling rules, are to specify (either explicitly or implicitly) the entire contingency array among antecedent stimulus, response, and consequence, in a given context. A rule must be understood in terms of the descriptions it makes of contingent relations among the three-term contingency (four or five term) in context. Such relations might or might not be present in the very situation where the rule is given, which imply more complexity of the entire contingencies embedded in the rule. The transmission of these "non-present complex contingent relations" can be achieved *only* through *language*. Clearly, the ultimate controlling character of a rule is based on ready-made discriminative attributes that, by virtue of the listener's verbal history, do not require new conditioning in every new situation in which the rule is provided. Moreover, individuals can behave from the outset in accordance with rules that they have never before encountered.

Zettle and Hayes (1982) stress that rule-governed behavior involves two sets of contingencies: those related directly to the behavior of interest, and those related to the verbal antecedents of such behavior (i.e., tracking and pliance). From our perspective, the emphasis is in the analysis of the *two sets* of the entire contingencies involved in terms of both *form* and *function*. The two sets of contingencies we are interested in analyzing are those specified in the rule (SD--R--SR) and those in which the listener's behavior is embedded (Sd--R--SR) --the latter contingencies resulting from direct-acting. Rules and rule-related behaviors can be meaningfully understood only when analyzed as an *interdependent* unit.

Analyzing the Interdependent Unit

There exists a co-dependent relation between the rule and the behavior of the listener. A rule's *function* can only be identified in terms of its relation to rule-governed behavior, and rule-governed behavior makes sense only in reference to a rule, or set of specified contingencies. A rule's *form* or structure, however, can be identified *a priori*, before identifying the behavior of the listener.

We should stress, though, that the verbal character of rules must not be understood in a strictly morphological sense (i.e., in terms of rule form or structure), given that verbal stimuli of different forms can have an identical functions (e.g., red traffic light, the word "STOP"). In studying rules we must consider both their structure *and* function. Functionally speaking, then, each contingency set involves a mutually dependent relationship between environmental stimuli and the individual's responses. Each set is influenced by its current and historical context (Kantor, 1924/1926; Morris, 1988; Peláez-Nogueras, 1994). In sum, the probability that the listener will behave according to a rule depends on (a) the contingencies *specified* in the speaker's rule, (b) the *context* within which the rule is provided, and (c) the listener's *history* with that or other similar rules.

In our present analysis, we focus on rules and on the set of contingencies that they *specify* for the listener (Skinner, 1989). The specifications of contingencies embedded in rules result from the speakers' verbal behavior. We should clarify that, we examine rules in terms of the contingencies they specify, although we do not analyze the behavior of the speaker per se (the behavior of the rule-giver), nor the history of contingencies and variables maintaining the speaker's rule-giving behavior. Rule-following behavior is controlled by the results of rule-giving behavior and it is in this sense that we are only indirectly interested in the behavior of the speaker.

Our main purpose in the remainder of this paper is to analyze: (a) the form and function of the contingency specifying verbal stimuli that can control listener's behavior, and, (b) the related listeners' rule-following behavior.

Dimensions of Rules and Their Related Behavior

A functional identification or classification among different types of rules and their correspondence to rule-governed behavior has been limited. The classification is made according to four dimensions: *(a) explicitness, (b) accuracy, (c) complexity, and (d) source.*

Explicitness of the Rule

Explicit versus implicit rules. Rules can be distinguished based on the completeness or specificity of the contingencies expressed by the speaker. The explicit rule clearly identifies the components of the entire contingency and its context. Such explicit rules incorporate all the contingency components, comprehensively specifying readily identifiable contexts. In contrast, in the implicit rule, the contingencies may not gain verbal expression, either because some of the components are unnamed or because they are expressed in a way not identifiable in time and space. An example of an implicit rule omitting components of the entire contingency would be: "Keep your eyes on the road while you are driving," in which the consequence is not specified. In studies of matching-to-sample and stimulus equivalence, subjects often follow rules where the antecedent stimulus-response relations are omitted in the instructions provided by the experimenter. Some maxims and proverbs represent examples of implicit rules that name components without assigning them concrete identification. For instance, "A peaceable person is a long-lived one."

Explicitly versus implicitly rule-governed behavior. For the most part, correspondence between rule-governed behavior of the listener and the rule provided by the speaker will be determined by the explicitness of the contingencies contained in the rule. The more explicit the elements of the contingency expressed in the rule, the more direct the influence upon the listener's behavior (Martínez, González, Ortíz, & Carrillo, in press; Martínez, Moreno, Ortíz, & Carrillo, in press; Trigo, 1998). Nevertheless, the subject can learn to respond to classes of rules characterized by incomplete contingency specification, such as when the subject complies with the rule "Don't do it!," even though entire elements of the contingency and its context lack description. This is possible due to the listener's learning *history* in a given context.

