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Reinforcement Theory and Behavior Analysis

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Empirical laws in the study of animal and human behavior have been the pursuit of behavior analytic psychologists for at least a century. One of the earliest theoretical, empirical laws in the history of behavior analytic psychology is "the law of effect", credited to E. L. Thorndike at the turn of the 20th century. Behavioral psychology has had quite a history since the law of effect and different directions for the science of human behavior have resulted. In this paper, the response deprivation/disequilibrium hypothesis is traced from its behavioral roots in the law of effect. Skinnerian reinforcement and predictive theoretical accounts of reinforcement are discussed. It is concluded that behavior analysis and the science of human behavior can benefit from theoretical and empirical accounts of reinforcement, further developing our understanding of the circumstances of reinforcement.

Empirical laws in the study of animal and human behavior have been the pursuit of behavior analytic psychologists for at least a century. One of the earliest theoretical, empirical laws in the history of behavior-analytic psychology is "the law of effect." The law of effect, as described by E. L. Thorndike near the turn of the century, is paraphrased below (Thorndike, 1911):

> Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that when it recurs, they will be more likely to recur; those which are accompanied or closely followed by discomfort to the animal will, other things being equal, have their connections with that situation reduced, so that, when it recurs they will be less likely to occur (p. 44).

This statement of the law of effect appears as a rudimentary and cumbersome description of reinforcers and punishers (Skinner, 1938). In addition, the terms used are susceptible to interpretation. However, the revival of the law of effect will serve as a reminder that the event of strengthening (or weakening) a response should be distinguished from circumstances under which strengthening occurs (Hayes, Adams, & Dixon, 1996; Champion, 1960).

Thorndike went beyond the statement of the law of effect as quoted above, by theorizing "satisfiers and annoyers could be defined independently of the learning situation as stimuli which the organism approaches and avoids, respectively" (Champion, 1960, p. 12). Thorndike spent considerable effort in suggesting ways by which these affective states could be independently assessed (Podsakoff, 1982). Thorndike's implicit supposition that "satisfiers are strengtheners and annoyers are weakeners has been tested empirically and proves to have more limited application than he might have hoped" (Champion, 1960, p. 12). In 1938, Muenzinger conducted experiments in Colorado showing that Mr. Thorndike's statement of the facts is correct, but incomplete (Muenzinger, 1938, p. 217).

Skinner's Atheoretical Account of Reinforcement

Shortly after Thorndike's initial and incomplete description of reinforcement and punishment, an entirely atheoretical approach to reinforcement dominated applied, experimental, and scholarly activities of behavior analysts. More specifically, B. F. Skinner's description of the law of effect (Skinner, 1938):

> The operation of reinforcement is defined as the presentation of a certain kind of stimulus in a temporal relation with either a stimulus or a response. A reinforcing stimulus is defined as such by its power to produce the resulting change. There is no circularity about this; some stimuli are found to produce the change, others are not, and they are classified as reinforcing and non-reinforcing accordingly. A stimulus may possess the power to reinforce when it is first presented (when it is usually the stimulus of an unconditioned respondent) or it may acquire the power through conditioning (p. 62).

Skinner's account of reinforcement, "the empirical law of effect," is purely pragmatic and a post-hoc classification of observed events. Decades of research have revealed the limited utility of reinforcement conceptualized in this manner in obtaining (or advancing) the scientific goal of predicting reinforcement effects a priori. This does not discount the extremely valuable utility of operant conditioning and the application of radical behaviorism in a wide variety of contexts. The intent is to point out the limitations as a theory and for predicting instrumental performance.

The empirical law of effect has been criticized as (Postman, 1947; Timberlake & Allison, 1974) circular, meaning it cannot be falsified or disproved by experiment. Skinner was aware of this criticism (or perhaps saw the potential circular interpretation), given the quote regarding reinforcement cited earlier. To illustrate the circularity criticism, "if a particular consequence is associated with an increase in the probability of the instrumental response, then it is a reinforcer; otherwise it is not" only defines a reinforcer; it is not a law (Timberlake & Allison, 1974, p. 146).

Based on these findings, some of the behavior analytic community began to look for alternative accounts of reinforcement, others decided to treat problems such as satiation and hunger "as boundary conditions in the application of the empirical law of effect" (Timberlake & Allison, 1974, p. 147). Paul Meehl (1950) attempted to salvage the empirical law of effect (or at least recognized that the circularity criticism would be mute) by introducing the "transituational hypothesis."

The Transituational Hypothesis

The circularity of the empirical law of effect (not falsifiable, experimentally disproved) could be avoided if stimuli identified as reinforcers or punishers would function to increase or decrease, respectively, the probability of behavior (Meehl, 1950). However, the observation that stimulus function (as reinforcer, neutral stimulus, or punisher) can change depending upon a multitude of variables, eliminates the possibility of "transituational" stimulus function. The simple observation that food will not function as a reinforcer for a satiated rat illuminates this transitory stimuli. Timberlake and Allison (1974) say, "this result is so intuitively obvious that little has been made of it" (p. 147). The lack of "transituational" reinforcers and punishers when applied by the layperson is perhaps the most popular, yet unfounded claim against the behavior analytic tradition. When a "reinforcer" does not "work" for someone, a common reaction is "reinforcement does not work". This is obviously a misrepresentation of the facts, brought about by confusion regarding the definition of reinforcement.

Although Meehl may not have developed a long-standing theory of reinforcement, he opened the door for other approaches to dealing with 'the inadequacy of the empirical law of effect as a predictor of instrumental performance" (Timberlake & Allison, 1974, p. 146). In Meehl's defense, the primary behaviors and reinforcers discussed in the behavior analytic literature at the time were bar pressing, key pecking, and food pellets, respectively. Although as Muenzinger (1938) points out, "the theoretical principles of behavior which we want to invent must be the same for rats and human beings" (Muenzinger, 1938,p. 215).

The Premack Principle

The probability-differential hypothesis of David Premack (1959, 1965) is the most cited progression in the pursuit of empirical laws predicting instrumental performance. Probably the most significant change in Premack's hypothesis was the radical departure from the typical methodology in experimental analyses of behavior. The change was from a focus on a stimulus consequence (reinforcer, punisher) following a behavior, to a focus on the relative probability of two known reinforcing responses. In one attempt to provide a comprehensive empirical framework for explaining instrumental performance, Premack (1965, 1971) has suggested that both the instrumental response and the contingent event be considered in terms of their behavioral characteristics (Heth & Warren, 1978). "Premack's approach marks an important change in the conception of reinforcement. In the traditional view, reinforcement is produced by a stimulus. In Premack's view, reinforcement is related to access to a response" (Timberlake & Farmer-Dougan, 1991, p. 381).

Premack boldly moved away from traditional notions of reinforcement (stimulus-response, linear) toward a response-response conception of reinforcement. "Most importantly, though, Premack's approach predicts outcomes that violate the assumptions of the transituationality approach" (Timberlake & Farmer-Dougan, 1991, p. 381). However, researchers quickly discovered that Premack's conception of reinforcement was also incomplete. Eisenberger, Karpman, and Trattner (1967) conducted experiments with results in conflict with Premack's postulation. They found that a lower-probability behavior could also serve as a contingent (reinforcing) response if the behavior is reduced (suppressed) below its baseline level. A related conception of reinforcement resulted from "a reanalysis and extension of research by Premack" (Timberlake & Farmer-Dougan, 1991, p. 383) called the response deprivation hypothesis (Timberlake & Allison, 1974).

Response Deprivation Hypothesis

Using the probability-differential hypothesis framework, Timberlake and Allison (1974) proposed an "adaptive-model" of instrumental performance, with the central concept of response deprivation. "The condition of response deprivation is defined to occur if the animal, by performing its baseline amount of the instrumental response, is unable to obtain access to its baseline amount of the contingent response" (Timberlake & Allison, 1974, p. 152). As Timberlake and Allison point out, "many of the contingencies that satisfy the response-deprivation condition satisfy the probability-differential condition as well" (Timberlake & Allison, 1974, p. 152). However, the major difference between the two theories of reinforcement is Premack assumed reinforcement to be the result of a probability differential between two responses, Timberlake and Allison assume reinforcement to be determined by the response-deprivation condition. Allison and Timberlake (1974) conducted experiments that demonstrated the probability-differential condition was not necessary for instrumental performance (an increase in instrumental responding above baseline) in schedules meeting the response deprivation condition requirements.

There are two major assumptions of the model. First, it is assumed that "instrumental performance is a result of the conflict between the freely occurring behavior of the animal and the restrictions of a schedule" (Timberlake & Allison, 1974, p. 150). The second assumption of the model is "that resolution of the conflict between the determinants of free behavior and the requirements of the schedule is based on the biological equipment and capacities of the animal involved. An adaptive outcome is not necessarily most efficient (profitable) in obtaining access to the contingent response" (Timberlake & Allison, 1974, p. 151). In short, if the conflict situation occurs or can be arranged by the scientist or practitioner, instrumental performance (increased instrumental responding relative to baseline) is predicted. The amount of increase in instrumental responding relative to baseline is not predicted, only increases (and decreases) in instrumental responding.

Disequilibrium Account of Reinforcement

Timberlake's most recent iteration of the response deprivation hypothesis introduces the "disequilibrium approach" to incorporate conditions of two types. The two types are "response deficit (originally referred to as response deprivation) and response excess" (Timberlake & Farmer-Dougan, 1991, p. 383). Response deficit conditions predict increased instrumental performance (positive reinforcement) and

response excess conditions predict decreased instrumental responding (punishment; Timberlake, 1980).

Timberlake provides a convincing argument for adopting the response deprivation/disequilibrium approach to predicting instrumental performance. "In sum, relative to the probability-differential model, the disequilibrium approach is both more specific and less limited in its application. Rewards are not restricted to higher probability responses, units of measurement are not limited to duration, and long-term denial of access is not required. In addition, rules for the specification of schedule terms are provided" (Timberlake & Farmer-Dougan, 1991, p. 385). At this point seems appropriate to point out that it is not the author's position that the goal or aim of behavior analysis should necessarily be the prediction and control of instrumental performance. However, the author certainly values the pursuit of empirical laws of prediction and control of behavior through scholarly pursuits regarding reinforcement theory and experimental methodology.

CONCLUSION

Almost 100 years after Thorndike's 1911 publication on the law of effect, it is clear that stimuli identified to function as reinforcers (or punishers) in one situation are not transituational. Furthermore, the circumstances under which reinforcers are utilized can enhance, hinder, reverse, and/or change the reinforcing effect of previously identified reinforcers. "Responses, no matter what their probability, have no absolute or pairwise value as reinforcers. Any directional reinforcement value must begin with the disequilibrium condition resulting form the degree of conflict between baseline responding and the requirements of the schedule" (Timberlake & Farmer-Dougan, 1991, p. 384). In addition, "there are not unique classes of reinforcers or punishers, sets of stimuli, or responses that have transituational reinforcement effects. Neither are there unique combinations of baseline response probabilities that produce reinforcement" (Timberlake & Farmer-Dougan, 1991, p. 384).

The majority of comments provided in this historical trace of reinforcement theory in behavior analysis, from the law of effect to the disequilibrium approach to reinforcement, are exact quotes or close approximations to statements made by many scientists, many times before. However, their import seems almost ignored in the majority of current experimental, applied and theoretical publications in behavior analytic psychology. Evidence for this ignorance is manifested in accounts of reinforcement without acknowledging alternatives and accepting without question, an atheoretical approach to reinforcement as conceptualized by Skinner and others early in the progression of behavioral accounts of psychological behavior.

The public proclamation of and empirical evaluation of theories of reinforcement in behavior analysis are important for a variety of reasons. The primary reason in the current instance is to remind behavior analysts of the potential to increase our "conceptual analysis of the circumstances of reinforcement" (Timberlake & Farmer-Dougan, 1991, p. 379). Furthermore, revisiting theoretical accounts of reinforcement is an attempt to highlight their utility, in both applied and basic settings. Regardless of the reader's opinion regarding the contents of the current manuscript and/or the goal of predicting instrumental performance, it is the author's intent to perpetuate the pursuit of theoretical accounts of reinforcement in behavioral psychology.

The applied utility of the atheoretical application of the law of effect, the probability-differential hypothesis and the response deprivation/disequilibrium approach to reinforcement and behavior control have been clearly established and as stated earlier, this has not been an attempt to discount these tremendous accomplishments. However, I have tried to make obvious to behavior analysts that the ability to predict the reinforcement effect of disequilibrium conditions would lead to a more complete understanding of the circumstances of reinforcement and is reason alone to pursue predictive, theoretical, empirical accounts of reinforcement. The results of these investigations will provide further information regarding a number of central and important aspects of both a theoretical and predictive conceptualization of reinforcement. Furthermore, it is a pursuit worthy of scholarly effort as behavior analysis continues efforts to advance the psychological science of behavior.

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A Behavioral Interpretation of Vygotsky's Theory of Thought, Language, and Culture

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Since the translation and publication of Vygotsky's work into the English language in 1962 his work has been widely cited and studied by western-European and American developmental psychologists and educators. This paper provides a description of Vygotsky's theory of culture and language and highlights the similarities of his views (e.g. scaffolding, assisted learning, private speech) and behavioral principles (e.g. shaping, cueing, chaining, and verbal behavior). While many philosophical differences exist between Vygotsky's theories and contemporary behavior analysis, identifying the similarities between these two positions may allow for a greater understanding of human development and for an increase in collaborative research between developmental psychologists and behavior analysts.

Vygotsky's views of development have become increasingly popular since the recent translation and republication of his work into English in 1962. There are similarities between Vygotsky's theories, of language and culture, and modern behavioral theory. Identifying these similarities may provide behaviorists with an opportunity to bridge with mainstream developmental psychology's interests and research.

Vygotsky's theory of thought and language is culturally and environmentally based. He offers a theoretical framework applicable to child development, schools, and applied learning. One of the primary assumptions of Vygotsky's psychology is that understanding the social relations of an individual is central to understanding the developmental path of that individual (Wertsch, 1985). "The social dimension of consciousness is primary in time and in fact. The individual dimension of consciousness is derivative and secondary" (Vygotsky, 1979 p.30). Vygotsky's argument is against reductionistic psychology such as methodological behaviorism on the basis that the S-R approach neglects the study of context and culture in which the individual develops. He stresses that the culture changes the private and public behavior of the individual (Wertsch, 1985). That is, human interactions can only be understood by looking at the culture in which the interactions are embedded.

Vygotsky's philosophy includes an interpersonal psychology that involves *learning* from other members of society while engaging in social interactions. Anything that is expressed in a child can first be detected in his/her environment: "Any function in the child's cultural development appears twice, or on two planes. First, it appears on the social plane, and then on the psychological plane." (Vygotsky, 1983, p. 163). There is a strong relationship between the social and psychological planes, in that the social plane can always influence the intrapsychological plane (Wertsch, 1985). In this way, Vygotsky emphasizes the role of shaping in the learning process especially as it relates to his description of the *zone of proximal development*.

Zone of Proximal Development and Scaffolding

The zone of proximal development is equivalent to the range of behaviors an organism can produce with the prompting or cues of a more "competent member of the culture, such as another adult or another child" (Novak, 1996, p.127). By this process (exposure to prompting and cues) the independent behavioral repertoire would be increased by *scaffolding*. Scaffolding is very similar to the behavioral process of shaping. By successively changing the criterion for reinforcement the behavior being shaped more closely resembles the targeted terminal behavior. Both scaffolding and shaping are examples of technologies derived from environmental determinism. That is, consequences of social interactions (behavior) act as determinants of behavior.

The view that the environment influences and changes behavior in different ways based on the historical and present context has also been incorporated into behavioral theory by several developmental behavior analysts (Morris, 1988; Hayes, Hayes, & Reese, 1988; Peláez-Nogueras & Gewirtz, 1997). That the individual's history with the environment, the current state of the organism, and other environmental influences combined to alter the probability, rate, form, and production of behavior is an overriding theme in Kantor's (1975) conceptualization of the event field in Interbehaviorism. The idea that a reciprocal interaction occurs between inter and intra personal psychology, that is, public and private behavior, has been emphasized by behavior analysis in the study of verbal behavior. The notion that intrapersonal experiences affect the interpersonal interactions is embedded in the behavioral notion of rule-governed behavior. While Vygotsky analyzed many types of phenomena, here we will examine only two aspects of his theory, language and thinking, pointing out similarities with behavioral models.

