DOCTOR OF PHILOSOPHY

Overcoming Barriers to ABA Implementation in Maintained SEN Schools in the UK

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I hereby declare that this thesis is the results of my own investigations, except where otherwise stated. All other sources are acknowledged by bibliographic references. This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree unless, as agreed by the University, for approved dual awards.

Chapter 1: General Introduction

Applied Behaviour Analysis (ABA) is a scientific approach to understanding behaviour. The principles of ABA are used to explain and understand how behaviours change, are affected by the environment, and how learning takes place. ABA focuses on improving socially significant behaviours that will lend towards meaningful change in a person's life, such as social skills, communication, reading, academic and adaptive learning skills such as fine motor, gross motor and hygiene. Interventions based on the principles of ABA use assessment, data collection and progress monitoring to develop individualised interventions (Behavior Analyst Certification Board, 2019).

Some of the first applications of ABA interventions were with individuals with Intellectual Disabilities (ID), and Autism Spectrum Disorder (ASD). ASD is a neurodevelopmental disorder that can impact many areas of development (Healy & Lydon, 2013). ASD is characterised by impairments in social interaction and communication, restricted and repetitive patterns of behaviour and excessive sensitivity to environmental stimuli (American Psychiatric Association, 2013). For children with ASD and ID interventions based on the principles of ABA have resulted in significant, meaningful and long-term gains (Birnbrauer & Leach, 1993; Eikeseth, Smith, Jahr, & Eldevik, 2002, 2007; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaas, 1987; McEachin, Smith, & Lovaas, 2013; Sheinkopf & Siegel, 1998; Smith, Groen, Wynn, & Smith, 2000). Even with the identification that ABA interventions are effective for children with ID and ASD, their implementation within UK schools is uncommon (ABA4ALL, 2020). This is despite an increase in students requiring additional educational or health care supports to access educational settings successfully. For example, in England 3.3% of students in schools have an Education, Health and Care (EHC) plan, a rise from 3.1% in 2019. The most common type of need for students with an EHC plan is ASD (Department for Education, 2020). In Wales the number of students with special educational needs (SEN) has risen from 90,624 in the

2003/04 academic year, to 97,551 in the 2019/20 academic year (Welsh Government, 2020). The SEN Code of Practice for Wales provides practical advice to educators in order to remove student barriers to participation and learning (Welsh Government, 2013). The code states provision of effective support for students with SEN entails an individualised approach and may require multi-disciplinary input for success. ABA interventions have been evidenced to provide individualised support that helps students access education through teaching adaptive behaviours and reducing barriers to learning. The lack of ABA dissemination within maintained SEN schools in the UK is therefore worthy of consideration. ABA may not be widely adopted in UK SEN schools due to barriers such as lack of funding, inadequate supply of trained professionals, misconceptions about the approach and a lack of evidence it can be applied in maintained UK SEN settings (Dingfelder & Mandell, 2011; Keenan et al., 2015).

ABA in SEN Education

Teaching strategies based on the principles of ABA have been evaluated within schools and have been found to produce greater gains than regular teaching approaches. In SEN education, teaching strategies are often influenced by a variety of methods from different models of treatment, these are referred to as eclecticisms (Heward, 2003). In the eclectic approach to intervention provision in education, strategies are applied as needed for a student (Marwick, Dunlop, & McKay, 2005; McMahon & Cullinan, 2016). Eclecticisms can include elements of ABA, speech and language therapy, occupational therapy; and programmes such as TEACCH, Sensory Integration Therapy, Floortime, Picture Exchange Communication Systems (PECS), Son-rise and other manualised programmes (Dillenburger, 2011). Interventions based on the principles of ABA have been evaluated against the eclectic approach to teaching within school settings and produced positive outcomes for students.

In Norway Eldevik, Eikeseth, Jahr, & Smith, (2006) retrospectively compared two groups of children with a diagnosis of ASD and ID under the age of 6 who received either

behavioural treatment (n=13) or eclectic treatment (n=15) for 12 hours per week. Children attended regular kindergartens or elementary schools for typically developing children. Researchers recruited two-to-four therapists from kindergarten or school staff to provide treatment for children in the behavioural group. Parental participation was a key part of the program as the main responsibility for the parents was to ensure generalization and maintenance of skills to home and community settings. A supervisor experienced in the provision of early behavioural intervention, provided training and supervision to therapists and parents. One-to-one direct instruction was delivered in a room separate to the classroom. To help generalise skills learned in one-to-one, skills were also targeted in the natural environment for example, self-help skills, social skills, or implementing behaviour support plans. Initially therapists and parents targeted pre-requisite skills for learning and progressed to more complex overarching skills for the child. The strategies implemented to teach these skills were based on the principles of ABA and included differential reinforcement, shaping, chaining, prompt and prompt fading. The eclectic treatment group were provided elements from various types of treatment including alternative communication, ABA, total communication, sensory motor therapies, programs based on the principles from treatment and education of autistic and related communication handicapped children (TEACCH) (Schopoler, 1997) and other methods that were incorporated based on the experience of the teacher. At pre-treatment groups did not differ on measures for intellectual functioning, receptive and expressive language, communication skills and behaviour pathology but following two years of treatment the behavioural group made significantly larger gains on measures. Also, the degree of mental retardation according to the ICD-10 classification improved more for participants in the intervention group versus the eclectic group.

Peters-Scheffer et al., (2010) compared the progress of 12 children receiving behavioural intervention and 22 children receiving regular intervention in regular preschool

settings in the Netherlands (i.e. day-care centres). Children were aged 3-6 years and had diagnoses of ASD and severe to mild intellectual disability. Regular staff at the preschools were trained and supported in the provision of behavioural intervention by a supervisor experienced in applying ABA interventions with children with ASD. Children in the behaviour intervention group received an average of 6.5 hours of one-to-one teaching per week. The control group received the same amount of intervention via an eclectic approach i.e. a combination of regular approaches for example, alternative communication and/or total communication, sensory motor treatment and TEACCH. After eight months of intervention, children in the behavioural group demonstrated significantly higher developmental ages and higher gains in adaptive skills than children in the control group.

Peters-Scheffer, Didden, Mulders, & Korzilius, (2013) compared behavioural treatment to regular treatment delivered to children aged between 3.1 and 7.10 years. All children in the intervention group (n=20) and control group (n=20) had a diagnosis of ASD and intellectual disability. Regular teachers and staff at pre-school settings, therapists employed part-time and parents were trained and supervised in the provision of behavioural treatment. The behavioural group received 4-10 hours of one-to-one intervention based on the principles of ABA over a two-year period. Children in the intervention group were compared to the control group receiving regular (pre)school interventions at pre-treatment, 1 year and 2 years into treatment. Children in the intervention group were higher in IQ at the time of follow-up than the control group. They also outperformed the children in the control group on developmental age, adaptive behaviour, interpersonal skills, play and receptive language and they had fewer reported characteristics of ASD and behavioural problems. Less progress for the intervention group was reported in the second follow-up which researchers attribute to nine children who terminated treatment after one-year, slower learning rate and ceiling effects of measures used.

ABA in UK SEN Education

Grindle et al., (2012) detailed the beneficial outcomes for students following the provision of an ABA intervention model in a maintained mainstream school in the UK. Researchers compared two groups of children receiving either behavioural treatment (n=13) or eclectic treatment (n=15) for an average of 12 hours per week. Parents were not involved in treatment delivery and one-to-one teaching was delivered in an autism specific classroom within a mainstream school. The staff to student ratio was 1:3. At pre-treatment there was no significant difference between groups for intelligence, language, adaptive functioning and maladaptive behaviour. After 2 years of treatment the intervention group made larger gains than the eclectic group in most areas. The results of this study indicate interventions based on the principles of ABA are more beneficial than eclectic approaches to teaching and can work in maintained settings in the UK, with resources typically available in these settings.

In Wales Foran et al., (2015) evaluated the effectiveness of an ABA model implemented within a maintained UK SEN school. Seven children with ASD aged 3 to 7 received on average seven hours of one-to-one direct instruction per week. Regular teachers and teaching assistants were trained and supervised to implement function-based behaviour plans and deliver teaching based on the principles of ABA in the classroom and across the school environment. Intervention was delivered for one academic year. Post-tests demonstrated significant gains in IQ, along with significant gains in language, academic skills, and social and play skills.

In England Pitts, Gent, & Hoerger, (2019) evaluated the effectiveness of school based behavioural intervention for students aged 4 to 13 years. Teachers and teaching assistants were trained and supervised in the implementation of function-based behaviour plans and one-to-one teaching programmes based on the principles of ABA. They were also trained to implement strategies to generalise skills learned in one-to-one teaching to the natural

environment. Following one academic year of behavioural intervention students demonstrated significant gains in learning skills, language and communication, social and play skills and self-help skills.

These school-based applications of ABA in the literature, indicate significant gains for recipients across a range of measures in UK educational settings and beyond (Eldevik et al., 2006; Foran et al., 2015; Grindle et al., 2012; Peters-Scheffer, 2010; Peters-Scheffer et al., 2013; Pitts et al., 2019). There is however no published information available on the prevalence of ABA intervention implementation in UK SEN schools. Parents of children with SEN have discussed the lack of evidence-based interventions in educational settings (Weitlauf et al., 2014). A study in maintained schools in North America found despite recommendations, fewer than 10% of behavioural or educational strategies used with students were evidence based (Hess, Morrier, Heflin, & Ivey, 2008). Education is a key part of every child's life and most children in the UK attend maintained school settings (Brittish Educational Suppliers Association, 2019). The provision of ABA interventions for students who might benefit is important. The school or classroom-based applications of ABA in maintained UK schools may be feasible way to achieve this.

The classroom-based ABA models described in the literature (Foran et al., 2015; Pitts et al., 2019) detail that students receive low one-to-one direct teaching time. However, regular staff were trained in ABA strategies in these studies. The provision of additional resources is not feasible for all school settings and training regular staff to implement ABA strategies removes the need to hire additional staff who are already trained in strategy implementation. When regular staff are able to implement ABA strategies, they may be better able to generalise strategies across the day to different environments and activities. This results in a behavioural approach to teaching being provided to students during one-to-one teaching, in group activities and in the natural environment. Staff can create or capture learning

opportunities that occur across the school day which enhances generalisation of skills learned during one-to-one teaching. In addition, the implementation of behaviour support strategies across the day i.e. behaviour plans, decrease barriers to learning such as challenging behaviour and increase readiness for learning skills such as tolerance and communication skills.

