Applied Behavior Analysis: Shaping Lives Through Science

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Applied behavior analysis (ABA) is a scientific discipline concerned with developing techniques based on the principles of learning and applying these to change behavior of social significance. It is the applied form of behavior analysis; the other two forms are radical behaviorism (or the philosophy of the science) and the experimental analysis of behavior (or experimental research).

The name "applied behavior analysis" has replaced behavior modification because the latter approach suggested attempting to change behavior without clarifying the relevant behavior-environment interactions. In contrast, ABA tries to change behavior by first assessing the functional relationship between a targeted behavior and the environment. This approach often seeks to develop constructive, socially acceptable behaviors to replace the aberrant behaviors.

ABA has been brought to bear on a wide range of areas and behavioral problems. Examples include such things as early intensive behavioral interventions for children with an autism spectrum disorder (ASD), research on the principles influencing criminal behavior, as well as HIV prevention, conservation of natural resources, education, gerontology, health and exercise, industrial safety, language acquisition, littering, medical procedures, parenting, psychotherapy, seatbelt use, severe mental disorders, sports, substance abuse, phobias, pediatric feeding disorders, and zoo management and care of animals.

Definition

ABA is an applied science devoted to developing procedures which will produce observable changes in behavior. It is to be distinguished from the experimental analysis of behavior, which focuses on basic experimental research, but it uses principles developed by such research, in particular operant conditioning, classical conditioning and social learning theory. Behavior analysis adopts the viewpoint of radical behaviorism, treating thoughts, emotions, and other covert cognitive activity as behavior that is subject to the same rules as observable responses. This represents a shift away from methodological behaviorism, which restricts behavior-change procedures to behaviors that are observable, and was the conceptual underpinning of behavior modification.

Behavior analysts also emphasize that the science of behavior must be a natural science as opposed to a social science. As such, behavior analysts focus on the observable relationship of behavior to the environment, including antecedents and consequences, without resort to "hypothetical constructs".

History

The beginnings of ABA can be traced to a group of faculty and researchers at the University of Washington and University of Kansas, including Donald Baer, Sidney W. Bijou, Bill Hopkins, Jay Birnbrauer, Todd Risley, and Montrose Wolf. In the 1960s, Baer, Hopkins, Risley, Birnbrauer, and

Wolf joined the Department of Human Development and Family Life at the University of Kansas,:570 where they recruited James Sherman,:571 and began to apply the principles of behavior analysis to a wide variety of human problems. In 1968, they founded the Journal of Applied Behavior Analysis which publishes research in behavior analysis to socially relevant behavior, and B. F. Skinner was the president of the journal until his death in 1990.

Notable graduate students from the University of Washington include Robert Wahler, James Sherman, and Ivar Lovaas. Lovaas established the UCLA Young Autism Project while teaching at the University of California, Los Angeles, and devoted nearly half a century to groundbreaking research and practice aimed at improving the lives of children with autism and their families. He even co-founded what is today the Autism Society of America. In 1965, Lovaas published a series of articles that outlined his system for coding observed behaviors, described a pioneering investigation of the antecedents and consequences that maintained a problem behavior, and built upon these methods to develop an effective way to teach nonverbal children to speak. He also described how to use social (secondary) reinforcers, teach children to imitate, and what interventions (including electric shocks) may be used to reduce aggression and life-threatening self-injury. In 1973, Lovaas published a long-term follow-up of his interventions and was dismayed to find that most of the subjects had reverted to their pre-intervention behaviors. He and his colleagues proposed several ways to improve outcomes, such as starting intervention during the children's preschool years instead of during late childhood or adolescence, involving parents in the intervention, and implementing the intervention in the family's home rather than an institutional setting.

Over the years, "behavior analysis" gradually superseded "behavior modification"; that is, from simply trying to alter problematic behavior, behavior analysts sought to understand the function of that behavior, what antecedents promote and maintain it, and how it can be replaced by successful behavior. This analysis is based on careful initial assessment of a behavior's function and a testing of methods that produce changes in behavior.

Applied behavior analytic methods are also used in a variety of other fields, such as applied animal behavior, criminology, organizational behavior management, positive behavior support, and clinical behavior analysis (including cognitive-behavior therapies).

Characteristics

Baer, Wolf, and Risley's 1968 article is still used as the standard description of ABA. It lists the following the seven characteristics of ABA.

Applied: ABA focuses on the social significance of the behavior studied. For example, a non-applied researcher may study eating behavior because this research helps to clarify metabolic

processes, whereas the applied researcher may study eating behavior in individuals who eat too little or too much, trying to change such behavior so that it is more acceptable to the persons involved, to others, and to society as a whole.