Thought, Language, and Culture

In Vygotsky's philosophy, language plays a central role in the theory of human cognitive development. Language plays multiple roles including culturally shaping the overt behavior

of individuals as well as influencing their covert behavior, such as thinking. Language has been defined as a psychological tool that shapes other mental functions while at the same time being socially-shaped itself (Kozulin, 1986). Vygotsky believed that language and thought initially have different roots but converge during the course of development and are influenced bi-directionally thereafter (Kozulin, 1986).

To understand Vygotsky's theory of individual consciousness, first we need to conceptualize thought as socially based (Vygotsky, 1979). In his view, higher mental functions are products of psychological tools such as verbal language, sign language, and logic. The use of socially-mediated language allows for interpersonal communication. Pre-intellectual language (e.g. screaming or cooing) and pre-intellectual thought (e.g. wants and needs) may develop concurrently but separately in children. Thought and speech begin as separate functions, with no necessary connection between them, but around age two language and thought come under bi-directional influence, when a child learns to functionally use social tools (such as verbal behavior). Until the child is able to learn or relate his/her actions to the social-environmental contingencies language cannot be acquired. Around this age, a relationship between language and cognition begin to develop. The relationship is more than the formal relation between the sign (or word) and its meaning. Language and other socially learned relations alter thought by setting up formal logical rules (derived relational systems) and methods of problem solving that are entirely verbal in nature (Vygotsky, 1986).

Vygotsky (1986) proposes that the first general concept acquired by verbal children is the understanding that every object should have a name. After the child is able to ***name*** objects, he/she can then express thoughts in the form of needs and wants. Once the child is able to name, and express wants, language and thought begin a reciprocal interaction that shape the form of thought and language through environmental experience and inner speech. The social shaping of appropriate vocal noises is dealt with in behavioral theory by differential reinforcement. The parents or caregivers give more attention to a child when they make noises that more closely approximate words. After the child has been able to properly produce the sounds of a word they get social attention that increases the future likelihood of similar responses (Skinner, 1953). After mastering the sounds needed to name an object the child can then use the name of the object first as an echoic (repeating the name after a verbal prompt), then as a tact (naming an object in the presence of the object) and as a mand (a demand or request for nonverbal action on the part of the listener). The child in this manner learns to name the object in the presence of a verbal prompt, learns to name the object in the presence of the object, and learns that by requesting an object in its absence he/she can acquire the object from the listener (Peláez, 1986). By repeated exposure the person can come under the functional control of the object (Skinner, 1957).

Inner speech. Vygotsky (1986) states that inner speech (private verbal behavior) is acquired in the same manner that all other mental operations are learned (including vocal speech). In language acquisition, the child starts forming words and is able to use the correct forms of grammar and structure before he/she has learned the formal rules of grammar. As the child becomes more experienced he/she begins to use external prompts, cues, and verbal behavior in the form of instructions to aid in problem solving. This is the beginning of egocentric speech. *Egocentric speech* is a form of self-talking with the function of inner speech, but an external form (a form of speech that has the function of altering the speakers own behavior). Examples of egocentric speech are reading to one-self quietly, verbally sounding out words, and counting on ones fingers. As egocentric speech develops the child is able to begin "internalizing" the outward form of language or using soundless speech, to count in his/her head and use logical memory (operate with given relations and derived relations in private verbal behavior). After the person comes under the functional control of language, language begins to have a large reciprocal effect with thought.

Thought and language are seen by Vygotsky (1986) as two interacting spheres. In his view, speech is involved in most thought, and thought is involved in most speech. However, development of thought and speech are not parallel. For example, there are aspects of thought such as emotions (e.g., anger, joy, disgust) that can be verbally discussed, but are not verbal in nature. That is, we can describe our own emotions but the experience of emotions is not necessary verbal. Conversely there are parts of speech in Vygotsky's conceptualization that do not require thought, such as reciting a well-known poem or prayer. While these spheres are mostly overlapping, the processes of thought and speech are not the same, even though both are influenced "indirectly by the process of verbal thought" or inner speech (Vygotsky, 1986).

An example of this interaction would be a person who smells a particular kind of flower and then remembers (through a history of conditioning) a long lost lover who used to ornament his/her house with this kind of flower. As the person uses inner speech in creating imaginary dialog of this memory he/she may experience sadness realizing that they should not have ended the relationship with this person (emotional response). In this case inner speech may affect and increase emotions indirectly. Reciprocally thoughtless speech (such as a recital of an extremely well known poem) can be influenced by inner speech by word *substitution* (e.g., saying the ex-lovers name in place of a similar sounding word in the poem).

In short, the bifurcation of function and structure of inner speech begins at the same time as the emergence of egocentric speech. For Vygotsky thought development is contingent on language, and language is socially determined. In this way a child's environment, and culture, play a pivotal role in language and thought development.

Skinner and Vygotsky

Similarities exist between Vygotsky's inner speech and Skinner's private verbal behavior. Both Skinner (1957) and Vygotsky (1986) state that thinking is a process learned from the verbal community, and learning to think is no different than language acquisition or other socially-learned behavior. Skinner goes so far as to say verbal behavior has no special properties and obeys no special laws when compared to other types of behavior (p.438). Vygotsky's egocentric speech is considered language (or verbal behavior), but the function of egocentric overt behavior (develops simultaneously with inner

speech) is different from the function of vocal verbal behavior (e.g. directed speech). The function of egocentric speech is to modify the behavior of the speaker (Vygotsky, 1986). This notion of a changed function, with the internalization of speech, is consistent with Skinner's statement that any speaker can be there own listener, and that individuals engage in self-editing. The similarity of the two positions in the acquisition of language and thought, or public and private verbal behavior, is central to the both theories because they philosophically share an externally based causation (that is, environmental determinism).

A Skinnerian interpreting the above example may conclude that a person who smells a particular kind of flower and remembers a long lost lover who used to ornament his/her house with this kind of flower because the response is under stimulus control of the smell of the flower). If the person uses inner speech in creating imaginary dialog of this memory (hearing in the absence of the thing heard) he/she may experience sadness or a similar emotion realizing that the person is not present any longer (emotional response influenced by absence of a source of reinforcement). In this case, the speaker acting as his/her own listener, may produce a verbal stimuli which evokes an emotional reaction on the part of the listener (in the same skin). Reciprocally verbal behavior (such as saying the ex-lovers name accidentally in place of a similar sounding word in the poem) can be influenced by multiple sources of control and response strength.

Both Skinner and Vygotsky omit some mental processes from their interpretations of thinking and inner-speech, or private verbal behavior (Vygotsky, 1986; Skinner, 1976) such as emotions. Emotions are considered by Skinner to be a reaction (or collateral byproduct) to environmental stimuli. Skinner (1957, p.155) states: "The emotional reaction is usually a by-product of some other verbal function" and Vygotsky (p.78, 88) argues that emotions are part of our thinking, which is indirectly influenced by inner speech, but not verbal in nature. Consequently, both Skinner (p.215) and Vygotsky (p.88) state that emotions can influence verbal behavior just as they can be influenced by verbal behavior but they are not verbal in nature.

CONCLUSION

While differences between behavior analytic theory and Vygotsky's developmental theory do exist, similarities were highlighted. These similarities offer exciting possibilities for collaborative research and expansion of the behavioral methodology and theory in developmental psychology. Vygotsky's emphasis on context, setting, and his use of culture make his theoretical approach to child psychology particularly interesting, and a good fit within the overall framework of behavioral psychology. Moreover, Vygotsky's focus on the social origins of higher mental functioning seems theoretically consistent with aspects of the behavioral theory of verbal behavior.

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Thinking as the Behaviorist Views It

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The title of my paper is a paraphrase of the title of Watson's 1913 article, "Psychology as the Behaviorist Views It," but unlike Watson, I intend "the Behaviorist" to refer to Watson. My paper is based largely on a paper Watson was invited to present in a symposium to be conducted in September 1920 at an international conference at Oxford University. The topic of the symposium was Watson's theory of thinking and speech, which he had presented a year before in his 1919 Psychology from the Standpoint of a Behaviorist. Watson accepted the invitation and wrote his presentation, but he was unable to attend the conference because of events that began in April 1920 when his wife Mary Ickes discovered Watson's affair with Rosalie Rayner and ended with Mary and John B. Watson's divorce in December 1920. The paper Watson would have presented was "Is Thinking Merely the Action of Language Mechanisms?" It was published with the proceedings of the symposium in the October 1920 issue of the British Journal of Psychology.

Watson's View of Thinking

The first question I will address is whether Watson acknowledged the existence of thinking. He did. For example, he said in the 1920 article that if a person is given a problem to solve alone in a room and emerges after a while with the problem solved, we are justified in inferring that the person did something in the room that solved the problem. We could not observe what the person did, but we are justified in trying to infer what the person did. Watson went on to say that if the person sits motionless before us and then writes down the solution, we are justified in inferring that the person did something to solve the problem and in trying to infer what that something was. The generic name for what the person is inferred to have done is *thinking*.

Watson's View of Introspection

My second question is about the kind of evidence a behaviorist could use to infer thinking. Watson recommended introspective reports. Edwin A. Locke said that "basic premises of behaviorism" are determinism, epiphenomenalism, and rejection of introspection as a scientific method. The first two premises are correctly identified as basic; but the third premise is correct only in a limited sense. Locke said that in behaviorism, introspective reports "may not be used to make inferences regarding the subjects's mental states or processes." Woodworth said in 1921 that behaviorists tried "to exclude introspection altogether, and on principle" and he said in 1932 that Watson "announced that introspection must not be employed, and that only motor (and glandular) activities must be discovered."

Neither Locke nor Woodworth cited any documentation, and none exists. Watson gave as examples of activities to be studied by behaviorists not only simple behaviors but also brick laying and house building, which by no stretch of antibehaviorist imagination can be classified as "motor (and glandular) activities." More to the present point, Watson said that behaviorists can and should use introspective reports, but must interpret them as what they really are--verbal, behavior that can provide data for inferences about thinking. Behaviorists reject the classical view that introspective reports provide direct, factual evidence about thinking.

One kind of verbal-report is the "thinking aloud" procedure. A standard reference is Ericsson and Simon's book *Protocol Analysis,* but as Ericsson and Simon (1984) pointed out, Watson had recommended in the 1920 article the same procedure for the same purpose. The research participant is given instruction in making cognitive behaviors overt by expressing them aloud verbally, but this procedure is not intended to be a version of the classical method of introspection. In introspection, the participant attempts to observe thinking as it occurs and then to describe it; in thinking aloud, the participant attempts to make covert thinking overt. However, "thinking aloud" probably reflects inner speech rather than thinking. This point leads to my third question, about the relation between thinking and speech.

Inner Speech

The Soviet psychologist Lev Vygotsky conceptualized inner speech as an abbreviated form of external speech. This view is also held by others, including Watson, Max Muller, and according to Muller, Leibniz. Vygotsky's position was that even though inner speech originates in external social speech, inner speech does not have the same form, or syntax as external speech because inner speech tends to preserve the predicate of a sentence and to omit the rest. Inner speech also does not have the same lexicon as external speech; external speech is vocalized in words and depends on denotative meanings, and inner speech is expressed in general senses of words, including denotation and also connotation. Watson's position was virtually the same: "In salient talking or thinking...the implicit processes...would be so abbreviated, short-circuited and economized that they would be unrecognizable unless their formation had been watched from the transition point where they are complete and social in character, to their final stage where they will serve for individual but not for social adjustments."

The Soviet formulation of the relation of speech to thinking seems very much like the formulations of Watson and Skinner, but most of the apparent similarities are actually not close. One real similarity is that Watson, Skinner, and the Soviet theorists did not limit thinking to verbal behavior but also included nonverbal behavior *and* all but ignored nonverbal thinking. One difference between the Soviet and behavioral views is that in the Soviet view, thinking and speech

were said to be separate, and thinking was said to shape speech rather than to be speech. As Sokolov said, "The same thought can be expressed in different words and different grammatical forms." However, the Soviet theorists did not explain what nonverbal thinking actually is.

Watson's View of Thinking and Speech

Watson's position on the relation of speech to thinking has been misrepresented or at least oversimplified by most writers who have mentioned it. The misrepresentation or oversimplification is that he believed that thinking is subvocal talking; it appears in books by, for example, Roback in 1923, Roback and Kiernan in 1969, Hergenhagen in 1976, Leahey in 1992, and Schultz and Schultz in 1992, and in Skinner's 1959 obituary of Watson. Actually, Watson believed that the whole body is involved in thinking--he said, "We think with our whole body." Many others have held this view. For example, Alexander Bain wrote in 1855, "Then brain is only a part of the machinery of mind; for although a large part of all the circles of mental action lie within the head, other parts equally indispensable extend throughout the body." Watson said that thinking involves "internal speech," or "subvocal talking," but "substitutions take place--for example, where the shrug of the shoulders of the movement of any other bodily part becomes substituted for a word. Soon *any, and every bodily response may become a word substitute.*" If these substitutions are overt, Watson said that they constitute behaving rather than thinking because thinking is covert. He ended his discussion in the 1930 edition of Behaviorism with "We thus think and plan with the whole body. But since, as I pointed out above word organization is, when present, probably usually dominant over visceral and manual organization, we can say that '*thinking' is largely subvocal talking*--provided we hasten to explain that it can occur without words."

However, Watson also said that conscious means verbalized and that people have little if any memory for events that occur before the age of 3 years because they did not verbalize the events. Watson also argued that language hinders treatment of problem behaviors because the client brings the old environment along in the form of words and gestures. The same point has been noted by Steve Hayes and Elizabeth Gifford, among others.

The use of gestures in thinking is illustrated by an anecdote Don Baer reported. He said that he wanted to describe the extraction of square-roots by hand to illustrate a point in a paper he was writing, but he could not remember what number was doubled in the algorithm. He said that he solved the problem by writing a number and beginning to go through the steps, and that his hand automatically wrote the doubled number at the appropriate step. He said, "My hand still knew the algorithm, but 'I' did not...I induced what doubled from what my hand wrote in extracting the root."

I have used a similar technique to "remember" my nine-digit identification code for making long-distance telephone calls from my office and my seven-digit code for entering my voicemail box. I punch what I believe is the first number and my hand automatically punches the rest. William James made the same point about other habitual acts: "Few men can tell off-hand which sock, shoe, or trousers-leg they put on first. They must first mentally rehearse the act; and even that is often insufficient--the act must be *performed*." Many children--and adults--remember which direction is "to the right" by moving the writing hand as though writing, and I have often remembered the locations of typewriter keys by simulating in the air how to type a familiar word. I classify such gestures as thinking even though they are overt. In this respect I disagree with Watson and agree with Skinner's statement in *Verbal Behavior* that thinking can be verbal or motoric and can be covert or overt.

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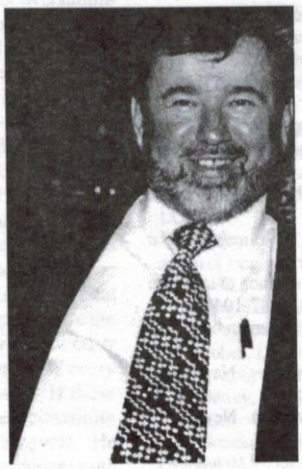
OBITUARY

Slobodan Boris Petrovich (1940–2000)



On February 11, 2000, in his sixtieth year, Slobodan Boris Petrovich died in Baltimore, following a massive heart attack. When anyone who was acquainted with Slo (or Slobo, as he was at times called), even remotely, first heard of his passing, he or she would startle and catch breath in a very personal way, for Slo's relationship with so many was so deeply personal and meaningful. He cared very much for so many, whether the relationship was scholarly, intellectual, simply social, or a mixture of these facets of acquaintance. Slo was a superlative friend to many; he was helpful, understanding, loyal, and fun to be with. He was a concerned and model parent to his son Boris. Slo had a great understanding of, and appreciated, fine food. As a generous host, he trained numerous friends in the appreciation of great food from different cousines. In short, Slo was bigger than life. And his enjoyment of life could be characterized as falling well beyond the sixth sigma above the mean.