Accuracy of the Rule

Accurate versus inaccurate rules. An accurate rule specifies contingencies that, when followed, match certain event-consequence relationship in the environment. Here, accurate rules specify contingencies that may occur. An inaccurate rule describes contingencies that do not correspond to those encountered in the environment. An example of the former is "If you keep looking away while you are speeding, you may have an accident." A rule of the inaccurate case is "If you keep speeding you are going to be rewarded by the police."When the programmed contingency corresponds to the feedback provided by the experimenter, we speak of accurate rules. Conversely, when programmed contingencies do not correspond to or contradict the experimenters' feedback or rules, then we speak of inaccurate rules.

Adjusted versus non-adjusted rule-governed behavior. The listener's behavior may adjust to the speaker's rules when the contingencies specified in the rules are accurate or correspond to the programmed (or direct) contingencies (Degrandpre & Buskist, 1991). Rule-governed behavior is sensitive (or adjusted) to the prescribed contingencies only to the extent that these prescriptions are consistent (or correspond) with the programmed contingencies. Following inaccurate rules may desensitize the listener to the effects of programmed contingencies (Buskist & Miller, 1986; Catania, Matthews & Shimoff, 1982; Martinez & Ribes, 1996; Michel & Bernstein, 1991). Hence, in addition to the degree of accuracy in a given contingency-rule prescription, the listener's history and current context significantly affect the extent to which rules will govern behavior.

Complexity of the Rule

Lower versus higher rule complexity. The contingencies specified in a rule always include at least one relation among behavior, its antecedent stimuli, and its consequences. In our analysis, rule complexity refers to the number of dimensions of the antecedent stimuli and their relations (Peláez, Moreno, Martinez, Trigo, & Qiang, in review). Dimensions are characteristics or attributes of stimuli employed, for instance, in matching procedures. Colors, shapes, sizes, and positions represent dimensions of stimuli and can be related to one another. The taxonomy of rule complexity offered here is organized hierarchically and is inclusionary, meaning that each lower level of complexity forms part of the next higher level.

A rule's lowest level of complexity specifies at least *one dimension* of a sample stimulus. For example, the instruction: "Name the *colors* of the figures appearing on the screen" specifies only one dimension (where green, red, and blue are instances of the color dimension). The following example specifies two dimensions of the stimuli: "Indicate the *color* and *shape* of the figures appearing on the screen" (where green, red, and blue are instances of color dimension, and triangles, squares and circles are instances of the shape dimension). However, a more complex level of the rule specifies a *relation among two or more dimensions*, each relation forming a relational frame (Trigo, Martinez, & Moreno, 1995). For example, in the instruction "Give me the apples that are smaller than the oranges," the speaker implies a relation between apples and oranges in terms of size dimension. This level of relationship is equivalent to the typical first order matching-to-sample procedure where behavior of the subject comes under discriminative control of a fourth-term--as in Sidman's four-term contingency (SD {SD—R—SR}) (1986).

Rules of higher level of complexity, however, involve a secondary or higher-order class of relation. A second-order response then involves abstracting a relation from other relation(s). Thus, a higher order relation includes a second-order stimulus control of rules and associates one relation to other dimensions (or to other relations). This level seems to correspond to Sidman's five-te rm contingency (S—SD—{SD—R—SR}). There is no limit to the complexity embedded in the rule because it is always possible to add one more dimension or to add more relations. For instance, a third order conditional relation would include at least one second order relation, and so on.

Simple versus complex rule-governed behavior. Correspondence between the level of rules and verbally-controlled behavior is likely. Less complex rule-governed behavior more often corresponds to simpler rules; in turn, more complex behavior adjusts to higher-level contingency arrangements. For the listener to adjust or respond according to a specified rule, his or her optimal performance should ultimately correspond to the complexity of the verbal stimuli controlling his /her behavior. A concept similar to maximizing may help here. Given two or more rules provided, an individual will follow the rule with higher probability of reinforcement. In addition to the level of rule complexity, the probability that the listener will follow a rule ultimately depends on the context within which the rule is provided and the listener's history with other similar rules. Listener's history may explain the disparities in behavior among recipients of similar rules in comparable contexts. For instance, a listener may interpret an algebraic rule of moderate complexity to be simple or complex, depending upon his or her knowledge of mathematics.

Sources of Rules

Rules provided by others versus self-provided and self-generated rules. Rule identification should consider the source of the antecedent stimulus control. In cases of rules provided by others, the speaker (other than the listener) specifies, implicitly or explicitly, the criterion for the listener's behavior. In the case of self-provided rules, the speaker and the listener are the same individual. Also, self-provided rules can be *taught by others* or *self-generated* or *abstracted* by the subject from learning experiences. In the first case, although the rule is self-provided, it does not originate in the behavior of the subject (e.g., problem solving behavior), but in the behavior of others. The speaker/listener may have no understanding of how to arrive at, or derive such a rule, because he or she may "know that" but not "know how or why" the contingencies specified in such rules are related. Rules taught by others are often learned via *imitation* processes (i.e., immediate, delayed and pervasive or generalized imitation processes, see Peláez-Nogueras & Gewirtz, 1995).

