

THE SCIENCE OF APPLIED BEHAVIOR ANALYSIS: A GENERAL OVERVIEW

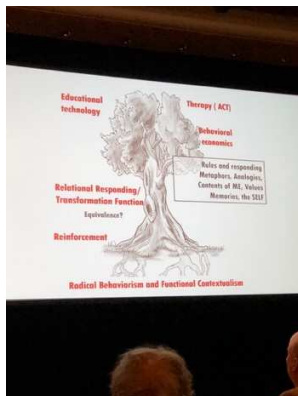
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Abstract

This paper defines Applied Behavioral Analysis (ABA), marking its development, basic philosophical tenets, and the research methodology it employs. Applied Behavior Analysis (ABA) has become an important credential specialization in education and psychology in the United States over the last 50 years. ABA provides a new and interesting focus on the philosophy of behaviorism and incorporates a unique and robust approach to functional behavioral assessment and analysis. The authors have been instrumental in the development of a new ABA graduate degree and credential program within the Sanford College of Education at National University and they provide both the philosophical tenets of Applied Behavior Analysis and its applications in classroom and other settings. This paper examines the philosophy and basic tenets of Applied Behavioral Analysis and how it is integrated into public school systems within the United States. However, National University's Applied Behavior Analysis program is also designed to facilitate delivery of direct ABA services into clients' homes, particularly to children, adolescents and adults with a diagnosis of autism or other developmental disabilities in which insurance coverage is provided for such services in the United States. Finally, the paper also provides a full description of applied behavioral research methods and its robust approach to functional behavior assessment, analysis, treatment.

Keywords: Functional Assessment, Stimulus Equivalence, Transformation of Stimulus Function, Relational Frame Theory, Acceptance and Commitment Therapy (ACT)



1 BACKGROUND

When the word psychology is mentioned in the community, most people around the world have an idea of what it entails, at least some kind of inkling. However, despite a 70-year old history of research and development, the general public has limited knowledge about what behavior analysis is? Nor does the community at large know about the benefits of applied behavior analysis (ABA). It was not until the publication of *Hear My Voice* by Catherine Maurice (1994) that the public became aware of the value of applied behavior analysis therapy. Maurice documented a heart-wrenching story about her family’s struggle to help her two children recover from autism utilizing the methodology of ABA to achieve a sense of normalcy in their everyday behavior at home and at school. As a result, at least 200 million people today in the United States receive behavior therapy services that are covered by health insurance. Universities across the United States and other parts of the world provide treatment services for children, adolescents, and adults diagnosed with autism and other developmentally delayed disabilities using ABA. National University (NU) is one of the many universities approved by the Behavior Analyst Certification Board to provide a verified course sequence leading to the attainment of a Board Certified Behavior Analyst (BCBA) credential, which allows a BCBA practitioner to practice internationally.

Applied Behavior Analysis by Cooper, Heron and Heward (2020) is the foremost textbook used currently in university ABA programs. These authors define the science of ABA in the following manner:

“Applied behavior analysis is the science in which tactics derived from the principles of behavior are applied systematically to improve socially significant behavior and experimentation is used to identify the variables responsible for behavior change.”

A ground-breaking seminal article written by Baer, Wolf, and Risely (1968) recommended the use of seven characteristics when conducting applied behavior research:

1	Applied	Select behaviors that are socially significant for the client.
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2	Behavioral	Select only the behavior that is in need of improvement, and it must be observable and measurable.
3	Analytic	The investigator must learn how and be able to control the occurrence and nonoccurrence of a behavior through experimental manipulation.
4	Technological	Procedures should be identified and described so that future investigators have a fair chance of replicating the application of the same results.
5	Conceptually Systematic	The procedures for changing behavior should be described in terms of the relevant principles from which they were derived, including operant conditioning, respondent conditioning, reinforcement, punishment, and extinction.
6	Effective	A procedure must improve the behavior under investigation to a practical degree, and it must be the behavior exhibited by the client.
7	Generality	A behavior change should last over time, appear in other environments and spread to other behaviors not directly trained.

To the present day of this writing these characteristics continue to serve as useful and relevant signposts for conducting research in applied behavior analysis. This article is cited more than any other article in the field of ABA (Cooper et. al., 2007). It is the guidepost used for all behavior analytic research. It ensures that the field is not just composed of a bag of tricks and gimmicks. The science of ABA is directly tied to philosophical and conceptual foundations.