He was the epitome of the interdisciplinary theorist and scientist, so is was no accident that he served as founder and creative director of the Interdisciplinary Studies Program at his beloved University of Maryland at Baltimore County for some 15 years, in addition to his membership in the Department of Psychology where he functioned, for some thirty years as an exciting professor of ethology and biopsychology. Slo was a world-class scholar and researcher who had a perpetually-open mind. He could discuss and add depth and dimensionality to almost any scientific topic or, for that matter, to any cultural, political, or social topic. As hereditary leader of his large family clan living concurrently in the United States and in Serbia, he manifested serene wisdom, creativity, and decisiveness. He was never interested in popularity, only in following the right policies and doing the right thing.

His constructive inputs greatly raised the quality of each of the myriad research studies on which he was consulted. In his own research, he sought to map the functional relations provided by the interactions among the species-specific genotypes and unlearned behavior repertories of the individuals of the different species with which he worked and the natural environmental units comprising the environment. In these endeavors, he often looked to conditioning paradigms (and operant learning in particular) to highlight the proximal causes of his explanation of process.

Now that Slo is gone, the lives of many of the individuals touched by him will miss those certain qualities that the relation with Slo provided, qualities that made life so much more interesting and worthwhile, so much more exciting for each of us.

Jack Gewirtz (friend and colleague)

Ethology and Attachment: A Historical Perspective

Eckhard H. Hess and Slobodan B. Petrovich*

An outline is presented of the assumptions underlying earlier and contemporary ethology. An example of ethological analysis is presented, with a focus on the ontogeny, mediating mechanisms of causation, function and evolution of cricket songs. In a historical frame, conceptual and methodological origins of modem ethology were sketched out and the significance of important trends explored. The conclusion of the analysis of this chapter is that researchers of human development studying attachment under the aegis of ethological theory have moved in a direction that diverges from the conceptualizations and research emphases of contemporary ethology. This paper describes elements of the ethological approach to attachment in an attempt to facilitate an interdisciplinary exchange among ethologists, and developmental psychologists. Its purpose is to share a historical perspective and habits of thought, and to communicate theoretical and methodological developments and that have had an impact on the ethological study of behavior.

At the, outset, our goal is to tell what ethology is about, in a historical context. As an example, the treatment considers the development, mediating mechanisms of causation, as well as the function and evolution of the cricket's song. Then we extrapolate some conceptual and methodological lessons of interest and of use to a wider audience. Our treatment proceeds with an appraisal of the contributions of ethology to the study of human attachment. Finally, we focus on some of the issues of relevance both to ethology and developmental psychology, and evaluate whether or not human-development theory and research on attachment in the frame of ethology have diverged from the emphases of contemporary ethology.

What Ethology Is About: A Historical Perspective On Some Conceptual And Methodological Extrapolations

Ethology has been described as the biology of behavior (Eibl-Eibesfeldt, 1975; Hinde, 1982; Tinbergen, 1963). While ethology has a relatively long and interesting history (Burghardt, 1986; Jaynes, 1969), for its most recent recognition it owes much to the contributions of a small group of investigators, among whom Lorenz (1965, 1970, 1971, 1974), Von Frisch (1967), and Tinbergen (1951, 1972) have received widest recognition.

Currently, the ethological literature on various aspects of animal (including human) behavior is so voluminous and varied that it leaves one wondering what it is that ethologists do not study. Faced with similar concerns, Tinbergen (1963) suggested that, once behavior is adequately described and operationalized, ethologists study its ontogeny or development, its immediate causation or mechanisms, its adaptive significance or function, and its evolutionary origins. In the words of Hinde (1982):

> Suppose you were asked, 'Why does your thumb move in a different way from the other fingers?' You might give an answer in terms of the anatomy of the hand - the differences in skeletal structure and muscle attachments between the thumb and the other fingers: that would be an answer concerned with the immediate causation of thumb movement. You might give an answer in terms of the hand's embryology describing how, as the finger rudiments developed, one came to have a different structure from the others. Or you might give a functional answer-an opposable thumb makes it easier for us to pick things up, climb trees, and so on. Or finally you might say that we are descended from monkey-like creatures, and monkeys have opposable thumbs, so of course we do too. This would be an answer in terms of evolutionary origin. All of these answers would be correct: no one would be complete. In the same way, ethologists are interested in questions of all four types of behavior. Indeed they believe that, although logically distinct and independent, questions concerning immediate causation, development, function and evolution are sometimes inter-fertile (p. 21).

As an example, we will briefly review the literature of cricket songs. The research involved is representative of ethological methodology. Our review includes the types of questions asked, the experimental subjects employed, the nature of the behavioral response studied and its measurement, comparative analyses within and across species, as well as how ecological example also can illustrate the process characteristic of ontogeny, causation, function, and evolution of species-typic isolation and of identification in simpler invertebrate systems. Invertebrates, and insects in particular, tell an interesting story (e.g., Wilson, 1975) and their message (even though unheard of in this volume) is important for an understanding of species-typic behavioral development.

Cricket-Song Study as an Example of Behavioral Analyses in Ethology

There are approximately 3,000 species of crickets, of which field crickets make up a special group of about 400. The field crickets are the most familiar. Relatively large, they are yellowish-brown insects known for their loud, musical chirping. Male crickets produce sounds by rubbing together stridulating areas located on the forewings and utilize a rapid fluttering motion to produce a typical vibrato chirp. The receiving auditory organs are tympana located within slits on the forelegs. Most cricket species chirp at night, some during the day, and others both day and night. In general, understanding of neurophysiological mechanisms involved in cricket bioacoustics has few parallels, if any, in the animal literature (Alexander, 1966; Bentley & Hoy, 1974; Ewing & Hoyle, 1964; Huber, 1962; Rose, 1986).

In a southeastern region of the United States during summer there are as many as 20 different species of tree crickets producing discrete sounds, mostly the male's calling song, the function of which is to attract the female for mating. How does a female distinguish the sounds of a conspecific? Studies have demonstrated that males of each species have a particular pulse rate in their song, and it is this pulse rate that

provides a female with discriminative cues. It is also interesting to note that the metabolic and physiological processes in a cricket are functionally affected by outside temperatures, so that a pulse rate in the song changes with temperature, earning some species the appropriate label of "thermometer crickets." The refinement of the evolved system is remarkable when one considers that physiological mechanisms which determine females' responsiveness to a signal change at the same time in a fashion that parallels the males' pulse rate. The sound-producing repertoire of the male cricket serves a number of functions.

1. facilitating and establishing sexual contact (the calling song);
2. mediating sexual attraction at a relatively short distance (the courtship song);
3. signaling departure of a courted female (the courtship-interruption song);
4. repelling or dominating other males (the aggressive sound);
5. maintaining contact between a mated pair (the postcopulatory song);
6. a wide range of what appear to be recognition sounds (e.g., Alexander, 1966, 1968).

How does this brief commentary on cricket bioacoustics illustrate the importance of acoustic communication in cricket speciation and evolution? What are some of the factors that maintain the species-specific integrity of a gene pool of some 20 different species of tree crickets that are not geographically isolated? The species-specific characteristics of the male calling song and the recognition of that song by a conspecific female were identified as an important isolating mechanism (Alexander, 1966; Dixon & Cade, 1996; Walker, 1957; Wiedermann & Loher, 1984).

Viewed in the context of our understanding of evolutionary processes, crickets tell an interesting overt and covert story in evolutionary terms. Among the 3000 cricket species, many are isolated by their geography and habitat. When a number of species occupy the same habitat, then temporal, ethological, or mechanical isolating mechanisms maintain species integrity. Thus, one species will chirp at night and another during the day (temporal isolation). If more than one species occupy the same habitat and "sing" at the same time, then the differences in the pulse rate (ethological isolation) maintain species identity. Acoustic signals and communication serve in the prezygotic isolation of closely-related species.

The literature on the ontogeny of acoustic communication in crickets also deserves more attention from behavioral scientists than it has received to date. It should be kept in mind that many insects mature without hearing the signals of their own species, and that they sense many sounds that have absolutely no resemblance to signals that they as mature adults must eventually produce. As Alexander (1968) has pointed out, there must have been intensive selection pressure for resistance to irrelevant acoustic influences and toward fixed relationship between acoustic genotype and acoustic phenotype.

Experiments investigating the genetic correlates of communication signals in several species of crickets offer further support to this thesis (e.g., Alexander, 1966, 1968; Bentley & Hoy, 1974; Fulton, 1933). For example, as early as 1933, Fulton hybridized Nemobius allardi and Nemobius finnulus. These two sibling species of ground crickets mature at the same time, overlap geographically and ecologically, but sing different songs. Fulton was able to develop FI and F2 hybrids, carry out F I backcrosses with parental species, and analyze the songs of various crosses. Fulton's results were generally clear cut and straightforward. Pulses in the song of F1 hybrids were delivered at a rate intermediate between those in the songs of the two parental generations. The songs of backcross progeny were more like the parent utilized in the backcross. Subsequent literature on other species has further elucidated the genetic determination of the song pattern of each cricket species. The songs are phenotypic expressions of different genotypes, thereby offering evidence that links together genetic information, developmental processes, structural and functional organization of the neuroendocrine system, and behavior (e.g., Bentley & Hoy, 1974; Schildberger, 1984).

In summary, crickets are sensitive to stimuli in other sensory channels: acoustic, chemical, visual, tactile, and thermal. This review has used one example to demonstrate how discrete acoustic signals function in species-typic isolation and identification, while it also offers overt and covert evidence for the proximate and the ultimate causation of such behaviors.

On the Relationship Between Ethological Theory and Research: Levels of Organization-Levels of Analysis

The development and the use of theory have been valued by researchers across disciplines and areas of inquiry. The characteristic thinking has been that theory generates research models and questions, thereby requiring that the empirical answers to those questions be referred back to evaluate merits of a particular model or, if need be, to modify or even discard an existing theory. Disciplined empiricism requires a theory, however informal or preliminary it may be or however difficult an investigator may find testing assumptions stemming from it.

The appreciation of what ethology is about is more meaningful if one is reminded of the early intellectual antecedents of present-day ethology. The clash involving an emphasis on laboratory-discovered facts as contrasted to naturalistic observation culminated in three famous debates at the French Academie des Sciences around the year 1830, in which the naturalistic evolutionary point of view suffered a profound defeat. Baron Cuvier had laboratory facts on his side, but as we have learned subsequently, by arguing for the immutability of the species, he was wrong in principle, whereas Geoffroy Saint-Hilaire was right in principle without the appropriate facts (Jaynes, 1969). The debates contributed to polarization between the two camps, with Cuvier's side insisting on the laboratory analysis and founding comparative psychology, while Geoffroy Saint-Hilaire's camp emphasized naturalistic observations and established ethology. Comparative neurophysiologist and protege of Cuvier, Pierre Flourens, the author of *Psychologie Comparee* (1864), is credited with developing a comparative psychology that synthesized the mechanistic neurophysiological approaches of Des-cartes' human psychology with Cuvier's animal psychology. It is worth noting,

however, that during that same year and consistent with the intellectual bias of his school, Flourens (1876) published another book, leading French science's attack on Darwin's Origin of Species (1859). The comparative psychology that developed in North America around the turn of the century embraced the Darwinian view of the world, but it remained a laboratory science, and its failure to appreciate the importance of the ecological-naturalistic dimension of behavior contributed to its decline (e.g., Lockard, 1971).

By comparison, throughout the nineteenth century the naturalistic bias was advanced by other prominent biologists. Alfred Giard (1904) emphasized ethology and E. Haeckel (1898) pushed for "oecology" (presently ecology), then and now defined as the study of the relationships among organisms and environments. It is no accident that the more recent pioneers of ethology sought to avoid a dichotomy between field and laboratory research, and they succeeded in doing so under the conceptual framework of evolutionary theory (e.g., Eibl-Eibesfeldt, 1975; Hess, 1973; Jaynes, 1969; Lorenz, 1981; Schneirla, 1966; Thorpe, 1963; Tinbergen, 1951).

Levels of Organization-Levels of Analysis

Any behavioral problem can be conceived as varying along dimensions identified as levels of analysis. Each level can be defined in terms of its position on an information continuum. The major unifying and consensually valid theme in the ethological perspective is the synthetic theory of organic evolution.

When Darwin and Wallace in the 1850s proposed their theory of evolution by natural selection of the fittest and by specific examples demonstrated how these processes could account for the evolution of organisms, they planted the seeds of the powerful scientific and intellectual conceptualization that is still unfolding. From Malthus, Wallace and Darwin knew that organisms reproduced in far greater numbers than could be sustained by a particular environmental setting. Their observational evidence was that populations remain relatively constant. They therefore concluded that a large proportion of the offspring must fail to survive. Moreover, they knew that animals compete for the available resources of the environment and thereby participate in an active "struggle for existence"
(Darwin, 1859/1869). As Darwin (1859/1869) indicated:

> ... owing to this struggle for life, any variation, however slight and from what-ever cause proceeding, if it be in any degree profitable to an individual of any species, in its infinitely complex relations to other organic beings and to external nature, will tend to the preservation of that individual and will generally be inherited by its offspring. The offspring, also, will thus have a better chance of surviving for, of the many individuals of any species which are periodically born, but a small number can survive. (p. 61)

Even though it was most important for the evolutionary theory that heritable variations be present in each generation, Darwin nevertheless freely conceded his ignorance of the mechanisms of inheritance. It was not until about 1900 that Mendel was rediscovered and that Hugo de Vries proposed his mutation theory by pointing out the likely possibility that the obvious morphological changes he observed in the evening primrose might provide the variations on which natural forces could exert selection pressure.

The major breakthrough and the beginnings of the modem synthesis surfaced in the 1930s, when R. A. Fisher (1930) published *The Genetical Theory of Natural Selection*, Dobzhansky (1937) produced *Genetics and the Origin of Species*, followed by Oparin's (1938) *The Origin of Life*, Mayr's (1942) *Systematics and the Origin of Species*, and Huxley's (1942) *Evolution: The Modern Synthesis*. These works brought together diverse areas of human knowledge and inquiry. Organic evolution began to be viewed as a by-product of the chemical evolution of matter and biophysics, biochemistry and molecular biology surfaced as the new and exciting areas of inquiry. The new neo-Darwinian synthetic theory of organic evolution made sense out of taxonomy. It explained the fossil record as well as the fitness of adaptations between organisms and their habitats. The cell theory put forward convincingly in 1839 by German microscopists, Schleiden and Schwann, was given a new vision: The cell is a Mendelian unit carrying the genetic code of stored variability that is crucial to evolution and, at the same time, is a physiochemical entity obeying the laws of physics and chemistry. The bridge between particle physics and human evolution and ecology was formed. The door was left open for the new generation of Nobel laureates such as Watson and Crick (1953), who, by their elucidation of the double-helical, physiochemical structure of the DNA molecule and its role in heredity, provided one of the major empirical validations for the new synthesis.

Unfortunately, the behavioral sciences were largely left out of the modem synthesis (Dawkins, 1986; Hess, 1973; Lockard, 1971; Lorenz, 1965; Wilson, 1975). The reasons were many. The pursuit of the mysteries of life focused the concerns of the biological sciences on the molecular universe, thereby leaving the behavioral territory to psychology, sociology, anthropology, and psychiatry). In turn, many professionals in these disciplines found the nativist, materialist, determinist implications of the modem synthetic theory of organic evolution to be either irrelevant or difficult to accept and incorporate procedurally, professionally, politically, and personally. For example, until very recently the lack of emphasis on the role of hereditary factors in behavior has been one of the hallmarks of North American psychology and sociology. Thus, many behavioral scientists were surprised by the "unconventional" decision of the Nobel Foundation in 1973 to award the prize for physiology and medicine to three ethologists, Karl Von Frisch, Konrad Lorenz, and Nikko Tinbergen, thereby acknowledging the efforts of those individuals in bringing the study of behavior under the umbrella of the synthetic theory of organic evolution. With the subsequent ad-vent of sociobiology (e.g., Wilson, 1975) and cultural materialism (Harris, 1966, 1979), the initial surprise gave way to exchanges characteristic of a paradigm clash (e.g., Cavalli-Sforza & Feldman, 198 1; Gould, 1980; Rose, Lewon-tin, & Kamin, 1984; Lumsden & Wilson, 1981; Trivers, 1985).