In the case of "self"-generated rules (or rule generated by the subject), a developmental history of direct experiences with at least some of the related contingencies specified in the verbal rule is required. (The term "self" as used here, does not imply the initiation of a behavior by an autonomous internal agent or by some imaginary part of the individual, it refers to the individual's behavior repertory.) The verbal contingency specifications produced by the individual allows him or her to arrive, derive, or abstract other relations. Rule generation (rule derivation or rule emergence) can occur through transfer processes of learning, as in *transitivity* (Sidman, 1986) and *combinatorial entailment* (Hayes, 1991; Hayes & Hayes, 1992). Only after having acquired a receptive understanding of a rule and expressed an explicit rule, can the listener emit *rule-corresponding* behavior. When an individual can state or describe to others the orderliness of the environmental relations (the contingencies) we assume he or she "knows" the rule.

Conforming versus complying behavior. With rules provided by others, the speaker specifies the criterion for the listener's behavior, expecting the listener to adjust, conform, or behave according to rule descriptions (e.g., as in the mand). With self-provided rules, whether previously taught by others or self-generated, the subject's ability to verbalize the rule seems to affect his or her subsequent performance on a transfer task (Peláez et al., in progress). The ability to self-state or self-provide a rule, however, may not be the sole cause of the rule-following behavior. This is due to the influence of the listener's experience with reinforcing contingencies and the nature of the specific contexts involved.

The distinction made in the literature between *complying* with and *conforming* to rules may be pertinent here (Verplanck, 1992). Rule compliance denotes following and behaving according to rules that have been either stated to the listener, or self-provided. Rule–conforming denotes behavior consistent with the rule, although the listener may remain unable to verbalize or self-generate the rule.

Taxonomy of Rules

The taxonomy is based on four different dimensions of rules and its corresponding rule-governed behavior. Each dimension stresses different aspects of rules and describes its potentially- related behavior. We examine the different dimensions of a rule in terms of accuracy, explicitness, complexity level, and source. Specifically, a rule should be described by analyzing *all four* dimensions involved, which will allow for a more systematic approach to the study of rule-governed behavior.

Figure 2 shows all possible types of rules (a total of 16 rules) resulting from combinations among the four different dimensions. The dimensions of a rule are presented in dichotomous fashion, even though they can operate along a *continuum* occurring within the four dimensions: (a) explicit vs. implicit, (b) accurate vs. inaccurate, (c) lower vs higher complexity, and (d) provided by others vs. self-provided. By deconstructing rules into their elements and examining each rule dimension individually, we attempt a more precise developmental approach to be employed in experiments where different types of rules are manipulated to determine their impact on rule-governed behavior and its progression.

The following are the 16 rules derived from a combination of the four basic dimensions discussed above:

(a) Explicit, Accurate, Lower Complexity, and Provided by Others

(b) Explicit, Inaccurate, Lower Complexity, and Provided by Others

(c) Explicit, Accurate, Higher Complexity, and Provided by Others.

(d) Explicit, Inaccurate, Higher Complexity, and Provided by Others.

(e) Explicit, Accurate, Lower Complexity, and Self-Provided

(f) Explicit, Inaccurate, Lower Complexity, and Self-Provided

(g) Explicit, Accurate, Higher Complexity, and Self-Provided

(h) Explicit, Inaccurate, Higher Complexity, and Self-Provided

(i) Implicit, Accurate, Lower Complexity, and Provided by Others

(j) Implicit, Inaccurate, Lower Complexity, and Provided by Others

(k) Implicit, Accurate, Higher Complexity, and Provided by Others

(l) Implicit, Inaccurate, Higher Complexity, and Provided by Others.

(m) Implicit, Accurate, Lower Complexity, and Self-Provided

(n) Implicit, Inaccurate, Lower Complexity, and Self-Provided

(o) Implicit, Accurate, Higher Complexity, and Self-Provided

(p) Implicit, Inaccurate, Higher Complexity, and Self-Provided.

For example, cell (a) represents an explicit, accurate rule, of lower complexity, provided by a speaker other than the listener. The parental order: "Pick up these toys now if you want to watch TV" exemplifies such a rule. This example posits a clear specification of all the components of the three-term contingency in context (is of lower complexity and lower developmental level). In this case, the verbal descriptions are provided by the parent (speaker other than the listener), and the contingencies correspond to (are congruent with) the actual contingencies encountered by the child (the listener). The last type of rule (see the right bottom cell (p) in Figure 2), represents an implicit, inaccurate, of higher complexity level and self-derived rule (the speaker and the listener being the same). A rule of this type can be found, for example, in the self-instruction, "At the party, I should approach Linda the same way that Juan approaches Mary when they are dancing--not how he approaches her when they are at school." This represents a self-provided rule, which the subject assumes to contain implicit positive consequences (i.e., acceptance). But Linda's aversion to guys renders the rule inaccurate and the real consequence will be rejection. The complexity of this rule is high because it involves a second-order conditional discrimination (i.e., it first requires approaching Linda during dancing and not approaching her during school, and second, it requires matching, that is, to behave just as Juan towards Mary). This relation requires that the subject *abstracts* the rule from the couple's relation (the sample stimuli) and applies it during his interaction with Linda, and only in a specific context. This type of rules represents higher complexity and developmental level.

