Three Years of Intensive Applied Behavior Analysis: A Case Study

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Abstract

A 2 years and 10 months old child receiving an early intensive teaching program using the Comprehensive Application of Behavior Analysis to Schooling (CABAS®) was taught using evidence-based teaching strategies and curricula based on existing research in both the applied and basic sciences. Progress was measured using behavioral assessment tools and mastery of pre-set learning criteria. Independent measures in the form of psychological assessments were also administered annually over a three year period. This paper will provide an overview of the learning profile provided and the results achieved.

Keywords: Autism; Early intervention; Evidence-based teaching, CABAS®, Outcomes

For more than thirty years empirical studies have been conducted and published in numerous peer-reviewed journals showing the efficacy of applied behaviour analysis (ABA) in the treatment of autism spectrum disorders. It is not surprising given the years of dedication by many well respected researchers that ABA has more empirical support than any other treatment or therapy for children diagnosed with autism. It incorporates numerous teaching strategies, each of which have an empirical basis demonstrating their effectiveness. (Matson, Benavidez, Compton, Paclawskyj, & Baglio, 1996). Applied Behaviour Analysis is a science-based approach to education. Numerous governmental and private agencies in the U.S.A. have endorsed it as the preferred therapy for children with autism (e.g., Surgeon-General, 1999; Maine Administrators of Service for Children With Disabilities, 2000; New York State Department of Health, 1999). There are hundreds of objective research studies that have shown applied behavior analysis to be an effective method for teaching language and communication, social and leisure skills,and independent functioning, as well as reducing, replacing and eliminating challenging behaviours (Matson et al., 1996.)

There are a number of comparison studies that have 'tested' the outcomes of treatment models for children with autism. The first large-scale and most well documented outcome study of ABA as a treatment for autism was published by Lovaas (1987). Out of 19 children given 40 hours of one-on-one treatment for two years, almost half were able to complete a typical first grade class without special supports or accommodations. These nine children achieved IQ scores in the normal range (94-120). They had achieved typical or average functioning both developmentally and educationally. In a follow-up study aimed at investigating the long-term outcomes of these same children, McEachin, Smith, and Lovaas (1993) found that IQ and behavioral gains were maintained over about a ten-year period. Using double blind clinical assessments, eight of the nine children with the best outcomes were indistinguishable from normal controls based both on clinical evaluation as well as standard clinical assessment measures. Results indicated that these children continued to function normally into adolescence (McEachin et. al., 1993).

A study conducted by Anderson, Avery, DiPietro, Edwards, and Christian (1987) produced results similar to Lovaas', but did not include a control group. Three additional studies have in part replicated Lovaas' original findings and demonstrated results in significant gains intellectually or in precise skills for participants (Birnbrauer & Leach, 1993; Sheinkopf & Siegel, 1998; Smith, Eikseth, Klevstrand, and Lovaas, 1997). All three of these studies demonstrated IQ improvements and other gains in children receiving ABA, although not to the same degree demonstrated by Lovaas (1987). However, the intensity of treatment differed somewhat from that in the Lovaas study with fewer hours of ABA intervention per week, so it is difficult to draw comparisons. Like Lovaas (1987), Sallows & Graupner (2001) demonstrated that 45% of those receiving ABA treatment in their study (these

children were considered to show the best outcomes) achieved average levels of intellectual functioning. While earlier research investigated the different effects of varying the intensity of treatment, more recently, research has focused on comparison of treatment types.

For example, recent studies have indicated important outcomes by providing a comparison between the use of an applied behavior analysis approach and 'eclectic' mixtures of procedures. Such studies presented one group of children with an applied behavior analysis program that emphasized the use of empirically supported techniques, such as reinforcement strategies, shaping, prompting, functional communication training etc. in structured, informal one-on-one and group settings. A second group of children received a variety of teaching procedures, including a component of applied behavior analysis, Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH; e.g., Schopler, 1997) sensory integration, music sessions, and circle time. Children in the ABA group received treatment for 28 hours per week in the first study (Eikeseth, Smith, Jahr, & Eldevik, 2002) and for 40 hours per week in the second study (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005). Results of both of these studies at follow-up indicated that the children receiving the applied behavior analysis program scored higher on standardised test, and had made more progress in a number of domains than the children in the other groups. Findings were reported in areas of language, communication, social skills, independence, and problem behaviors.

Most recently, Remington et al., (2007) compared the effectiveness of early intensive behavioral intervention (EIBI) with a standard 'eclectic' preschool provision. Results showed that EIBI led to significant, positive changes amongst the children with autism, including gains in intelligence, language and daily living skills, as well as in motor and social skills. In addition, these positive changes in children were achieved without negative impact on the psychological wellbeing of parents. Remington et al. argue that further research is required to identify factors that best predict the effectiveness of the intervention, factors that increase its impact, and factors that ensure its benefits are maintained in the longer term.

Reed, Osborne & Corness (2006) compared home-based interventions for young children using applied behavior analysis models. Hi- intensity (mean of 30 hours per week) and low-intensity (mean of 12 hours per week) applications were compared. Children in the high-intensity group made more gains in educational progress and cognitive functioning that the children in the low-intensity group. Additionally, when the three types of hi-intensity applications were compared, the CABAS® approach was found to produce superior gains "...in terms of statistical significance and effect sizes..." (p. 10).