Behavioral: ABA is pragmatic; it asks how it is possible to get an individual to do something effectively. To answer this question, the behavior itself must be objectively measured. Verbal descriptions are treated as behavior in themselves, and not as substitutes for the behavior described.

Analytic: Behavior analysis is successful when the analyst understands and can manipulate the events that control a target behavior. This may be relatively easy to do in the lab, where a researcher is able to arrange the relevant events, but it is not always easy, or ethical, in an applied situation. Baer et al. outline two methods that may be used in applied settings to demonstrate control while maintaining ethical standards. These are the reversal design and the multiple baseline design. In the reversal design, the experimenter first measures the behavior of choice, introduces an intervention, and then measures the behavior again. Then, the intervention is removed, or reduced, and the behavior is measured yet again. The intervention is effective to the extent that the behavior changes and then changes back in response to these manipulations. The multiple baseline method may be used for behaviors that seem irreversible. Here, several behaviors are measured and then the intervention is applied to each in turn. The effectiveness of the intervention is revealed by changes in just the behavior to which the intervention is being applied.

Technological: The description of analytic research must be clear and detailed, so that any competent researcher can repeat it accurately. Cooper et al. describe a good way to check this: Have a person trained in applied behavior analysis read the description and then act out the procedure in detail. If the person makes any mistakes or has to ask any questions then the description needs improvement.

Conceptually Systematic: Behavior analysis should not simply produce a list of effective interventions. Rather, to the extent possible, these methods should be grounded in behavioral principles. This is aided by the use of theoretically meaningful terms, such as "secondary reinforcement" or "errorless discrimination" where appropriate.

Effective: Though analytic methods should be theoretically grounded, they must be effective. If an intervention does not produce a large enough effect for practical use, then the analysis has failed

General: Behavior analysts should aim for interventions that are generally applicable; the methods should work in different environments, apply to more than one specific behavior, and have long-lasting effects.

Other proposed characteristics

In 2005, Heward et al. suggested that the following five characteristics should be added:

Accountable: To be accountable means that ABA must be able to demonstrate that its methods are

effective. This requires the repeatedly measuring the success of interventions, and, if necessary, making changes that improve their effectiveness.
Public: The methods, results, and theoretical analyses of ABA must be published and open to scrutiny. There are no hidden treatments or mystical, metaphysical explanations.
Doable: To be generally useful, interventions should be available to a variety of individuals, who might be teachers, parents, therapists, or even those who wish to modify their own behavior. With proper planning and training, many interventions can be applied by almost anyone willing to invest the effort.
Empowering: ABA provides tools that give the practitioner feedback on the results of interventions. These allow clinicians to assess their skill level and build confidence in their effectiveness.
Optimistic: According to several leading authors, behavior analysts have cause to be optimistic that their efforts are socially worthwhile, for the following reasons:

The behaviors impacted by behavior analysis are largely determined by learning and controlled by manipulable aspects of the environment.
Practitioners can improve performance by direct and continuous measurements.
As a practitioner uses behavioral techniques with positive outcomes, they become more confident of future success.
The literature provides many examples of success in teaching individuals considered previously unteachable.

Concepts

Behavior

Behavior refers to the movement of some part of an organism that changes some aspect of the environment. Often, the term behavior refers to a class of responses that share physical dimensions or functions, and in that case a response is a single instance of that behavior. If a group of responses have the same function, this group may be called a response class. "Repertoire" refers to the various responses available to an individual; the term may refer to responses that are relevant to a particular situation, or it may refer to everything a person can do.

Operant conditioning

Operant behavior is the so-called "voluntary" behavior that is sensitive to, or controlled by its consequences. Specifically, operant conditioning refers to the three-term contingency that uses stimulus control, in particular an antecedent contingency called the discriminative stimulus (SD) that influences the strengthening or weakening of behavior through such consequences as reinforcement or punishment. The term is used quite generally, from reaching for a candy bar, to turning up the heat to escape an aversive chill, to studying for an exam to get good grades.

Respondent (classical) conditioning

Respondent (classical) conditioning is based on innate stimulus-response relationships called reflexes. In his famous experiments with dogs, Pavlov usually used the salivary reflex, namely salivation (unconditioned response) following the taste of food (unconditioned stimulus). Pairing a neutral stimulus, for example a bell (conditioned stimulus) with food caused the bell to elicit salivation (conditioned response). Thus, in classical conditioning, the conditioned stimulus becomes a signal for a biologically significant consequence. Note that in respondent conditioning, unlike operant conditioning, the response does not produce a reinforcer or punisher (e.g. the dog does not get food because it salivates).

Environment

The environment is the entire constellation of stimuli in which an organism exists. This includes events both inside and outside of an organism, but only real physical events are included. A stimulus is an "energy change that affects an organism through its receptor cells".