Early Intensive Behavioural Intervention

Whilst the evidence base for classroom-based ABA models are growing, Early Intensive Behavioural Intervention (EIBI) has the largest evidence base for effective ABA intervention for children with ASD and ID. EIBI is an application of ABA (Cooper, Heron, & Heward, 2019) that incorporates function-based interventions, reinforcement, prompt and prompt-fading, discrete trial teaching and natural environment teaching. EIBI is used to teach a range of skills including social, academic, and functional skills to children with developmental disabilities (Dixon et al., 2016; Eikeseth et al., 2002; Lovaas, 1987; McEachin et al., 2013; Sheinkopf & Siegel, 1998).

Components of EIBI

EIBI is typically delivered to children between the ages of 2- and 6-years old (Dawson, 2008; Green, 1996) because early intervention can have a significant impact on developmental gains (Volkmar, 2014). Direct instruction is conducted for twenty-five to forty hours per week and recommended for a minimum of two years (Dawson, 2008; Green, 1996). The focus of direct instruction is to help children achieve developmental milestones and give them the skills necessary to learn from the natural environment. A comprehensive curriculum informs the areas targeted during teaching and can involve focusing on language, play skills, social interaction, imitation, motor and adaptive behaviour (Dawson, 2008). The sequence in which skills are targeted and taught is developmentally sequenced and individualised to the child's needs. Planning is undertaken so that the skills acquired generalise and are

demonstrated in novel and more natural environments. Initially, EIBI is delivered in a structured one-to-one teaching format. When the child develops skills necessary to learn within a group, they are transitioned to small and subsequently larger groups (Eikeseth et al., 2002; Peters-Scheffer et al., 2010; Reichow, 2012).

Direct instruction requires an ABA tutor be trained to implement strategies based on the principles of ABA with high fidelity (Leaf et al., 2016). Parental involvement is encouraged and training is tailored to parental needs (Green, 1996). Implementation of EIBI requires a Board Certified Behaviour Analyst (BACB, 2018) (BCBA), to conduct thorough assessments for each child and develop an individualised curriculum informed by assessment results. The BCBA is also responsible for ensuring supportive and empirically validated strategies are used to teach skills and data-based decisions are made to ensure meaningful gains for the child. A functional analytic approach is taken to address barrier behaviour, and strategies used are functionally informed (Dawson, 2008). ABA tutors and parents implementing EIBI need adequate supervision to implement strategies as this can effect child outcomes (Dixon et al., 2016; Waters, Dickens, Thurston, Lu, & Smith, 2018).

Lovaas' (1987) seminal paper of EIBI described how nineteen participants received early and intensive direct instruction from trained therapists at home for one year. Parents were also trained to implement strategies so that participants received up to 40 hours of intervention per week. Children who received the intervention made significantly more gains in IQ and social functioning compared to a control group (these were also participants) who only received 10 hours of intervention per week. Forty eight percent of participants in the intervention group went on to attend mainstream education with their typically developing peers whilst only two percent of the control group did. Since Lovaas' (1987) paper, numerous studies have replicated the Lovaas model. The beneficial effects of EIBI for children with ASD and pervasive developmental disorder (PDD-NOS) have been repeatedly demonstrated

(Eikeseth, 2009; Eldevik et al., 2009, 2010). However gains made in the original study have not been replicated for subsequent recipients (Howard et al., 2005; Remington et al., 2007; Sallows & Graupner, 2005).

EIBI versus the eclectic approach

Eikeseth et al., (2012) investigated the effectiveness of EIBI in community settings by evaluating whether 35 children who received 1 year of EIBI would make larger gains in adaptive behaviours than 24 children who received Treatment as Usual (TAU) via an eclectic approach. The study was conducted in Norway and baseline assessments identified no significant differences between groups for chronological age or adaptive behaviours. The EIBI group received 23 hours of 1:1 teaching using behaviour analytic strategies per week. EIBI was delivered to participants in their preschool, kindergarten and home settings using the staff who regularly worked in these settings. Staff in these typical community settings did not have prior training in ABA but were successfully trained to implement ABA strategies and deliver EIBI effectively. After one year of intervention, the EIBI group scored significantly higher than the TAU group on standardised measures of adaptive behaviour. There was also a significant reduction of maladaptive behaviours as well as excess and deficit behaviours associated with ASD. Effect sizes were moderate to large for all scales within measures and participants continued to make gains into a second year of treatment. In the second-year researchers demonstrated EIBI could be delivered in mainstream school settings. To do so however, additional resources such as staff and specialised behaviour analytic supervisors were provided. Parents also participated and allocated 10 hours per week to attend meetings, prepare resources and deliver 1:1 discrete trial teaching and natural environment training.

EIBI in the UK

In a study conducted in the UK Remington et al., (2007) compared the outcomes of an EIBI intervention group (*n = 23*) and a TAU group (*n* = 21). The EIBI intervention was either provided by public funds or paid for privately. EIBI was provided by the university of Southampton for thirteen families and a range of private UK based ABA providers delivered services to the remainder. Participants were diagnosed with ASD and aged between 20 and 42 months. Groups were organised according to parent preference and baseline assessment was undertaken. There was no significant difference between groups before treatment. The EIBI group received an average of 25.6 hours of 1:1 teaching per week. The TAU group received provision to ameliorate the impact of ASD and enhance functioning. They were provided speech therapy, TEACCH, picture exchange communication system (PECS) (Bondy & Frost, 1994), Makaton (Grove & Walker, 1990) and dietary interventions. Following treatment, robust group main effects were found for IQ, mental age (MA), Expressive Language and Comprehension and Vineland Daily Living Skills. There were also significant changes in Vineland Motor Skills and Responding to Joint Attention. The intervention group made significant gains in IQ, MA, adaptive behaviour and language. 26% of the children in the EIBI group made clinically significant gains in IQ scores i.e., exceeded 81.93. Kovshoff, Hastings, & Remington, (2011) conducted a two-year follow-up and found differences in skill maintenance between the university and parent managed EIBI groups. The university managed group did not maintain gains two years after treatment cessation, however the parent managed group maintained or increased gains. The authors suggested that the difference in treatment intensity and participant characteristics (university group was less intensive, and participants had more severe ASD characteristics) may have contributed to group differences. Also, parents may have continued to deliver the intervention following the

initial study. The authors recommend that consideration should be given to whether maintenance programs would benefit those who receive EIBI.

EIBI intensity and duration affects outcomes

The components of EIBI have been analysed to identify how each one can affect recipient outcomes. One such component which has been investigated is that of treatment intensity and subsequent outcomes (Eldevik, Titlestad, Aarlie, & Tønnesen, 2019; Granpeesheh, Dixon, Tarbox, Kaplan, & Wilke, 2009; Linstead et al., 2017; Virués-Ortega, 2010; Virues-Ortega, Rodríguez, & Yua, 2013). Meta-analytic reviews by Makrygianni & Reed, (2010) and Virués-Ortega, (2010) identified correlations between intensity and gains for IQ and adaptive behaviour. This correlation has also been identified by Granpeesheh et al., (2009) and Linstead et al., (2017) for children up to 7 years old. Linstead et al., (2017) evaluated the effects intensity and duration of treatment had on the number of learning objectives mastered by 1468 children with ASD across eight domains (academic, adaptive, cognitive, executive function, language, motor, play and social). Data analysis revealed treatment intensity and treatment duration had significant effects on all eight domains. The study found duration relationships to be stronger for academic and language domains. Academic and language domains had effect sizes of 1.68 and 1.85 for treatment intensity and 4.70 and 9.02 for treatment duration.

Age of recipient can affect outcomes

Studies have also noted the affects age at the beginning of treatment have on outcomes (Smith, Klorman, & Mruzek, 2015; Vietze & Lax, 2018). Smith et al., (2015) identified that in a group of 71 children, those who entered the study at a younger age and received EIBI made greater gains in IQ, adaptive behaviours and Autism Diagnostic Observation Schedule (ADOS) severity ratings. Granpeesheh, Dixon, Tarbox, Kaplan, &

Wilke, (2009) measured the effects between age, treatment intensity and gains made for 379 children. Granpeesheh et al., (2009) grouped children into three age groups: 2 – 5.15 years; 5.15 – 7.14 years; and 7.14 – 12. The youngest group responded best to low intensity treatment. The youngest and middle groups responded best to high intensity treatment but there was no significant difference between low or high intensity in gains for the older group. It is suggested younger children between the ages of 2 and 5 make superior gains as it is during a critical period where the brain develops and refines (Losardo et al, 2016). Because the brain is developing quickly at this age, it is more malleable to change and shaping by external variables (McGarrell, Healy, Leader, O'Connor, & Kenny, 2009). This is referred to as neural plasticity and results in interventions being more effective when they are delivered to children during this critical period (Losardo et al, 2016). Teaching new behaviours to children at a young age can help them overcome skill and behavioural excesses or deficits from the outset. Whilst some research has not identified a link between age and outcome (Eikeseth et al., 2012, 2002; Hayward, Eikeseth, Gale, & Morgan, 2009) it is accepted that early intervention can help children acquire skills faster, change their developmental trajectory and help narrow the gap with their typically developing peers (Klintwall, Eldevik, & Eikeseth, 2015). EIBI may also prevent the development of problem behaviours not observed in the child's younger years due to the focus on skill and adaptive behaviour development. As a result, barrier behaviours may even be prevented later in life for the child (Mundy, Sullivan, & Mastergeorge, 2009).