Case studies have been documented in which independent evaluators used objective measurement instruments to track children's progress (Green, Brennan, & Fein, 2002; Perry, Cohen, & De Carlo, 1995). For example, Perry et al. report the effectiveness of early intensive behavioral intervention with two siblings with autism diagnoses. The intervention involved up to 35 hours of intensive 1:1 teaching sessions. Professionals who diagnosed the children evaluated their progress systematically and reported that both no longer met the criteria for diagnosis of autism.

Since the publication of the Lovass study in 1987 there has grown a number of prominent behavioral approaches to treating autism. One such approach is a school-based intervention based on over 26 years of research by Professor R. D. Greer and his colleagues. The approach is a called The Comprehensive Application of Behavior Analysis to Schooling (CABAS®) (Greer, 1994a, Greer, Keohane & Healy, 2002; Lamm & Greer, 1991). It is a research-based, systems-based approach, school-wide application to education. The system has accrued an extensive database for developing and maintaining quality applications. CABAS® professionals draw on the existing 65 years of basic and applied research in behavior analysis and 22 years of research in verbal behavior based on Skinner's theoretical model (1957) to design curriculum for students, teachers, and teacher mentors, measure results, and inform new research.

Research drives, instruction for acquisition as well as performance tasks, and supports curricula for students, and the training and monitoring of teachers, parents, supervisors, and systems performance (Greer, 1987; 2002; Greer, Keohane & Healy, 2002). This systems science of schooling can produce from four to seven times more learning than the learning found in normative practice (Albers & Greer, 1991; Diamond, 1992; Ingham & Greer, 1992; Selinski, Greer, & Lodhi, 1991).

The CABAS® system not only adopts the entire behavioral research literature where appropriate for analyzing the learner but it similarly adopts the relevant literature for monitoring the progress and the skills of the teacher (Keohane & Greer, 2005). Intensive one-to-one interactions involve two persons, both child and educator. Many behavioral approaches analyze and monitor the child's progress, but omit an examination of the effectiveness of the educator in presenting the teaching material or in shaping the target response. In addition to a detailed analysis of the level of effective and appropriate teaching of educators, continuous assessment and monitoring of all instructors at all levels is conducted. This emphasis on both sides of the learning equation and on all individuals at all levels of participation produces a system of instruction that is constantly evolving and perfecting itself. CABAS® is the only such system which does this (Greer, Keohane, & Healy, 2002).

The current study provides a case study of an early intensive behavioral intervention based on the CABAS® system for a young child diagnosed with autism spectrum disorder and tracks the progress made based on independent psychological assessments and behavioral assessment tools.

Method

Participant

The participant was born on March 11th 2000. She was full-term and there were no complications at birth. She had one brother aged 11 and lived at home with both parents. She was diagnosed with Autism Spectrum Disorder at age 2 years and 2 months. At the time of entry into the CABAS® program, the participant was aged 2 years and 10 months.

Assessment History

The first assessment was conducted in April 2002 when the participant was 2 years and 1 month of age. At this point there was a suggestion of a possible diagnosis of Autism Spectrum Disorder. A follow-up assessment was recommended following one month.

The second assessment was conducted in May 2002, at 2 years and 2 months.
It was concluded by the psychologist that 'present assessment and the developmental profile obtained from parents confirm that the child has the impairments of social interaction, social communication, social imagination, and tendency towards repetitive behaviour patterns which are diagnostic of an autistic spectrum disorder'

The third assessment in July 2002, at 2 years and 4 months, was conducted to determine an appropriate educational provision. It was concluded that the participant displayed poor compliance to adult directions, poor attention to tasks and difficulties with compliance, stereotypical patterns and self-stimulatory behaviors, language and social communication difficulties that impacted primarily on her ability to learn. The following is a summary of the deficits highlighted in the third assessment:

- not toilet trained
- fed with a spoon and drinks from a bottle
- receptive and expressive language skills are delayed
- has 3 words (sorry, no and now)
- communicates by leading people by the hand to what she wants
- object exchange e.g., brings bottle to ask for items
- visitors to the house are ignored

- just beginning to imitate actions of favorite characters on TV
- repetitive hand movements - she clenches her hands and presses them tightly up against her face
- walks on tip-toes
- dislikes loud noises (e.g., runs from the garden when she hears the lawnmower)
- has a fascination with a toothbrush and likes to have one in her hand
- watches videos in a repetitive fashion
- difficult to get her to do something she doesn't want to do
- attention to adult-driven tasks is more limited than it is for self-chosen activities
- very limited expressive language skills
- core difficulties with comprehension affect her ability to perform in a range of activities

It was recommended, following this assessment that the participant should immediately access an autism-specific educational environment and a teaching approach based on applied behavior analysis.

The CABAS® System

The Comprehensive Application of Behaviour Analysis to Schooling (CABAS®) is a system for developing and maintaining quality in schools that provides a system-wide application of behavior analysis to all of the components of education including curricula focused on the education of the whole child (e.g., language acquisition, social skills, academic skills), and protocols to induce pre-requisite verbal developmental cusps (Greer, 2002; Keohane & Greer 2005; Greer & Ross 2008) . The system has been developed using an extensive database for ensuring and maintaining quality applications. Those components include: minimal standards of teaching as applied behavior analysis, curricula for teachers and other professionals, research-based tools to train and monitor professionals and, curriculum revisions for students occasioned by research.

