Applied Behavior Analysis:
OVERVIEW AND SUMMARY OF SCIENTIFIC SUPPORT
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Applied Behavior Analysis
Applied behavior analysis (ABA) is a discipline concerned with the application of behavioral science in real-world settings such as clinics, schools, and industry with the aim of improving socially important issues such as behavior problems and learning (Baer, Wolf, & Risley, 1968).

With regard to individuals diagnosed with intellectual and developmental disabilities including autism, ABA-based procedures can be loosely categorized as "comprehensive" or "focused." It should be noted that these categories are broad and are mainly distinguished by the goals of treatment. Many children with autism and intellectual disabilities require both types of procedures.

Comprehensive ABA interventions are aimed at producing changes in specific skills that impact global measures of functioning including IQ, adaptive skills, and social functioning in children with autism. Typically, such treatment is provided for an extended period (often spanning several years) and is often a home- or center-based program (sometimes in an educational setting). Skills frequently targeted include attention, discrimination, language/communication, socialization, as well as more advanced educational skills (e.g., reading, math, etc.). These programs rely on the use of clear instructions, reinforcement, teaching small units of behavior, and repeated learning trials to maximize learning opportunities. When utilized with younger children, these interventions are often referred to as "early intensive behavioral interventions" (EIBI). Several research studies have demonstrated that center-based comprehensive ABA interventions are highly effective in improving IQ, adaptive skills, and social functioning when programming is delivered 25-40 hours per week. Research also suggests that these gains are more robust the earlier programming is initiated. Therefore, comprehensive ABA-based treatment is often sought out when a diagnosis of autism is made. Research on comprehensive interventions, or EIBI is summarized below.

Focused ABA interventions are generally more time-limited in nature because they are designed to address specific concerns including aggression, self-injury, disruptive behavior, pica and other challenging behaviors. Individuals with such problem behavior often meet criteria for certain psychiatric diagnoses, such as "Disruptive Behavior Disorder" or "Stereotypic Movement Disorder with Self-Injurious Behavior." ABA-based treatment of these problems involves first conducting a functional behavioral assessment to identify the variables controlling problem behavior (i.e., the cause of the behavior). Then, this assessment information is used to guide the development of an individualized treatment(s). Typically, function-based treatments involve altering the environment to minimize problem behavior, establishing and reinforcing adaptive behaviors, and withholding reinforcement for problem behavior. Focused interventions can also address other concerns such as anxiety and skills deficits (i.e., social skills and self-care deficits). These services are generally needed when attempts to address these concerns using standard teaching and parenting practices are unsuccessful. Nearly four decades of research has shown that ABA-based treatment approaches are effective in reducing problem behavior and establishing appropriate skills with children and adults; in home, school, and community settings; and with individuals with different
types of intellectual and developmental disabilities, including autism. **Research on focused interventions is summarized below.**

Regardless of the specific category or goals of treatment, features common to all ABA-based approaches are: 1) the objective measurement of behavior, 2) use of procedures based on scientifically established principles of behavior, and 3) precise control of the environment to allow for the objective evaluation of outcomes. Any clinical procedure or research investigation adhering to these basic criteria can be considered to be an ABA-based procedure. This includes "functional behavioral assessment," approaches such as "Positive Behavioral Support," and forms of "Behavior Therapy" that rely on direct observation of behavior, procedures based on behavioral principles, and analysis of behavior-environment relations.
1. Scientific Support for Applied Behavior Analysis

Over the past 40 years an extensive body of literature has documented the successful use of ABA-based procedures to reduce problem behavior and increase appropriate skills for individuals with intellectual disabilities (ID), autism, and related disorders. The literature consists of numerous controlled studies employing single-case experimental designs, consecutive controlled case-series studies, controlled group studies, and some randomized controlled trials.

1.1 Types of Research Designs

A number of different research designs are used to evaluate treatments and answer other questions about treatment procedures. Each type of design has its own scientific and practical strengths and limitations, and each is ideally suited to answer particular types of questions are are discussed further here.

1.2 Findings from Controlled Studies Employing Single-Case Experimental Designs

1.2.1 Small-n Controlled Studies. Over a thousand studies reporting on ABA-based assessment and treatment techniques have been published since the 1960’s. As noted above, these controlled studies have strong internal validity as they use experimental designs that permits one to conclude that the intervention was responsible for the change in behavior. Studies on topics relevant to the use of ABA with persons with intellectual and developmental disabilities are most frequently published in journals such as: Behavioral Interventions, Journal of Applied Behavior Analysis, Journal of Autism and Developmental Disorders, Journal of Intellectual Disability Research, Research in Developmental Disabilities, Research in Autism Spectrum Disorders. Topics of these studies include communication training, social skills training, behavioral assessment and treatment of problem behavior (self-injury, aggression), educational instruction, early intensive behavioral intervention, etc. For further information, the reader is referred to these journals or to an on-line search engine (i.e., PsychINFO, Google Scholar).