The rule-governed behaviors derived from this taxonomy are labeled according to each type of rule governing. We are starting a program of research that focuses on investigating these taxonomy of rules from a developmental perspective, that is, in determining their hierarchical organization in learning. Our assumption is that the taxonomy of rules offered here, by ranging from explicit to implicit, lower level to higher level of complexity, accurate to inaccurate, imposed by others to self-generated, can organize behavior by increased level of difficulty, compliance, and adjustment to the contingencies they specify.

Other Related Rule Taxonomies

Our taxonomy is not exhaustive; when employing other criteria, other taxonomies can be identified. *Ply* and *track* rules (Zettle & Hayes, 1982) were not included in our classification because, according to our analysis, a rule should *first* be defined in terms of the contingencies it specifies regardless of whether the listener obeys or violates such rule. Thus, given that ply and track rules are exclusively defined in terms of their correspondence to pliance and tracking, rule-dimensions in plys and tracks cannot be identified nor manipulated (i.e., as independent variables)--independently of the specific behavior of the listener. This posits serious problems for an experimental situation, where the types of rules to be studied must be defined first. In such circular cases, an investigator would be unable to isolate and define a priori a rule and its dimensions for the purpose of experimental manipulations.

We have excluded Skinner's (1957) *mand* and *tact* from our rule taxonomy for similar reasons. Just like plys and tracks, mands and tacts are defined exclusively in terms of the listener's responses— these types of rules can not be properly identified *a priori* or independently of the history of the listener. Another distinction made in the literature is that between *normative* and *normal* rules (Reese, 1989; Reese & Fremow, 1984). In our analysis, we are only concerned with normative rules. Normal rules are not considered due to their lack of contingency specification and their dismissal of the listener's behavior, both necessary conditions in our taxonomy.

Conclusion

We offered a classification of 16 types of rules derived from four dimensions (i.e., explicitness, accuracy, complexity, and source) and their differential effects on listeners' behavior. Even though we assume a functional co-dependence between rules and rule-governed behavior, the taxonomy requires a separate analysis of the contingencies specified in the rule and of those related to the rule-following behavior. In studying the control that a rule exerts on rule-following behavior, one must first adequately define and identify separately the rule and the rule-following behavior. In studying behavioral development, when analyzing the various effects each rule exerts on the listener's behavior, one must consider the four dimensions of rule, the contingency history of the listener, and the context within which the rule is provided. Even though manipulations of some types of rules have been conducted in studies of self-instruction, relational frames, and derived relations, we believe that a more systematic study of the differential effects of the proposed four dimensions of rules on the listener's behavior is needed.

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Authors' Note:

Portions of this article were first reported in a paper titled *The Development of Rules that Control Behavior* delivered by the first author at the annual meeting of the Experimental Analysis of Behavior Group, London, UK, April, 1996. The taxonomy here reported was originally published in the *Mexican Journal of Behavior Analysis, 24, 1998.* Appreciation is extended to Carlos Bruner, Editor of the Mexican Journal, for granting permission for publication in this Bulletin of a version of the original article. We thank Bryan Midgley, Peter Nogueras, and John Visconti for their critical reviews of an earlier version of this paper. Correspondence on this article should be addressed to Dr. Martha Peláez, Department of Educational Psychology & Special Education, College of Education-EB 242B, Florida International University, Miami, FL, 33199, USA. (E-mail: marthapn@aol.com)

1999 Developmental SIG Dinner at ABA

The SIG Dinner will take place on Friday, May 28, starting around 6:00p.m. and terminating before 9:00p.m. It will be held in REZA'S RESTAURANT, 432 West Ontario, Chicago. The cuisine great Persian and great. A family style dinner will be served for $22.45 (tax & gratuity included). The appetizers will include a vegetarian plate, hummos, and grilled mushrooms. The entrees will be filet mignon, shish kebab, seasoned ground beef, and chicken breast kebab. Tea, coffee, soft drinks and dessert are included. A cash bar for alcoholic drinks will be set up in the room. The restaurant 14-seat bus will leave at approximately 10-min intervals, beginning at 5:45 p.m., from the North side of the Hilton Towers. There is no charge for the service. Please make reservations and provide advance payment to Jack Gewirtz, 2025 Brickell Ave. # 1802, Miami, FL 33129.

We hope you can make the dinner. It was memorable two years ago.

DEVELOPMENT & BEHAVIOR ANALYSIS AND THEORETICAL SIG PRESENTATIONS AT ABA, CHICAGO, IL MAY 25-31, 1999

Paper Session
Thursday, 5/27/99
1:00 PM- 2:20 PM
4F
TPC

Complex Behavior
Chair: Kimberly A. Becker (Eastern Michigan University)
• Cumulative-Hierarchical Learning: An Important Concept in Understanding Complex Human Behavior. MICHAEL D. HIXSON (Western Michigan University)
• Welcome Back My Lovelies: Testing Models of Learning through Cumulative Records. DAVID A. ECKERMAN and Steven M. Kemp (University of North Carolina at Chapel Hill)
• An Approximation Between M. M. Bakhtin and B. F. Skinner for the Study of Language. MARIA E. PEREIRA (Catholic University of Sao Paulo PUC-SP)