1 CONCEPTUAL FOUNDATIONS & PHILOSOPHICAL UNDERPINNINGS

This paper does not provide an extensive background and history of the development of ABA. The reader is referred to Cooper et. al. (2007) and Jay More (2008) for the history leading to B.F. Skinner's experimentation. B.F. Skinner started his basic experimental research, called experimental analysis of behavior (EAB), in 1932 at Harvard University, (Skinner, 1938). Using an operant conditioning model, Skinner explored the effects of the environment on the development of behavior using the principles of reinforcement, punishment and extinction. His subjects were a non-human species: pigeons and rats. He used single case designs that focus on baseline logic to demonstrate the effects of the independent variable on the behavior of individual subjects (Skinner, 1938). This same research approach is used today. It is set apart from the experimental work done by traditional psychologists in that it is not based on inferential statistics. ABA scientists prefer not to mask the variability of their subjects. In fact, if a variable becomes variant, an ABA scientist is likely to follow its path. ABA accepts variation in behavioral data and organizes its research to investigate what might happen to a variant variable by actively manipulating it along with other variables rather than set up an initial hypothesis hoping that the experimental results will match the hypothesis. It is an inductive approach as opposed to a hypothetical-deductive approach used in traditional psychological studies. ABA is based on empiricism and its goal is pragmatic in nature. Based on a philosophy of determinism, ABA scientists presume that the universe is a lawful and orderly place in which all phenomena occur as a result of other events.

The field of applied behavior analysis was created as a direct result of Skinner's early investigations. Human beings became the main subjects for investigation. The tree diagram

presented above depicts the growth and advancements of ABA from the beginning stages (Skinner, 1953) to the present day, and briefly described in this article.

The tree serves as a metaphor with the roots of the tree representing the initial findings obtained by Skinner in his seminal basic research conducted between 1932-1938 describing the contingencies of reinforcement shaping behavior (Skinner, 1938).

When thinking about behaviorism many people do not believe that an understanding of human behavior can be or should be based on experiments with rats or pigeons. Criticisms still flourish in this respect by individuals who may have had only limited exposure to behavior principles. However, the results of extensive research and development in ABA over the past seventy years demonstrate the principles of ABA are perfectly aligned with enhanced socially important behavior change in human beings regardless of age and/or diagnosis.

In medical science, the aim is to observe symptoms presented by a patient in order to determine a diagnosis and provide a consequent treatment strategy. For example, if there is an eruption on the skin and the dermatologist recommends the removal of a mole as it might be cancerous, a decision is made to perform a biopsy to rule out any malignancy. An analysis of the mole under the microscope determines if it is cancerous or not. This type of examination and practice is common in medical practice. This strategy is described as the medical model. This same model of discovery has been adopted by various social sciences, including clinical psychology, social work, marriage, family, and child therapy and psychiatry. However, there has been only one example in history in which psychological symptoms have been found to be a direct manifestation of a disease, in the case of syphilis. Removal of the spirochete bacteria cures this disease including the associated psychological symptoms. Unfortunately, this is the only parallel that has resulted in a direct relationship between psychological illness and cure. Despite this fact, the medical model continues to pervade the field of social sciences. The search still persists in finding an entity inside the skin of a person that provides a cure.

3 MEDICAL MODEL

Sigmund Freud originated the practice of psychoanalysis and believed that psychopathology was created by the malfunctioning of inner causes, mainly by the id, ego and superego (Freud, 1889). These entities were reified and hypothetical in nature. They cannot be observed or measured. They are like ghosts from a made up non-existent metaphysical and non-dimensional plane. Like Freud, social scientists continue to search for an inner single cause or entity to explain the reasons for psychological illness, such as depression or anxiety or any other category listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V). It is as if a homunculus, a little person, resides, lives, and breathes in the human body directing the behavior and assuming responsibility for the occurrence or non-occurrence of psychological disability or mental illness. Despite evidence to the contrary, Freud's psychoanalysis which developed over one hundred years ago continues to be the exemplar of how the medical model is diffused throughout the world's marketplace for the delivery of psychotherapeutic processes designed to facilitate a cure for psychological disease. The medical model is a disease model.

In commenting about Skinner's radical behaviorism, Murray Sidman (2013, p. xvi) stated:

“Behavior analysts dispense with the myth of the inner person as creator of behavior. Both philosophically and empirically to the behavior analyst, we are what we do, when and where we do it.”

As indicated by Sidman, the practice of applied behavior analysis stands in sharp contrast to the medical model. The science of applied behavior analysis is a natural science, similar to biology, chemistry and physics. It is not a social science. ABA is evidence-based and driven by observable data. Single case design methodology uses repeated measures over time to graphically and visually display comparisons between baseline and treatment data. Rather than focusing on an inner homunculus determining the behavior of an individual, the environment is viewed as the major source of influence in the development of both nonverbal and verbal human behavior, maladaptive or adaptive. The analysis of a behavior is primarily considered contingent or dependent on the context in which a behavior occurs, (Skinner, 1953). The function of a person's behavior is determined by a functional analysis that consists of analyzing the interaction between the behavior and the environment to determine which reinforcer causes a problem behavior (Iwata et. al. 1994). The results of a functional analysis are used to generate a treatment program which enables alternative behavior. Behavior tactics such as differential reinforcement is used to reinforce the alternative behavior and simultaneously disable the problem behavior through extinction.