Participant IQ can affect outcomes

It has also been identified that IQ at intake can predict outcomes of EIBI. Participants in studies evaluating EIBI who had higher IQ at intake showed greater outcomes on measures (Dixon et al., 2016; Eikeseth et al., 2002; Smith et al., 2015). Some studies in EIBI have

specified IQ as an exclusionary criteria for example, Eikeseth et al., (2002) and Lovaas, (1987) required participants to have an IQ of 50 and 61 respectively. Children who had a higher IQ and better social and communication skills at baseline made greater gains on receptive and expressive language as well as play skills (Ben-Itzchak & Zachor, 2007; Eikeseth et al., 2002).

Supervision quality of EIBI affects outcomes

Eikeseth, Hayward, Gale, Gitlesen, & Eldevik, (2009) identified that supervision must be delivered at a certain intensity for optimal child outcomes. For children between 28 and 48 months old who received EIBI, IQ scores increased by 0.21 with each hour of supervision. They noted that low intensity supervision produces little benefit, a certain level will achieve optimal effects but increasing beyond this point may not produce meaningful gains. What constitutes the optimal level varies from child to child, parental involvement, and tutor competency.

Dixon et al., (2016) identified supervisor credentials also impact child outcomes. Children who were supervised by a BCBA made more skill gains than children whose programs were supervised by individuals without this credential. Children whose supervisors had more years of experience in EIBI, also made more gains. Results indicated that supervisor credentials and years of experience had more of an impact on skill mastery than intensity of supervision. This suggests that supervision intensity, quality and relevant supervisor credentials impact outcomes for recipients of EIBI.

In the UK, policy guidelines do recommend strategies based on the principles of ABA (ASD info Wales 2015; National Institute for Health and Care Excellence (NICE), 2013), but EIBI is not specifically cited and it is not prevalent in UK maintained SEN schools (North-Bates, 2016). There is a lack of evidence that EIBI can be effective in UK maintained schools

(Anderson, Smith, & Wilczynski, 2018). In Reichow et als., (2018) Cochrane report on the effectiveness of EIBI, no study included in the report was conducted in a maintained UK SEN school. Research in behaviour analytic interventions that are practical and effective enough for maintained school settings is needed. When EIBI has been implemented in maintained schools, additional resources have been required (Eikeseth et al., 2012) but the provision of additional resources is not feasible for all school settings. Implementation of EIBI can be expensive, time and resource intensive (Peters-Scheffer, Didden, Korzilius, & Matson, 2012).

Barriers to EIBI provision in the UK

In the UK EIBI is mostly delivered via home programmes however, the number of organisations and ABA consultants delivering home-based EIBI programmes is limited (Peters-Scheffer et al., 2010). Parents are often responsible for arranging appropriate personnel to implement the home program which requires time and financial resources (Hastings & Johnson, 2001). Specialist ABA schools may provide EIBI programmes for students, but these currently educate only a small portion (400) of children with ASD in the UK (ABA4ALL, 2020). Because EIBI and specialist ABA school provision are not provided by local health and education services, they are more likely to be available to those from more affluent socioeconomic backgrounds (Keenan et al., 2015). Trained tutors typically deliver the high level of one-to-one teaching involved in EIBI. Tutors need supervision by a competent behaviour analyst who also needs to provide comprehensive and individualised teaching targets based on assessments. This means EIBI is labour intensive and expensive (Peters-Scheffer et al., 2012) which results in funding issues for its provision to all students who may benefit in the UK.

The teaching strategies EIBI employs may not be compatible with the preferences of educators. Schools often adopt eclectic strategies despite the evidence base for these being poor (Eikeseth et al., 2002; Eldevik et al., 2009; Howard et al., 2005; Makrygianni & Reed, 2010). In education, interventions are selected based on teaching and/or clinical expertise and consideration of consumer choice, preferences and culture (American Psychological Association, 2006; Wolfe, 2001). However a need to support teachers in understanding what constitutes research validated approaches has been acknowledged (Gray, 2013; Hess et al., 2008) and less than 50% of teachers in England feel confident in supporting a child with ASD (All Party Parliamentary Group on Autism, 2017). As previously discussed, the eclectic approach to education can involve many styles and does not promote one method over another (Dillenburger, 2011). Educators that perceive ABA interventions such as EIBI as a single approach, may choose eclectic approaches on the belief that the needs of the child are put first and not that of a theoretical orientation (Callahan, Shukla-Mehta, Magee, & Wie, 2010; Schoen, 2003).

Classroom-Based ABA Models may overcome barriers in the UK context

The limited integration of ABA into maintained schools in the UK may be due to barriers such as funding, misconceptions about the approach and the gap between conditions present within research settings that facilitate implementation versus conditions in the applied setting (Horner, Blitz, & Ross, 2014; Roll-Pettersson, Olsson, & Ala'i-Rosales, 2016). Integrating effective ABA interventions into UK maintained educational settings may require adaptations to enhance the rate of their adoption. Consideration of funding restrictions, intensity, current school timetabling and less parental involvement may be necessary (Liao, Dillenburger, & Buchanan, 2018). For effective behaviour analytic interventions to be available for all those who may benefit, ABA interventions should be provided at a local

level and within services that all UK residents are entitled to. Schools are the primary setting where children with ASD and ID receive intervention services (Brookman-Frazee et al., 2009; Kang-Yi, Locke, Marcus, Hadley, & Mandell, 2016; Mandell, Cao, Ittenbach, & Pinto-Martin, 2006). To make ABA more accessible to students who might benefit, further evaluations need to be conducted on interventions that are suitable for the UK educational context. EIBI research has detailed the delivery of treatment by trained tutors and parents within their home and/or university research centres or clinics. Implementation of ABA interventions in maintained school settings are relatively under researched (Grindle et al., 2012). Classroom-based ABA interventions could make effective ABA interventions available to students who may benefit as regular staff are trained to implement strategies across the school day. Relative to the evidence base of EIBI, there is very little research exploring classroom-based ABA models in maintained schools. This is a socially significant area to investigate as classroom-based models may help schools implement recommended strategies based on the principles of ABA (ASD info Wales 2015; National Institute for Health and Care Excellence (NICE), 2013) and overcome barriers to dissemination that EIBI has faced in the UK context.

This thesis explores the implementation of a classroom-based ABA model in which a behaviour analyst collaborated with educational teams to deliver educational strategies and behaviour support based on the principles of ABA. Students in foundation phase of a maintained UK SEN school were supported by regular teachers and teaching assistants trained in the use of behaviour analytic strategies. Educators delivered one-to-one direct instruction, natural environment teaching and implemented behaviour support plans. The classroom-based ABA model forms the foundation of the first two studies in this dissertation. The aim was to evaluate the application of the classroom-based ABA model whilst considering potential barriers for its implementation in UK educational settings. The first

study in this dissertation is a replication study of a classroom-based ABA model (Foran et al., 2015; Pitts et al., 2019) and is translational research for the benefit of the target audience (educators). This study used terminology and measures familiar to educators in maintained UK SEN schools, to elucidate for them, the beneficial outcomes this model provides for their students. Classroom-based ABA models have been demonstrated as effective, however evidence of effectiveness does not guarantee dissemination to settings for the benefit of relevant populations. The second study in this thesis sought to explore the social and organisational variables that affect people's perceptions of the classroom-based ABA model. This study aimed to identify barriers the classroom-based ABA model might face in order to achieve a contextual fit for settings it is implemented in. It also aimed to identify variables that can lead to the model's successful implementation and sustainability in maintained SEN settings. During completion of the first two studies in this dissertation, it emerged that a component of the classroom-based ABA model was perceived as resource heavy by model implementers. The final study in this dissertation seeks to address this potential barrier to implementation of ABA interventions in maintained SEN settings. A control group design was used to evaluate universal behaviour management strategies as an alternative to individual behaviour plans for students. This study aimed to add to the limited research base on universal strategies for students in maintained UK SEN settings whilst evaluating the effectiveness of training and support provided to staff. This thesis will conclude with a summary of study findings, limitations, recommendations for future research and implications for implementation of ABA interventions in maintained SEN schools.

Chapter 2: Implementing a Classroom-Based ABA Model in a maintained special education school in Wales

Introduction

Teaching based on the principles of Applied Behaviour Analysis (ABA) has produced positive outcomes for students with special educational needs (SEN) in mainstream and special educational settings. Early Intensive Behavioural Intervention (EIBI) is an evidence-based application of ABA typically used for children with autism spectrum disorder (ASD) and learning disabilities (Eldevik et al., 2009; Eikeseth, 2009; Makrygianni & Reed, 2010). On an EIBI programme, behaviour analysts conduct rigorous assessments and design individualised curriculum for each child. Direct instruction is used to help children achieve developmental milestones and provide the skills they need to learn from the natural environment. The programmes often target developmental skills such as imitation, receptive and expressive language, and play skills. EIBI is typically conducted with children with autism under the age of 6-years-old and with a student to teacher ratio of 1:1. The programmes are conducted for twenty five to forty hours per week and last for 1-2 years (Eikeseth, 2009; Fava & Strauss, 2014; Caron, Bérubé, & Paquet, 2017). EIBI is delivered by Board Certified Behaviour Analysts (BCBA) (BACB, 2018). BCBAs qualify by taking 310 hours of post-graduate coursework, completing 2000 hours of supervised fieldwork and passing a qualifying exam.

The benefits of EIBI have been compared to Teaching as Usual (TAU). TAU includes eclectic therapies such as Project TEACCH, sensory motor therapies, total communication and alternative communication. Students who received EIBI produced significantly greater gains than students who received TAU on measures of IQ, language comprehension, expressive language, adaptive behaviour, socialisation and daily living skills (Birnbrauer & Leach, 1993; Eikeseth et al., 2002, 2007; Howard et al., 2005; Lovaas, 1987; McEachin et al., 2013; Sheinkopf & Siegel, 1998; Smith et al., 2000).

EIBI is a legally mandated teaching approach for those eligible in 50 North American states (Autism Speaks, 2019). A guide published by ASD info Wales (2015) recommends ABA strategies for children with autism in early years settings and includes conducting antecedent, behaviour and consequent analysis to understand challenging behaviour. EIBI is not referenced in educational guidelines or legally mandated in Wales. EIBI provision can be expensive. A recent evaluation of the annual cost to publicly fund EIBI in Canada, estimate ranges from $29,975 (£18,597.84) to $90,882 (£56,387.28) per child (Tsiplova et al., 2019).