Symposium
Thursday, 5/27/99
1:00 PM- 2:50 PM
PDR 2
DEV

Behavioral Developmental Stage and the Evolution of Intelligence in Animals
Chair: Michael Lamport Commons (Harvard Medical School)
Discussant: Slobodan Petrovich (University of Maryland, Baltimore County)
• Scoring the Stage of the Behavior of Computers and of Non-Primate Animals Using the General Model of Hierarchical Complexity. MICHAEL LAMPORT COMMONS (Harvard Medical School)
• Scoring the State of Performance of the Behavior of Great Apes using the General Model of Hierarchical Complexity. PATRICE MARIE MILLER (Salem State College)
• The Evolution of Abstract, Formal Operational and Beyond Formal Operational Stage Reasoning in Humans. PATRICE MARIE MILLER (Salem State College), Miriam Chernoff (Harvard School of Public Health) and Michael Lamport Commons (Harvard Medical School)
• Structures as Causes of Behavior and Developmental Psychobiology's Radical Alternative. PATRICIA M. MEINHOLD (The Summit Centre for Preschool Children with Autism)

Symposium
Thursday, 5/27/99
1:00 PM- 2:50 PM
4D
TPC

Talking and Doing in Behavior Analysis: Are They Related?
Chair: Bryan Roche (National University of Ireland, Cork)
Discussant: NONE
• Pivotal Responses: Implications for Basic and Applied Research. YVONNE BARNES-HOLMES and Dermot Barnes-Holmes (National University of Ireland, Cork)
• Relational Frame Theory and Skinner's Verbal Behavior: A Possible Synthesis. VERONICA CULLINAN and Dermot Barnes-Holmes (National University of Ireland, Cork)
• Response Forms and Stimulus Objects. BRYAN ROCHE, Dermot Barnes-Holmes and Yvonne Barnes-Holmes (National University of Ireland, Cork)
• Behavioral Pragmatism: No Place for Reality and Truth. DERMOT BARNES-HOLMES and Yvonne Barnes-Holmes (National University of Ireland, Cork)

Paper Session
Thursday, 5/27/99
2:30 PM- 3:50 PM
4F
TPC

The Methodology of Behaviorism
Chair: Erika C. Campbell (Eastern Michigan University)
• Was John B. Watson a Methodological or Metaphysical Behaviorist? JAMES T. TODD (Eastern Michigan University) and Edward K. Morris (University of Kansas)
• The "Future" in Psychological Perspective. LINDA J. HAYES (University of Nevada, Reno)
• Some Conceptual Topics of Problem Solving. MELANIA MOROA (Pontificia Universidade Catolica de Sao Paulo)

Symposium
Thursday, 5/27/99
3:00 PM- 4:50 PM
PDR 2
DEV

Behavioral Gerontology: Increasing Engagement and Independence of Older Adults
Chair: Deborah E. Altus (University of Kansas)
Discussant: David P. Wacker (University of Iowa)
• Increasing Independent Dressing by Persons with Dementia. KIMBERLY ENGELMAN, Deborah E. Altus and R. Mark Mathews (University of Kansas)
• Increasing Engagement at a Senior Center Through Intergenerational Activities. PAMELA K. XAVERIUS and R. Mark Mathews (University of Kansas)
• Examining the Impact of Elder Cottages on Residents and Their Caregivers. DEBORAH E. ALTUS, Pamela K. Xaverius, R. Mark Mathews (University of Kansas) and Karl Kosloski (University of Nebraska, Omaha)
• Increasing Resident-to-Resident Social Interactions in a Skilled Nursing Facility. NICK C. JACKSON and Elizabeth L. Winterton (Eastern Washington University)

Symposium
Thursday, 5/27/99
3:00 PM- 4:50 PM
4D
TPC

Conceptual and Experimental Analyses of Social Behavior
Chair: John R. Kraft (University of New Hampshire)
Discussant: Bernard Guerin (University of Waikato)
• 16 Ways That Acting Alone Can Be Social Behavior. BERNARD GUERIN (University of Waikato)
• Explaining Helping: Are Humans Altruistic? CYNTHIA M. ANDERSON (West Virgina University)
• Group Choice: An Ideal Free Distribution of a Social Phenomenon. JOHN R. KRAFT (University of New Hampshire)
• Dress for Success: An Evolutionary Perspective. DIANE F. DICLIMENTER and Donald A. Hantula (Temple University)
• Attitudes About Gay Men: A Behavior Analytic View of Stereotyping. KURT A. FREEMAN (Father Flanagan's Boys' Home) and Philip Chase (West Virginia University)

Paper Session
Thursday, 5/27/99
4:00 PM- 4:50 PM
4F
TPC

Evaluating Our Current Practice
Chair: Matthew L. Cole (Eastern Michigan University)
• Behavior Analysis and Casino Gambling. W. SCOTT WOOD (Drake University)
• Are We Really Satisfied with Social Validity? REBECCA S. MORRISON (The Ohio State University)