Skinner viewed behavior as occurring inside and outside the skin of a person. Behavior in the public arena is observable and measurable. Private events occurring inside the skin of the individual are determined by the same principles utilized in describing events outside the skin. In this way thoughts, feelings and bodily sensations occurring inside the skin are also behaviors. The only difference between private events (covert events) and public events (overt events) is the inaccessibility of the private events to observation and measurement. Although Skinner's views of private events were considered radical for his time, they are now considered thorough going.

What is a behavior? It must be observable and measurable. Ogden Lindsey (1922) developed the dead man's test to help decide if a person exhibited a behavior or not: If a dead man can do it, it is not a behavior. In addition, it is important to operationally define a behavior. For example, a person may describe a person's behavior as aggressive. This statement is too general. During an interview, the behavior analyst asks, “What does the behavior look like?” We get the response that Johnny bites, hits and slaps people in the face. Such behavior is both observable and measurable, but does not answer the question of why does Johnny manifest these behaviors?

4 BEHAVIORAL MODEL

The topography or form of a behavior does not provide information about why a behavior occurs. It merely provides the structure of a behavior. For example, a cheerleader uses a variety of behaviors including jumping up and down, fist pumps, and hand clapping as the marching band supports her physical gestures. These movements however alone do not explain the purpose for this behavior. A person from another planet observing this behavior would have no idea why such a person is making such movements, especially out in the field or on the court while football, basketball or soccer players run around chasing a ball. In order to determine the purpose of a behavior, a functional behavior assessment must be performed. This involves

observing contextual environments (antecedents and consequences) from the perspective of time and space.

Antecedent (including discriminate stimuli and motivational stimuli)	Behavior	Consequent
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The learning unit depicted above can be either a three or four term contingency utilized for determining the cause of either non-verbal or verbal behavior. For example, the purpose of cheerleading is to arouse support for the team on the same side of the field. The cheerleading is the antecedent behavior and the consequence is the audience's enthusiastic response for the team, typically social praise (clapping, shouting, jumping up and down). The antecedents and consequences have direct effects on the behavior of the athletes on the field or court.

Here is another example of the contrast between structure and function: How many ways can a bag of peanuts be opened? There are several forms or topography used when opening a bag of peanuts. The reader may automatically visualize numerous ways a bag of peanuts can be opened. These forms are structural in nature. They, however, do not tell us the purpose of opening the bag. The antecedent stimulus is the bag of peanuts. The behavior is opening the bag and the consequence is the reinforcement experienced from eating the peanuts. The history of positive reinforcement received in this situation will most likely influence behavior in the future given the presence of a similar contextual environment.

5 DERIVED RELATIONAL RESPONDING

In his research on stimulus equivalence, Murray Sidman (2013) demonstrated that three young men showed emergent patterns indicative of oral reading and reading comprehension for the first time in their lives, even though these particular performances had not been directly taught. The reader is referred to the study noted in the reference section. Without describing these procedures in detail due to time constraints, this finding was a major breakthrough and led to the development of non-equivalent relationships and arbitrary applicable relational responding (AARR), a new verbal operant response associated with cognition and language. New terminology ensued, including mutual entailment (symmetry), combinatory mutual entailment (transitivity), derived stimulus functions, derived relational responding, and the transformation of stimulus functions (Hayes et al 2001). These new developments and concepts are placed on the upper branches of the tree. These new formulations were directly related to cognition and language derivations and relational frames that stimulate one another and cause arbitrary applicable relational responding (AARR). AARR is derived and not attached to any formal physical stimuli in the immediate environment. Stimuli are frames that communicate with one another and can be accessed through abstractions, cues, or discriminative stimuli in the current environment. Any stimuli can be related to one another. Relational networks also can be related to one another.

For example, let's say Sarah and Harry fight like cats and dogs. Each relation (Sarah and Harry) and (Cats and Dogs) forms a separate relational network that can relate to one another. The

metaphor describing the two relational networks coordinate with one another and provide a good idea about how Sarah and Harry relate to one another. There are literally millions of such relational networks that coordinate with one another and cause a transformation of stimulus functions across networks. Relational framing is derived instantly and automatically as a result of any discriminative stimuli, even things seen but not seen, as in imagination. For example, the reader can think of an apple. Or, better yet, not think of an apple. The author bets the reader cannot stop herself from thinking about an apple, including all the types of apples that exist in the world, incorporating color, taste, and consistency. Any and all stimuli are connected together and automatically arise through a repertoire of relational networks of verbal behavior acquired over time and space *without being taught to do so*.