Current ethology is occupied with four hierarchical biological questions and concerns: What are the ontogeny, causation, function, and evolution of behavior? Explanation and understanding require that attention be given to each of these questions and concerns and to the various levels of

interrelationship among them. The magnitude of the hierarchical concerns requires a breadth of synthesis that transcends levels of analysis from genotype to behavior and ecology–a synthesis that transcends the extremes of levels of biological organization.

In general, the consensus among ethologists has been that: (a) organic evolution has been a by-product of the chemical evolution of matter, (b) animal species, including Homo sapiens, are the products of natural selection, and (c) genes are chemically code for phenotypic expressions. In terms of reproductive success, natural selection favors those animals whose genes, through their phenotypic expressions, successfully interact with the environment of the ecosystem. The above-listed considerations stem from the world view shared by ethologists (Dawkins, 1986). Even so, some considerations are often neglected. We now attempt to relate these considerations to levels of analysis in the behavioral sciences.

The ethological model incorporates in a hierarchical fashion levels of organization from subatomic particles to ecosystems. No level of organization or analysis is conceived as more "important" or "adequate" than another, since a position on the information continuum is not in itself a criterion for importance or adequacy. The reduction of a behavioral problem to a neurophysiological one, or of a neurophysiological one to a biochemical one, does not in itself generate a more fundamental or a more important explanation of the original behavioral problem. Surely, we recognize that the water molecule has characteristics and properties independent of those of hydrogen and oxygen. At the same time, we must note that knowing the characteristics of hydrogen and oxygen does provide us with some important information about water. Thus, it follows that the usefulness and appropriateness of her particular level of analysis is circumscribed by theoretical orientation, parameters of the problem under investigation, and contextual circumstances, as well as by general purposes of the discipline or the investigator. Thus, as our introductory example indicates, a student in modem ethology investigating the behavioral biology of the cricket song would find it necessary to acquire at least some sophistication in language and the tools of genetics, neurophysiology and neuroanatomy, quantitative behavioral analysis, systematics, ecology, and evolution.

Ethology And Attachment

The attachment behavior of young precocial fowl toward biologically-appropriate adults or surrogates including humans, was noted two thousand years ago (Hess & Petrovich, 1977). Konrad Lorenz's (1935) paper on companions as factors in the socialization of birds represents the first post-Darwinian experimental attempt to deal extensively with the phenomenon of "imprinting" (see Petrovich & Gewirtz, Chapter 5; for a review of the literature from a historical perspective, see Hess, 1973; Hess & Petrovich, 1977). The more recent interest in human attachment has been sparked by the elegant contributions of Bow1by (1958, 1969/1982, 1973, 1980) and by the derivative approach and refinements of Ainsworth (1969, 1982) and her associates (Ainsworth, Blehar, Waters, & Wall, 1978). Among students of human development, these contributions have come to be known as the ethological approach to attachment.

The attachment theory proposed by Bowlby (1969/1982) was developed in an attempt to extend and improve traditional psychoanalytic approaches. The three volumes of Attachment and Loss (1969, 1973, 1980) provide a modem synthesis that goes well beyond the modesty of Bowlby's original claims. Nevertheless, Ainsworth's (1969) observation that "In effect what Bowlby has attempted is to update psychoanalytic theory in the light of recent advances in biology" (p. 998) still rings true. Bowlby's (1969/1982) synthesis of psychoanalytic thought and ethological research was very compatible with the ethology of the 1950s and 1960s period. Patterns of infant-adult attachment were approached from a comparative cross-species perspective as evolved species-typical behavioral adaptations. Bowlby was careful to distinguish between "teleological assumptions" under which the purposes of behavior are assumed and "teleonomy" under if which the contingencies facilitating the survival value of behavioral adaptations may be demonstrated. Bowlby attributed the evolutionary origins of attachment behavior to predatory selection pressures. This conceptualization of human attachment was articulated within the framework of biopsychosocial systems theory (Bowlby, 1969/1982; Bischof, 1975) that invites comparisons with levels of organization and analysis that we have identified as characteristic of the ethological approach.

If one reviews the methods and practices of present-day adherents of the ethological theory of attachment, there is found a mismatch between those conceptualizations and objectives of modem ethology (as we have elaborated them) (e.g., Ainsworth, Blehar, Waters, & Wall, 1978; Bretherton & Waters, 1985; Sroufe & Waters, 1977). In a striking contrast to the cricket song example, these contributions are characterized by the paucity of research on ontogeny, including mechanisms of causation, function, and evolution of attachment. Considerations of genetic, neurophysiological, neuroendocrine, functional analyses, the latter including such molar processes as perception, preverbal, nonverbal and verbal communication, and learning, and evolutionary processes of attachment are missing or are dealt with superficially.

In contemporary ethology, Darwinian formulations such as "adaptations for the good of the species" have given way to considerations of evolutionary strategies of ultimate causation and conditional probabilities in proximal development that are derived from theory and empirical evidence from both experimental and field ethology, population genetics, evolutionary biology, behavioral ecology, and developmental psychobiology. Among the researchers of human attachment, these developments have received but scant attention. We noted in an earlier section that Bowlby (1969/1982) was careful to distinguish between teleological and teleonomic assumptions. Admittedly, "adaptive" is a troublesome term incurring problems of teleology in its use, if ecologic-teleono mic contingencies of survival value are not specified. Moreover, given the biological history of *Homo sapiens*, various modes of adaptation may be outcomes of specific experiences rooted in learning and tradition as of genetically programmed processes. At some level of analysis, however, the modem view holds that conditional responses are an outcome from the coaction. of these processes (probablistic epigenesis). Even so, analyses of these processes in a given ecological setting are required. Lack of sensitivity to these issues is noteworthy

among human developmentalists investigating attachment under the aegis of ethology.

Contemporary ethology is neutral about the relative contributions of laboratory and field research. The consensual view holds that the problems of interest to researchers are to be found in nature. A laboratory is a tool that allows the investigator an opportunity to test specific hypotheses under controlled conditions and investigate experimentally puzzling aspects of behavioral development. In turn, laboratory solutions are evaluated in terms of their putative biological/ ecological origins, thereby allowing researchers to explore the fitness of behavioral adaptations found in nature. By comparison, the application of the Strange-Situation laboratory procedure for assessing attachment has dominated the methodological landscape in the human-development approach to attachment under the conceptions of ethology. The relation of these laboratory assessments to the ecological dimensions of attachment have not been pursued systematically or with discipline (Lamb, Thompson, Gardner, Chamov, & Estes, 1984).

The treatment of functional aspects of behavior is limited. For example, Waters' and Deane's (1985, p. 42) statement that "questions about what is learned during the attachment relationships, about the course of attachment after infancy, and about individual differences beyond security and anxiety have received little attention," is likely to be shared by any ethologists interested in molar and ecological dimensions of early socialization.

The conceptualizations and research in modem ethology are characterized by testing hypotheses stemming from evolutionary processes of inclusive fitness, parental investment, and kin selection. Response to predation is just one measure of parental investment. Two decades ago, Bowlby (1969/1982) attributed the evolutionary origins of attachment to predatory selection pressure, a view that is still widely held by researchers of human development and by authors of texts of child development (e.g., Sroufe & Cooper, 1988). In contrast, from the perspective of contemporary ethology, the most plausible ultimate explanation of the origins of attachment is that behaviors denoting attachment increase the inclusive fitness of the individual whose mode of reproduction is characterized by intricate patterns of parental investment (Petrovich & Gewirtz, 1985; Petrovich, Gewirtz, & Hess, 1986).

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Exploring Stimulus Equivalence Formation in Infants

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A systmatic replication of the Devany, Hayes and Nelson (1986) and the Augustson and Dougher (1992) studies was conducted with infants to explore the relation of stimulus equivalence to language development. 9 normal infants, age 21 to 25 months participated in 5 to 15 experimental sessions, each session on a different day. Infants expressive language skills were assessed (REEL Scale 2, 1991) before submitting each of them to a learning task consisting of matching different animal-like figures in a matching-to-sample (visual-visual) conditional discrimination format. In a single-subject design, infants were taught four conditional discriminations: if A, then B; if A, then C; if D, then E; and if D, then F. The order of presentation and the left-right position of correct response were counterbalanced across training and testing trials. Once an infant learned these mixed relations under various reinforcers, the transitivity test was given. Equivalence was established when a child matched B and C, in as much as A had been the matching sample for both, and when a child matched E and F, both of which earlier had been paired to D. Every subject attained criterion on the four independent conditional discriminations and on the mixed training. 5 subjects who attained transitivity (at 80% or above), performed below chance level on at least one of the four symmetry tests. 8 out of our 10 subjects performed between 80 and 100 % correct responses in the transitivity tests. We found a significant negative correlation between the total number of trials to criterion during the conditional discrimination training and the combined receptive and expressive language quotient. Those infants with higher language-skill scores required fewer trials to complete the conditional-discrimination training. The results suggest that language skills play a role in stimulus equivalence formation.

There are at least three reasons why the concept of stimulus equivalence has captured the imagination of behavior analysts. First, the formation of equivalence classes is one of a range of cognitive phenomena, including those that denote concept formation, categorization, and rule-governed behavior that can be addressed and organized from a behavior-analytic perspective. Second, stimulus equivalence appears anomalous, unexpected, and emergent. And it is not immediately apparent that the emergence of stimulus equivalences are direct outcomes of operant learning. And, third, equivalence-class formation appears to be related to language development (see Devany, et al., 1986). In some way, the relations seen among stimuli in an equivalence class parallel the symbolic relations commonly said by cognitive developmental psychologists to be characteristic of language.

The Relation Between Thought and Language

The debate between Piaget and Vygotsky over the relationship between language and thought raised many questions about their developmental sequence in humans. Piaget deemphasized language by subordinating it to thought. He saw language primarily as a vehicle for expressing thoughts, not as a precursor to thought. On the other hand, Vygotsky (1962) argued that in the sensorimotor and early preoperational stages, thought and language develop independently. His position was that thought is prelinguistic and language is preintellectual. If educators knew the developmental point when symbolic representation and stimulus equivalence is possible, they would be able to teach more effectively. We assume that if infants are in fact capable of thought and of forming equivalence classes before language, we would not have to wait until their language has developed to start teaching them concepts, numbers, etc. Moreover, with definitive answers to how we develop thought and language and other human capabilities at an early age, we could structure more reliable tests as predictors of how infant conceptual progress would occur.

The Development of Language

Most normally developing infants can discriminate between the distinctive features of closely similar phonetic elements in speech, even at 1 month of age (Eimas, Siqueland, Einar, Jusczyk, & Vigorito, 1971). In natural circumstances, infants can recognize some symbolic word meanings as early as 6 to 8 months after birth (Bzoch & League, 1991). This recognition is followed shortly by demonstrated language skills for discriminating the meanings of most simple sentences by 9 to 12 months after birth. Receptive recognition vocabulary often rises to over 100 words by the first year of age, and the first intelligibly spoken words in expressive language normally tends to appear in the infant's repertory between 9 and 14 months. Important for our research, however, is that expressive syntactic advances, typically, do not appear in the child's repertoires until after 18 months. For us, the key issue is to determine at which early developmental points stimulus equivalence-class formation can occur. The assumption that language skills can cause or facilitate successful equivalence-class formation needs further exploration.

Objectives of the Present Study

The main aim of this study is to explore how early in human development equivalence relations may appear and to examine the relation between stimulus equivalence and language competency. Previous studies have shown stimulus equivalence in normal children (Augustson et al., 1992), language-able mentally-retarded children (Devany et al., 1986, Saunders & Spradlin, 1993), and adults (Hayes, Thomas, & Hayes, 1989). An equivalence class is shown if the stimuli in the class show the three defining relations of reflexivity, symmetry, and transitivity (Sidman & Tailby 1982). Matching-to-sample procedures have been used to establish and test for these relations. In this test, the subject is presented with a sample visual stimulus, and given an array of three comparison visual stimuli underneath the sample stimulus. They are then asked to point to the comparison stimulus that goes with the one above, the sample. That is the child will learn that in the presence of the sample visual stimuli, if they pick a certain comparison visual stimuli they will be reinforced.
Reflexivity is generalized identity matching, by matching a novel stimulus to itself under conditions of no reinforcement. That is to say, if a child is shown a picture of a car, the sample, and then asked which one of these comparisons go with the above, and they have to choose between a bat, tree or car. If the child picks the car, (comparison), to match the car, (sample), then this shows an identity relationship ("if A, then A"). Symmetry refers to the functional reversibility of the conditional relation; "if A, then B, and if B, then A". This means that if the sample visual stimuli is a car, and the comparisons are a house, truck and swimming pool, the child would be asked "Which one goes with the car?" If the child picks the truck then they will receive reinforcement for that behavior. This is called visual-visual conditional discrimination.

Some previous matching-to-sample tests have used auditory stimuli and asked the subject to match visual stimuli with it; this is called auditory-visual conditional discrimination. In a matching to sample test, in order to show transitivity at least 3 stimuli are required. If after the relations "if A, then B" and "if B, then C" have been taught with conditional discrimination trials, and then when tested for the relation "if A, then C" and the relation emerges without ever being explicitly trained with reinforcement or paired together, transitivity has been demonstrated.

Problems with Previous Studies with Young Children

From their findings, Devany, et al. concluded that language skills are related to the demonstration of stimulus equivalence. In their study, three groups of children were trained and tested on equivalence relations: (1) normally developing preschoolers, (2) children termed "retarded" showing expressive speech or signs, and (3) children termed "retarded" showing language-deficiency. Devany et al. reported the acquisition of visual-visual conditional discrimination and transitivity in every one of their language-able children (retarded and normal), whereas none of the language-deficient "retarded" children exhibited transitivity after having succeeded in the conditional discrimination training. Devany et al. concluded that the failure of the language-deficient children to form equivalence classes could not be explained on the basis of an inability of those children to learn conditional discriminations per se. That is because *all* the retarded/no language subjects in their study did learn the 4 conditional discriminations, while only those with language skill were able to show transitivity. Devany et al. attributed the inability of the retarded non-language children to form equivalence class to their language deficit. However, the Devany et al. (1986) study was based on the constraint sample of mentally-retarded infants that posits some potential confounds explain below. Based on the Devany et al. study, one can not arrive at a definitive conclusion about equivalence-class formation in 1- to 2-year-old children and its relationship to differential language (or cognitive) skills.

Our study was designed as a systematic replication of the Devany et al. (1986) and Auguston and Dougher (1992) studies. The same materials were used, mode of presentation, order of training the conditional relations and testing, as well as same reinforcement schedule. One divergence was that we used a more stringent criterion for training the conditional discriminations than did Devany et al. Instead of 9 correct out of ten responses, we used 9 consecutive correct responses to index the learning of each conditional discrimination. The reader is cautioned to look carefully when viewing the information given in the figures of the Devany et al. results. Their charts represent individual training and testing data for the 12 children (4 of whom were classified as "normal", 4 as "retarded-with-language," and 4 as "retarded-without language"). Their classification, based on the Bayley Scale and the Stanford-Binet standardized intelligence test score, led to conclusions that: (1) the retarded/language skilled and the normal children all required fewer trials to complete the discrimination training than did the retarded children with no language skills; and (2) that all their language-able children performed better than the language-deficient children on the stimulus-equivalence test. However, when one examines the Devany et al. results showing the transitivity test scores of their 12 Ss, at least a question remains: Was transitivity indeed shown by the 8 language-skilled children? If we look at the results in the *first* block of every language-able subject on this test, we see that none of these subjects attained greater than 70 % correct responses in that first block, with many subjects scoring between the 50 and the 60 % level. One problem in interpreting the Devany et al. results is the way in which the data were calculated and plotted. In their graphs, each data point represented the number of correct responses out of the number of responses attempted, in a block of ten trials. This way of plotting presents an inconsistency in the representation of those data that can be misleading. For example, in a sample block of ten trials, there may have been only 4 trials with responses attempted and 6 trials with no attempts at all. Out of the 4 responses attempted, 3 may have been correct, resulting in a correct score of 75%. The enormous variability of the denominators yielding these percentages may provide a questionably-valid representation of performance during the transitivity tests. To correct for this problem, in the present study denominator values were held constant, always with 10 responses *attempted*. In general, subjects improved their performance from the first to the last transitivity test block of a

series. Even so, the answer as to whether or not infants subjected to this control procedure were able to form a new relation without implicit or explicit training remains unanswered.