Despite the significant up-front costs, researchers estimate that EIBI can result in savings of $656,000 (£535,161.52) to $1,082,000 (£882,690.19) across the lifespan for individuals with ASD (Chasson, Harris, & Neely, 2007). Recipients of EIBI require less support throughout their lives because of gains in IQ, academic, communication, social, and daily living skills. Peters-Scheffer, Didden, Korzilius, & Matson (2012) employed a cost-offset model that estimated the annual cost for an individual to receive EIBI in the Netherlands was €100,000 (£91,563.35). However, savings across the individual's life span was estimated at €1,103,067 (£1,002,428.68) compared to individuals who received treatment as usual. Despite research showing that the long-term benefits of EIBI outweigh the short-term costs, providing funding upfront for all students eligible in Wales may be an unrealistic goal for the Welsh Department for Education and Skills.

It is difficult to ignore the benefits EIBI could provide prospective recipients in Wales. Research conducted on EIBI has evidenced statistically significant improvements in cognitive, adaptive and social functioning, reductions in behavioural problems and some recipients have achieved normal functioning (Orinstein et al., 2014). National Institute for Health and Care Excellence (NICE) guidelines outline evidence-based services suitable for individuals with a specific condition in England, and did not recommend EIBI (National Institute for Health and Care Excellence, 2013) which differs significantly from conclusions

in the United States, France and Canada (Mottron, 2017). The lack of endorsement by NICE may contribute to the scarcity of EIBI disseminating in England. In Wales, the Social Care Institute for Excellence (2019) (SCIE) released a guide describing interventions that result in positive outcomes for children with Autistic Spectrum Disorder (ASD). Many of the interventions described were based on the principles of ABA including discrete trial teaching, direct instruction and pivotal response training, but it did not specifically reference EIBI.

Reichow, Hume, Barton, & Boyd (2018) conducted a review of the evidence base for EIBI. They concluded there is evidence that EIBI improves the functional behaviours and skills for students with ASD, however there are no randomised controlled trials (RCTs) evaluating efficacy against TAU. RCTs are considered the gold standard level of proof that a treatment is effective, as the way in which they are conducted removes many sources of bias from the process. Conducting RCTs on EIBI is a challenge however, due to the intervention being costly, labour-intensive and requiring at least two years of twenty to forty hours per week of intervention delivered by trained personnel. Families who are willing to commit to an EIBI intervention are unlikely to agree to be randomly assigned to a treatment or a no treatment group. There are also ethical considerations when designing an RCT of EIBI. It is an evidence-based intervention which makes it difficult to ethically withhold for the purposes of research.

Classroom based interventions based on the principles of ABA cost less than EIBI, and can benefit students when EIBI is unavailable. Recent studies have shown classroom based ABA interventions can significantly increase students' functioning in the areas of academic, communication, social and play skills (Peters-Scheffer et al., 2010; Grindle et al., 2012; Peters-Scheffer, Didden, Mulders, & Korzilius, 2013; Foran et al., 2015; Pitts, Gent, & Hoerger, 2019). As described by Foran et al., (2015) and Pitts, Gent, & Hoerger, (2019) classroom models of intervention can be delivered more affordably than traditional EIBI.

Classroom based interventions also demonstrate benefits for students with diverse diagnoses for example, ASD, ADHD, sensory processing disorder and global developmental delay.

Foran et al. (2015) detailed how a classroom model of early intervention can be delivered in a maintained SEN school in Wales. The SEN classroom model utilises the principles of ABA to teach students in the foundation phase and Key Stage 1. The skills taught include language, social and play skills and early academic knowledge. The five components that make up the model are: 1) the Behaviour Analyst allocates one hour per week for each student; 2) each student has an individual learning plan (ILP) based on a developmental curricula; 3) 1:1 Discrete Trial Teaching (DTT) is delivered to the student for 5-7 hours a week; 4) each student has a function based behaviour plan, and 5) time in school is structured so that each student has meaningful activities to engage in throughout the day. They found the classroom model results in significant gains for students in academic, communication, social and play skills.

Further investigation is necessary to support its dissemination to other applied settings (Rogers, 2003). Researchers must replicate the classroom model using the same methods but with different students, behaviour analysts and teaching teams. This will help determine if the classroom model can generalize to other maintained SEN settings. Replication of the model will make evidence-based interventions available to more participants. It will also repeatedly demonstrate the significant gains reported in results are valid and reliable.

Evidence-based interventions do not always translate into educational practice. Malouf & Schiller, (1995) note that researchers use highly technical styles of reporting to explain findings, which can lead to the target consumer to not see the relevance of strategies or gains achieved by the intervention. Therefore, to increase understanding and dissemination

of evidence-based practices, researchers should seek to communicate their methods and results using terminology and measures understood by the target audience. This may overcome one of the barriers for translating evidence-based interventions into educational practice and lend towards their dissemination (Rogers, 2003).

In SEN schools, educators use curriculum measures such as P-Scales to monitor and report student achievement. Teachers report P-Scales every term and year and tend to judge student outcome based on these curricular assessments. Researchers typically use validated and normed assessments which make data comparable to other research. However, this can result in data that is not always meaningful for teachers. The current study aimed to replicate the classroom-based ABA model in a maintained SEN school in Wales and consider student outcome using both curriculum measures typically used by educators and validated, normed-assessments used by researchers to evaluate gains made by participants. It was hypothesized that participants would make significant gains on curriculum measures and normed-assessments following classroom-based ABA model implementation.

Methods

Participants

Thirteen students (2 females, 11 males) who attended two Key Stage 1 classrooms in a maintained special educational school in Wales participated in this study. The mean age of participants was 62 months (range 52-75). Students attended school from 9AM to 3PM five days per week. All students had an Intellectual Disability and a range of additional diagnoses, which included ASD, Global Developmental Delay (GDD), Down Syndrome and Spina Bifida with Hydrocephalus. One student had no formal diagnosis but exhibited behaviour consistent with an ASD profile. The participants school initially approached the researcher to provide early intervention to their students. The researcher proposed

implementing the classroom-based ABA model and the school requested that it be provided to all students eligible. Participants included in this study were between the ages of 3-7 years which was a criteria, however all students in the early years classrooms met this criteria and therefore no student was excluded.

Measures

Performance Scales (P Scales)

Students were assessed using P Scales. P Scales were developed to assess students between the ages of five and sixteen with SEN (Department for Education, 2017). P Scales are used in SEN settings to assess and describe the performance of students working below the standards of the national curriculum and were the curriculum used by the school. The school used a software programme called B-Squared (B-Squared, 2015) which tracked the progress of students on levels of the P Scales. B-Squared reported progress as a percentage complete on each level across subjects. This study analysed the results of; Reading, Writing, Receptive and Expressive Communication, Number, Measurement, Geometry, Science, Art Design, Citizenship, Computing, Music, PE, PSHE and Self Help. To obtain a smaller group of scores Reading, Writing, Receptive and Expressive Communication were averaged to form the meta-domain of 'English/Welsh'. Number, Measurement and Geometry were averaged to form the meta-domain of 'Mathematics'. The Welsh Department for Education and Skills announced it is planning to replace levels testing due to its focus on student linear progress (Welsh Government, 2019). At the time of this research, P Scales was the curriculum measure employed by the educational team and therefore the measure available to include in this study.

Mullen Scales of Early Learning (MSEL)

MSEL (Mullen, 1995) has been evaluated and identified as an appropriate normed, standardized assessment for students with additional learning needs and allows comparison to typically developing peers (Akshoomoff, 2006). The MSEL provides a measure of the children's skills in the area of receptive communication, expressive communication, visual reception, and fine motor. The assessment covers the age ranges from birth to 68 months. The Mullens provides an age equivalent score for each domain based on neuro-typical development, and the normed scores are often not scalable for children with SEN. We calculated the developmental quotient (DQ) by dividing a student's Age Equivalent score by their chronological age. MSEL DQ are commonly used in SEN research to evaluate the progress of students with SEN who receive treatment (Dawson et al., 2010; Dawson et al., 2012).

Vinelands Adaptive Behaviour Scales, Second Edition (VABSII)

The VABSII was used to measure Adaptive Behaviour, Communication, Daily Living Skills, Socialization and Motor Skills (Sparrow, Cicchetti & Balla 2005). It is a standardised and norm referenced assessment which produces overall adaptive behaviour composite scores, standard scores and age equivalents for Communication, Daily Living Skills, Socialization and Motor Skills.

Procedure

Classroom Based ABA Model

The classroom based ABA model was implemented with the five core elements detailed by Foran et al., (2015).

1. The Behaviour Analyst allocated one hour per week for each student receiving classroom-based ABA intervention.

A behaviour analyst was provided to the school by the local university in order to implement the classroom-based ABA model. They spent 13 hours per week across two classrooms. The behaviour analyst collaborated with the educational team to design individualised learning and behaviour plans for participants. This involved multi-disciplinary collaboration between the behaviour analyst, teachers and other professionals such as Speech and Language therapists. The behaviour analyst designed behaviour and teaching plans to accommodate the resources that were available in the classroom setting. The behaviour analyst was responsible for updating behaviour and teaching plans. Teachers organised stimuli and managed the implementation of plans in the classroom. The behaviour analyst delivered an initial theory-based training on behaviour analytic interventions that included topics such as how to build rapport with students, captivate their motivation and how to implement teaching strategies such as prompts and reinforcement during learning opportunities across the day. During their time in class, the behaviour analyst modelled ABA intervention implementation, and provided feedback and supervision to the teaching team. The behaviour analyst collected assessment data to develop function based behavioural interventions and educational interventions. The behaviour analyst in this study had been working in the field of ABA and education for over three years but had no previous experience of working as a behaviour analyst with early learners in a maintained SEN setting. A Board Certified Behaviour Analyst – Doctorate (BCBA-D), supervised the behaviour analyst responsible for implementing the classroom-based model in this study. The Behaviour Analyst Certification Board (BACB) is a non-profit organisation which outlines the professional standards behaviour analysts must meet to be accredited as Board Certified Behaviour Analysts (BACB, 2018) (BCBA). A BCBA-D is a BCBA who has additional training in behaviour analysis to a doctoral level. The first teacher in this study had more than

five years' experience working with students in SEN settings. The second teacher was newly qualified and participated in this study during their induction year.