6 RULE GOVERNED BEHAVIOR

Based on Sidman's findings in equivalent relations, Hayes et. al (2001) discovered the link between contingency based behavior and rule-governed behavior. An immediate contingency consists of lapse of 1 second between a behavior and a consequence. For example, Johnny says, "Thank you" to his father. Father praises him immediately. Johnny is therefore likely to say thank you in the future due to the positive reinforcement received immediately by his father. Rule-governed behavior consists of a lapse of more than 30 seconds between a behavior and a consequence. However, with rule-governed behavior, the lapse between a behavior and a consequent could be years. For example, Harry at the age 16 years was told by his father to visit the Vase Museum if he ever visited the city of Stockholm in Sweden. When Harry was 32, he traveled to Stockholm where he purchased a ticket and observed the Vase. This type of learning was not contingent on receiving immediate reinforcement for his behavior. It was rule governed behavior because there was a gap of 16 years between his father's verbal behavior and the consequence of observing the Vase. How does such behavior occur?

Some linguists would say that the information is encoded in the brain until a time in which it is used. They would describe it as an *engram*, a unit of cognitive information inside the brain, theorizing that memories are stored as biophysical or biochemicals in the brain or neural tissue until there is a response to external stimuli. An engram is a hypothetical concept. It does not really exist. It is a reified concept, an inner homunculus used to explain Harry's visit to the Vase. The behavior analyst would say that Harry's behavior occurred due to relational framing and arbitrary applicable relational responding, a verbal process.

Although Skinner indicated that rule-governed behavior was possible, he did not live long enough to *specify* how it occurred. Hayes et. al. (2001) formulated Relational Frame Theory which provides that link. This discovery has expanded the ability of behavioral science to account for the cognitive and language capabilities learned and used by individuals in everyday life.

7 RELATIONAL FRAME THEORY AND ACT

Skinner believed that his most important contribution to behavioral science would eventually be in the field of verbal behavior. His view of what determined verbal behavior included not only vocal behavior but all other forms of non-verbal communication, including sign language,

braille, writing as well as many other similar forms. This viewpoint was markedly different than a psycholinguistic view of verbal behavior held seventy years ago, but, is respected and utilized by linguists and speech pathologists in the field today. As depicted in the tree diagram, the foundation of Skinner's verbal behavior, particularly rule-governed behavior, has served to generate research associated with the development of modern-day behavioral psychotherapeutic treatment, namely ACT (Acceptance and Commitment Therapy) supported by Relational Frame Theory (Hayes et al, 2001). The focus of the therapy is on increasing psychological flexibility by learning to accept feelings, thoughts, and bodily sensations rather than experientially avoiding these private events. In addition, the therapy focuses on individuals moving in the direction of their values in life supporting an existence of purposefulness, meaningfulness and vitality, regardless of age or condition. For the interested reader, there is extensive research and numerous books on the subject, some of which are listed in the bibliography.

How did this evolution in thinking and behavioral development occur? It was based on the research design approach promulgated by Baer, Wolf and Risley (1968) and published in the flagship Journal of Applied Behavior Analysis (JABA).

8 SCIENCE OF BEHAVIOR IN THE FUTURE

As depicted by the tree diagram, it is not surprising that a scientific discipline starts at an elementary level and expands in scope as a result of scientific pursuit. It is not the first time such an event has occurred. Scholars of the Renaissance believed that the Earth was flat, and Columbus proved it to be false. Copernicus, a Renaissance-era mathematician and astronomer, formulated a model of the universe that placed the Sun rather than the Earth at the center of the universe. Prior to his discovery, the earth was believed to be the center of the universe and the sun, Mercury, Venus, Mars, Jupiter, Saturn and Neptune revolved around the earth. Galileo supported the Copernican theory which supports a sun-centered solar system. Legend has it that a young Isaac Newton was sitting under an apple tree when he was hit on the head by an apple, resulting in the insight that prompted him to suddenly come up with his law of gravity. The author's 3-year-old granddaughter was astonished when she witnessed a balloon given to her lose her grip and suddenly fly into the air. She did not know that helium defied gravity because it is lighter than air. But, she will.

History is a good predictor of future change. What we know about the science of behavior today is likely to change tomorrow. What if it is true that the science of behavior can save mankind?

The following quote by Donald Baer is apropos:

“That there could a science of behavior of what we do, of what we are? How could you resist that?”

This article was written to increase public awareness about the field of applied behavior analysis. The information provided in this article is a general summary of the history and development of ABA, a very promising and expanding field designed to increase the quality of life by improving important social behaviors regardless of age or condition. For further in-depth study of applied behavior analysis, the author refers the reader to the following references.

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