In January 2003, an early intervention program based on the Comprehensive Application of Behavior Analysis to Schooling (CABAS®) was established at the opening of the Dublin CABAS® School, based on parent initiative. The participant was enrolled in the program which applied the following teaching practices:

- Logical and empiraclly based curricular sequences
- Functional curriculum based on an analysis of verbal behavior across domains
- 1:1 teacher/student ratio of instruction
- Logical curricular sequences based on research and eduactional standards
- Personalised System of Instruction (PSI) (Keller, 1968)
- Peer tutoring
- Group Instruction (e.g. use of direct instruction curricula and observational learning)

The intervention program was characterised by several key tools that are used to teach different repertoires and maintain and motivate performance. These tools are derived from ongoing research. Some of these tools include: use of learn unit instruction (Bahadorian, 2000, Greer & McDonough, 1999), the Teacher Performance/Rate Accuracy Observation Protocol (Ingham & Greer, 1992), the CABAS® Decision Protocol (Keohane, 1997; Greer (revised August 2001); Keohane & Greer, 2005), implementation of a parent education program; and system monitoring and staff training (Greer, 1997).

Learn Unit Instruction: The learn unit is a measure of both the accuracy of teacher presentations and the productivity of instructors (Greer & McDonough, 1999). The learn unit is a complex but robust predictor of student or client outcomes. In CABAS® schools, learn units are graphed by curricular areas and individual programs. The learn units taught to students by curricular area are critical in assessing whether the student is receiving necessary and sufficient instruction. In addition, learn units are graphed to criterion at the levels of individual students, instructors, classrooms, and school-wide.

Teacher Performance Rate/Accuracy Performance Protocol (TPRA): This observation protocol measures the instructor's accuracy and rate at presenting learn units to students. Presentations of instructional units that are learn units predict student outcome and can increase from four to seven times (Ingham & Greer, 1992). In CABAS® schools, supervisors use the TPRA procedure on a regular basis to dramatically improve the prognosis of the student, whether the student is receiving massed or captured learn units (e.g., incidental learn units). The procedure affects teacher performance almost immediately and its continued use insures consistent quality. The TPRA is a measure also of the accuracy of teachers' data as well as their instructional accuracy.

CABAS® Decision Protocol: This protocol involves continual review and scripting of long-term objectives that were broken down into short-term objectives. One of the key aspects of quality instruction is the accuracy of the practitioner's use of visual displays of data to insure that the student/client is making progress towards long and short-term objectives. Decisions to alter short-term objectives were based on visual displays of data and the use of 'The decision tree protocol' (Keohane, 1997; Greer (revised August 2001); Keohane & Greer, 2005). The practitioner's use of visual displays of data to insure that the student is making progress towards long and short-term objectives is a key means of monitoring the degree to which the practitioner is acting as a strategic scientist. Research demonstrates that when the decision tree protocol is used by instructors, students learn significantly more than when it is not used (Keohane, 1997; Keohane & Greer, 2005; Nuzzolo-Gomez, 2002).

Parent Education Program: As part of the initiative, parent education was provided within the school once per month. This allowed the participant's parents to attend the school to learn behavior change procedures that would be effective within the home setting. Training was given by the school director and involved a generalization plan for mastered skills. Procedures were modelled by the school instructors and parents were taught how to deliver learn unit instruction. The participant's parents were required to participate in the initial assessment of skills, assist in establishing specific objectives as targets within the home setting and demonstrate direct instruction followed by feedback from the school director.

System Monitoring and Staff Training: In addition, the quality of the training program delivered to staff ensured that certain expected standards were met resulting in continued improvement in the quality of the professional service delivered. In this particular case, the CABAS® system for ongoing staff training builds on Keller's Personalised System of Instruction (PSI) approach (Keller, 1968) within a 'rank' training protocol. That is, the components of behavior analytic teaching and supervision are divided into three categories for each rank, and arranged from less difficult to complex. Professionals move through the levels of expertise in an individual fashion.

The three broad repertoires of teachers as scientist-practitioner are: (a) the vocabulary of the science of applied behaviour analysis or verbal behavior about the science, (b) classroom and supervisory practice in situ or contingency-shaped repertoires of in class practice, and (c) verbally mediated repertoires making decisions about applications of behavioral strategies. Instruction in these three repertoires is arranged in levels of difficulty or modules that are tied to three teacher ranks (Teacher I, II, and Master Teacher), followed by three behavior analyst ranks, and three research scientist ranks. There are 10 modules for each of the three repertoires and several components within each module. A component in a module is an instructional objective for the professional. For example, in the first teacher rank there are 87 individual criterion referenced-objectives or components in the 30 modules. The ranks, and the modules in each rank, are used as a way to organize professional instruction by levels of difficulty, motivate staff, recognize achievement, and acknowledge expertise. When individuals in CABAS® schools complete the requirements for each rank under the supervision of a senior behavior analyst, those individuals may submit their achievements to the CABAS® Professional Advisory Board for board certification. The CABAS® model of behavioral instruction is one of the very few models which have produced valuable research into the role of teaching in relation to student progress (Greer, 1994b; 1996a; 1996b, Greer, 2002).