Paper Session
Friday, 5/28/99
9:00 AM- 9:50 AM
4F
TPC

Understanding Neural Networks
Chair: Amy Cordaro (Eastern Michigan University)
• Recurrent Connections in Selectionist Neural Networks: Implications for Autistic Behavior. JOSE E. BURGOS (Universidad Catolica Andres Bello)
• Causality in Digital Simulations with Artificial Neural Networks. JOSE E. BURGOS (Universidad Catolica Andres Bello)

Symposium
Friday, 5/28/99
9:00 AM- 10:20 AM
PDR 2
DEV

Contemporary Issues in Children's Learning and Reinforcement
Chair: Sidney W. Bijou (University of Nevada)
Discussant: Maricel Cigales (Liberty Health Care Corp.)
• Review and Critique of Infant Conditioning Studies. HISELGIS PEREZ (Florida International University)
• Infant Laughter: A Basis for the Study of Parent-Infant Interaction. YASMIN LAROCCA (Florida International University)
• Choice, Presentation, and Stimulus Variation as Processes That Influence the Efficacy of Reinforcers. GUILLERMO RAMON (Florida International University)

Paper Session
Friday, 5/28/99
9:00 AM- 10:20 AM
4D
TPC

Extension of Applications of Behavior Analysis
Chair: Michelle D. Corbin (Eastern Michigan University)
• Multi-Brand Purchasing as Matching, Consumer Choice as Melioration: From the Observation of Aggregate Buying to its Operant Interpretation. GORDON R. FOXALL (Keele University)
• Further Thoughts on Methodological Behaviorism. JAY MOORE (UW-Milwaukee)
• The Outer-Inner, Public-Private, Over-Covert Behavior Continuum Assumption: Evidence from Psychophysiology. STEPHEN R. FLORA (Youngstown State University)

Symposium
Friday, 5/28/99
10:30 AM- 11:50 AM
PDR 2
DEV

The Successful Control of Human Behavior by Schedules of Reinforcement
Chair: Joel Greenspoon (University of North Texas)
Discussant: M. Jackson Marr (Georgia Tech)
• Conditioning and Maintenance of Schedule Performances in Humans. JESUS ROSALES-RUIZ, Richard Anderson, Kristina Hensley and Yuka Koremura (University of North Texas)
• Extinction and Variation of Schedule Performances in Humans. RICHARD ANDERSON, Jesus Rosales-Ruiz, Kristina Hensley and Yuka Koremura (University of North Texas)
• Some Stimulus Functions of the "Operandum" in the Control of Schedule Performances in Humans. YUKA KOREMURA, Jesus Rosales-Ruiz, Richard Anderson and Kristina Hensley (University of North Texas)

Symposium
Friday, 5/28/99
10:30 AM- 11:50 AM
4D
TPC

Behavioral Epistemologies
Chair: Blanca Patricia Ballesteros (Konrad Lorenz Foundation University)
Discussant: Morris Edward (University of Kansas)
• How Do Behaviorisms Answer Basic Epistemological Questions? AMANDA REY and Blanca Patricia Ballesteros (Konrad Lorenz Foundation University)
• Theoretical Limitations Of Conceptual Foundations In Behaviorism. LOPEZ L. WILSON (Konrad Lorenz Foundation University),
• Existentialist Phenomenology and Behaviorism. ANGARITA M. JOSE (Konrad Lorenz Foundation University)

Panel Discussion
Friday, 5/28/99
1:30 PM- 2:50 PM
PDR 2
DEV

Beyond the "Nurture Assumption": Parents Matter More Than Some People Think
Chair: Gary Novak (California State University, Stanislaus)
• JACOB L. GEWIRTZ (Florida International University)
• WENDY E. ROTH (Jackson State University)
• MARTHA PELAEZ-NOGUERAS (Florida International University)
• GARY NOVAK (California State University, Stanislaus)

Symposium
Friday, 5/28/99
1:30 PM- 3:20 PM
4D
TPC

Some Current International Topics in Applied Behavior Analysis
Chair: Mark F. O'Reilly (National University of Ireland, Dublin)
Discussant: David P. Wacker (The University of Iowa)
• Establishing Operations; Implications for the Assessment and Treatment of Problem Behavior. PETER MCGILL (University of Kent at Canterbury)
• The Treatment of Phobic Behavior: An Assessment of Generalization and Maintenance of Treatment Effects. ERIK ARNTZEN (University of Oslo)
• Why Not? Dismantling Obstacles to the Wider Use of Applied Behavior Analysis in Applied Psychology. JULIAN C. LESLIE (University of Ulster)
• A Long Term Evaluation of the Use of Noncontingent Reinforcement by Parents in Home-Based Interventions. MARK F. O'REILLY (National Universit of Dublin, Ireland)

Panel Discussion
Friday, 5/28/99
3:00 PM- 4:20 PM
PDR 2
DEV

Behavior Analysis in Geriatric Care Settings
Chair: Debra W. Fredericks (University of Nevada)
• MICHELLE S. BOURGEOIS (Florida State University)
• NICK JACKSON (Eastern Washington University)
• WANDA L. SMITH (McMaster University)