1.2.2 Consecutive Case Series Studies. As noted above, consecutive controlled case-series studies describe a series of cases where single-case experimental designs were used with all individuals encountered (regardless of whether the treatment was effective or not).

1.2.2.1 Functional Analysis of Problem Behavior. As noted above, focused ABA interventions for problem behavior are designed for each individual based on an understanding what antecedents that may “trigger” problem behavior, and what consequences that may reinforce it. Functional behavioral assessment can be performed using a range of procedures, including interviews, questionnaires, direct observation in the individuals natural setting, and the use of structured conditions where environments are simulated in the clinic setting (termed “analog” conditions). This latter type of procedure, functional analysis, is the most rigorous type of functional behavioral assessment. It involves the use of analog conditions designed to test hypotheses while behavior is precisely recorded, typically using computerized data collection. In most
cases, the results can reveal why problem behavior occurs and persists – and thus provides a foundation for focused interventions targeting these behaviors.

Literature reviews by Hanley, Iwata, and McCord (2003) and Beavers, Iwata, & Lerman (2013) collectively identified 435 peer-reviewed articles where functional analysis of problem behavior was reported. Studies listed below represent large-scale consecutive controlled case series studies involving functional analysis. These studies demonstrate that functional analysis is highly effective in identifying the controlling variables for problem behavior.

Iwata, Pace, Dorsey, Zarcone, Vollmer, Smith et al., 1994
Assessment: Functional analysis across a variety of settings (inpatient, residential)
Participants: 154 cases
Results: Conclusive results in over 90% of cases

Mueller, Nkosi, & Hine, 2011
Assessment: Functional analysis in school settings
Participants: 69 cases
Results: Conclusive results in over 90% of cases

Hagopian, Rooker, Jessel, & Deleon, 2013
Assessment procedure: functional analysis of severe problem behavior
Participants: 176 cases with severe problem behavior
Results: Conclusive results in over 90% of cases

1.2.2.2 ABA-Based Focused Treatment for Problem Behavior. As noted in section 1.2.1 above, studies employing rigorous single-case experimental designs describing ABA focused interventions for problem behavior have been reported for four decades. The following large-scale consecutive controlled case series studies provide further support for the effectiveness of these interventions. Findings from these studies parallel findings from reviews and meta-analysis of small-n studies.

Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998
Treatment: Functional communication training for treatment of problem behavior
Participants: 19 inpatient cases with IDD
Results: 80% or greater reduction in problem behavior in 90% of cases

Asmus, Ringdahl, Sellers, Call, Andelman, & Wacker, 2004
Treatment: Function-based treatment for severe problem behavior
Participants: 138 inpatient cases with IDD
Results: 90% or greater reduction in problem behavior in over 83% of cases

Kurtz, Fodstad, Huete, & Hagopian, 2013
Treatment: Functional-based treatment delivered by care providers (mostly parents) for severe problem behavior
Participants: 42 outpatient cases with IDD
Results: 80% or greater reduction in problem behavior in 95% of cases

Rooker, Jessel, & Kurtz, 2013
Treatment: Functional communication training for treatment of severe problem behavior
Participants: 50 inpatient and outpatient cases with IDD
Results: 80% or greater reduction in problem behavior in 86% of cases

1.3 Review Papers

Broadly speaking, **review papers** summarize the published literature on a specific topic (i.e., diagnosis, type of assessment or treatment procedure). The reader is referred to recent reviews on comprehensive and focused ABA-based interventions for problems associated with Autism:

Dawson & Bruner, 2011 Early Intensive Behavioral Intervention (EIBI) for ASD
Lang et al., 2010 Treatment of anxiety in ASD
Reichow & Volkmar, 2010 Social skills training for ASD
Myers & Johnson, 2007 Management of ASD
Anderson et al., 2012 Elopement in ASD
Doehring et al., 2013 Severe problem behavior in ASD

Recent reviews on ABA-based procedures for persons with intellectual and developmental disabilities (IDD):

Brosnan & Healy, 2011 Treatment of aggression in IDD
Lang et al., 2009 Treatment of elopement in IDD
Lilienfeld, 2005 Psychiatric disorders in IDD
Sturmey, 2002 Psychiatric disorders in IDD
Kahng et al., 2002 Treatment of self-injurious behavior
Hanley et al., 2003 Functional analysis of problem behavior
Tiger et al., 2008 Functional communication training for problem behavior