A stimulus can be described:

Topographically by its physical features.
Temporally by when it occurs.
Functionally by its effect on behavior.

Reinforcement

Reinforcement is the key element in operant conditioning and in most behavior change programs. It is the process by which behavior is strengthened. If a behavior is followed closely in time by a stimulus and this results in an increase in the future frequency of that behavior, then the stimulus is a positive reinforcer. If the removal of an event serves as a reinforcer, this is termed negative reinforcement. There are multiple schedules of reinforcement that affect the future probability of behavior.

Punishment

Punishment is a process by which a consequence immediately follows a behavior which decreases the future frequency of that behavior. As with reinforcement, a stimulus can be added (positive punishment) or removed (negative punishment). Broadly, there are three types of punishment: presentation of aversive stimuli (e.g., pain), response cost (removal of desirable stimuli as in monetary fines), and restriction of freedom (as in a 'time out'). Punishment in practice can often result in unwanted side effects. Some other potential unwanted effects include resentment over being punished, attempts to escape the punishment, expression of pain and negative emotions

associated with it, and recognition by the punished individual between the punishment and the person delivering it.

Extinction

Extinction is the technical term to describe the procedure of withholding/discontinuing reinforcement of a previously reinforced behavior, resulting in the decrease of that behavior. The behavior is then set to be extinguished (Cooper et al.). Extinction procedures are often preferred over punishment procedures, as many punishment procedures are deemed unethical and in many states prohibited. Nonetheless, extinction procedures must be implemented with utmost care by professionals, as they are generally associated with extinction bursts. An extinction burst is the temporary increase in the frequency, intensity, and/or duration of the behavior targeted for extinction. Other characteristics of an extinction burst include an extinction-produced aggression--the occurrence of an emotional response to an extinction procedure often manifested as aggression; and b) extinction-induced response variability--the occurrence of novel behaviors that did not typically occur prior to the extinction procedure. These novel behaviors are a core component of shaping procedures.

Discriminated operant and three-term contingency

In addition to a relation being made between behavior and its consequences, operant conditioning also establishes relations between antecedent conditions and behaviors. This differs from the S-R formulations (If-A-then-B), and replaces it with an AB-because-of-C formulation. In other words, the relation between a behavior (B) and its context (A) is because of consequences (C), more specifically, this relationship between AB because of C indicates that the relationship is established by prior consequences that have occurred in similar contexts. This antecedent-behavior-consequence contingency is termed the three-term contingency. A behavior which occurs more frequently in the presence of an antecedent condition than in its absence is called a discriminated operant. The antecedent stimulus is called a discriminative stimulus (SD). The fact that the discriminated operant occurs only in the presence of the discriminative stimulus is an illustration of stimulus control. More recently behavior analysts have been focusing on conditions that occur prior to the circumstances for the current behavior of concern that increased the likelihood of the behavior occurring or not occurring. These conditions have been referred to variously as "Setting Event", "Establishing Operations", and "Motivating Operations" by various researchers in their publications.

Verbal behavior

B.F. Skinner's classification system of behavior analysis has been applied to treatment of a host of

communication disorders. Skinner's system includes:

Tact (psychology) - a verbal response evoked by a non-verbal antecedent and maintained by generalized conditioned reinforcement.
Mand (psychology) - behavior under control of motivating operations maintained by a characteristic reinforcer.
Intraverbals - verbal behavior for which the relevant antecedent stimulus was other verbal behavior, but which does not share the response topography of that prior verbal stimulus (e.g., responding to another speaker's question).
Autoclitic - secondary verbal behavior which alters the effect of primary verbal behavior on the listener. Examples involve quantification, grammar, and qualifying statements (e.g., the differential effects of "I think..." vs. "I know...")

For assessment of verbal behavior from Skinner's system see Assessment of Basic Language and Learning Skills.

Measuring behavior

When measuring behavior, there are both dimensions of behavior and quantifiable measures of behavior. In applied behavior analysis, the quantifiable measures are a derivative of the dimensions. These dimensions are repeatability, temporal extent, and temporal locus.

Repeatability

Response classes occur repeatedly throughout time--i.e., how many times the behavior occurs.
Count is the number of occurrences in behavior.
Rate/frequency is the number of instances of behavior per unit of time.
Celeration is the measure of how the rate changes over time.

Temporal extent

This dimension indicates that each instance of behavior occupies some amount of time--i.e., how long the behavior occurs.

Duration is the amount of time in which the behavior occurs.

Temporal locus

Each instance of behavior occurs at a specific point in time--i.e., when the behavior occurs.

Response latency is the measure of elapsed time between the onset of a stimulus and the initiation of the response.

Interresponse time is the amount of time that occurs between two consecutive instances of a response class.