2. Each student had an Individual Learning Plan (ILP) based on a developmental curriculum.

The behaviour analyst used the Assessment of Basic Language and Learning Skills-Revised (ABLLS-R) (Partington, 2006) to assess each participant. The ABLLS-R is a developmental curriculum that provides a thorough assessment of 544 skills from 25 areas that include language, social interaction, academic, self-help and motors skills. The items assessed within each area are organised from simpler to more complex skills. Targets for each students' ILP were derived from the results of their ABLLS-R assessment.

3. 1:1 Discrete Trial Teaching (DTT) was delivered to the student for 5-7 hours a week.

DTT is a strategy used to teach each target on a student's ILP and is usually conducted at a table with a teacher (Knapp, 2010). DTT is typically delivered at a student: teacher ratio of 1:1. The behaviour analyst trained and supervised teachers and teaching assistants to conduct DTT. The teacher delivered an instruction, the student responded, if they responded correctly they received reinforcement (praise, positive feedback, tokens, toy). Teachers used error correction and prompts to facilitate learning (Kodak & Grow, 2011). Targets were taught until students met pre-specified mastery criteria (80% correct across three days, with at least two different teachers).

4. Each student had a function-based behaviour plan.

The behaviour analyst conducted a functional assessment including direct observation and interviews with staff to determine the function of challenging behaviour and identify strategies to increase adaptive behaviours and decrease inappropriate behaviours. In a typical behaviour support plan, the behaviour analyst would suggest a replacement behaviour that

served the same function as the challenging behaviour. For example, when assessment identified a student engaged in challenging behaviour to access a preferred item, the behaviour analyst taught them to request the item appropriately. The behaviour analyst collaborated with teachers to allow continual monitoring of behaviour plans. Self-stimulatory behaviours were not targeted as behaviours to decrease.

5. Time in school was structured so that each student has meaningful activities to engage in throughout the day.

Teachers planned the day so that 1:1 or group activities were scheduled across the day. These included compulsory curricular activities for example, Welsh language, literacy and numeracy. During 1:1 and group lessons teachers used proactive strategies from behaviour plans to increase students target behaviours such as on task engagement, independent requests for help to complete tasks, the appropriate use of activity materials, and being able to tolerate waiting e.g. turn taking/waiting for turn to participate in group activity. To promote generalisation, targets from ILP's were incorporated into activities across the day and taught via strategies, for example, DTT or Natural Environment Teaching (NET). NET utilizes the principles of ABA to teach students skills in naturally occurring situations. NET emphasizes child-directed interaction, increasing motivation to respond and generalization of skills from 1:1 or group teaching sessions to the natural environment (LeBlanc, Esch, Sidener, & Firth, 2006). For example, when a student had a target of increasing their use of pronouns, in a painting activity, the teacher presented options of utensils (e.g. paint brushes) and asked "*which one do you want?*". The student was taught to respond "*this brush*".

Data Collection

The classroom teachers completed the P Scales assessment prior to classroom-based model implementation (pre-intervention) and 10 months later (post- intervention).

A behaviour analyst trained in the administration of the MSEL and VABSII conducted concurrent pre and post- interventions on all participants.

Reliability and Validity

Inter Observer Agreement (IOA) is a procedure for enhancing the believability of data that involves comparing independent observations from two or more people of the same events. Exact agreement IOA is computed by calculating the percentage of items in an assessment in which independent observers exactly agreed on scored items. Exact agreement for the MSEL was collected by trained assistant behaviour analysts on 25% of assessments across pre- and post- tests and produced 100% agreement. Exact Agreement was collected across 30% of pre and post-tests for the VABSII and produced 100% agreement. Exact agreement was collected for 30% of pre and post-tests for the P-Scales and yielded 98% agreement.

Results

Researchers analysed the P Scale results to determine what gains the students made following the classroom-based ABA model. The results of the MSEL and VABSII were also analysed to identify if gains recorded were consistent with educator's assessment (P Scale).

A Wilcoxon Signed Rank Test analysed changes from pre- intervention to post- intervention. The Wilcoxon Signed Rank Test is designed for analysis of repeated measures. It is the non-parametric equivalent to the paired samples t-test and was used because the current data did not meet the assumption criteria to run a t-test. The output of the Wilcoxon generates a Z value and associated significance levels. If the significance level (the p value) is equal to or less than .05 one can conclude the difference between pre- intervention and post- intervention was unlikely to be caused by chance.

Effect sizes were calculated following procedures outlined by Pallant (2007). Effect size criteria were applied using Cohen's (1988) criteria of .2 = small effect, .5 = medium effect and .8 = large effect.

P-Scales

Wilcoxon Signed Ranks Tests revealed statistically significant increases for all subjects assessed by the P-scales at post- intervention. There were increases in the median scores (*M*d) from pre- intervention to post- intervention across all subjects and Cohen's criteria indicated medium effect sizes for most subjects and large for one subject.

Table 1: Wilcoxon Signed Ranks Test Results for median P-Scale scores after 10 months intervention

Measure	N	Pre Test *M*d	Post Test *M*d	Z	P	Effect Size
English/Welsh	13	113	177	-2.34	.019	*r* = .65
Mathematics	13	53	111	-3.20	.001	*r* = .88
Science	13	53	111	-2.22	.026	*r* = .61
Art Design	13	22	44	-2.55	.011	*r* = .70
Citizenship	13	119	179	-2.00	.045	*r* = .55
Computing	13	24	62	-2.28	.022	*r* = .63
Music	13	32	61	-2.53	.011	*r* = .70
PE	13	29	68	-2.58	.010	*r* = .71
PSHE	13	120	180	-2.28	.023	*r* = .63
Self Help	13	137	163	-2.02	.043	*r* = .56

MSEL

Statistically significant gains were observed for the Developmental Quotients across all four scales of the MSEL. The Visual Reception scale assessed participants abilities at visual discrimination, memory, organization, sequencing and spatial awareness. The Wilcoxon Signed Rank Test revealed a statistically significant increase in Visual Reception at post-test (Z = -3.18, p<.01). The Fine Motor scale included assessments of motor planning and control, unilateral and bilateral manipulation and writing readiness. The Wilcoxon detected a significant increase in Fine Motor at post-test (Z = -2.69, p<.01). The Receptive Language scale assessed participant's ability to process linguistic input and included auditory comprehension, memory and sequencing. The Wilcoxon detected a significant increase in Receptive Language at post-test (Z = -3.11, p<.01). The Expressive Language scale measures participant's ability to use language productively and specifically targets speaking, language formation and verbal conceptualisation. The Wilcoxon detected a significant increase in Expressive Language at post-test (Z = -2.48, p<.05). Large and medium effect sizes for all scales when applying Cohen's criteria were also indicated.

Table 2: Wilcoxon Signed Ranks Test Results for median MSEL scores after 10 months intervention

Measure	N	Pre Test *Md*	Post Test *Md*	P	Effect Size
MSEL Visual Reception DQ	13	18.00	43.47	.001	r = .88
MSEL Fine Motor DQ	13	34.32	40.00	.007	r = .74
MSEL Receptive Lang. DQ	13	3.92	23.33	.002	r = .86
MSEL Expressive Lang. DQ	13	22.95	36.50	.013	r = .68

VABSII

Statistically significant increases were detected in means for the VABSII subscales of Communication (Z = -2.76, p<.01), Daily Living Skills (Z = -2.90, p<.01), Socialization (Z =

-2.74, p<.01), Motor Skills (Z = -2.34, p<.05) and Adaptive Behaviour Composite (Z = -3.06, p<.01). Large and medium effect sizes for all scales when applying Cohen's criteria were also indicated.

Table 3: Wilcoxon Signed Ranks Test Results for median VABSII scores after 10 months intervention

Measure	N	Pre Test *Md*	Post Test *Md*	P	Effect Size
VABS Communication	13	42.00	57.00	.006	r = .76
VABS Daily Living	13	53.00	62.00	.004	r = .80
VABS Socialisation	13	53.00	63.00	.006	r = .75
VABS Motor Skills	13	56.00	61.00	.019	r = .64
VABS Adaptive Behaviour	13	49.00	58.00	.002	r = .84

Discussion

Results of this study confirm the hypothesis that following classroom-based ABA model implementation, students made significant gains on curriculum measures (P Scales) and normed-assessments (MSEL and VABSII). All subjects assessed on the curriculum measures made statistically significant gains. Effect sizes for all subjects were large. All items on the normed-assessments also made statistically significant gains with large effect sizes.

P Scales were designed to be summative assessments. However, the continuous focus on levels throughout the academic year leads educators to focus on tracking and teaching students to progress through levels. This can influence teachers to focus on the linear progress of all students, rather than their development of individual strengths and weaknesses (Donaldson, 2015). Educators are encouraged to incorporate a range of measures to better assess for meaningful gains in students for example, benchmarking with standardised tests

(Donaldson, 2015). As previously discussed, the MSEL and VABSII are assessments used and identified as appropriate for testing early learners with SEN. The similarity in results obtained by these standardised, norm-referenced assessments with that of educators provides evidence of an assessment technique that is appropriate for its purpose.

The MSEL and VABSII assessments are norm referenced which means that these assessments were tested on a representative group of typically developing students. The use of normed assessments is therefore useful to determine the gains of participants relative to others in the population. The participants in this study were administered the MSEL at baseline and ten months later at post-test. If these students were typically developing one would expect to see developmental gains of ten months after the intervention. The mean gain in age equivalent months on the MSEL was 22.33 for Visual Reception, 12.49 for Fine Motor, 15.58 for Receptive Language and 11.02 for Fine Motor. This indicates gains made within ten months of intervention were greater than what one would observe over a 10-month period for a typically developing child. Results demonstrate that with the classroom-based ABA model, strategies and application of behaviour analytic principles can accelerate a student's learning in important areas such as academic, self-help, play and social skills, receptive and expressive communication. The students acquired skills rapidly, which positively affects their ability to participate more independently in their education and everyday functioning. Their performance on educational and norm-referenced assessments demonstrate their ability to transfer and generalize skills, knowledge and strategies taught during intervention to new and unfamiliar situations.