The quality of program delivery in the participant's school was set up by the Senior CABAS® Consultant and the Associate CABAS® Consultant for the CABAS® model and maintained through the use of a hierarchy of supervision with close monitoring by two doctoral level consultants. The consultants were both certified by the CABAS® Board of Directors as Senior Research Scientist, and Assistant Research Scientist, and provided consultancy to the school four times annually. In addition, a further professional provided inservice training in Applied Behavior Analysis to the school six times annually. This consultant was certified within the CABAS® system as an Assistant Behaviour Analyst and was also certified as a Board Certified Behavior Analyst from the Behavior Analyst Certification Board (BACB®). The school was directed by a doctoral level behaviour analyst who was certified as a CABAS® Master Teacher and received ongoing training in the CABAS® system from both consultants. The system provided ongoing instruction and monitoring of all instructors within a curriculum for the education of professionals, a continuous monitoring of system for maintaining quality applications by professionals, and a motivational system (Greer, Keohane, & Healy, 2002). Twelve of the instructors at the school were certified as Teacher I ranks and four were certified as Teacher II ranks.

Curricula

Curricular goals were derived from The Preschool Inventory of Repertoires for Kindergarten (PIRK®), (Greer & McCorkle, 2003) which is a curriculum for use within CABAS® accredited schools only, and The Assessment of Basic Language and Learning Skills (ABLLS) (Partington & Sundberg, 1998). The PIRK® constitutes the curricular objectives for teaching the repertoires necessary for a child to excel in Kindergarten including the repertoires associated with academic literacy, communication, self-management for school self sufficiency, social self management, community of reinforcers (inventory of the child's interests and preferences), and physical development. That is, the assessment covers what a child needs to be very successful in the school, the home, and the community. This assessment is based on behavior analysis and pedagogical research. It includes 242 objectives across 14 different curricular areas. Curricular goals are then selected based on deficits identified in the PIRK.

The ABLLS protocol is an assessment, curriculum guide, and skills tracking system for children with language delays. It contains a task analysis of 455 skills divided into four broad categories (basic learner skills assessment, academic skills assessment, self-help skills, and motor skills assessment). In total, there are 24 different areas of ability across each of the broader categories.

Intervention

During the early phases of instruction, the participant would not sit down in a chair, displayed no appropriate forms of communication, displayed tantrum behaviours and cried for most of the school day, gathered items, displayed no eye contact, had little or no appropriate play skills, and displayed high rates of self-stimulatory behaviour by tensing her arms and contorting her upper body. An intensive school-based intervention was delivered that involved 32.5 hours per week using The CABAS® System outlined above.

Socially significant objectives were selected and prioritized during the early stages of intervention. Goals were operationalized and criterion referenced. Instruction for each long term goal was provided using scientifically derived tactics and interventions from the research literature in applied behavior analysis. Teaching was provided using learn unit presentations. During daily intervention for the participant, instructors graphed all correct responses to learn units according to curricular areas and individual programs. Instruction was provided in the following curricular areas in accordance with the CABAS® educational system:

- Communication (speaker and listener objectives)
- Academic literacy

- Problem-solving
- Self-management and social self-management (behaviour management, social skills, self-help and school routines)
- Physical repertoire
- Play and leisure skills (enlarging community of reinforcers)

Performance was measured throughout instruction and included total learn units and correct responses presented daily (broken into curricular area and individual programs), cumulative criteria and learn units to criterion.

Measures

The participant was evaluated by the same independent, self-employed educational psychologist three times across a three year period (2004-2006). This psychologist was a registered member of the British Psychological Society and was qualified in the administration of diagnostic and assessment tools. The measures employed covered three broad areas: autistic severity (Gilliam Autism Rating Scale), educational functioning (British Abilities Scales II), and adaptive behavioral functioning (Vineland Adaptive Behavior Scale).

Gilliam Autism Rating Scale: The Gilliam Autism Rating Scale (GARS; Gilliam, 1995) comprises four subtests, each describing behaviors symptomatic of autism. These subtests are: *Stereotyped Behaviors* – describing stereotyped behaviors, motility disorders and other unique and strange behaviors. *Communication* – describes verbal and nonverbal behaviors that are symptomatic of autism. *Social Interaction* – evaluates the child's ability to relate appropriately to people, events, and objects. *Developmental Disturbances* – asks questions about the child's development during early childhood. The raw scores from these subscales can be converted into standard scores (mean = 100, standard deviation = 15). These subscales combine to give an *Autism Quotient*, high scores meaning greater autistic severity (mean = 100 [average autistic severity], standard deviation = 15).

According to Gilliam (1995) the scale is appropriate for persons aged 3 to 22 years, and is completed by parents or professionals in about 10 minutes. Its internal reliability ranges from 0.88 (*Developmental Disturbances*) to 0.93 (*Social Interaction*), with the overall *Autism Quotient* having an internal reliability of 0.96. The GARS has high criterion validity with other tools, for example, the Autism Behavior Checklist (0.94).

British Abilities Scale: The British Abilities Scale (BAS II; Elliott, Smith, & McCulloch, 1996) is a battery of tests of cognitive abilities, which index educational achievement. It is suitable for use with children and adolescents from two years, six months old (2:6) to seventeen years, eleven months old (17:11). The present use of the test concerned educational achievement, and therefore the *Verbal Cluster*, *Pictorial Reasoning Cluster*, and *Spatial Cluster* subscales were used. These scales allow the calculation of a *General Cognitive Ability* scale (mean = 100, standard deviation = 15), which represents early educational achievement.