Derivative measures

Derivative measures are unrelated to specific dimensions:

Percentage is the ratio formed by combining the same dimensional quantities.
Trials-to-criterion are the number of response opportunities needed to achieve a predetermined level of performance.

Analyzing behavior change

Experimental control

In applied behavior analysis, all experiments should include the following:

At least one participant
At least one behavior (dependent variable)
At least one setting
A system for measuring the behavior and ongoing visual analysis of data
At least one treatment or intervention condition
Manipulations of the independent variable so that its effects on the dependent variable may be quantitatively or qualitatively analyzed
An intervention that will benefit the participant in some way

Functional analysis (psychology)

History of functional analysis

Prior to the seminal article on functional analytic methodology for aberrant behaviors, behaviorists used the behavioral technology available to them at the time. Instead of treating the function of the disruptive behavior, behavioral psychologists would instead pre-assume consequences to alter disruptive behaviors. For example, in the past to decrease self-injurious behavior in an individual, behaviorists may have delivered an aversive stimulus contingent on the response, or assume a reinforcer without identifying the reinforcer that would be most motivating to the client (Iwata, 1988). This type of intervention was successful to the individual, but it was not uncommon to see other variations of aberrant behavior begin to appear. When applied behavior analysts let clients choose from a wide array of reinforcers (often determined through data collection and reinforcement assessments) in the mid-1980s, reinforcement was shown to be more effective than punishment contingencies. In general, applied behavior analysis as a field favors reinforcement based interventions over aversive contingencies, but at the time the behavioral technology was not

advanced enough and the individuals needing intervention had a right to an effective treatment (Van Houten et al., 1988). Nevertheless, not all behavioral therapies involved the use of aversives prior to the mid-1980s. Some behaviorists (for instance, B.F. Skinner) always preferred reinforcement and extinction contingencies over punishment even during that time.

In 1977, Edward Carr published a paper on potential hypotheses for the occurrence and maintenance of self-injurious behaviors. This paper laid out the initial groundwork for a functional analysis of aberrant behaviors. In the paper, Carr described five potential causes for self-injurious behaviors that included (1) positive social reinforcement contingent on the response, (2) negative reinforcement in the form of removal of an aversive stimulus contingent on the response, (3) the response produced stimuli possessed reinforcing qualities (automatic reinforcement), (4) the behavior was a byproduct of an underlying psychological condition, and (5) psychodynamic hypothesis in which the behavior was an attempt to reduce guilt. Throughout the paper, Carr cited recent research to support the first three hypotheses, and disprove the latter two hypotheses, but no formal experiment was conducted to determine the controlling variables of the problem behavior.

In 1982, Iwata and colleagues conducted the first experimental analysis of the maintaining variables for self-injurious behavior. In the paper, the researchers alternated between specific conditions to examine whether or not the behavior occurred under specific environmental conditions. Through direct manipulation of the environment, the researchers could accurately identify the controlling variables of the aberrant behavior, and provide interventions that targeted the functional relationship between the behavior and the environment. Since this seminal article was published, a wide range of research has been published in the area of functional analyses of aberrant behaviors. The methodology has since become the gold standard in assessment and treatment of aberrant behaviors.

Functional behavior assessment (FBA)

Functional assessment of behavior provides hypotheses about the relationships between specific environmental events and behaviors. Decades of research have established that both desirable and undesirable behaviors are learned and maintained through interactions with the social and physical environment. Functional behavior assessments are used to identify controlling variables for challenging behaviors as the basis for intervention efforts designed to decrease the occurrence of these behaviors.

Functions of behavior

Behavior serves two major functions for an individual: (1) to obtain desired events, or (2) to escape/avoid undesired events. Put another way, individuals engage in behavior to get something

or to get out of something. When trying to identify the function of a behavior, it is often helpful to think, What purpose is this behavior serving the individual? Described below are the common functions of behavior.

Obtain socially mediated events

Access to attention (positive reinforcement: social): The individual engages in the behavior to obtain attention from another person. For example, a child throws a toy because it characteristically results in mom's attention. (If this behavior results in mom looking at child and giving him lots of attention--even if she's saying "NO"--he will be more likely to engage in the same behavior in the future to get mom's attention.) Common forms of attention include, but are not limited to, hugs, kisses, reprimands, frowns, smiles, etc.

Access to tangibles (positive reinforcement: tangible/activity): The individual engages in the behavior to obtain a specific item or engage in a specific activity from another person. For example, a child hits mom because s/he wants the toy mom is holding. (If this behavior results in mom giving the child the toy, s/he will be more likely to engage in the same behavior in the future to get mom's attention.) Common forms of tangible items include, but are not limited to, food, toys, movies, video games, etc.