The significant results obtained in the P-Scale correspond with results of assessments used by the researchers. Students made significant gains across all subject areas. The P Scale, MSEL and VABSII therefore provided a summative report of what the students had learned. The results of this study further contribute to the evidence base of a classroom-based ABA

model with regards evidencing its effectiveness. Students demonstrated gains across a range of measures as a result of successful implementation of the classroom-based ABA model.

The MSEL and VABSII come with instructions and clear marking criteria. This facilitates all participants being tested on the same items, in the same way and scoring in a standard and consistent manner, which ensures reliability of results. In addition, reliability and validity checks for conducting assessments in this study were performed. These checks produced high agreement that enhance the believability of results. The results of these standardized assessments may offer important benchmarking information for educators of this population, as recommended by Donaldson (2015).

As previously discussed, disseminating EIBI within maintained SEN settings in Wales may be unfeasible due to resource constraints. However, the classroom-based ABA model overcomes many of the barriers for dissemination. It has been demonstrated as a sustainable model within a maintained SEN setting in Wales (Foran et al., 2015) and England (Pitts et al., 2019) and has been acknowledged for its beneficial outcomes for recipients by the Inspectorate for Education and Training in Wales (Estyn, 2017). The teaching strategies in this study coincide with recommendations by ASD info Wales (2015) and the Social Care Institute for Excellence (2019). Replication studies of the classroom-based ABA model have shown that children make significant gains across different settings, teaching teams and behaviour analysts. To increase understanding, methods and results have been communicated using measures and terminology familiar and meaningful to the target audience (Malouf & Schiller, 1995; Rogers, 2003).

This study does have some limitations; the sample size is small and it does not include a control group. Future research should include a control group to identify if gains measured across measures is replicable with greater experimental control.

Teachers utilised behaviour analytic strategies to prepare students with readiness for learning skills essential for accessing curriculum. The low intensity, collaboration between the behaviour analyst and teacher and adaptability to specific classroom settings clarify the classroom-based ABA models feasibility for implementation in similar settings. The current research has shown how strategies based on the principles of ABA can complement educational provision in maintained SEN schools in Wales.

Chapter 3: Qualitative and Quantitative Study of the Organisational Variables which affect Classroom-Based ABA Model Implementation and Sustainability

Introduction

As reviewed in Chapter 2, the Classroom-Based Applied Behaviour Analysis (ABA) Model is an affordable and effective intervention that has been delivered to students in Foundation Phase and Key Stage 1 of maintained special education schools in the UK (Foran et al., 2015; Pitts et al., 2019). The model utilises the principles of ABA to teach skills such as language, social and play, academic and self-help skills and reduce challenging behaviour. Behaviour analysts collaborate with educational teams to enhance the educational provision for students with Autism Spectrum Disorder (ASD) and intellectual disabilities (ID). Behavioural intervention is provided to students to promote self-management and engagement in education. Direct instruction is provided to students, to teach them educationally and developmentally appropriate skills (Foran et al., 2015).

Achieving intervention implementation in the applied setting is critical for overcoming the research to practice gap (Dingfelder & Mandell, 2011). Effective implementation is as critical as an effective intervention; one without the other will not produce the positive outcomes demonstrated in research (Metz, 2016). Implementation fidelity, also known as 'integrity' is the degree to which an intervention is implemented as intended by the developers (Dusenbury, Brannigan, Falco, & Hansen, 2003). The fidelity with which an intervention is implemented, can influence recipient outcomes positively or negatively (Dusenbury et al., 2003; Dane & Schneider, 1998; Elliott & Mihalic, 2004; Mihalic, 2002; Mandell et al., 2013). For example, Gresham (1993) found significant, moderate correlations between fidelity of school based behavioural intervention implementation and the magnitude of treatment effects. Fidelity of intervention implementation can be influenced by the quality of training and support delivered to implementers (Rogers, 2003; Allen, 1998; Barat et al., 2001), and it may also be a reflection

of the perceptions that implementers have of an intervention (Martens, Van Assema, Paulussen, Schaalma, & Brug, 2006; Ringwalt et al., 2003).

Evidence Based Practices (EBP) are effective educational strategies implemented through a combination of individual teaching expertise and support by evidence from systematic research (Coldwell et al., 2017). As seen in chapter two, the classroom-based ABA model is effective at teaching students essential academic and functional skills. Behaviour analysts collaborated with educational teams which facilitated the introduction of ABA strategies to improve the educational provision and behaviour management of students. Whilst the evidence base for the classroom-based ABA model is increasing, evidence of effectiveness does not guarantee that EBPs like this model will translate successfully into applied settings (Stahmer, Collings, & Palinkas, 2005). In chapter two, researchers aimed to address one of the barriers EBPs like the model face; the target audience not understanding the relevance of an intervention due to researchers using highly technical styles of reporting to explain outcomes (Malouf & Schiller, 1995). Whilst clarity of EBP benefits may increase their likelihood of adoption, it does not guarantee the intervention will be implemented as it was intended in the school setting (Kasari & Smith, 2013). Sustainability is the extent to which an EBP can deliver its intended benefits over an extended period of time after external support is terminated and staff are required to implement it with regular support and resources (Rabin, Brownson, Haire-Joshu, Kreuter, & Weaver, 2008). Individual and organisational variables can affect the implementation and sustainability of an EBP. Studies have investigated how individual variables for example, attitudes about EBPs can be a barrier or enable adoption and implementation (Aarons et al., 2010; Becker-Haimes et al., 2017; Smith, 2013; Stahmer & Aarons, 2009). Organisational variables such as leadership support for EBPs affect their translation into applied settings (Aarons, Ehrhart, & Farahnak, 2014; Ehrhart, Aarons, & Farahnak, 2014). Because individual and organisational variables can

affect implementation and sustainability, researchers may need to study these contextual variables to understand how they impact implementation in applied settings. Researchers have described contextual variables that make intervention implementation successful as 'Enablers'. Conversely contextual variables that inhibit successful implementation are called 'Barriers'. Enablers and barriers can be present in any applied setting and are a result of the contextual variables of that setting. For example, Bambara, Goh, Kern, & Caskie, (2012) noted the importance of establishing a positive school culture to facilitate intervention implementation. They investigated the perceptions of implementers of a school based behavioural intervention by conducting interviews with stakeholders. Analysis of data revealed if a supportive school culture for the intervention is not established, this can function as a barrier for implementation and sustainability. The absence of a supportive school culture was characterised by staffs' lack of knowledge or awareness of the intervention, conflicting beliefs, values and practices. When a supportive school culture was not present, it was described as a barrier to successful intervention implementation. In educational settings professionals from multiple disciplines often collaborate to provide educational provision for the benefit of a student. In a study investigating the variables that affect sustainability of behavioural interventions Bambara, Nonnemacher, & Kern, (2009) identified collaboration between professionals enables the implementation of EBPs. However, when professionals from different disciplines failed to collaborate due to time constraints or conflicting beliefs, this created a barrier to successful intervention implementation. To implement interventions successfully, implementers require continued development and support (Bambara et al., 2012, 2009; Kincaid, Childs, Blase, & Wallace, 2007; Klingner, Ahwee, Pilonieta, & Menendez, 2003). Implementers may require specific skills to implement EBPs which differ from those involved in regular educational approaches. Klingner et al., (2003) investigated barriers and enablers for increasing successful implementation of four research-based practices in

inclusive classrooms. Twenty-nine teachers from six primary schools participated in a 2-week professional development program and received follow-up support from researchers throughout the school year. Interviews were conducted to better understand the barriers and enablers experienced by teachers for strategy implementation. Teachers reported during interviews that they would have liked more frequent visits by the researcher to support, model, give feedback on performance and collaborate with the teacher to adapt the practice for a better contextual fit. Not having enough continued development and support by the researcher was acknowledged as a barrier for successful implementation.

In educational settings, school leadership and teachers are not passive recipients of an intervention. When they are considering to or actively implementing an intervention, school leaders and teachers evaluate, develop positive or negative perceptions, modify and try to improve the intervention by redesigning it (Rogers, 1995). Therefore, to investigate the contextual variables that affect the implementation and outcome variables of the classroom-based ABA model, there is a need to investigate the perceptions of those responsible for its adoption, implementation and sustainability (Rogers, 1995; Vaughan, Klingner, & Hughes, 2000). Rogers (2003) proposed the Diffusion of Innovations Theory, which suggests that implementers' perceptions of an intervention can influence how successfully an intervention is adopted, implemented and sustained. Rogers (2003) suggested that the perceptions of adopters and implementers is the best predictor of an intervention's successful dissemination, implementation and sustainability. Implementers' perceptions of 5 attributes of an intervention can explain 49 to 87 percent of the variance in how readily people will adopt and implement it at their setting. These five attributes are 1) Relative Advantage, 2) Compatibility, 3) Complexity, 4) Trialability and 5) Observability (Rogers, 2003). Relative Advantage means that an intervention offers a clear improvement relative to strategies the school currently use. If an intervention has relative advantage it will be more readily adopted

and implemented than an intervention with clear evidence but low relative advantage. Interventions that are considered compatible with the organisation work environment and work style will be more readily assimilated into the educational setting. The compatibility of an intervention can be evaluated against the organisations' values and their perceived needs.

Typical EIBI interventions may have parental involvement (Green, 1996) and an ABA tutor trained to degree level implementing teaching strategies (Leaf et al., 2016), however the classroom-based ABA model involves training teachers and teaching assistants to use strategies based on the principles of ABA. As described in chapter two, and by Foran et al., (2015) and Pitts et al., (2019), students who received the classroom-based ABA model made significant gains in language and communication, social and play skills and self-help skills (Foran et al., 2015; Pitts et al., 2019). Exploring implementers' perspectives of experiences will likely yield important information about what variables affect successful implementation and sustainability of the model. It is therefore meaningful to identify how fidelity and sustainability of the classroom-based ABA model can be achieved in applied settings.