Figure 1 shows results from our first subject (#1) when we tried to conduct a direct replication of the Devany et al. procedure. Notice that using their procedure, we were only able successfully to train the 2 conditional relations (A:B, D:E) independently and then mixed, in this 25-mos.-old language-skilled girl, with receptive and expressive language scores normal for her age. However, our subject was unable to demonstrate the emergence of the new relation during the transitivity test. We were about to run additional subjects to verify this contradictory finding, when Augustson's and Dougher's systematic replication of the Devany et al. study came to our attention (EAHB, 1992). By failing to replicate the Devany et al. results, Augustson and Dougher corroborated our concerns about the complexity of the Devany et al. procedure. But Augustson and Dougher left us with additional concerns about their own design. Their subjects were ***never tested*** for transitivity because they could not attain criterion during the mixed-training phase. We believe that this occurred because Auguston and Dougher used three comparison stimuli instead of two. Several reasons might explain why the subjects in these two studies failed to derive the new stimulus relation:

First, there is the possibility that children 24 mos. and younger may have difficulty in learning (and/or remembering) more than two conditional discriminations at a time before being tested for stimulus equivalence. In the Devany et al. design, all 4 conditional discrimination relations (A:B, D:E, A:C, D:F) were trained in a complex sequence, before the equivalence test was presented. Augustson and Dougher also trained the 2 conditional discrimination relations independently, before they introduced the mixed task. However, as in the aforementioned, their subjects were not able to reach criterion on the mixed task. Thus, Augustson and Dougher neither trained the next two relations nor tested for the transitive relation. Although Augustson and Dougher attempted to replicate the Devany et al. study, their results are not comparable to those of Devany et al. because those researchers made the learning more difficult for the children by adding a third comparison stimulus. They used an array of 3 comparison stimuli (one correct and two incorrect) on each trial. It is possible that this methodological change in the Auguston and Dougher design increased the complexity of the mixed training task beyond the skills of their 2 year-old subjects. Augustson and Dougher, in the second phase of their study, extended the mixed task and found that their subjects continued to perform at chance level even after two hundred trials, so they terminated the mixed training. But, even had the training been extended beyond 200 trials, one wonders if any of their child subjects would have succeeded in attaining criterion in the mixed training task, much less derived a new equivalence relation?

Is important to note that neither of those two studies tested for *symmetrical* responding. The possibility of such symmetrical responding was only inferred. In the present study we break down the complexity of the training sequence by training only one conditional-discrimination at a time and testing immediately for *symmetry* before training a new relation. We expected that this addition in the design would permit us to assess for symmetry routinely after each subject has attained the response criterion in a conditional-discrimination training task. Thus, one purpose in our study was to test for symmetry, not to train it (see Figure 1).

Devany et al. used mentally-retarded subjects as a means of determining if language skills are prerequisite for stimulus equivalence. We believe it is difficult to determine if behavior patterns denoting "mental retardation" are associated with the failure of the subjects to derive equivalence relations (even when the groups are matched using mental age), or if the deficit in language skills *per se* could be responsible. Very importantly is that the data of Devany et al. revealed a significant difference in the number of unattempted trials between the retarded language and the retarded no-language groups. The retarded language group averaged 5 unattempted responses per child, whereas the retarded no-language group averaged 10. This could be another possibility for the failure of the retarded no language group to show the transitive relation. In addition, Devany et al. made only an informal assessment of the language and speech skills of their subjects. A formal method for assessing the language skills of infants was employed in our study.

All of these aforementioned issues prompted us to modify the procedure from that used in the earlier studies and to look for alternative tactics in the study of equivalence relations in very young children. Apart from concerns with methodological problems, our main long-term interest is to detect at which developmental points infants are able to demonstrate the emergent relations denoting symmetry and transitivity. We are interested in determining if any particular sequence in the conditional-discrimination training can facilitate the acquisition of equivalence relations. We are open to the possibility that stimulus-equivalence class formation would be manifested in young children at early developmental points, even before they show expressive language skill.

METHOD

Participants. 9 normal subjects, 7 males and 2 females aged 21 to 25 months, participated in this study. The mostly daily experimental sessions lasted between 20 and 30 minutes. The number of trials presented was not fixed, but usually involved at least 20 trials. The number of sessions ranged between 5 and 15.

Assessment Materials and Experimental Setting. Language Skills and Equivalence Relations. Before the first training session, each child's receptive and expressive language skills were assessed through the administration of The Bzoch-League Receptive-Expressive Emergent Language Scale (1991), for the Measurement of Language Skills in Infancy (REEL Scale 2). For reliability purposes, this language-skill assessment was made twice, one time by the experimenter alone, and a second time using the mother as an informant (with the experimenter reading each item to the mother). The average scores of the two informants were used for analysis of the data. This language test includes a 132-item checklist and uses observational information to identify the level of language skills in infants.

Two functional language systems, receptive and expres-

sive, are assessed directly. To the test developers, *receptive* language refers to the unified activity of all the sensory-neural associations and auditory-perceptual processes that are involved in the decoding and understanding of the intended meaning of oral languages (i.e., auditory comprehension). In contrast, *expressive* language refers to all of the underlying sensory-neural processes and also to the motor neural skills of the breathing, phonation, resonance, and articulation mechanisms of the body that are involved in communicating with others through the mediation of spoken symbolic languages.

Setting. In the experimental room, two video cameras recorded all activities. The subject sat at a table facing the experimenter. Six stimulus figures were used in the experiment. The tasks consisted of matching animal-like figures using a matching-to-sample format. Each stimulus figure was colored with one of six watercolor paints (red, brown, green, purple, yellow, and orange). Color assignment was random, except that all six colors had to be used in each stimuli set.

Procedure. A single-subject design was implemented. The children were taught four conditional discriminations: if A, then B; if A, then C; if D, then E; and if D, then F. This order was counterbalanced for half of the subjects. During training, either the A or D stimulus was presented as a sample with either B and E or C and F as comparisons. The left-right order of presentation of the comparison stimuli was counterbalanced across trials. Each child was trained and tested using a different stimulus set, made by randomly selecting from a pool of items. (The stimuli used in the equivalence test were identical to those used in the previous training phase, except that the sample stimuli were stimuli that previously had been comparisons during the conditional discrimination training.) Equivalence was indicated by matching B and C, inasmuch as A had been the matching sample for both, and by matching E and F, both of which earlier had been matched to D.

First, a child was taught to select B in the presence of A, the sample stimulus (A:B). The criterion for terminating training is nine consecutive (unprompted) correct responses. Once the child reached criterion on this relation, testing for the symmetrical relation (B:A) was conducted. Symmetry tests consisted of a block of ten trials in which responses were emitted. (Trials in which the child did not respond were not included in the ten trial blocks.)

After the symmetry test, the child was taught the second conditional discrimination, which was to select C in the presence of A (A:C). When the child reached mastery criterion on this task, testing for the symmetrical relation (C:A) was conducted. (Notice that at this point in the sequence the relation D:E was not trained as Devany et al. and Augustson and Dougher had; instead, A:C was trained). Then, a mixed task followed. In the mixed training the stimulus cards from both sets of the two previously acquired relations were mixed together and presented in a random order. Once the child reached criterion on this mixed task, the transitivity equivalence test was presented. The entire procedure was then repeated for the D:E, D:F relations.

At the start of each trial, the experimenter pointed to the sample stimulus and said, "See that one? Which one at the bottom goes with it?" Correct responses during training were reinforced with either praise, the blowing of bubbles, the ringing of a bell, or the delivery of food (cereal, M&Ms). Incorrect responses were not reinforced. Physical prompting (guiding the child's hand to the correct choice) and visual prompting (placing the experimenter's finger on the correct choice) were used with some children at the beginning of training. Initially, a continuous reinforcement schedule was used and was gradually thinned until a programmed consequence was delivered only after every three or four correct responses. Reinforcement was not delivered for the target response during testing. Instead, the child was praised for cooperation, good sitting, and the like two or three times during a block of ten trials. The mixed training and the equivalence test were administered within the same session.

Recording. Behavior in each trial was scored as "correct", "incorrect" or "no response". A "correct" response is defined as touching the correct comparison stimulus while refraining from touching the incorrect comparison or the sample stimulus. An "incorrect" response is defined as touching the incorrect comparison or touching both the correct and incorrect comparisons. Any other behavior was scored as "no response."

RESULTS

As seen in Figure 1, the number of correct responses divided by ten (ten-trial block) was calculated to give a percentage of unprompted correct responses for each ten-trial block. The first block of each training period may reflect fewer than10 trials with responses. In symmetry and transitivity testing periods, *all* blocks are comprised of 10 trials, each involving a response.

Figure 1 shows that all 9 subjects attained criterion (9 consecutive correct responses) on the four independent conditional discriminations and on the mixed training. Subjects required from 34 to 242 trials (mean=103) to learn the two relations (A:B, A:C,) and the mixed training. In contrast, the Devany et al. subjects required from 50 to 70 trials, with a mean of 68, to reach their response criterion. This difference in number of training trials to criterion may have to do with the fact that our subjects were less developmentally advanced, than the subjects of Devany et al. Our children ranged from 21 to 25 months and theirs from 25 to 52 months. The average number of correct responses for all subjects in the symmetry tests was 6.5. Surprisingly, 5 subjects who attained transitivity (at 80% or above), failed at least one of the four symmetry tests, that is, performed below chance level. Eight out of our 9 young subjects performed between 80 and 100 % correct responses in the transitivity tests.

A significant negative correlation of -.84 (at better than $p < .01$ alpha level) was found when the total number of trials to criterion during the conditional discrimination training was related *to* the combined receptive and expressive language quotient. That is, those children with higher language-skills scores required fewer trials to complete the conditional-discrimination training.

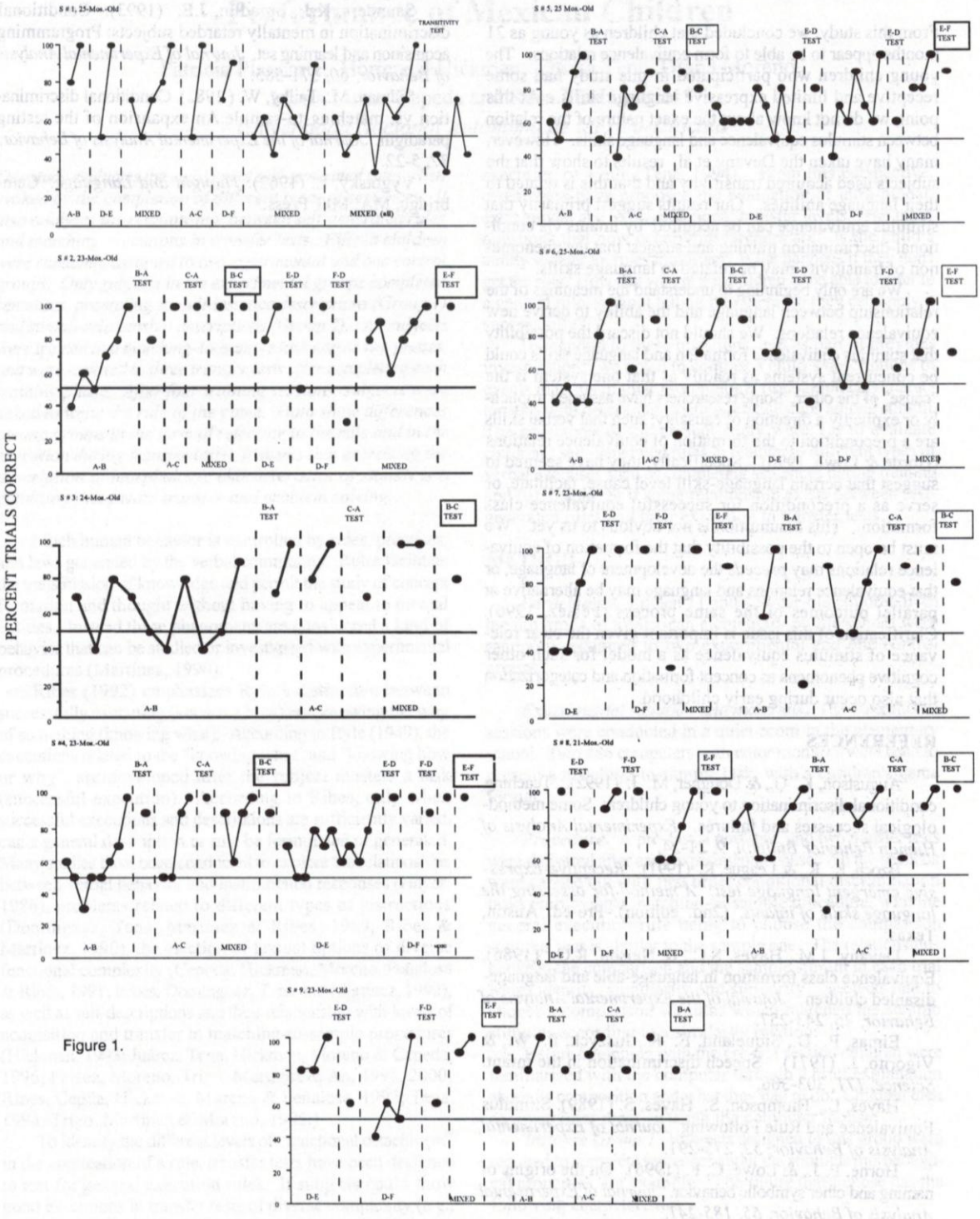
S # 1, 25-Mos.-Old
TRANSITIVITY TEST
A-B
D-E
MIXED
A-C
D-F
MIXED
MIXED (all)
S # 5, 25 Mos.-Old
B-A TEST
C-A TEST
B-C TEST
E-D TEST
F-D TEST
E-F TEST
A-B
A-C
MIXED
D-E
D-F
MIXED
S # 2, 23-Mos.-Old
S # 6, 25-Mos.-Old
S # 3: 24-Mos.-Old
S # 7, 23-Mos.-Old
S # 4, 23-Mos.-Old
S # 8, 21-Mos.-Old
S # 9, 23-Mos.-Old
PERCENT TRIALS CORRECT
BLOCKS OF TEN TRIALS

Figure 1.

DISCUSSION

From this study, we concluded that children as young as 21 months appear to be able to form equivalence relations. The young children who participated in this study had some receptive and limited expressive language skills. At this point, we do not know about the exact nature of the relation between stimulus equivalence and language skills. However, many have taken the Devany et al. results to show that the subjects used acquired transitivity and that this is related to their language abilities. Our results suggest primarily that stimulus equivalence can be acquired by infants via conditional-discrimination training and suggest that the phenomenon of transitivity may be related to language skills.

We are only beginning to understand the meanings of the relationship between language and the ability to derive new equivalence relations. We should not discard the possibility that stimulus equivalence formation and language skills could be concurrent systems as readily as that one system is the "cause" of the other. Some researchers have assumed implicitly or explicitly a direction of causality, such that verbal skills are a precondition to the formation of equivalence relations (Horne & Lowe, 1996). Specifically, they have seemed to suggest that certain language-skill level cause, facilitate, or serve as a precondition for successful equivalence-class formation. This assumption is not obvious to us yet. We must be open to the possibility that the formation of equivalence relations may *precede* the development of language, or that equivalence relations and language may be alternative or parallel outcomes of the same process (Pelaez, 1996). Clarification of this issue is important given the clear relevance of stimulus equivalence as a model for such other cognitive phenomena as concept formation and categorization that also occur during early childhood.

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Correspondence of Verbal Descriptions and Matching Performance of Mexican Children

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This study evaluates the emission of self–generated rules when evoked by the completion of different types of sentences. It also analyzes the relationship between self-generated rules and matching executions in transfer tests. Fifteen children were randomly assigned to two experimental and one control groups. Only subjects in the experimental groups completed sentences, prompting stimuli-instance descriptions (Group 1) and stimuli-relationship descriptions (Group 2). All subjects were trained in a matching–to–sample task across two phases, and were exposed to three transfer tests after completing each training phase. After four training sessions, subjects were asked to write the rule of the game. Data show differences among groups in the form of referring to the rule and in the execution during transfer tests. It seems that exercising the description of morphologic characteristics of stimuli is a condition that favors transfer and problem solving.