Automatic positive reinforcement: The individual engages in the behavior because the response-produced stimulation possesses reinforcing characteristics. In other words, engaging in the behavior produces reinforcing stimulation unique to the specific context. For example, a child hits his/her eyes because it produces the specific stimulation of various colors and effects. Another example includes a child spinning a bowl on a table to produce the specific auditory stimulation unique to that object. Common forms of automatic stimulation include, but are not limited to, auditory stimulation, visual stimulation, endorphin release, etc.

Escape/avoid undesirable events (negative reinforcement)

Escape/avoid socially mediated events

Escape/removal of attention: The individual engages in the behavior to escape aversive socially mediated attention. Put another way, social situations that are aversive to the child are removed contingent on the behavior occurring. For example, a child hits the teacher to avoid talking in front of the class. Common forms of aversive social situations include, but are not limited to, smiles, hugs, frowns, corrections, group settings, etc.

Escape/removal of tasks or activities: The individual engages in the behavior to escape aversive tasks or demands. For example, when a child is told to take a bath he begins to cry, and his

mother tells him he no longer has to take a bath. Another example includes a teacher telling a student to complete a series of math problems, to which the student flips the desk and is sent to the principal's office. Being sent to the principals office reinforced the behavior of flipping the desk because it allowed the child to escape the aversive activity of completing math problems. Common forms of aversive demands/activities include, but are not limited to, difficult tasks, changes in routines, unpredictability, novel tasks, etc.

Escape/avoid specific stimulation

Automatic negative reinforcement: The individual engages in the behavior because it produces a decrease in aversive stimulation. Put another way, something aversive is occurring in some location on the organism's body, and engaging in the behavior decreases the level of discomfort. For example, a child bangs his head against the wall to decrease the pain experienced from a toothache. Another example includes a child scratching his arm to decrease the level of itchiness experienced from a bug bite. Common forms of aversive stimulation abated by engaging in specific behaviors include sinus pain, itching, hunger, etc.

Function versus topography

As previously stated function refers to the effect the behavior produces on the environment. The actual form of the behavior is referred to the topography. Different behaviors may serve the same function, thus describing one limitation of treating behaviors based on form alone. For example, a child may scream, hit, and cry to obtain attention from his mother. What the behavior looks like often reveals little useful information about the conditions that account for it. However, identifying the conditions that account for a behavior, suggests what conditions need to be altered to change the behavior. Therefore, assessment of function of a behavior can yield useful information with respect to intervention strategies that are likely to be effective.

Method of identifying functions of behavior

FBA methods can be classified into three types:

Indirect assessment
Descriptive assessment
Functional (experimental) analysis

Indirect FBA

This method uses structured interviews, checklists, rating scales, or questionnaires to obtain information from persons who are familiar with the person exhibiting the behavior to identify

possible conditions or events in the natural environment that correlate with the problem behavior. They are referred to as "indirect" because they do not involve direct observation of the behavior, but rather they solicit information based on others' recollections of the behavior. This form of assessment typically yields the least reliable information about the function of behavior, but can provide insight as to possible functions of the behavior to be tested in the future, the form of the behaviors (e.g. screaming, hitting, etc.), and environments in which the behavior typically occurs (e.g. school, home, etc.). This type of assessment should be performed as the initial step of any functional behavior assessment to gather relevant information to complete more direct assessments.

Descriptive FBA

Unlike the indirect methods of FBAs, descriptive functional behavior assessment employs direct observation of behavior. These observations occur in the environment in which the behavior naturally occurs (e.g. school, home, etc.) therefore there is no direct manipulation of the environment. The most common form of descriptive assessment involves recording the antecedents and consequences that naturally occur when the individual emits the behavior. This is referred to as ABC data collection, in which (A) represents the common antecedent, (B) represents the behavior of interest, and (C) represents the immediate consequences that occur following the behavior. ABC data collection is used to identify the naturally occurring consequences delivered in the environment in which the behavior occurs. ABC data collection can be conducted by a wide array of individuals who have received appropriate training on how to record the data. Another form of descriptive FBA is called a scatterplot. In this assessment, staff record the time and setting in which the behavior of interest occurs over a series of days. The data are plotted on a visual scale to indicate whether there are any patterns in the behavior (for example, if the behavior occurs more frequently during math instruction than it does during lunchtime). Although this assessment does not indicate the consequences maintaining the behavior, it can be used to identify some of the antecedent conditions that typically precede the behavior of interest.