Vineland Adaptive Behavior Scale: The Vineland Adaptive Behavior Scales (VAB; Sparrow, Balla, & Cicchetti, 1998) is a semi-structured interview, administered to a parent or other caregiver of the child. It can be used from birth to 5:11 years, making it suitable for the present participant. The VAB scale assesses children's day-to-day adaptive functioning. Scores from four domains of adaptive behavior were used in the present study: *Communication* – reflecting the child's receptive, expressive, and written language skills; *Daily Living Skills* – reflecting the child's personal self-care, domestic and community living skills; *Socialization* – reflecting the child's interpersonal play or leisure skills, and coping skills; *Motor Skills* – reflecting the child's ability to utilize implements. The raw scores can be converted to standard scores, and a *Composite Overall* score can be derived based on sum of scale standard scores (mean = 100; standard deviation = 15). Sparrow et al. (1999) have reported that the internal reliability of the subtests ranges from 0.80 (*Daily Living Skills*) to 0.87 (*Socialization*), with the *Overall Composite* score having an internal reliability of 0.93.

Systematic Integration into the Mainstream Setting

During the period from October 2005 to November 2006, the participant began to attend a mainstream primary school for integration purposes. She was accompanied by an ABA instructor who provided prompting when necessary to acquire learning targets. Such learning targets during the early stages of integration included play and social skills, and were gradually increased to include academic goals in a large group instructional situation. Behavioral tactics were employed within this setting, e.g. self-management for peer initiations and self-management of self-stimulatory behavior. Learning during this period was also measured and decisions about increases in integration were data-based. The participant attended for Junior Infant classes up to June 2006 (The Irish Primary School designates the first year of school as junior infants, the second year as senior infants; all remaining school years are labelled first to sixth classes). Peers in this class were on average one year older than the participant. In September 2006 the participant began attending first class which was the age-appropriate grade level.

Results

Assessments were carried out over a three year period by an independent educational psychologist to review progress made. Table 1 summarizes the recommendations made by the independent psychologist following each assessment. The psychologist outlined that during an early assessment, the participant displayed a 'moderate-severe cognitive deficit at that time and indicated a significant learning disability.' However, during the final assessment he articulates that her 'cognitive skills have developed quickly so that on this current assessment they are all within the average range.' During the final assessment in March 2006, the psychologist recommended that the remaining of the school year be spent preparing the participant for full-time mainstream attendance.

Table 1: Summary of recommendations by the independent educational psychologist over a three year period.

Date of assessment	Time spent in intervention	Report of independent psychologist
July 2004	One year 6 months	• moderate-severe cognitive deficit with a significant learning disability
June 2005		• Language skills have made significant gains since July 2004 • Verbal comprehension is now functioning at the 4:1 year level- only a few months delayed • Her cognitive ability presents overall being within the average range for her age
March 2006		• Cognitive skills have continued to make very good progress and all of her skills on testing now present as being within the average range • The change in her cognitive profile has been highly significant • Her cognitive skills have developed quickly so that on this current assessment they are

		all within the average range. • The remainder of this school year could be actively spent in preparing her for that transition with support to mainstream school.

Table 2 summarizes scores obtained using the British Ability Scales, the Vineland Adaptive Behavior Scales and The Gilliam Autism Rating Scales over a three year period. During the period from June 2002 to March 2006 the participant made significant gains in all areas of testing with her autism quotient decreasing from 94 to 75. Her communication skills increased from an age-equivalent of 1 year in 2002 to 5:1 years in 2006. In addition, the measure of adaptive behaviour composite increased from a score of 69 to 75.

Table 2: Summary of scores obtained during assessment on psychological testing.

Test	Subtest	June 2002	July 2004	June 2005	March 2006
BAS II British Ability Scales	Verbal Cluster	n/a	83	92	96
	Pictorial Reasoning Cluster	n/a	90	85	102
	Spatial Cluster	n/a	96	105	103
	General Cognitive Ability	n/a	87	92	100
Vineland Adaptive Behaviour Scales	Communication	67 1:0 years	73 2:8 years	74 3:5 years	84 5:1 years
	Daily Living Skills	73 1:6 years	77 3:2 years	78 3:11 years	85 5:2 years
	Socialisation	61 0:9 years	64 1:9 years	66 2:5 years	75 3:10 years
	Motor	98 2:2 years	99 4:3 years	103 5:5 years	n/a 6:4 years
	Adaptive Behaviour Composite	69	72	74	75
Gilliam Autism Rating Scales	Autism Quotient	94	80	77	75

Table 3 provides an overview of the gradual integration process that was implemented. In October 2005, the participant attended mainstream schooling, accompanied by an ABA instructor, for 30 minutes per day with the primary behavioral targets identified as play skills at the Junior Infant level. The period of access to mainstream education was gradually expanded with the participant attending Math and English classes by April 2006. By September 2006, the participant showed the

ability to access the first class curriculum of Math and English classes, with the independent psychologist noting that she was functioning at the equivalent level to her peers. By this date, the participant was no longer accompanied by an ABA instructor. Attendance was systematically increased to 2 hours per day by November 2006.

Table 3: Summary of systematic increases in attendance at mainstream schooling.

Date	Duration	Curriculum Area	School Year
Oct 2005	30mins	Play with peers	Junior infants ABA instructor present
Jan 2006	60mins	Math Class & Play	Junior infants
April 2006	90mins	English, Math classes & play	Junior infants
May 2006	120mins	Social Physical and Health Education (SPHE) class, English, Math classes, & play	Junior infants
June 2006	150mins	Social Physical and Health Education (SPHE) class, English, Math classes, play & lunch time	Junior infants No ABA instructor present
Sept 2006	60mins	Math & English Classes Functioning at equivalent level to peers	First class without support from ABA instructor
Nov 2006	120mins	Math & English classes	First class

Tables 4, 5 and 6 depict the acquisition of skills under each of the curricular areas of the ABLLS. The participant gained 417 items across 24 skill areas between the initial entry assessment in December 2002 and February 2006. The participant completed all items within 19 of the 24 areas and in the remaining areas she showed greater than 75% acquisition on the final assessment date (see Figure 1).