Symposium
Saturday, 5/29/99
9:00 AM- 10:50 AM
4D
TPC

Relational Stimulus Control and Emergent Behavior: Current Views and Research Directions
Chair: Michael J. Dougher (University of New Mexico)
Discussant: Richard L. Shull (UNC at Greensboro)
• Testing Relational Frame Theory. STEVEN C. HAYES (University of Nevada - Reno)
• Naming and Novel Behavior. PAULINE J. HORNE and C. Fergus Lowe (University of Wales, Bangor)
• Stimulus Equivalence and Relational Stimulus Control: What are the Proper Units of Analysis? CAROL PILGRIM and Mark Galizio (UNC at Wilmington)
• Stimulus Control Topography Coherence Theory: A Brief Introduction. WILLIAM McILVANE (E.K. Shriver Center)

Symposium
Saturday 5/29/99
10:00 AM- 11:50 AM
PDR 2
DEV

Developmental Implications of Reinforcement Delay and Other Patterns
Chair: Peter R. Killeen (Arizona State University)
Discussant: Anne S. Kupfer (The May Institute)
• Developmental Implications of Delay of Reinforcement. A. CHARLES CATANIA, Elliot Shimoff (University of Maryland at Baltimore County) and Terje Sagvolden (University of Oslo, Norway)
• The Effects of Delayed Reinforcement on Learning in Infants. MYRA DUARTE and Jacob L. Gewirtz (Florida International University)
• Conjugate Reinforcement in Early Development. ANTHONY J. DECASPER (University of North Carolina at Greensboro)
• Some Issues in Delayed and Conjugate Reinforcement. PETER R. KILLEEN (Arizona State University)

Paper Session
Saturday, 5/29/99
11:00 AM- 11:50 AM
4D
TPC

Issues in Radical Behaviorism
Chair: Laura K. Grose (Eastern Michigan University)
• The Contextual Stance. GORDON R. FOXALL (Keele University)
• Radical Behaviorism and the Varieties of Determinism: Is There an Agreed upon Definition within Radical Behaviorism? MICHAEL B. EHLERT (Brigham Young University)

Symposium
5/29/99
Saturday, 1:30 PM- 2:50 PM
PDR 2
DEV

Perspectives on Social and Ecological Validity in Applied and Basic Research
Chair: Gary Novak (California State University, Stanislaus)
Discussant: Gary Novak (California State University, Stanislaus)
• "Jealousy" in Infants: Measuring the Ecological Validity of Laboratory Research. WENDY E. ROTH (Jacksonville State University) and Jacob L. Gewirtz (Florida International University)
• Meanings of Validity. HAYNE W. REESE (West Virginia University)
• If You Know Why You Are Changing the Behavior, You Will Know When You Have Been "Valid". DONALD M. BAER (University of Kansas)

SIG DINNER
Friday, 5/28/99 6:00-9:00pm
(See announcement in this Bulletin)

Symposium
Saturday, 5/29/99
2:30 PM- 4:20 PM
4D
TPC

Functional Analysis Technology: Issues in Methodology and Application
Chair: Matthew L. Cole (Eastern Michigan University)
Discussant: Robert E. O'Neill (University of Utah)
• A Functional Analysis of Functional Analyses? JOHN P. FORSYTH (University At Albany, SUNY), Scott L. Kollins (Western Michigan University) and Mark A. Canna (University at Albany, SUNY)
• Smoking Cessation through Functional Analysis: A Case by Case Study. MATTHEW L. COLE and Marilyn K. Bonem (Eastern Michigan University)
• How I.D.E.A. Increases the Need for Functional Behavior Analytic Skills in Public Schools: What They Don't Know Can Hurt Us. ROBERT W. MONTGOMERY (Reinforcement Unlimited)
• An Empirically Testable Question: Are Functionally-Derived Interventions Superior? MARILYN K. BONEM, Rochelle McDonald and Matthew L. Cole (Eastern Michigan University)

Symposium
Saturday, 5/29/99
3:00 PM- 4:20 PM
PDR 2
DEV

The Transfer of Environmental Control from Respondent to Operant Paradigms in Infants' Developmentally-Adaptive Behaviors (Such as Vision and Laughter)
Chair: Lewis P. Lipsitt (Brown University)
Discussant: Lewis P. Lipsitt (Brown University)
• The Transfer of Environmental Control from Respondent to Operant Conditioning in the Saccadic Eye Movement Responses of Newborns. JEAN-CLAUDE DARCHEVILLE (University of Lille, France)
• Reinforcement of the Visual Responses of Tracking and Fixation as the Basis for Improving Visual Acuity of Infants. NEELU AUJLA and Jacob L. Gewirtz (Florida International University)
• The Transfer of Respondent to Operant Control in Infant Laughter. YASMIN LAROCCA and Jacob L. Gewirtz (Florida International University)

Paper Session
Sunday, 5/30/99
9:00 AM- 10:20 AM
4D
TPC

Perspectives on Behavior
Chair: Flora Hoodin (Eastern Michigan University)
• Historical Processes and the Nature of Behavioral Evolution. FREDY REYES and Sigrid Glenn (University of North Texas)
• Biology and Behavior: Context, Content, and Consequences. PAUL T. ANDRONIS (Northern Michigan University)
• Behavior Analysis and Horse Whispering. JAMES D. DOUGAN (Illinois Wesleyan University) and Valeri Farmer-Dougan (Illinois State University)