Much human behavior is controlled by rules, premises, and laws generated by the verbal community. Rules facilitate the transmission of knowledge and permit the study of concept formation and thought without having to appeal to mental entities. Instead these phenomena are considered a kind of behavior that can be studied or investigated with experimental procedures (Martínez, 1990).

Ribes (1992) emphasizes Ryle's distinction between successfully executing (knowing how) and knowing the why of something (knowing what). According to Ryle (1949), the executions related to the "knowing what" and "knowing how or why", are developed after the subject masters a task (successful execution). According to Ribes, only when successful executions and descriptions are sufficiently varied, can a general description or rule be formulated or generated. Many studies have been conducted to explore the relationships between verbal behavior and instrumental responses (Hayes, 1986), problems related to different types of instructions (Domínguez, Tena, Martínez & Ribes, 1989; Ribes & Martínez, 1990), the election of textual options of diverse functional complexity (Cepeda, Hickman, Moreno, Peñalosa & Ribes, 1991; Ribes, Domínguez, Tena and Martínez, 1992), as well as self-descriptions and their relationship with levels of acquisition and transfer in matching-to-sample procedures (Hickman, 1993; Juárez, Tena, Hickman, Moreno & Cepeda, 1996; Peláez, Moreno, Trigo, Martinez & An, 1998, 2000; Ribes, Cepda, Hickman, Moreno & Peñalosa, 1992; Tena, 1994; Trigo, Martínez & Moreno, 1995.)

To identify the different levels of "functional detachment" in the application of a rule, transfer tests have been designed to test for general execution rules. If subjects could show good executions in transfer tests of diverse complexity (e.g., higher order conditional discrimination), this would be an indicator that indeed the behavior is based on a general execution of a rule (Tena, 1994). From this perspective, researchers have proposed the evaluation of intra-modal, extra-modal and extra-situational transfer levels. The main questions that now occupy researchers are: Is the child's ability to refer to rules important? What happens if they don't get the rule? How can we get the children to be able to refer to a general rule, without telling it to them, so they can apply it successfully?

To respond to these questions, and as part of previous investigations, we opted to contrast a child's descriptions of events in terms of their morphologic (topographical) characteristics with describing existing relationships among stimuli. The objectives of the present study were: (a) to evaluate children's self–generated rules in relation to different types of verbal exercises such as completing sentences during training and (b) to analyze if some relationship exists between self-generated rules and their execution in transfer tests.

METHOD

Participants. Fifteen 11 and 12-year-old children from the 6th grade of a Mexican elementary public school were randomly assigned to two experimental and one control groups.

Experimental situation and materials. The experimental sessions were conducted in a quiet room in the elementary school. Two 486 computers with color monitors were used to present a matching-to-sample task, with a children's game format.

Procedure. A pre–test, a post–test, and two transfer tests were delivered after each experimental phase. All the sessions were carried out with first order conditional discrimination tasks employing a matching-to-sample procedure, with the general execution rule being to choose the comparison stimulus that is similar to the sample one. The relationships between the comparison and the sample stimuli in each trial were: identity, singularity and similarity. Subjects had to choose a comparison stimulus which matched the sample stimulus according to a similarity relation.

Before beginning with the pre-test session children were familiarized with the computer through a brief explanation about its composition and what they had to do. Children then received brief practice using the computer mouse.

Instance Group 1. Subjects assigned to this group were required to complete sentences about the stimulus morphological properties, for example: "The figure that I chose has the following characteristics..."

Relation Group 2. These subjects were required to complete sentences about the relationships among stimuli, for

example: "The figure that I chose is related with the figure on the upper side of the screen because... "

Control Group 3. These subjects did not complete sentences.

Pre-test and Post-test. Pre and Post tests contained a balanced mixture of the arrangements used in the training phases and transference test sessions. Each session consisted of 36 trials. During the tests, continuous feedback was not given to the subjects, but they were informed at the end of the session about the total of correct responses.

General Conditions. Each training session consisted of 36 trials with continuous feedback, also presenting the total of correct responses at the end of each session. After three trials, subjects from experimental groups completed an incomplete written sentence (Groups 1 and 2), while those subjects from the control group (Group 3) did not complete any sentence. At the end of the fourth session, subjects from all groups were requested to write the general task rule. To complete a training phase, each subject was required to reach mastery criterion of 90% of correct responses in three consecutive sessions. Intra-modal and extra-modal transfer tests were presented after each training phase without continuous feedback. Only at the end of each test session the total of correct responses was presented.

Training Phase 1. During this phase a correct response consisted of choosing the comparison stimulus that only shares form with the sample.

Training Phase 2. During this phase the correct response consisted of choosing the comparison stimulus that only shares color with the sample (two thirds of the trials) or the stimulus that shares form (one third of the trials).

Intra-modal Transfer Tests of Phases 1 and 2. Stimuli presented included instances different from those used during training (different colors and forms). A correct response during Intra-modal transfer test of Phase 1 was to choose a comparison stimulus which matched the sample stimulus only on the shape similarity criterion, while during intra-modal test of Phase 2 the correct response consisted of matching the sample with a color similarity criterion.

Extra-modal Transfer Tests of Phases 1 and 2. Shapes and colors different from those used during training were included and the relevant dimension of the trained relationship was also different. That is, if during training Phase 1, subjects were to choose based on a shape similarity matching criterion, in the extra-modal test of Phase 1 they ought to choose based on a similarity color matching criterion. In the same way, since during training Phase 2, subjects chose based on a color or shape similarity matching criterion, in the extra-modal test of Phase 2, they had to respond based on a size similarity matching criterion.

Extra-situational Transfer Test. After the last transfer test was completed, children were provided with sheets of paper that included 36 matching-to-sample trials each one conformed by words, a single sample word and three comparisons ones. Children had to choose a comparison stimulus circling the one, which matched the sample stimulus only in one letter. No continuous feedback was given to the subjects, but all of them were informed at the end of each session about their total of correct responses.

For the selection of the categories used for the analysis of self–generated rules we used only two dimensions of Peláez and Moreno's (1998, 1999) taxonomy of rules:

Precise Implicit Rules (P.I.R.). Specific reference is made to the correct trained relation(s) in a generic way.

Precise Explicit Rules (P.E.R.). Specific reference is made the to the correct trained relation(s) describing the different dimensions or instances involved.

Inexact Implicit Rules (I.I.R.). Reference is made to an incorrect (non–trained) relation(s) in a generic way.

Inexact Explicit Rules (I.E.R.). Reference is made to an incorrect (non–trained) relation(s) describing the different dimensions or instances involved.

Descriptions (D). Reference is made to the task, pointing out dimensions, instances or given instructions, without establishing any type of relationships.

RESULTS

Results are described in three sections. First, considering the mean percentage of references emitted in each category by group when subjects were requested to write the rule of the game. Second the median of correct responses per subject in each group in relation with the kind of self-generated rule emitted. In the third section, considering the mean percentages of correct responses reached in transfer tests by each one of the groups. Figure 1 shows the mean percentage of categories obtained by each group. More Precise Explicit Rules (PER) were emitted than Precise Implicit Rules (PIR) by the Instance Group, while the Relation Group showed an opposite response pattern.

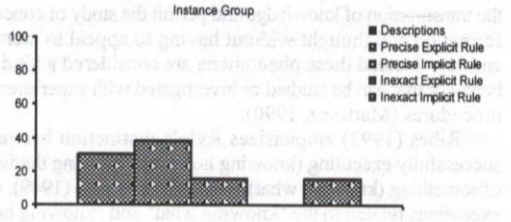

Figure 1.- Mean percentage of categories obtained by each group.

In general, the data revealed differences in the form of the rule referred to game depending on the group. The Instance Group 1 obtained the best percentages considering the precision of their references and independently of their explicitness or implicitness. In the Instance group the most frequent categories were the Precise Explicit Rules (PER) and Descriptions (D). Precise Implicit Rules (PIR) and Inexact Implicit Rules (IER) were less frequent. No emissions of Inexact Explicit Rules (IER) were observed.

In the Relation Group 2 the most frequent categories were the Precise Implicit and the Inexact Implicit Rules, with fewer Descriptions. The differences are very clear with respect to the Control Group; in this group the most frequent category was Descriptions. With the purpose of carrying out a detailed analysis of the immediate effect of self-descriptions on execution and self-generated rules, the median of single correct responses obtained in training sessions prior each rule petition was calculated for the first training phase only. Figure 2 shows the sorts of individual self–generated rules in relation with medians. In this figure from one up to three medians per subject are shown because the execution criteria consisted of

reaching three serial sessions with 90% of correct responses. Therefore, the number of training sessions that they were exposed to and the number of petitions of the rule varied from one subject to another.

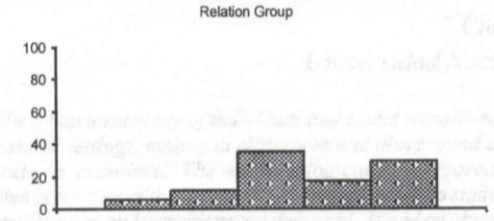

Figure 2.- Kinds of self-generated rules in relation with medians of correct responses obtained per subject in each group. PER = Precise Explicit Rule; PIR = Precise Implicit Rule; IER = Inexact Explicit Rule; IIR = Inexact Implicit Rule; D = Descriptions.

The data show that even when important differences are not observed in terms of medians of correct responses among the three groups, differences are clear in the types of self-generated rules observed. In the Instance Group, a prevalence of emission of Precise Rules was observed, whether explicit or implicit, contrary to the Relation and Control Groups. In the Relation Group, an equal number of precise and inexact rules were emitted, with the largest number of the implicit sort. In the Control Group, Descriptions and Inexact Rules were emitted, both Implicit and Explicit.

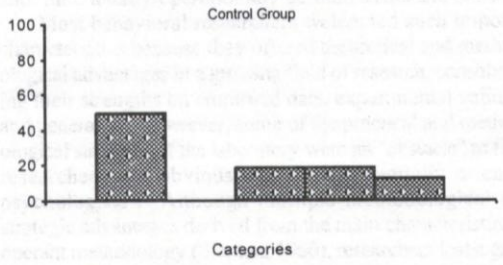

Figure 3.- Mean percentage of correct responses obtained in transfer tests by each group.

Figure 3 shows the mean percentage of correct responses in transfer tests by group. The group that obtained the best percentages of correct responses in each transfer test was the Instance one with exception of their executions during extra-modal transfer test of Phase 2. The Relation and Control Group only transferred during intra-modal tests.

DISCUSSION

These data suggest that the type of incomplete sentences that the children completed during the experiment influenced rule references. That is, the type of sentences that children were requested to complete (instance or relation sentences) seemed to influence such rule references. In the Instance Group 1, the most used category was where the rule was correctly referenced (Precise Explicit Rule), in contrast with the Relation Group whose subjects tended to refer to Correct Implicit Rules. In the Control Group subjects tended to refer to incorrect rules in most of their emissions.

On the other hand, the execution of all the children was higher than 80% of correct responses in the intra-modal transfer tests, suggesting that with or without descriptions, training facilitated transfer and functional detachment when new colors and shapes were presented, but maintained the previously trained dimensions. However, when the transfer was evaluated modifying the trained dimension (extra-modal and extra-situational tests) the Relation and Control Groups showed lower percentages of correct responses than the Instance Group in two of the three tests. This indicates that exercising the description of morphological characteristics of the involved stimuli is a condition that favors this kind of transfer.

As Trigo, et al. (1995) pointed out, the fact that subjects have an effective performance does not imply that all of them are able to formulate a rule corresponding with the programmed contingencies. Results show that most subjects trained in the Relation Group, although executing successfully during training sessions, failed to develop adequate rules, emitting more inexact rules than subjects trained in the other groups. We agree with Trigo et al. (1995), in that a causal relation between rules formulation and performance could not be defended. Instead, it would be relevant to identify the elements that make more probable the construction of accurate self-rules and the development of adequate executions. The results obtained in our study showed that prompting instance descriptions along training sessions seems to be an important element to consider for the development of the *accurate self generated-rules* described in the Pelaez's & Moreno's (1998) taxonomy and their correspondent performances in children.

In general, the data seem to confirm that executing successfully (knowing how) is not enough to get the knowing why of something and to describe it (knowing what) (Ribes, 1992). Successful execution joined with exercising self–descriptions about stimuli instances contributes to the formulation of precise rules and to the transfer of the learning to novel situations where this rule is applied. In this way, for children to elaborate a general rule, it is advisable that they carry out activities where they should describe the morphological characteristics of the involved events. Facilitating them in this way may help to establish generalizations to other dimensions or circumstances and therefore promote problem solving.

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On Steady States or Transitional Behavior: The Case of Social Interference Patterns in Children

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The behavioral study of individual and social transitions in natural settings, mainly in classroom and playground contexts, is examined. The methodological and theoretical characteristics of the behavior-analytic approach to studying steady states and transitions are discussed. Based on observational methodology a description of a current project of social interference as behavioral transition is outlined as well as some implications for behavior analysis of development.

Most of contemporary behavioral research has been characterized by focusing on steady states and unidirectional study of individual behavior. Some of the main characteristics of operant methods (Honig, 1966; Skinner, 1966) have included: (a) Intensive study of individual subjects, replicability of findings, stable baseline condition upon which the independent variable of interest is imposed, strict control of the experimental environment, environmental constancy and control to produce behavioral stability, effective means of controlling the subject's behavior, continuous observation and recording of behavior, concentration upon independent variables, emphasis on external observable causes of behavior and functionally/operationally defined terms and concepts.

Most behavioral researchers welcomed such imposed characteristics because they offered theoretical and methodological advantages in a growing field of research, consolidating their strengths on empirical data, experimental validity, and generality. However, some of the practical and methodological strengths of the laboratory were an "obstacle" to field researchers and obviously to developmentally oriented psychologists . Although multiple methodological and strategic advantages derived from the main characteristics of operant methodology (Sidman, 1960), researchers lost a great quantity of interesting information regarding transitional behavior. There is a problem when researchers attempt to extend some of the main principles of behavior analysis to the natural environment, where there is neither strict control nor environmental constancy as a means of controlling the subject's behavior. In addition, there is a problem with functionally and operationally defined terms and concepts, because the search for controlling variables *in situ* follows non-experimental strategies. Therefore, an observational methodology was developed that takes into account the problem of an exhaustive and exclusive system of behavioral categories and an adequate sequential analysis (Bakeman & Gottman, 1986; Cairns, 1979; Sackett, 1978).

The study of *transitional* behavior is interesting because some relevant behavioral phenomena result from transitions among several ecological situations, which exert different control on behavior and provide different setting factors or establishing operations for the behavior. We can identify several levels of transitions between activities, settings, social status, biological status, academic behaviors, and other factors. Three examples of transitions between activities are presented as follows: from a specific academic activity to another activity in a school setting, from a coercive episode to a prosocial episode, from on-task behavior to off-task behavior in a classroom. Also, the transition between settings offers interesting aspects for research, such as the study of the effect of transitions from classroom to playground or viceversa, the first day in a school setting, a quiet classroom to a busy class environment, the change to a new school or neighborhood.

Some conceptual ideas from different levels of transitions can be identified in the ecology of human development approach (Bronfenbrenner & Morris, 1998). For instance, in Fisher and Cooper's (1989) book "The Psychology of Change and Transition" the effects of some other "life transitions", like divorce, unemployment, disease, marriage, and death of a relative, are examined. Also, Wapner and Denick (1998) conducted a developmental study of educational transitions and transitions across the life span from a person-in environment transition approach.

This paper deals only with transitional behavior in natural settings. When in the context of the steady state-transitional behavior discussion, transitional behavior represents variability sources as "noise" and scarce experimental control, then order could be requested for methodological purposes. However, the study of transitional behavior should be the object of study, the research problem itself, calling for special research procedures and methodologies. Transitional behavior refers to any changes in behavior that accompany a "sustained operational change in the environment, such as a change in the stimulus situation, the conditions of reward or the contingencies or requirements of the responses" (Logan & Ferraro, 1978, p. 268). Transitional behavior can be usefully dichotomized into those behaviors that accompany differentiated (i.e., stimulus control) and non-differentiated operational changes in the environment (i.e., extinction, level of adaptation, inhibition; effects of "frustration" and "elation" related to a change in the density or magnitude of reinforcement). In fact, according to Sidman (1960), a transition state always involves a change from one stable state of behavior to another. For this reason, the study of transition states cannot easily be separated from the study of steady states.