Table 4: Raw scores from ABLLS® assessments of basic learner skills from December 2002 to February 2006.

Date	Basic Learner Skills						
	Cooperation	Visual Perform.	Receptive Language	Imitation	Vocal Imitation	Request	Labelling
Dec 2002	0/11	2/21	0/52	0/13	0/9	3/27	0/42
Sept 2003	3/11	5/21	1/52	1/13	2/9	3/27	0/42
Jan 2004	7/11	11/21	9/52	4/13	2/9	6/27	3/42
June 2005	11/11	18/21	33/52	9/13	6/9	14/27	15/42
Feb 2006	10/11	16/21	52/52	13/13	9/9	27/27	37/42

ABLLS® Assessment Scores in Skill Areas
December 2002-February 2006

Date	Basic Learner Skills						
	Intraverbal	Spontaneous Vocalizations	Syntax	Play	Group	Classroom Routine	Generalized Responding
Dec 2002	0/42	0/9	0/20	0/10	0/12	0/10	0/6
Sept 2003	0/42	0/9	0/20	1/10	0/12	0/10	1/6
Jan 2004	3/42	3/9	0/20	2/10	0/12	0/10	1/6
June 2005	9/42	7/9	1/20	3/10	0/12	3/10	2/6
Feb 2006	42/42	9/9	20/20	10/10	12/12	10/10	6/6

Table 5: Raw scores from ABLLS® assessments for motor skills from December 2002 to February 2006.

ABLLS® Assessment Scores in Skill Areas
December 2002-February 2006

Date	Academic Skills				Self-Help Skills			
	Reading	Maths	Writing	Spelling	Dressing	Eating	Groom	Toilet skills
Dec 2002	0/15	0/42	1/9	0/6	0/16	2/10	2/7	0/10
Sept 2003	0/15	0/42	0/9	1/6	1/16	5/10	2/7	0/10
Jan 2004	0/15	2/42	1/9	1/6	3/16	5/10	3/7	8/10
June 2005	5/15	5/42	8/9	1/6	11/16	9/10	5/7	10/10
Feb 2006	15/15	42/42	9/9	6/6	15/16	10/10	7/7	10/10

Table 6: Raw scores from ABLLS® assessments for motor skills from December 2002 to February 2006.

ABLLS® Assessment Scores in Skill Areas
December 2002-February 2006

Date	Motor Skills	
	Gross motor skills	Fine motor skills
Dec 2002	9/28	4/28
Sept 2003	13/28	7/28
Jan 2004	18/28	18/28
June 2005	18/28	18/28
Feb 2006	24/28	28/28

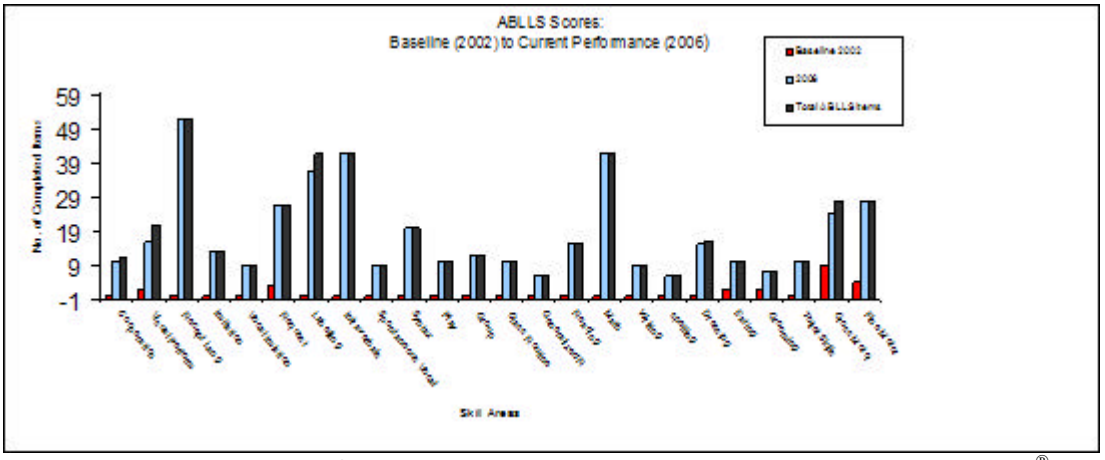

Figure 1. Comparison of scores on each assessment date with total items in ABLLS®

Table 7 illustrates baseline and follow-up scores across each curricula area within the PIRK. Baseline scores indicate 18 behavioral assets out of a possible 242 skills. Following approximately 3 years of intervention, the participant reached 209 long-term goals across 14 curricula areas (see Figure 2).