Functional (experimental) analysis

A functional analysis is the most direct form of functional behavior assessment, in which specific antecedents and consequences are systematically manipulated to test their separate effects on the behavior of interest. Each manipulation of the antecedent and consequence in a particular situation is referred to a condition. In a functional analysis, conditions are typically alternated between quite rapidly independent of responding to test the different functions of behavior. When data paths are elevated above the control condition (described below) it can be said that there is a functional relation between that condition and the behavior of interest. Complexity, time restraints, and setting restraints, are a few limitations to this particular method. When deciding to use this method, it

should be noted that there is a chance of high-risk behavior and the possibility of low-rate behaviors.

Below, common examples of experimental conditions are described. A standard functional analysis normally has four conditions (three test conditions and one control).

Attention

In this condition, the experimenter gives the individual moderately preferred items and instructs them to go play. After that initial instruction, the experimenter pretends to act busy and ignores all bids for attention from the individual. If the individual engages in the behavior of interest, the experimenter provides the individual with attention (commonly in the form of a reprimand). Behaviors that occur more frequently in this condition can be said to be attention maintained.

Escape

In this condition, the experimenter instructs the individual that it is time to work. After the initial instruction, the experimenter delivers a series of demands that the individual is typically required to complete (e.g. math problems, cleaning up, etc.). If the individual engages in the behavior of interest, the demand is removed and the child is allowed to take a break. Behaviors that occur more frequently in this condition can be said to be escape maintained.

Alone

In this condition, the child is left alone with a variety of items to engage with. If the child engages in the behavior of interest, no programmed consequences are delivered. Behaviors that occur more frequently in this condition can be said to be automatically maintained.

Control (play)

In this condition, the child is allowed to engage with a variety of items during the session. No demands are placed on the child throughout the duration of the session. The experimenter provides attention to the individual throughout the session on any behavior that is not the target behavior. If the target behavior occurs, the experimenter removes attention until the behavior has subsided. This session is meant to act as a control condition, meaning that the environment is enriched for the purpose of the behavior not occurring. Said another way, by meeting environmental needs for all possible functions, the individual is not likely to engage in the behavior of interest. This condition is used as a comparison to the other conditions. Any condition that is elevated to a large degree form the control condition, shows a higher degree experimental control

indicating the functional relationship between the specific environmental conditions and the behavior of interest.

Conducting a functional behavior assessment

Functional behavior assessments are rarely limited to only one of the methods described above. The most common, and most preferred, method for identifying the function of behavior can be seen as a four-part processes.

The gathering of information via indirect and descriptive assessment.
Interpretation of information from indirect and descriptive assessment and formulation of a hypothesis about the purpose of problem behavior.
Testing of a hypothesis using a functional analysis.
Developing intervention options based on the function of problem behavior.

Technologies developed through ABA research

Task analysis

Task analysis is a process in which a task is analyzed into its component parts so that those parts can be taught through the use of chaining: forward chaining, backward chaining and total task presentation. Task analysis has been used in organizational behavior management, a behavior analytic approach to changing the behaviors of members of an organization (e.g., factories, offices, or hospitals). Behavioral scripts often emerge from a task analysis. Bergan conducted a task analysis of the behavioral consultation relationship and Thomas Kratochwill developed a training program based on teaching Bergan's skills. A similar approach was used for the development of microskills training for counselors. Ivey would later call this "behaviorist" phase a very productive one and the skills-based approach came to dominate counselor training during 1970-90. Task analysis was also used in determining the skills needed to access a career. In education, Englemann (1968) used task analysis as part of the methods to design the Direct Instruction curriculum.

Chaining

The skill to be learned is broken down into small units for easy learning. For example, a person learning to brush teeth independently may start with learning to unscrew the toothpaste cap. Once they have learned this, the next step may be squeezing the tube, etc.

For problem behavior, chains can also be analyzed and the chain can be disrupted to prevent the problem behavior. Some behavior therapies, such as dialectical behavior therapy, make extensive use of behavior chain analysis.

Prompting

A prompt is a cue that is used to encourage a desired response from an individual. Prompts are often categorized into a prompt hierarchy from most intrusive to least intrusive, although there is some controversy about what is considered most intrusive, those that are physically intrusive or those that are hardest prompt to fade (e.g.,verbal). In order to minimize errors and ensure a high level of success during learning, prompts are given in a most-to-least sequence and faded systematically. During this process, prompts are faded quickly as possible so that the learner does not come to depend on them and eventually behaves appropriately without prompting.

Types of prompts Prompters might use any or all of the following to suggest the desired response:

Vocal prompts: Words or other vocalizations
Visual prompts: A visual cue or picture
Gestural prompts: A physical gesture
Positional prompt: e.g., the target item is placed close to the individual.
Modeling: Modeling the desired response. This type of prompt is best suited for individuals who learn through imitation and can attend to a model.
Physical prompts: Physically manipulating the individual to produce the desired response. There are many degrees of physical prompts, from quite intrusive (e.g. the teacher places a hand on the learner's hand) to minimally intrusive (e.g. a slight tap).