The current study used a mixed methods design; researchers used direct observation to investigate implementation fidelity and semi-structured interviews to investigate implementers' perceptions of the model. The aim of the research question was to examine the contextual variables associated with successful implementation of the classroom-based ABA model. Analysis of results from direct observations allowed for the identification of settings that implemented the model successfully (with high fidelity). The fidelity with which each setting implemented the model was examined through data collected on Function-Based Behaviour Support Plan implementation. This component of the model was chosen as a proxy measure for model fidelity, as behaviour plans were provided to all students and staff were required to implement strategies from plans across the day in various environments.

Behaviour plans included general and/or individualised teaching strategies for students, therefore regardless of the observation period, elements of a behaviour plan are observable across all students and activities. Behaviour plans were individualised to each child and considered one of the most complex model components to implement. To successfully implement a behaviour plan, teaching staff needed to know each child's plan and recall which strategies to use in different circumstances. Other components of the model were more prescribed and easier to implement. It was hypothesized that settings which had high fidelity in behaviour plan implementation, would also have high fidelity in other components of the model.

Questions within the semi-structured interviews were developed to explore how advantageous and compatible participants perceived the model to be. Quantitative and qualitative results were examined alongside one another for each setting to allow for the examination of whether the settings with higher coding's for advantages and compatibility also implemented the model with high fidelity. As the data collection for this study was conducted three years prior to the writing of this paper, researchers were able to identify which settings had sustained the model after the support of a university trial was withdrawn. The primary research questions were: Do settings with positive perceptions of the model have higher implementation fidelity? Did the settings with higher fidelity and positive perceptions sustain the model?

Method

Participants and Setting

Ten early-years foundation phase classrooms across six schools participated in a university led trial of the classroom-based ABA model, and a subset of the Senior Leadership Team and teachers from that trial participated in this research. For the current research, a total

of 27 participants were interviewed. These included six behaviour analysts, seven teachers, seven teaching assistants, five department heads and two head teachers across settings.

Each classroom was assigned a pseudonym: Glyder, Snowden, Tryfan, Gable, Ben, Garn, Aran, Grassmoor and Crag. In Bowfell, Snowden, Garn and Gable, the behaviour analyst was employed by the school and was available to support the teachers in model classrooms every day, in addition to their other responsibilities in the school. In other settings (Grassmoor, Crag, Ben and Aran) the school used a consultant model and the behaviour analyst supported the school for one full day a week. The local university donated a behaviour analyst's time for one day per week for Glyder and Tryfan. Behaviour analysts supported their model classrooms for an average of one hour per child per week, with a range of .82 – 1.3 hours. Data on the fidelity of behaviour support plan implementation was collected for 40 students who attended Key Stage 1 classrooms in the maintained special educational schools implementing the model.

Design

A mixed methods research design was used. Quantitative measures investigated the fidelity with which each setting implemented Function-Based Behaviour Support Plans (FBBSP). Fidelity observations included direct observations of classrooms to measure if FBBSP's were implemented as described by Foran et al., (2015). Qualitative measures derived from Rogers (2003) theory used a conceptual framework approach to investigate participants' perceptions of how advantageous and compatible they considered the model.

Procedure

Quantitative Measures of Fidelity

Fidelity data was collected on FBBSP implementation as it was identified as a suitable proxy measure for overall model implementation. FBBSP implementation is an

important component of the model because behaviour plans include individualised strategies to reduce challenging behaviour and enhance the behavioural support provided to students. In addition to this, behaviour plans include individualised strategies to promote students learning of important skills for example, language, social and play, academic and self-help skills. Researchers conducted direct observations of each student receiving the classroom-based ABA model. The observations were conducted during a range of functional routines and group activities for students, such as circle time, assembly, lunchtime, playtime etc. The components of the behaviour plans were coded into 'antecedent strategies' which were strategies meant as an attempt to reduce the possibility of the target behaviour occurring, and 'reactive strategies' which were how staff were to respond to target behaviour once it occurred. Data collection included the following components, 'antecedent strategy used', 'opportunity for antecedent strategy missed', 'reactive strategy used', 'opportunity for reactive strategy missed', 'no opportunity'. Each student was observed for 15 minutes. Data were collected using 30second partial-interval recording. If the behaviour plan strategy included the word 'constantly' or a word with a similar meaning to 'constantly' then the interval would only be ticked if the strategy occurred for the whole interval. If no antecedent or reactive strategies were used within an interval because no setting events or challenging behaviour occurred that necessitated the use of plan strategies, this was scored as zero. These data were not coded under correct or incorrect implementation during data analysis as there was no opportunity to use strategies. Behaviour plan fidelity is reported as percent correct of intervals to implement strategies. Percent correct was calculated by dividing the number of intervals scored for strategies used correctly by the total number of intervals scored for correct and missed and multiplied by 100. See appendix A for sample behaviour plan.

Data were collected by two trained observers enrolled in an MSc of Applied Behaviour Analysis course in the UK and one Board Certified Behaviour Analyst (BCBA) (BACB, 2018).

Table 1. Definitions of student target behaviours detailed within behaviour plans

Behaviour	**Definition**
On task	When a task has been set and the child is following instruction and doing what is expected of them.
Requesting help	When the child asks another peer or staff for assistance through touch, gesture, verbal etc.
Using materials appropriately	Using the materials for their specified purpose.
Waiting	When the teacher has specified to the child/ children that the next task is approaching and the child is waiting without instances of undesirable behaviours.
Using materials inappropriately	Not using the materials for their specified purpose.
Not on task	When a task has been set and the child is not following instruction i.e., doing what is expected/ asked of them.
Wandering	When a task has been set i.e., the child is supposed to be doing a certain task, but instead the child is walking around the classroom.
Unsafe activity	Participating in an activity that is unsafe for the child or others.
Aggression to others	Any occurrence of contact with another person's body with the intent of harming either by using their own body or other objects. E.g., Pushing others, stealing toys from others.
Aggression to property	Any occurrence of aggression towards an item, objects, etc. E.g., throwing items, attempting to tear a book.
Self-injury	Any occurrence of deliberately harming the surface of their own body.
Disrobing	Taking clothes off inappropriately.
Inappropriate vocalisations	Any instances of inappropriate noise such as swearing, crying, screaming, whinging etc.

The duration with which each setting implemented the classroom-based ABA model is presented alongside the results of fidelity data analysis. This was done to compare the

fidelity of settings which had been implementing it longer than others as research has identified when staff are given time to learn, develop and maintain skills, fidelity improves (Stahmer et al., 2015).

Reliability Observations

Interobserver agreement (IOA) was collected during fidelity data collection. Interval-by-interval IOA was calculated by dividing the number of intervals both observers agreed by the number of intervals agreed plus disagreed and multiplying by 100. Interval-by-Interval IOA was calculated for data collected on FBBSP implementation (fidelity). Exact Count-per-Interval was calculated for 20% of intervals and resulted in 97.32% agreement.

Quantitative Analysis and Results

Table 2. presents the fidelity results per setting. Criteria's for fidelity were set at; High fidelity; 80% or more, Medium fidelity; 55-79%, Low fidelity; less than 55%. Settings Bowfell, Snowden and Glyder had the highest fidelity. The subsequent settings had medium to low fidelity, which indicate varying levels of successful implementation. Setting Crag had the lowest fidelity, and implementation of the model was withdrawn prior to the end of the academic year. This indicates implementation of behaviour plans in this classroom was unsuccessful.

Table 2. Percent correct of behaviour plan implementation across settings and duration of model implementation

Setting	Fidelity	Duration of Implementation
Bowfell	95% (high)	More than 2 years
Glyder	92% (high)	Less than 1 year
Snowden	89% (high)	More than 5 years
Tryfan	75% (med)	Less than 1 year
Gable	63% (med)	Less than 1 year
Ben	56% (med)	Less than 2 years
Garn	53% (low)	Less than 1 year
Aran	37% (low)	Less than 2 years
Grassmoor	31% (low)	Less than 1 year
Crag	0% (low)	Less than 1 year

Qualitative Measures

Researchers conducted interviews with members of the school leadership teams and teachers to better understand their perspective of the model in terms of relative advantage and compatibility (Seidman, 2006). Semi-structured interview guides were developed to investigate interviewee's perceptions of how Advantageous and Compatible the classroom-based ABA model was. See appendix B for an example of the semi-structured interview guide. Ten questions within the interviews were designed to address the perceived Relative Advantages, and ten questions addressed the perceived Compatibility of the model. Interviewees were asked about their colleagues' perceptions of the model, for example *"do you think the classroom-based ABA model is a priority to your head teacher?"* Interviewers listened to interviewees' answers and asked open-ended questions for details as to why or why not the model was perceived as advantageous or compatible (Seidman, 2006). For example, if an interviewee expressed they did not think the classroom-based ABA model was beneficial, the interviewer asked the interviewee to "*tell me more about that".* All interviews were audio-recorded, transcribed, and imported into NVivo QSR 11, a software package used to manage qualitative data.

Qualitative Analysis and Results

The primary researcher in this study was previously trained in quantitative analysis. Whilst quantitative methods provides useful information, combining quantitative and qualitative methods can lend towards researchers understanding the reasons behind quantitative results. Employing qualitative analysis can lend towards the discovery of variables for further analysis and is therefore a useful tool for any researcher to employ. The philosophical framework for the analysis for this study was informed by Rogers (2003) theory of intervention diffusion. The method of analysis chosen for this study was a hybrid approach of qualitative methods for thematic analysis. It incorporated both the deductive a priori approach and data-driven inductive approach (Boyatzis, 1998). When taking a deductive approach to develop hypotheses based on a theory, a researcher collects data that can be used to test the hypotheses and assess whether the data collected support the hypotheses (Elliott, 2018). When taking an inductive approach the researcher looks for patterns in the data, and works to develop a theory that could explain those patterns. Thus, when researchers take an inductive approach, they start with a set of observations and then move from those particular experiences to a more general set of propositions about those experiences. In other words, they move from data to theory, or from the specific to the general (Arthur, Waring, Coe, & Hedges, 2013; Elliott, 2018). This approach complemented the research questions by allowing the themes of relative advantage and compatibility to be integral to the process of deductive thematic analysis while allowing for themes to emerge direct from the data using inductive coding. It involved the identification of themes through "*careful reading and re-reading of the data*" (Rice & Ezzy, 1999, p. 258). This procedure for data analysis ensured overarching themes were supported by excerpts from raw data so that data interpretation remained directly linked to the words of the participants. This process allowed for the analysis of raw data from interview transcripts to progress toward the

identification of overarching themes that captured the perspectives of implementers of the model.