Table 7: Raw scores from PIRK® assessments from December 2002 to February 2006

Date	Academic Equiv. Relations	Reading	Number Skills	General Knowledge	Intraverbal Academic Responses	Writer	Listener Behavior
Dec 2002	0/26	0/14	0/20	0/34	0/7	0/9	1/7
Spet 2003	2/26	3/14	2/20	8/34	2/7	0/9	2/7
Jan 2004	6/26	4/14	2/20	10/34	2/7	1/9	3/7
June 2005	12/26	7/14	4/20	18/34	4/7	3/9	6/7
Feb 2006	25/26	14/14	19/20	27/34	7/7	9/9	7/7
	Speaker Behavior	Social Intraverbals	Enalrging Reinforcers	Self-Manage	Self-Help	Social	Physical
Dec 2002	2/21	0/12	0/13	0/13	4/17	0/28	11/21
Spet 2003	4/21	1/12	3/13	1/13	5/17	1/28	13/21
Jan 2004	9/21	4/12	3/13	4/13	5/17	3/28	14/21
June 2005	13/21	6/12	5/13	9/13	13/17	11/28	16/21
Feb 2006	19/21	10/12	13/13	13/13	17/17	26/28	21/21

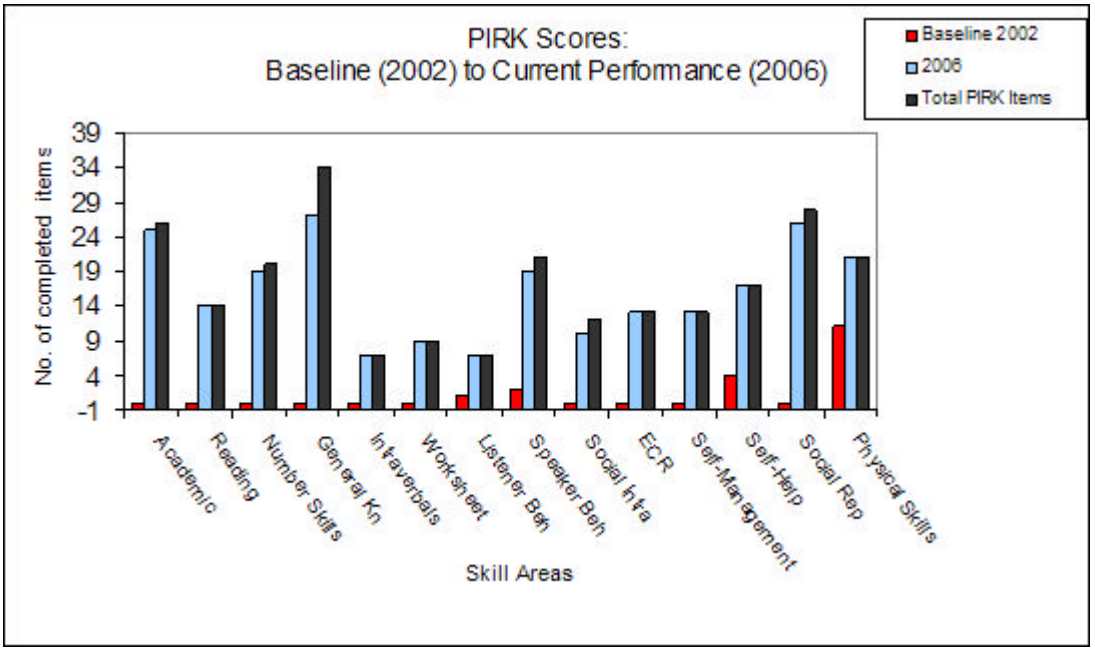

Figure 2. Comparison of scores on each assessment date with total items in PIRK®

Discussion

The case study reported here included important features based on empirical evidence for applied practice.. Firstly, baseline measures of each repertoire were taken before treatment began. Secondly, objective measurement of treatment effects repeated over extended periods of time were implemented along with corroboration of diagnosis, baseline measures and follow-up provided by an independent psychologist. Thirdly, intensive applied behavior analysis was introduced systematically across many repertoires of behaviors producing methodical improvements in skill areas across time.

The data reported support the hypothesis that early intensive behavioral intervention for preschool children with autism can result in achievement of normative functioning, defined by standard psychological methods and practical outcomes. Applied Behavior Analysis is a treatment approach that, under certain conditions, can produce systematic, substantial and durable effects. Factors must be considered that produce optimal results. For example, in this study the participant accessed a consistently comprehensive behavioral program using the CABAS® approach over a three year period. The age of treatment onset was two years and ten months. Fenske, Zalenski, Krantz, and McClannahan (1985) reported that between 40% and 60% of children who had begun behavioral therapy before reaching the age of five improved to the point where they could be enrolled in public schools. Subsequently, in 1987, Lovaas demonstrated that nine of nineteen children who underwent intensive behavioral interventions achieved normal cognitive and intellectual functioning and were integrated and mainstreamed with typical peers. Further research is required in this area to determine the age for optimal effectiveness. Many plausible theories have been put forward such as the malleability of the developing brain at a very young age. However, further investigation in scientific studies is warranted.

The program described here demonstrated strong treatment integrity parameters. It was supervised directly by two Ph.D.-level, behavior analysts, both certified at the highest level within the CABAS® system, who designed and oversaw the entire educational program. This ensured quality of program design, program delivery, and guaranteed that the instruction provided was never static, with any instructional problems encountered quickly remedied. In addition, the quality of the training program delivered to staff ensured that certain expected standards were met resulting in continued improvement in the quality of the professional service delivered. More research is necessary in this

area to determine the importance of levels of supervision from senior behaviour analysts as a factor in outcome data for the treatment of autism using Applied Behavior Analysis.