In many procedures the start of a transition can be identified operationally as the point at which the experimental conditions were changed. Conceptually, transition states imply change in relationships between environment and behavior. The identification of this change is important to the study of individual behavior and social interactions in natural settings. Perhaps the main difference between the concepts of Logan and Ferraro (1978) and Sidman (1960), rely in the "molecularity" and "molarity" of the approach, from transition

between behaviors to transition between one stable state of behavior and another. However, transition as a state implies necessarily the assumption of steady state and control (Sidman, 1960).

Transitional behavior takes place as a dynamic phenomenon in time and must be analyzed as a part of the behavior stream. Transitional behavior is not only a function of the direct variables that produce the change, but it is also a function of the variables that have maintained such behavior in the past. Thus, the study of change in that perspective takes in to account the interaction between present and past conditions of behavior control. Also, behavioral transition must not be studied in isolation from its concurrent and sequential context. Such kinds of transitions have been studied in the experimental laboratory, manipulating specific stimulus, schedules of reinforcement, different variables, and analyzing their effects on the behavioral stream (Logan & Ferraro, 1978). It is necessary, however, to design methodological strategies for the study of the class of "non-differentiated" transitions in natural settings, like school settings in the case of this work. Further, it is convenient to emphasize that behavioral field research also implies an assumption of order in the environment, where such order is not imposed by the manipulation of the experimenter but occurs as natural environmental or behavioral constraints that must be identified (Patterson, 1974, 1979; Santoyo, 1996). Therefore, rather than analyze behavior as an increase or decrease of response rate, the emphasis must be on the processes of organization (or "reorganization") of *behavior patterns.* In short, this paper deals with a special class of "non-differentiated" transitions produced by behavior of third persons: *Social interference*. The study of such phenomena has implications for the psychology of motivation, behavioral development, social interaction, behavior preferences and behavior regulation and organization in natural settings.

Social Interference

There are three main sets of antecedents from other areas to consider. The first of them comes from the old work of the European studies by Zeigarnik (1927) and Ovsiankina (1928) about finished and unfinished tasks. The specific question posed was: "What is the relation between the retention of activities that have been interrupted before completion and the retention of completed activities?" (Zeigarnik, 1927, p.3; 1938, cited in Van Bergen, 1968, p.300). In general, the core of the theory reads as follows:

> When a person intends to perform a task, a quasi need is established which presses in the direction of fulfillment of the intention. Completion of the tasks means release of the tension system, or discharge of the quasi-need. If, however, the activities that are used for execution of the intention are blocked, the quasi-need remains unsatisfied... It was hypothesized that this unreleased tension has an effect on memory" (Van Bergen, 1968, p. 3).

As a matter of fact, such original ideas promoted many experimental studies between 1927-1967 which were reviewed by the group of Annie Van Bergen (1968).

> The main conclusion of Van Bergen's book is forceful: The combined results of the studies on selective recall which have been performed since 1927 are shown to be inconclusive. The assumptions made in the interruption studies are evaluated: several shortcomings with regard to the operationalization of the concepts of Lewin's tension system theory are brought to light. It is concluded that the problem of the selective recall of uncompleted and completed task should be regarded as a non-problem" (p. 342).

The implications of conceptual terms and methodological problems, so suggestive and provocative in Zeigarnik's experiments, had a great impact at that stage of research. But the main problem was empirical: the lack of replication of the Zeigarnik effect on the studies derived from the 12 different experimental variations conducted by the Van Bergen's group. Another problem is the scarce ecological validity of the studies regarding the contrived tasks and experimental situation.

The second set of antecedents comes from the "psychology of motivation and cognition" (Mandler, 1964, 1989; Miller, Galanter & Pribram, 1960). This is a set of well-organized experimental studies of the interruption of behavior, where "the interruption of an integrated or organized response sequence produces a state of arousal which will be followed by emotional behavior" (Mandler, 1964, p. 164). Such a state of arousal implies disorganized responses or persistence, depending on the level of organization of the interrupted response sequence. One problem here for the behavioral psychologist relates to the subjective concepts of "state of arousal", "emotional behavior," "organized response," "level of organization," etc. The other problem is the ecological validity of the arbitrary tasks and experimental situations.

The third set of antecedents comes from the "environmental psychology" field of research directed toward the study of "crowding" (Schopler & Stockdale, 1977; Schopler, McCallum, Rusbult, Hong, & Walden, 1979). This area refers to field studies on a social interference model and crowding, based on indirect psychological measures obtained in natural settings (i.e., college dorms). The social interference model predicts that the "importance of the behavioral goals directly affects not only the magnitude of the interference but also the mechanisms by which people cope with it. Important goals would induce a more active coping strategy in a crowded setting... and would maintain task performance at the price of increasing crowding stress. When the behavioral goal is unimportant, decrements in task performance preclude a rise in stress" (Schopler et al, 1979, p. 1304). Problems with the third antecedent rely on the nature of indirect psychological measures of concepts such as "crowding stress", "perceived social interference," "importance of behavioral goals," and "mechanisms of coping."

Behavior researchers have marginally studied *social interference* with both "behavior modification" and "applied behavior analysis" approaches aimed as the study of "on-task & off-task" behavior and disruptive behavior. However, they have not really analyze transitional behavior and interruption of behavioral sequences, both of which serve as the antecedents, patterns and consequences of social interference. Although the previous psychological approaches subsuming such perspectives are different and their main conceptual assumptions limited from a behaviorist view, both have an heuristic value for behavioral researchers in order to study such ideas with a systematic, reliable, replicable, and objective

methodology. In fact, there is scarce behavioral literature about social interference as a transition. There is no longitudinal research on social interference. The study of social interference as a behavioral transition class is relevant for behavior analysis in school settings, social behavior, and developmental psychology, as we can see in the next section.

Social Interference and Behavioral Patterns

In general, behavior analysts have emphasized chronically the study of steady states instead of behavioral transitions. The latter helps to understand the sequential dynamics of behavioral organization in natural settings. Recently, a conceptual and methodological strategy was developed for the study "in situ" of behavioral transitions produced by the behavior of third persons and their individual and social consequences, like "social interference" (Santoyo, Espinosa & Bacha, 1996). This strategy involves the observational study of the behavior stream "in situ" based on a behavioral code and key words, which permits the identification of the main ongoing activity and the activity or behavior that the target emits as a consequence of interruption (behavioral transition). Based on sequential analysis, the strategy provides information on the components of the behavior pattern, like the specific behavior of a person (i.e., peers and teacher) that interrupts the activity of the target. Also the length of the ongoing activity, the time that it takes for the interrupted subject to reinitiate the activity, the changes of activities of the target without the intervention of a third person, are to be analyzed. Specific details on the strategy and some representative results are described in Santoyo, et al. (1996).

The study of social interference patterns in a school setting permits the investigator to respond to questions about time allocation in the classroom and playground, the coherence of behavioral distributions with educational and normative goals, control by the teacher or materials on the activities. At an individual level, the analysis of interference patterns also offers important information on individual behavioral transitions independent on explicit changes of the stimuli in classroom, "on-task persistence", individual differences between children showing different patterns of transitional behavior, etc. For developmental psychology, the study of the stability or change of patterns of behavioral transitions and the individual differences involved is scientifically important.

The interruption of behavior stream research is a "core" component to the comprehension of social interference as a behavioral transition. However, the effects of social interference can be heterogeneous, as a function of behavioral preferences of subjects and time allocation of the activities. Technically, in order to analyze such a complex behavior stream, an observational design must be proposed, with a high level of flexibility and with the goal to integrating information from four basic sources of information: (a) target repertoire (defined by activities time allocation); (b) the nature of interruption: who, how, when?; (c) responsiveness of social agents in setting; (d) consequences of the interruption.

The delimitation of such basic sources of information requires the development of systematic strategies for the study of social interference "in situ". The main strategy to cope with this research problem is to take advantage of observational methodology (Santoyo & Anguera, 1992).

Advantages of Observational Methodology to the Study of Social Interference

The experimental study of the processes derived from the individual transitions (i.e., the target changes the activity, ten seconds or more, without an explicit stimulus), and social interference transitions (i.e., the target changes the activity, ten seconds or more, as a consequence of the intervention of another person) is possible. Experimental study has the advantages of control, manipulation, the use of automatic recording equipment, etc. In the context of this work, however, we attempt to direct the attention to the study "in situ" of behavioral transitions and their implications for behavioral development in school settings.

Observational work implies assumptions of order and consequence control, systematically identifying and describing events that control behavior, strategically analyzing the stream of behavior, searching for regularities and making predictions on the basis of sequential analysis (Sackett, 1978; Bakeman & Gottman, 1986; Santoyo, et al. 1996). The use of non-intrusive strategies permits the evaluation of the generality of some behavior principles in natural settings. The research must be supported by an observational design, with an adequate framework of categorization of ongoing activities and interference events, sampling strategy for sequences of events and time allocation, reliability, validity, coding, and sequential analysis. However the main guidelines of the work are theoretical. Without a clear idea of where we want to go, the outcomes could be irrelevant and useless. One initial step is empirical, the other is theoretical, and both of them will be described in the next section. The main characteristics of an "observational and behavioral system of social interactions," fitted to the study of social interference and behavioral transitions, responds properly to the four sources of information previously mentioned (Santoyo, et al. 1996).

The general characteristics of an observational and behavioral system of social interactions include: (a) the coding system contains exclusive and exhaustive behavioral categories; (b) it is a flexible system of categories; for example, it allows the definition of academic activity or play behavior to be adjusted depending on the changes in the behavioral setting (i.e., teacher instructions, availability of resources); (c) it is made up of representative behavioral categories of the actions that subjects exhibit in educational settings (i.e., on-task behavior, social interaction, off-task behavior, individual play, group play behavior, self-stimulation).

The above categories can be divided in the following classes: (a) individual behavior, including academic behavior, non-academic behavior (self stimulation, isolated play); (b) social interaction defined as social actions initiated by and directed to another person; social actions initiated and directed by others to the target; dyadic and group activities or social interactions such as coercive behavior, group play, negotiation, and sharing; (c) the observational system is an event-based sequential record, with five second intervals, where well trained observers write the order and sequence of the events within an interval; (d) the observational system makes possible the sequential study of the processes of social

interaction, academic persistence, social interruption, change of activities of target, conflict and aggression; (e) it allows the study of the context *where* social interchanges emerge; (f) it allows the detection of the direction of social interaction to identify *who* initiates an interchange. This information is important for the comprehension of the mechanisms of mutual control, interpersonal choice and social preference.

Finally, the observational and behavioral system of social interaction (Santoyo, et al. 1996) includes information about the quality, direction, contents and resolution of individual and social episodes. Using key words or verbs that describe the class of specific action of the category, it provides a descriptive complement to the codified information.

Social Interference as Behavioral Transition

The study of "social interference" embraces the analysis of contextual constraints, which influence social interactions, and the study of the behavioral stream of individual and social activities of children (i.e., time allocation, on-task behavior, social interaction, the effect of availability of resources on behavioral interruptions, behavioral setting, and so forth). The effects of social or non-social events, which interrupt the behavior stream, can be evaluated on the basis of time allocation of the interrupted activity. In that case, behavioral interference can be analyzed as a function of the following factors: time allocation of the target activity, the particular partner who interrupts the activity (considering subject's social preference), and the context of the interchange.

This class of elements permits the development of a simple model of social interference among children (Santoyo, et. al., 1996). This model is not directed at the study of "crowding," but at the behavioral consequences of social interference, depending on behavioral and environmental factors. Knowledge of this phenomenon shows us situational information of interaction mechanisms of behavior organization *in situ.* Thus, in order to study social interference in natural settings, like school, it is necessary to evaluate children's behavioral organization or patterning, considering transitions between activities in school settings, the quality of "on-task" behavior, and mainly the behavioral consequences of social interference. For example, we found some temporal properties of social interference episodes such as: preschool and elementary school children involved in three behavioral episodes each minute. Children's bouts of "on-task" behavior were very short (around 30 seconds). Also, the probability of the "off-task/on-task" transition, after a behavioral interruption, depended lineally on the time allocation of the interrupted activity.

In a recent study (Santoyo, 1999), we analyzed the dynamic properties of behavioral transitions in school settings, based on the organization of behavior (defined as time on the activity), and the behavioral preferences of the target. To obtain this goal, our research attempted to respond to the following: (a) *Quantity and context?* What is the "natural" frequency of elementary school children's behavioral transitions, whether or not they are produced by the behavior of a third person in school settings?; (b) *timing?* What are the consequences of social interference as a function of "on-task" time constraints, before the interruption?; (c) *stability or change?* Are there changes in patterns over time?

As part of the procedure, we observed ten children in the first grade of an elementary public school, during three annual samples. Behavioral observations were conducted in the classroom and playground. Each child was observed, with the "observational and behavioral system of social interactions", during three consecutive years, based on 11 behavioral samples (six samples of 15 minutes in the classroom and five samples of 10 minutes on the playground). Reliability was always higher than 80% of agreement between observers, and Kappa index was always higher than 0.7.

Coding and sequential analysis. The identification of social interference episodes was based on behavioral transitions produced by the third persons' behavior toward the target, which changed or interrupted the pattern of the ongoing behavior for 10 seconds or more. All the episodes were computed and revealed that the quantity of individual transition episodes (not produced by a third person's behavior) varied between three and four per minute in the classroom. The data are consistent with that obtained in previous studies with children of different ages (Santoyo et al., 1996).

In short, this longitudinal study showed a decreasing trend between ages on the frequency of behavioral transitions, probably due to the control of the classroom by teachers; but, developmental factors also could be involved. Even so, there were differences on the number of transitions between settings (context), where the frequency of transitions was varying between two or three per minute in the playground. No systematic trend between ages was detected in this setting. The quantity of social transition episodes (produced by a third person's behavior or social interference) was stable over time, approximately . Three episodes per minute, and no trend between ages and context was found.

In general, time allocation to on-task behavior before the interruption was a good predictor of the frequency of interrupted episodes. The data describe a general pattern where short duration of the activity predicts more social interference. While the involvement grows (defined as a higher on-task time allocation), the probability of social interference decreases. Quantitative differences between ages were found. The smaller children were more easily interfered than the older . However, the pattern of dynamic changes is similar, where frequency of social interference is a negative function of time on task before the interference (i.e., an inverted J curve). Also, small children take more time to return to task once interrupted with than the oldest ones. However, there were similarities in the trend of data of the same children in the second and third year of longitudinal observation. The average length of time to return to task was a negative lineal function of time on task allocation before the interference. Finally, there were changes in the magnitude of the effects but not in the trend of data. The only exception found was in the playground setting where no effects on frequency of episodes (or transitions) and no differences in trends were found.

CONCLUSION

A strategy for the behavioral study of individual and social transitions of school age children was presented. Some of the descriptive data refers to differences in quantity but not necessarily in pattern or trend. There are several implications

for this. First, social interference can be systematically studied as a behavioral transition, and individual and social transitions can be compared on the basis of their different sources of control. Second, differences in context can be identified and described, showing different levels of occurrence of the behavioral transitions. Of course, differences in sources of control must be emphasized. For example, the differences in frequency of behavioral transitions between classroom and playground could be due to normative control, instructional control, the quality of materials, or some interaction of them.

One implication of such differences could be found in the relative reinforcing value of the activities for children. Perhaps the reinforcing value of playground activities is higher than that of classroom activities. Perhaps persistence is higher on the playground because children often select the activities there, whereas they cannot select as often as they want the activities in the classroom. One of the main advantages that the behavior analysis approach has is the empirical possibility of submitting to experimental or empirical evaluation the different questions that investigations offer. Evaluation of the value of different stimulus situation or different behaviors can be conduced as a choice responding approach with the advantages of consistent theoretical and methodological models, both in the laboratory and in natural settings (e.g., Fisher & Mazur, 1997).