Review articles indicating that treatments for autism and intellectual disability derived from ABA-based procedures are empirically supported treatments also have been published in non-behavioral journals. For example, the journal *Current Opinion in Psychiatry* is a journal designed to assist clinicians and researchers by synthesizing the psychiatric literature. An article which reviewed the assessment and treatment of individuals with intellectual disabilities and psychiatric disorders concluded that: "**Interventions based on applied behavior analysis have the strongest empirical basis, although there is some evidence that other therapies have promise**" (Sturmey, 2002, p. 489). Also, in the journal *Pediatrics*, the official journal of the American Academy of Pediatrics (AAP), an article offering guidelines on scientifically supported treatments for childhood psychiatric disorders concluded: "**The most efficacious psychosocial treatment for autism is applied behavior analysis**" (Lilienfeld, 2005, p. 762). The AAP issued a Clinical Report in *Pediatrics* regarding the management of children with autism, and where the authors noted: "**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, and their outcomes have been significantly better than those of children in control groups.**" (Myers, & Johnson, 2007, p. 1164). In the *Archives of Pediatric and Adolescent Medicine*, Barbaresi et al. (2006) concluded, "**ABA should be viewed as the optimal, comprehensive treatment approach in young children with ASD.**"

Review papers finding support for ABA can be found in the following non-behavioral journals:
1.4 Meta-Analyses

In general, meta-analysis involves quantitative re-analysis of data reported in published studies. This requires standardizing treatment outcomes by statistically calculating “effect sizes” obtained within each study, for the purpose of evaluating data obtained across a group of studies on a particular treatment.

Similarly, seven meta-analyses (Campbell, 2003; Didden, Duker, & Korzilius, 1997; Harvey, Boer, Meyer, & Evans, 2009; Heyvaert, Maes, Van den Noortgat, Kuppens, & Onghena, 2012, Lundervold & Bourland, 1988; Ma, 2009; Weisz, Weiss, Han, Granger, & Morton, 1995) that collectively analyzed hundreds of studies concluded that ABA-based procedures were more effective for reducing problem behavior displayed by individuals with ID (as well as typically-developing individuals) than were alternative treatments. The large body of literature reviewed in these studies provides empirical evidence indicating that focused ABA interventions effective at assessing and treating a variety of socially important behaviors engaged in by individuals with a variety of diagnoses.

Furthermore, several meta-analytic studies also have found comprehensive ABA-based approaches for educating children with autism result in favorable outcomes (Eldevik, Hastings, Hughes, Jahr, Eikeseth, & Cross, 2010; Makrygianni & Reed, 2010; Reichow, 2012; Reichow, Barton, Boyd, & Hume, 2012; Virues-Ortega, 2010). In a recent meta-analytic study involving 22 studies, Virues-Ortega (2010) concluded: “Results suggest that long-term, comprehensive ABA intervention leads to (positive) medium to large effects in terms of intellectual functioning, language development, and adaptive behavior of individuals with autism.” (p. 397).

1.5 Systematic Evaluative Reviews

Systematic approaches for formally evaluating a body research have been developed to determine if a particular intervention can be characterized as “empirically supported” or “established” based on the number, quality, and outcomes of published treatment studies. These efforts have been undertaken for the purpose of guiding clinical practice, influencing regulations and standards, providing priorities for funding (for both research and treatment), and guiding professional training (see Mesibov & Shea, 2011). For example, the American Psychological Association (Task Force Promoting Dissemination of Psychological Procedures, 1995) described a process to identify “empirically supported treatments.” Those interventions with the highest level of support are characterized as “well-established” (Chambless, et al, 1996). Evaluations of the most commonly used focused ABA-based interventions (functional communication training and noncontingent reinforcement) indicated that these interventions meet criteria as “well-established” empirically supported treatments (Carr, Severtson, & Lepper, 2009; Kurtz, Boelter, Jarmolowicz, Chin, & Hagopian, 2011). ABA-based treatments for pica (Hagopian, Rooker, & Rolider, 2011), and for treatment of phobic avoidance (Jennett &
Hagopian, 2008) displayed by individuals with intellectual disabilities also have been characterized as “well-established.”

The National Standard Project of the National Autism Center developed a similar model to evaluate interventions for problems associated with autism (2009) – that evaluative method used the term “established” to describe interventions with the highest level of support. The National Autism Center’s report characterized antecedent treatments and behavioral treatments as “established” interventions for autism in particular. Using their evaluative method, the National Autism Center (2009) characterized comprehensive ABA-based interventions have been characterized as being “established” treatments for autism.