This is not an exhaustive list of prompts; the nature, number, and order of prompts are chosen to be the most effective for a particular individual.

Fading

The overall goal is for an individual to eventually not need prompts. As an individual gains mastery of a skill at a particular prompt level, the prompt is faded to a less intrusive prompt. This ensures that the individual does not become overly dependent on a particular prompt when learning a new behavior or skill.

Thinning a reinforcement schedule

Thinning is often confused with fading. Fading refers to a prompt being removed, where thinning refers to an increase in the time or number of responses required between reinforcements. Periodic thinning that produces a 30% decrease in reinforcement has been suggested as an efficient way to thin. Schedule thinning is often an important and neglected issue in contingency management and token economy systems, especially when these are developed by unqualified practitioners (see professional practice of behavior analysis).

Generalization

Generalization is the expansion of a student's performance ability beyond the initial conditions set for acquisition of a skill. Generalization can occur across people, places, and materials used for teaching. For example, once a skill is learned in one setting, with a particular instructor, and with specific materials, the skill is taught in more general settings with more variation from the initial acquisition phase. For example, if a student has successfully mastered learning colors at the table, the teacher may take the student around the house or his school and then generalize the skill in these more natural environments with other materials. Behavior analysts have spent considerable amount of time studying factors that lead to generalization.

Shaping

Shaping involves gradually modifying the existing behavior into the desired behavior. If the student engages with a dog by hitting it, then he or she could have their behavior shaped by reinforcing interactions in which he or she touches the dog more gently. Over many interactions, successful shaping would replace the hitting behavior with patting or other gentler behavior. Shaping is based on a behavior analyst's thorough knowledge of operant conditioning principles and extinction. Recent efforts to teach shaping have used simulated computer tasks.

One teaching technique found to be effective with some students, particularly children, is the use of video modeling (the use of taped sequences as exemplars of behavior). It can be used by therapists to assist in the acquisition of both verbal and motor responses, in some cases for long chains of behavior.

Interventions based on an FBA

Critical to behavior analytic interventions is the concept of a systematic behavioral case formulation with a functional behavioral assessment or analysis at the core. This approach should apply a behavior analytic theory of change (see Behavioral change theories). This formulation should include a thorough functional assessment, a skills assessment, a sequential analysis (behavior chain analysis), an ecological assessment, a look at existing evidenced-based behavioral models for the problem behavior (such as Fordyce's model of chronic pain) and then a treatment plan based on how environmental factors influence behavior. Some argue that behavior analytic case formulation can be improved with an assessment of rules and rule-governed behavior. Some of the interventions that result from this type of conceptualization involve training specific communication skills to replace the problem behaviors as well as specific setting, antecedent, behavior, and consequence strategies.

Efficacy in autism

ABA-based techniques are often used to change behaviors associated with autism, so much so that ABA itself is often mistakenly considered to be synonymous with therapy for autism. ABA for autism may be limited by diagnostic severity and IQ. The most influential and widely cited review of the literature regarding efficacy of treatments for autism is the National Research Council's book Educating Children with Autism (2001) which concluded that ABA was the best research supported and most effective treatment for the main characteristics of autism. Some critics claimed that the NRC's report was an inside job by behavior analysts but there were no board certified behavior analysts on the panel (which did include physicians, speech pathologists, educators, psychologists, and others). Other criticisms raised include the small sample sizes used in the published research to date. Medications have not been proven to correct the core deficits of ASDs and are not the primary treatment. ABA is the primary treatment according to the American Academy of Pediatrics. Recent reviews of the efficacy of ABA-based techniques in autism include:

A 2007 clinical report of the American Academy of Pediatrics concluded that the benefit of ABA-based interventions in autism spectrum disorders (ASDs) "has been well documented" and that "children who receive early intensive behavioral treatment have been shown to make substantial, sustained gains in IQ, language, academic performance, and adaptive behavior as well as some measures of social behavior".

Researchers from the MIND Institute published an evidence-based review of comprehensive treatment approaches in 2008. On the basis of "the strength of the findings from the four best-designed, controlled studies", they were of the opinion that one ABA-based approach (the Lovaas technique created by Ole Ivar Løvaas) is "well-established" for improving intellectual performance of young children with ASD.

A 2009 review of psycho-educational interventions for children with autism whose mean age was six years or less at intake found that five high-quality ("Level 1" or "Level 2") studies assessed ABA-based treatments. On the basis of these and other studies, the author concluded that ABA is "well-established" and is "demonstrated effective in enhancing global functioning in pre-school children with autism when treatment is intensive and carried out by trained therapists". However, the review committee also concluded that "there is a great need for more knowledge about which interventions are most effective".