Another problem remaining is the developmental study of individual differences, stability and the change of behavioral patterns of children, focusing on behavioral transitions. Research on such transitions is being conducted in an ongoing longitudinal study in our laboratory to evaluate the effects of peer relationships on the interference patterns. This longitudinal study also evaluates the quality of the academic context, the nature of the interrupted activity (i.e., social play, self-stimulation, social interaction) and the degree of control that the teacher exerts, to name a few. Time allocation on task before the interruption is a good predictor of the frequency of interrupted episodes and the time needed to take up the task again. This data set has a relationship with Zeigarnik (1927) effect, and Mandler's (1964, 1989) and Schopler' s et al. (1977) work. The main advantage of this strategy relies on the systematic approach and on the environmental situations that are included in the study of behavioral transitions and their ecological validity.

Our approach in the longitudinal project was descriptive and several implications are derived from it. The number of behavioral transitions in this sample is high (3 or 4 per minute) and the children take a lot of time to return to the activity once they were interrupted. The study was replicated in a private school, with preschool age children, and within different grades of elementary school displaying similar results. The results have an important implication for instructional psychology and the psychology of motivation. Conceptually, this strategy, based on a behavior-analytic approach, can be related with some of the main topics of experimental analysis of behavior, in our case they included: time allocation, choice and behavioral preferences. Some preliminary data on the study of relative frequency of transitions as a function of behavioral preferences were obtained. In fact, a regression analysis describes the data of relative frequency of transitions as a function of behavioral preferences defined by the relative frequency of activities (Santoyo, 1999). However, this function is different depending on the class of analyzed activity.

In sum, some implications of trends on persistence and "susceptibility" to social interference must be analyzed focusing on individual data rather than on aggregated information across subjects (Magnusson & Stattin, 1998). In fact, a primary goal of developmental research should be to understand "those individual processes that contribute to the ontogeny of the child's adaptations in the particular settings of life" (Cairns, Cairns, Rodkin & Xie, 1998, p.16). On this account, the present perspective is full of challenges and we may have more questions than answers at this point, but it seems like a worthwhile task.

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SYMPOSIUM
05/27/2000
01:00 PM - 02:20 PM
Nathan Hale
DEV
Touch as a Reinforcer in Practical Applications- Co-Sponsored by Development and Trainers SIG
Chair: Jacob Gewirtz (Florida International University)
Touch in Humans HISELGIS PEREZ (Florida International University)
Touch in Horses LINDA TELLINGTON-JONES (T-Touch Training International)
Touch in Dogs MARK LIPSITT (Lipsitt Training Service Inc.)
Touch in Monkeys STEPHEN SUOMI (NICHD Laboratory of Comparative Ethology)

INVITED EVENT
05/27/2000
02:30 PM - 03:20 PM
Nathan Hale
DEV
Short- and Long-Term Biobehavioral Consequences of Early Social Experiences in Rhesus Monkeys
Chair: A. Charles Catania (University Of Maryland, Baltimore County)
STEPHEN SUOMI (National Institute of Child Health & Human Development)

SYMPOSIUM
05/27/2000
03:30 PM - 04:50 PM
Nathan Hale
DEV
Evolutionary Psychology and Behavioral Development
Chair: Jacob L. Gewirtz, Florida International University
Discussant: Paul Thomas Andronis (Northern Michigan University)
Proximate and Ultimate Explanations in Evolutionary Processes William M. Baum (University of New Hampshire)
Coming Out by Gay and Lesbian Offspring: Psychological Distress and Social Consequences TIMOTHY WISNIEWSKI (UMBC - Psychology)
Consilience through Contemporary Syntheses: An Invitation to Behavioral Analysts MATTHEW AVILA (UMBC - Psychology)

PAPER SESSION
05/27/2000
05:00 PM - 05:20 PM
Nathan Hale
DEV
Designing Effective Interventions for Dementia in Long-Term Care: Giving Away the Technology
Chair: Michelle Bourgeois (Florida State University)
Designing Effective Interventions for Dementia in Long-Term Care: Giving Away the Technology
CAMERON J. CAMP (Myers Research Institute, Menorah Park Center for Senior Living)

DINNER
Developmental SIG
05/27/2000
06:15 PM - 08:30 PM
Mama Ayesha's Calvert Cafe (Arab cousine)
1967 Calvert Street, NW (202-232-5431)
Cost at Cafe: $25 (includes tax but not tip)
See announcement on this bulletin.
DEV

SYMPOSIUM
05/28/2000
09:00 AM - 10:20 AM
Nathan Hale
DEV
Fluency of Elements and Cusps During Acquisition of Compounds: An Empirical Account of Development
Chair: Michael Lamport Commons (Department of Psychiatry, Harvard Medical School)
Discussant: Michael Lamport Commons (Department of Psychiatry, Harvard Medical School)
Component/Composite Analysis and Programming from the Real World PATRICE MARIE MILLER (Department of Psychology)
Teaching Component Skills of Mands PATRICK MCGREEVY (private practice)
Divide and Teach JESUS ROSALES-RUIZ (Department of Behavior Analysis)

SYMPOSIUM
05/28/2000
10:30 AM - 11:50 AM
Nathan Hale
DEV
John B. Watson and the Root of Behavioral Approach to the Study of Development
Chair: Lewis P. Lipsitt (Brown University)
Discussant: Lewis P. Lipsitt (Brown University)
Truth about the "Little Albert' study HAYNE W. REESE (West Virginia University)
Watson's Approach to Learning: Why Pavlov? Why not Thorndike? JACOB L. GEWIRTZ (Florida International University)
John B. Watson's Extensive Yet Neglected Work on Development PETER HARZEM (Auburn University)

SYMPOSIUM
05/28/2000
03:00 PM - 04:20 PM
Nathan Hale
DEV
Applied Behavior Analysis in Dementia Care Settings
Chair: R. Mark Mathews (University of Kansas)
Discussant: Bill L. Hopkins (Auburn University)
Evaluating a Practical Method to Increase Engagement in a Dementia Care Unit DEBORAH E. ALTUS (Kansas State University) , Kimberly K. Engelman (Kansas University Medical Center) , R. Mark Mathews (University of Kansas)
Using a Simplified Graduated Prompting Procedure to Increase Dressing Independence by Older Adults with Dementia KIMBERLY ENGELMAN (Kansas University Medical Center) , Deborah Altus (Kansas State University) , R. Mark Mathews (University of Kansas)
Intergenerational Activities at a Special Care Unit PAMELA K. XAVERIUS (University of Kansas) , John Smagner, Beth Nolan, R. Mark Mathews (University of Kansas)

SYMPOSIUM
05/29/2000
09:00 AM - 10:20 AM
Nathan Hale
DEV
Behavioral History: Spanning the Basic / Applied Continuum
Chair: Patrick R. Progar (Bancroft NeuroHealth)
Discussant: Barbara A. Wanchisen (Baldwin-Wallace College)
Remote Reinforcement Contingencies and Behavioral History Effects ADAM H. DOUGHTY (West Virginia University), Sergio Cirino (West Virginia University), Hiroto Okouchi (West Virginia University), Kristin H. Kristin H. (West Virginia University), Stephanie P. Home (West Virginia University), Kennon A. Lattal (West Virginia University)
Infant Learning: From Basic to Applied Research MARTHA PELAEZ (Florida International University)
Don't Know Much About History: The Clinical Importance of Behavioral History PATRICK R. PROGAR (Bancroft NeuroHealth), Stephen T. North (Bancroft NeuroHealth), Tracy Holden (Bancroft NeuroHealth), Robin Robin (Children's Seashore House)

INVITED EVENT
05/29/2000
10:30 AM - 11:20 AM
Nathan Hale
DEV
The Broadening of Behavior Analysis
Chair: Beth Sulzer-Azaroff (The Browns Group)
NATHAN AZRIN (Nova Southeastern University)

SYMPOSIUM
05/29/2000
01:30 PM - 02:50 PM
Nathan Hale
DEV
Conjugate Reinforcement Today
Chair: Jacob Gewirtz (Florida International University)
Discussant: Jacob Gewirtz (Florida International University)
An Analysis of Conjugate Reinforcement in Psychological Research MICHAEL VOLTAIRE (Florida International University)
Conjugate Reinforcement of Operant Responding in Infants LEWIS LIPSITT (Brown University)
Synchronized Reinforcement Procedure in Adult-Infant Social Interaction MARTHA PELAEZ (Florida International University) , Jacob Gewirtz (Florida International University)

SYMPOSIUM
05/29/2000
03:00 PM - 04:20 PM
Nathan Hale
DEV
Behavioral Similarity and the Formation of Generalized Imitative Classes in Infants and Children
Chair: Claire L. Poulson (Queens College/CUNY)
Discussant: Donald M. Baer (University of Kansas)
Response-Class Formation Across French, Greek, and Turkish Words in Generalized Vocal Imitation by Preschool Children NURSEL KAHYA (United Cerebral Palsey Association of Nassau County) , Effie Kymissis (Alpine Learning Group) , Claire L. Poulson (Queens College/CUNY)
Generalized Imitation Training of Infants and Children Along Different Properties of the Same Modeled Responses CONCETTINA PAGANO (Queens College/CUNY) , Claire L. Poulson (Queens College/CUNY)
Similarity of Parent and Infant Vocal Behavior as a Dimension of Reinforcer Quality MARIE PARNES (Queens College/CUNY), Nancy S. Hemmes (Queens College/CUNY), Bruce L. Brown (Queens College/CUNY), Clarie L. Poulson (Queens College/CUNY)

POSTER SESSION
05/29/2000
05:30 PM - 07:00 PM
Marriott Salon 2
1. Helping Older Adults with Dementia Locate Their Room in a Nursing Home BETH A. D. NOLAN (University of Kansas) , Gina Trusedale-Todd (University of Kansas), Amy VanDorp (Resthaven Nursing Home) , R. Mark Mathews (University of Kansas)
2. It Is Plausible that Parents Train their Infants to Avoid ("Fear"), or Approach Strangers KERRIE LUM LOCK (Florida International University), Jacob Gewirtz (Florida International University) , Martha Pelaez-Nogueras (Florida International University)
3. The Application of Behavioral Principles to Promote Safety Practices and Reduce Accidents and Injuries in Health Care Settings WANDA T. ROSADO (Florida International University), Scott L. Fraser (Florida Internation-

al University)
4. The Value of Diverse Tactile Stimuli as Putative Reinforcers for Infant Behavior HISELGIS PEREZ (Florida International University), Jacob L. Gewirtz (Florida International University)

SYMPOSIUM
05/30/2000
09:00 AM - 10:20 AM
Nathan Hale
DEV
New Educational Technologies in Institutions of Higher Education and Special Education
Chair: Cathy L. Watkins (California State University)
Development of Educational Technology at Universidad Veracruzana JOSE E. DIAZ-CAMACHO (Universidad Veracruzana)
Academic Development of Universidad Veracruzana from a Global Perspective VICTOR A. ARREDONDO (Universidad Veracruzana)
Intervention Diagnosis in the Special Education Schools in the State of Veracruz SEBASTIAN FIGUEROA (Universidad Veracruzana)
The Evaluation of 3 Procedures for Improving the Learning and Attitudes of Secondary School Students MARCO WILFREDO SALAS MARTINEZ (University of Veracruz) , Experanza Ferrant Jimenez (Secretary of Culture and Education of Veracruz Mexico)

SYMPOSIUM
05/30/2000
10:30 AM - 11:50 AM
Nathan Hale
DEV
Language Modes and Transfer of Learning
Chair: A. Daniel Gomez-Fuentes (U. Veracruzana)
Discussant: Martha Pelaez (Florida International University)
Transference Between Language Modes and Interaction Levels: Reading-Writing, Talking-Listening, Pointing at-Looking A. DANIEL GOMEZ-FUENTES (Universidad Veracruzana), Emilio Ribes Inesta (Universidad de Guadalajara)
Interactions of Instructional History, Instructional Accuracy and Contingencies on Human Performance in Conditional Discrimination HECTOR MARTINEZ (University of Guadalajara), Ricardo Tamayo (University of Guadalajara), Gerardo Ortiz (University of Guadalajara)

SYMPOSIUM
05/30/2000
12:00 PM - 01:20 PM
Nathan Hale
DEV
Rules, Instructions, and Conditional Discrimination Learning
Chair: Martha Peláez (Florida International University)
Discussant: Martha Pelaez (Florida International University)
Rules and Rewards in Preschool Settings FLORENTE LOPEZ RODRIGUEZ (Universidad Autonoma de Mexico) , A. Daniel Gomez Fuentes (Universidad Veracruzana) , Ruth Arvizu Gonzalez (Universidad Autonoma de Mexico)
Interactions of Instructions and History of Consequences on Human Performance in Conditional Discrimination HECTOR MARTINEZ (University of Guadalajara) , Gerardo Ortiz (University of Guadalajara)
Evaluating Procedures of Conditional Discrimination on the Learning of Geometric Shapes of Kindergarden Children MARCO WILFREDO SALAS MARTINEZ (University of Veracruz) , Martin Ortiz Bueno (Secretary of Culture and education of Veracruz).

Developmental Behavior Analysis SIG Annual Dinner

This year's Dinner of the Developmental Behavior Analysis Special Interest Group is scheduled to be held at Mama Ayesha's Calvert Café, 1967 Calvert Street, N.W., Washington, DC (202-232-5431), on Saturday, May 27, 2000, from approximately 6:15 to 8:30 pm. The late Mama Ayesha migrated some 55 years ago to Washington from Bethlehem. The cousine is Arab. Service will be family style. Vegetarians and meat eaters will both be accommodated. Thus, vegetarian stuffed grape leaves and cabbage, as well as vegetarian mujadrah and couscous dishes, will be served as entrees. Meat dish entrees will include kifta kebab (charcoal skewered ground lamb), shish taouk (marinated chicken breast kebab), shish kebab, and the like. Appetizers will include houmous, baba ghanouj, tabouleh, and fattoush salad. Desert and coffee/soft drink will conclude the repast. The cost will be $25 (that includes the high DC sales tax). However, the tip will be extra. Payment will be made individually.

Mama Ayesha's is on Calvert Steet, 3 short blocks from the Marriott. The southernmost of the three Marriot Hotel buildings backs onto Calvert Street. From that building, turn left (east) and walk to the restaurant (crossing Connecticut Ave. on the way). Alternatively, from the main hotel building, turn right and walk to Connecticut Ave., turn right (south) on Connecticut and, after one block turn left (east) onto Calvert Street (crossing Connecticut Ave.) for the short walk to the restaurant. Our group will sit in the second room from the entrance room.

Jack Gewirtz

The 26th Annual Association for Behavior Analysis (ABA) Conference will be held at the Marriott Wardman Park Hotel in Washington, D.C. on May 26-30, 2000. ABA is dedicated to promoting the experimental, theoretical, and applied analysis of behavior. It encompasses contemporary scientific and social issues, theoretical advances, and the dissemination of professional and public information. For information about the conference please see the website at http://www.wmich.edu/aba.

The Fourth European Meeting for the Experimental Analysis of Behaviour EMEAB4 will be in Amiens, FRANCE on July 9-13, 2000. The general topic of the meeting will be "Ecological and Economical Approaches to Behaviour." A number of other topics have also been invited for presentation. For more information see the conference website at http://www.u-picardie.fr/~LaboECCHAT/EMEAB4/ or contact Michel Sokolowski, EMEAB 4, Universite de Picardie - Jules Verne, Faculte de Philosophie, Sciences Humanines et Sociales, UPJV, Chemindu Thil, 80025 Amiens cedex 1, France.

The Year 2000 International Conference on Infant Studies will be held in Brighton, England on July 16-19. This conference serves as a venue for the latest research findings on applied and basic aspects of infant development. For information on this conference please see the website at www.isisweb.org/conf.htm or write to ICIS 2000 SEcretariat, School of Cognitive & Computing Sciences, University of Sussex, Falmer, Brighton, BN1 9QH, UK

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 Jacob Gewirtz, Michael Markham and Wendy Silverman, as well as adjunct faculty Beth Sulzer-Azaroff 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, Smita Shukla and Martha Peláez. For information on graduate programs in Educational Psychology & Special Education contact Martha Peláez (305) 348-2090.

The Fifth Annual International Congress on Behaviorism and the Sciences of Behavior will be meeting in Xalapa, Mexico on Oct. 5-8, 2000. The international congress provide a forum for discussion of conceptual and empirical issues related to behaviorism and its place in sciences of behavior. For more information please see the website at http://udgserv.cencar.udg.mx/~ceip.