Wong and colleagues (2013), as part of the Autism Evidence-Based Practice Review Group, describe a process for the identification of clinical practices that have sufficient empirical support to be termed “evidence-based.” The group stated in regards to the strength of evidence of ABA “Twenty-seven practices met the criteria for being evidence-based (see table 7, page 20). Evidence-based practices consist of interventions that are fundamental applied behavior analysis techniques (e.g., reinforcement, extinction, prompting), assessment and analytic techniques that are the basis for intervention (e.g., functional behavior assessment, task analysis), and combinations of primarily behavioral practices…”
2. Scientific, Professional, and Government Organizations' Position on ABA

Based on the empirical evidence, many scientific, government, and professional agencies and organizations have concluded that ABA-based procedures represent best practices for individuals with autism and intellectual disability.

2.1 Scientific and Professional Organizations

- Autism Speaks states that “ABA is widely recognized as a safe and effective treatment for autism”; and “Behavior analysis is a scientifically validated approach to understanding behavior and how it is affected by the environment.”
- The American Association on Intellectual and Developmental Disabilities (formerly the American Association on Mental Retardation), the oldest and largest interdisciplinary organization of professionals concerned with intellectual disability and related disabilities, designated ABA-based procedures for the treatment of behavioral problems with individuals with intellectual disability and related disorders as "highly recommended" (Rush & Frances, 2000).
- American Academy of Child and Adolescent Psychiatry concluded: "ABA techniques have been repeatedly shown to have efficacy for specific problem behaviors, and ABA has been found to be effective as applied to academic tasks, adaptive living skills, communication, social skills, and vocational skills" (Volkmar et al., 2014).
- Organization For Autism Research ("The Best of the OARacle"; see page 100) “...[ABA] is distinguished from other interventions because it has been proven effective in promoting skill development in persons with autism.”
- National Autism Center’s National Standards Report (2009). Behavioral interventions based on ABA were found to have an established level of evidence to support their use. Examples include, behavioral packages, antecedent packages, comprehensive behavioral treatment for young children, modeling, schedules, pivotal response training, and self-management packages.
- National Professional Development Center on Autism Spectrum Disorders provides a list of several treatment options or components founded in applied behavior analysis (i.e., antecedent-based intervention, differential reinforcement, discrete trial training, functional behavior assessment, functional communication training, extinction, prompting, reinforcement, etc.) which have been demonstrated to be efficacious in children with autism.
- Association for Science in Autism Treatment (ASAT). In summary, ASAT found that “...ABA is effective in increasing behaviors and teaching new skills....ABA is effective in reducing problem behavior...and also indicates that, when implemented intensively (more than 20 hours per week) and early in life (beginning prior to the age of 4 years), ABA may produce large gains in development and reductions in the need for special services”

2.2 Federal Agencies. Various federal government agencies have also concluded that ABA-based procedures are well-established - particularly for individuals with intellectual disability and autism who display problem behavior.
- Center for Disease Control (see types of treatment) indicate that a “... notable treatment approach for people with an ASD is called applied behavior analysis (ABA). ABA has
become widely accepted among health care professionals and used in many schools and treatment clinics…"

- National Institute of Mental Health (NIMH) recognizes that ABA has become widely recognized as an effective treatment for individuals with autism (see treatment options section).

- National Institute of Child Health and Human Development states that “…applied behavior analysis (ABA), [is] a widely accepted approach that tracks a child's progress in improving his or her skills…”

- The Surgeon General of the United States stated, "Thirty years of research demonstrated the efficacy of applied behavioral methods in reducing inappropriate behavior and in increasing communication, learning, and appropriate social behavior." (1999)

- The Senate Select Committee on Autism and Related Disorders: During an informational hearing on Health Insurance Coverage for Autism Spectrum Disorders (ASD) in 2010 and 2011 the California Department of Insurance concluded that “…Applied Behavioral Analysis therapy (ABA) is a medically necessary treatment for individuals with autism.” Furthermore, it was determined that “ABA therapy is neither experimental nor investigational; and leads to significant improvements in IQ, communication and language skills, and adaptive behaviors; as well as to reduction in self-injurious behaviors.” The reviewers further note, “providing such essential health care treatment to children with autism results in enabling them to learn in school, succeed at work, and participate fully and productively in family and community activities, thereby providing a better quality of life for the patient and the family”.