Panel Discussion
Sunday, 5/30/99
9:00 AM- 10:50 AM
4M
DEV

The Behavior Analysis of Imitation in Animals and Children
Chair: Lewis P. Lipsitt (Brown University)
• RACHEL BARR (Rutgers University)
• JACOB L. GEWIRTZ (Florida International University)
• MARK S. LIPSITT (Lipsitt Training Services)
• SLOBODAN PETROVICH (University of Maryland at Baltimore County)
• NEAL E. MILLER (Yale University)

Symposium
Sunday, 5/30/99
10:30 AM- 11:50 AM
4D
TPC

Interbehavioral Expansions of Behavior Analysis in Instruction and Education
Chair: William S. Verplanck (University of Tennessee)
Discussant: William S. Verplanck (University of Tennessee)
• Compatible Developments in Interbehavioral Technology: The Lens is the Thing! TOM SHARPE (Purdue University) and Monica Lounsberry (Utah State University)
• Assessing Setting Events for Challenging Behaviors in Schools and Preschool. JAMES FOX (East Tennessee State University) and Maureen Conroy (University of Florida, Gainesville)
• Student Authoring of Digital Hypermedia: A Taxonomy for Shaping "Constructionistic" Learning Skills? ROGER D. RAY (Rollins College)

INVITED EVENT
Sunday, 5/30/99
11:00-11:50 AM
4M
DEV

On Shaping Behavior
Chair: Lewis P. Lipsitt, Brown University
NEAL E. MILLER, Yale University

Paper Session
Sunday, 5/30/99
12:00 PM- 12:50 PM
4D
TPC

Influenced by B. F. Skinner
Chair: Christine Hurley (Eastern Michigan University)
• The FBI File on B. F. Skinner. W. JOSEPH WYATT (Behavior Analysis Digest)
• Remembering Behavior: An Alternative Analysis. SEAN M. CORIATY and Linda J. Hayes (University of Nevada, Reno)

Symposium
5/30/99
12:30 PM- 1:50 PM
4M
DEV

Basic Behaviorist Perspectives of Developmental Phenomena
Chair: Martha Pelaez-Nogueras (Florida International University)
Discussant: Jacob L. Gewirtz (Florida International University)
• Thinking as the Behaviorist Views It. HAYNE W. REESE (West Virginia University)
• Watson and Freud: Strange Bedfellows. LEWIS P. LIPSITT (Brown University)
• Watson and Instinctive Behavior and the Development of Learned Behavior in Children. PETER HARZEM (Auburn University)

Paper Session
5/30/99
1:00 PM- 1:50 PM
4D
TPC

Views on Behaviorism
Chair: Krista M. Manganello (Eastern Michigan University)
• Extensions of Skinner's Naturalistic Theory of Values. KRISTIN H. HAZLETT (West Virginia University)
• Domain Specifications and Their Consequences: Analyzing the Friction Between Behavioristic and Religious Worldviews. ANDREW P. LLOYD and N. J. Rodriguez (University of Nevada, Reno)

BEHAVIOR ANALYSIS AT FLORIDA INTERNATIONAL UNIVERSITY

Formal training in basic and applied behavior analysis is one of the goals of the Department of Psychology and the Department of Educational Psychology & Special Education at Florida International University.

The Department of Psychology currently offers the M.S. degree in behavior analysis and the Ph.D. degree in Developmental Psychology with a track in behavior analysis. Research opportunities in this program include 2 infant laboratories, a laboratory for the experimental analysis of human and animal behavior, a daycare center, a child phobia center, a learning center, a state hospital and various community facilities. Recent research includes studies on stimulus equivalence and transfer of function, an exploration of infant learning using conditional discrimination and matching procedures, the treatment of school phobias, an exploration of the conditioned basis of fear of the dark and fear of strangers in small children, "jealousy" between siblings, the effects of touch in mother-infant interactions, and imitation vs. direct contingency learning.

The Department of Educational Psychology & Special Education (EPSE) offers opportunities for doctoral and masters' degrees in Special Education with a track in Applied Behavior Analysis through several fields/programs including Exceptional Student Education, Community College Teaching, Curriculum and Instruction, and Adult Education and Human Resource Development. Recent research includes studies of social and motor skills among children with severe disabilities, comparisons of error correction procedures used to teach academics, interaction patterns between babies and their depressed-adolescent mothers, and generalization strategies used in parent training programs.

The behavioral faculty of the Psychology Department include Scott Fraser, Jacob Gewirtz, Michael Markham and Wendy Silverman, as well as adjunct faculty Beth Sulzer-Azaro ff and Steve Starin. For more information on graduate programs contact Jacob Gewirtz, Department of Psychology, Florida International University, Miami, Fl 33199, phone (305) 348-3375.

The behavioral faculty of the Department of Educational Psychology and Special Education are Patricia Barbetta, Michael Brady, Martha Peláez and Smita Shukla. For information on graduate programs in Educational Psychology & Special Education contact Martha Peláez (305) 348-2090.