The effectiveness of the CABAS® System as an educational approach to the treatment of autism has been documented and summarized in several papers (see Greer & Ross, 200). Such studies have focused on the development of numerous teaching strategies to teach verbal behavior, first instances of vocal verbal behavior, problem-solving skills and effective writing repertoires. The application of these research findings to hundreds of students attending CABAS® schools has drastically altered the prognoses for these students. In addition, the CABAS® system recasts national, state, and international educational standards into functional repertoires of verbal behavior ranging from academic literacy to problem solving repertoires. The participant in this study was educated from the outset within the CABAS® system. Such a system has accrued an extensive database for developing and maintaining quality applications. The components include minimal standards of teaching using Applied Behavior Analysis, curricula for teachers and other professionals, research-based tools to train and monitor professionals, curriculum revisions for students occasioned by ongoing research. Each of the components of the CABAS® system plays a vital role in the delivery of quality education. Other students with autism diagnoses educated alongside the participant in this study demonstrated significant improvements in intellectual and adaptive functioning. Specifically, a further eight students have been successfully integrated from the CABAS® system into mainstream education. Autism severity ratings for each of these students reduced on average by 15 points. Future research will provide an analysis of the ongoing educational gains of students who have completed the PIRK® curriculum within the CABAS® system in Ireland.

Numerous studies have demonstrated the effectiveness of early intensive behavioral interventions with children with autism diagnoses. Some studies have shown that children with autism can achieve levels of functioning that result in them being indistinguishable from their peers. Certainly, steady progress can be made with all children using behavioral interventions and it is possible to accentuate potential outcomes. Recent studies have demonstrated the effectiveness of early intensive behavioral intervention. One such study demonstrated significant gains in language, communication and reciprocal social interaction skills with 20 children aged between 22 -34 months (Zachor, Ben-Itzchak, Rabinovich, & Lahat, 2007). The authors concluded that behavioral intervention is highly effective in improving autism core symptoms in young children with autism

Research has shown that the application of behavioral techniques is optimally effective when commenced with children between the ages of 2 and 5 years (Ramey & Ramey, 1998). Findings from early intervention research indicate that treatment that is intensive, long in duration, and delivered directly to children (rather than just to their caregivers) produces better outcomes than treatment that lacks those elements (Ramey & Ramey, 1999). Applying behavior-change procedures that are derived from the scientifically established principles of behavior produces effective change (Matson et al., 1996). Best outcomes have been reported for children who participated in behavioral treatment for a minimum of 30 hours per week (Green, 1996). The participant in this study received 32.5 hours per week of intensive learn unit instruction and the onset of intervention was at age 2 years and 10 months. Results of this case study are therefore consistent with previous research findings.

The question of whether other children who undergo early intensive behavioral intervention will achieve the kind of success reported in this case study remains, and much research is necessary to investigate such factors that attribute to greater achievements for some children than others. The challenge remains for behavior analysts in identifying predictor variables for the type of success reported here and to improve outcomes for the children who do not attain such capability.

An additional component to the educational program which this participant received involved an emphasis on parental involvement. Specifically, parents had access to monthly educational and training sessions at the school and received in situ training in programming for generalization within the home environment. Parent education empowers parents to apply the most effective instructional methods for teaching their child within the home as well as acquiring the skills to manage problem

behaviors. Other studies have demonstrated the results of parental involvement in behavioral treatment programs. For example, Sallows and Graupner (2005) showed that ratings of parental involvement were weakly related to outcome measures, suggesting that increased efforts to improve parental contributions to treatment planning may enhance treatment effects. The extent and accommodation of parental involvement in program success and outcome measures is an important variable for future research.

It is important to note that the participant in this case study did not receive any other therapy for the treatment of autism other than the CABAS® intervention. There are many treatments available that have no empirically derived, experimentally based research to show effectiveness. Such treatments are often used with students in special education programs because they receive positive public recognition. More recently the 'eclectic' model of education to the treatment of autism has gained popularity. This model involves a multi-skills approach where a range of teaching methods are available e.g., Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH), Speech and Language Therapy, Occupational Therapy, Auditory Integration Therapy, Applied Behavior Analysis (ABA), Picture Exchange Communication System (PECS), etc. However, research to date demonstrates that behavioral interventions must constitute the primary and fundamental methodological framework in the treatment of autism (Remington et al., 2007). Any number of the necessary dimensions of ABA, which make up successful behavioral programs, will be compromised when a multitude of educational approaches are involved in the treatment program. This case study has demonstrated significant gains in intellectual functioning and adaptive behavior along with a significant reduction in autism severity without the implementation of therapies that do not have empirical support.

An important question for the future education of this participant involves examining what post-treatment environmental factors will mitigate outcomes. Although participation within a mainstream environment was systematically increased and monitored closely by behavioral instructors, it will be important to structure a relationship with the mainstream educational environment when the participant is in full attendance there. Periodic reviews and close links should be maintained to ensure continued success. Follow-up assessments by independent psychologists should also be continued.

This study demonstrates the consequences and significance of the provision of an early intensive ABA program using the CABAS® educational system. Such a case study will have relatively limited value, however, if it is not replicated by other practitioners and researchers. Fortunately, there are continued efforts in the field of ABA to report and publish such findings and to continue the analysis of treatment variables. Additional research on the importance of such variables is needed to ensure that decision-making by governments who provide educational funding is informed by valid scientific research.

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