2.3 State Agencies. Several states have assembled task forces comprised of parents and professionals to develop guidelines and position statements. These committees identified ABA-procedures as representing best practices:

Task Force and Position Statements:

- New York State Department of Health ("Guidelines: Autism/Pervasive Development Disorders, Assessment and Intervention for Young Children (0-3), Chapter IV - Behavioral and Educational Approaches") “It is recommended that principles of applied behavior analysis (ABA) and behavior intervention strategies be included as an important element of any intervention program for young children with autism”

- Maine Administrators of Services for Children with Disabilities ("Report of the MADSEC Autism Task Force"; see page 21 of report) “Over the past 40 years, several thousand published research studies have documented the effectiveness of ABA…across a variety of populations, interventionists, settings, and behaviors”

- New Jersey Position Statement on Treatment “Applied Behavior Analysis (ABA) and Positive Behavior Supports (PBS) have been demonstrated to substantially improve an individual's quality of life”

- New Hampshire Taskforce on Autism (Part One: Assessment and Intervention) stated several advantages to ABA approaches including “Individualized treatment is based on clear definitions, specific goals, and observable behavior…there is more objective research for ABA techniques than for any other class of interventions…ABA techniques are useful for individuals at different developmental levels who possess a variety of skills and/or problem behaviors…ABA techniques in general are promising in improving overall functioning in children, adolescents, and adults."
Best Practice Guidelines and Technical Assistance Manuals recognizing the importance of applied behavior analysis:

- California Department of Education: Best Practice Guidelines for Designing Effective Programs for Individuals with Autism Spectrum Disorders  
  “Applied behavioral analysis is usually needed to assist a child to gain skills and reduce negative or undesirable behaviors”

- Autism Spectrum Disorders: Services in West Virginia Schools; Guidelines for Best Practice: Teaching strategies shall be based on peer reviewed and empirically validated evidence-based practices/methodologies for students with autism.  
  “At this time the science heavily favors, but is not limited to those based on the science of applied behavior analysis, defined as the application of behavioral principles for the benefit of the learner and includes simultaneous evaluation of the effect of these applications”.

3. National and State Legislation in Support of ABA-Based Services

Over the years multiple federal and state legislative rulings have supported the efficacy of ABA-based approaches for addressing both focused treatments for individuals with intellectual disabilities and autism and comprehensive interventions. Listed below are pertinent examples. Readers are encouraged to search The National Conference of State Legislatures (NCSL), Autism Legislation Database for a comprehensive summary. http://www.ncsl.org/issues-research/health/autism-policy-issues-overview.aspx

3.1 Judicial Rulings in Support of Funding and Access to ABA-Based Services

The following court proceedings found school districts financially responsible for all, or a portion of the costs associated with an in-home or center-based ABA-program. These funds were often reimbursed to families who were compelled to pay for these services out of pocket.
- South Carolina Federal District Court: J.B. and M.B v Board of Education for Horry County (2001)
- Federal District Court of Philadelphia: Bucks County Department of Mental Health v. DeMora
- United States Court of Appeals for the 9th District: Clark County Schools and the Nevada State Department of Education (2001)
- J.P. v. School Board of Hanover County, VA (2008)

Other pertinent proceedings:
- Potter, et al. v. Blue Cross Blue Shield of Michigan (2013). S. Eastern District Judge Stephen Murphy III noted that “ABA therapy is supported by numerous authorities…” Judge Murphy also stated that “denial of insurance coverage for this therapy on the grounds that the therapy is “experimental” was arbitrary and capricious under federal law”.

3.2 Federal Legislation
The following laws offer support or recognition to the importance of ABA or ABA-based procedures:

- The Education of the Handicapped Act (1970)/ Individuals with Disabilities Education Act (IDEA, 1997/2004) requires that participating state and local educational agencies “to assure that handicapped children and their parents are guaranteed procedural safeguards with respect to the provision of free appropriate public education.” Functional behavior assessment (FBA; the standard behavioral assessment procedure of ABA) was codified in IDEA (2004) which requires that an FBA inform behavior-intervention plans developed to ameliorate problem behavior in children with disabilities.

- For a more comprehensive list of state and federal initiatives, readers are encouraged to review: http://www.wrightslaw.com/caselaw.htm

- Insurance coverage laws: Federal and state initiatives have led to widespread insurance reform with respect to coverage of ABA services.
  
  i. Caring for Military Kids with Autism Act (2011): ABA treatment found to be medically necessary treatment, not educational
  
  ii. Burge v. United State of America (2012): ABA services were found to be medically necessary and TRICARE military insurance was found liable for costs associated with an ABA in-home program
  
  iii. State Legislation: Since 2007, over half of the states in the U.S. have pursued insurance reform and have been successful in passing bills which require insurers to pay for autism services, with many explicitly listing ABA services.

- For a comprehensive list of insurance reform, state-by-state, see these websites:
References


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