A 2009 paper included a descriptive analysis, an effect size analysis, and a meta-analysis of 13 reports published from 1987 to 2007 of early intensive behavioral intervention (EIBI, a form of ABA-based treatment with origins in the Lovaas technique) for autism. It determined that EIBI's effect sizes were "generally positive" for IQ, adaptive behavior, expressive language, and receptive language. The paper did note limitations of its findings including the lack of published comparisons between EIBI and other "empirically validated treatment programs".

In a 2009 systematic review of 11 studies published from 1987 to 2007, the researchers wrote "there is strong evidence that EIBI is effective for some, but not all, children with autism spectrum disorders, and there is wide variability in response to treatment". Furthermore, any improvements are likely to be greatest in the first year of intervention.

A 2009 meta-analysis of nine studies published from 1987 to 2007 concluded that EIBI has a "large" effect on full-scale intelligence and a "moderate" effect on adaptive behavior in autistic children.

In 2011, investigators from Vanderbilt University under contract with the Agency for Healthcare Research and Quality performed a comprehensive review of the scientific literature on ABA-based and other therapies for autism spectrum disorders; the ABA-based therapies included the UCLA/Lovaas method and the Early Start Denver Model (the latter developed by Sally Rogers and Geraldine Dawson). They concluded that "both approaches were associated with ... improvements in cognitive performance, language skills, and adaptive behavior skills".:ES-9 However, they also concluded that "the strength of evidence ... is low", "many children continue to display prominent areas of impairment", "subgroups may account for a majority of the change", there is "little evidence of practical effectiveness or feasibility beyond research studies", and the published studies "used small samples, different treatment approaches and duration, and different outcome measurements".:ES-10

A 2009 systematic review and meta-analysis by Spreckley and Boyd of four small-n 2000-2007 studies (involving a total of 76 children) came to different conclusions than the aforementioned reviews. Spreckley and Boyd reported that applied behavior intervention (ABI), another name for EIBI, did not significantly improve outcomes compared with standard care of preschool children with ASD in the areas of cognitive outcome, expressive language, receptive language, and adaptive behavior. In a letter to the editor, however, authors of the four studies meta-analyzed claimed that Spreckley and Boyd had misinterpreted one study comparing two forms of ABI with each other as a comparison of ABI with standard care, which erroneously decreased the observed efficacy of ABI. Furthermore, the four studies' authors raised the possibility that Spreckley and Boyd had excluded some other studies unnecessarily, and that including such studies could have led to a more favorable evaluation of ABI. Spreckley, Boyd, and the four studies' authors did agree that large multi-site randomized trials are needed to improve the understanding of ABA's efficacy in autism. Some initial, theoretical work has been initiated to use applied behavioral analysis (ABA) as a foundation for agent-mediated, AI-based instructions for children with autism spectrum disorder.

A United States District Court Judge ruled withholding ABA from children (0-21) with autism causes irreparable harm, finding Elizabeth Dudek of Florida's Agency for Healthcare Administration's position suggesting ABA was experimental was arbitrary and capricious, ordering AHCA enjoined

from withholding ABA. Thereafter, CMS ordered its guidance that all states to cover ABA via Head Start and Early Head Start EPSDT programs.

Further research is clearly required, specifically to include larger and thus more representative samples.

Criticism

Conversely, various major figures within the autistic community have written biographies detailing the harm caused by the provision of ABA, including restraint, often used with mild self stimulatory behaviors such as hand flapping, and verbal abuse. Several of these have since been diagnosed with PTSD and depression. The Autistic Self Advocacy Network campaigns against the use of ABA in autism. Less scholarly reviews were provided by Elizabeth Devita-Raeburn of The Atlantic and by an ex-practitioner.

Major journals

Applied behavior analysts publish in many journals. Some examples of "core" behavior analytic journals are:

Journal of Applied Behavior Analysis
Journal of the Experimental Analysis of Behavior
Journal of Organizational Behavior Management
Journal of Behavioral Education
Journal of the Analysis of Verbal Behavior
Behavior Analysis Research and Practice
The Behavior Analyst Today
The Behavior Analyst
The Journal of Speech-Language Pathology and Applied Behavior Analysis
Journal of Early and Intensive Behavioral Interventions
The International Journal of Behavioral Consultation and Therapy
The Journal of Behavioral Assessment and Intervention in Children
The Behavioral Development Bulletin
The Journal of Precision Teaching and Standard Celeration
Behavior and Social Issues
Journal of Behavior Analysis of Sports, Health, Fitness, and Behavioral Medicine
Journal of Behavior Analysis of Offender and Victim: Treatment and Prevention
Behavioral Health and Medicine
Behavior Therapy
Behavior and Philosophy