Primary Coding Results

Initially interviews were systematically coded according to the pre-determined definitions of Relative Advantages and Compatibility (deductive approach). Identifying the proportion of interviews which Relative Advantage and Compatibility were discussed across settings, provides a useful indicator for the presence of these attributes within settings (Elliott, 2018). Questions about relative advantage included, "*do you think implementing the Classroom-Based ABA Model has been advantageous for your students?*". Examples of responses coded under relative advantage were: "*they probably learn better than just sitting down, because they are doing it in different places. They're learning as a three-year-old should, you do it more, because you do it even at playtime. It's all the time, even if it's just little things like playing on the yard. You do it all the time without realizing it*" (Teacher, Snowden) and "*When I look at the kids from last year, they weren't so vocal, no. I think they were a lot more in their own worlds. These kids are communicating, initiating social play and more keen to work with the staff rather than just sat there in their own world*" (Teaching Assistant, Glyder). Questions about compatibility included, "*do you think strategies within the Classroom-Based ABA Model is compatible with the needs of your students?*". An example of a response that was coded under compatibility was: "*It's foundation phase children I have anyway, so it works in-hand with the foundation phase because that's what they do; they learn through play and it just fits in quite nicely with that.*" (Teacher, Snowden).

NVivo software organized the data that had been coded for relative advantage and compatibility per setting. This made it possible to compare the proportion of interviews coded for advantages and compatibility between settings.

Table 3. Results of primary coding for Relative Advantage and Compatibility per setting.

Setting	Relative Advantage & Compatibility	Duration of Implementation
Bowfell	51%	More than 2 years
Glyder	35%	Less than 1 year
Snowden	35%	More than 5 years
Ben	32%	Less than 2 years
Grassmoor	31%	Less than 1 year
Tryfan	26%	Less than 1 year
Gable	15%	Less than 1 year
Aran	15%	Less than 2 years
Garn	4%	Less than 1 year
Crag	4%	Less than 1 year

Table 3. presents the results of primary coding. Settings Bowfell, Glyder and Snowden had the highest proportion of codings for how Advantageous and Compatible they perceived the model. The subsequent settings had varying levels of primary coding's with setting Garn and Crag having the lowest proportion of interviews coded for the two attributes.

A primary research question was whether settings with positive perceptions of the advantages and compatibility of the model have higher fidelity. It was therefore necessary to investigate the results of primary coding alongside the quantitative analysis results for fidelity. Primary coding and fidelity results were combined to explore the patterns of successful implementation and perceptions of advantages and compatibility per setting.

Figure 1. Bars on this graph indicate the percentage of interviews coded for Relative Advantage and Compatibility per setting. Implementation fidelity is displayed above each setting denoted as '*(IF=)*'. The length of time each setting implemented the model at the time of this study is denoted above fidelity as '>/< years'.

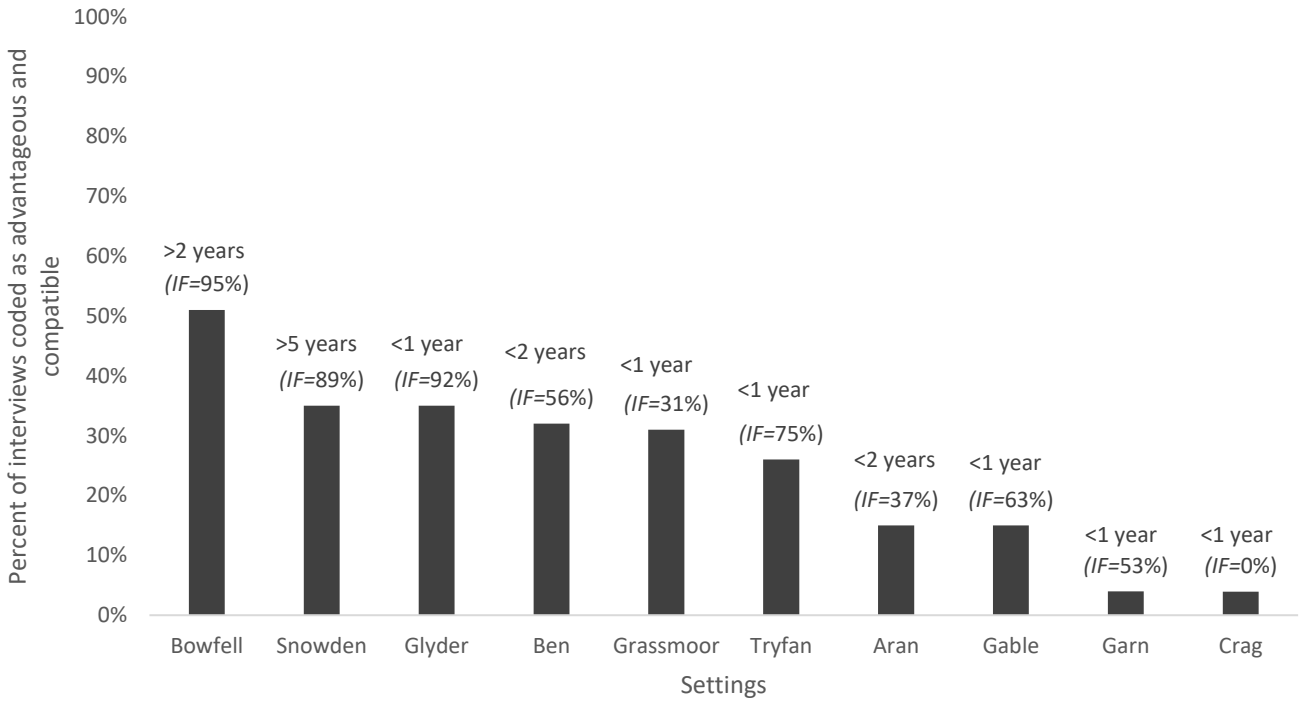


Figure 1 illustrates that the settings with the highest proportion of coding's for advantages and compatibility were the settings with the highest fidelity (Bowfell, Snowden and Glyder). Two out of three of these settings (Bowfell and Snowden) had been implementing the model longer than other settings. Subsequent settings had varying levels of fidelity and positive perceptions. Setting Crag had the lowest coding's for positive perceptions and was unsuccessful at implementing the model.

An aim of this study was to explore if settings with higher fidelity and positive perceptions would sustain the model post three years. The high fidelity settings which sustained this model post three years were Snowden and Bowfell. These settings also had positive perceptions of the model. However, settings Aran, Garn, Ben and Gable also sustained the model despite not achieving high fidelity and having variable results for positive perceptions of the model.

Secondary Coding Analysis

Secondary coding entailed independent line-by-line coding and indexing recurring concepts to be considered for additional code development (inductive approach) (Richards & Richards, 1994). Concepts chosen as additional codes were defined. The same procedure of line-by-line coding was conducted for the additional codes. After reading through and coding the dataset, researchers studied the results to identify themes. A second researcher collaborated and discussed theme choices. After agreement was reached, an additional step was taken to match codes to themes. This required the researchers to re-read data within the codes, and then allocate the codes to the appropriate themes. The results of secondary coding's were reviewed alongside quantitative data collected on the successful implementation of the Classroom-Based ABA Model.

Coding Reliability

The principal researcher and a designated second researcher coded 25% of the interview transcripts separately. Researchers independently noted what secondary codes were recorded for each interview. When each researcher was finished coding the sample interviews, the results of their secondary recording of the sample interviews were compared. Both researchers had agreement for 86% of coded content of the sample interviews.

Secondary Coding Results

Analysis of the data revealed contextual variables that impacted interviewees perceptions of how advantageous and compatible the model was. These are listed in Table 4. The focus of this study was to explore whether positive perceptions of the advantages and compatibility of the model correlates with higher fidelity, if the model sustained, and what variables impact stakeholder's perceptions. The data were analysed for evidence of whether stakeholder's perceptions of the model were advantageous and compatible. Further inductive

analysis revealed the variables they discussed which may impact perceptions. These variables are presented as enablers and barriers for implementation. For example, enablers to the model are variables present in the educational setting which support model implementation and having senior leadership support for implementing the model is an enabler.

Table 4 presents the percentage and number of interviewees whose interviews were coded for each of the four themes and subthemes within themes. The open-ended nature of the interviews means these figures provide an indication of the occurrence of topics discussed by interviewees in the context of why (or why not) the model was advantageous and compatible. Percentages do not indicate the proportion of interviewees who agreed or disagreed with a perspective.

Table 4. Percentage and number of participants who contributed to the four major themes and their subcategories

Key Themes and Subcategories		
Key Themes	**Percent of respondents**	***n***
Classroom Culture	96%	26
Barriers		
Lack of understanding of Classroom-Based ABA Model	37%	11
Lack of understanding FBBSP	48%	13
Lack of classroom leadership	41%	12
Conflicting beliefs and practices	66%	18
School culture	41%	12
Enablers		
Understand the model is to be applied across environments	66%	18
Understand the model enhances education through EBP	41%	12
Perceive implementation of the model as a priority	70%	19
Prepare for implementation	70%	19
Understand implementation takes time to master	59%	16
Implementers willing to try new approaches	55%	15
Continued Development and Support for implementation	92%	25
Barriers		
Lack of behaviour analytic assistance provided to teams	37%	10
Lack of time dedicated to development and support	51%	14
Enablers		
Behaviour analytic presence	78%	21
Provision of ongoing training	48%	13
Multi-Disciplinary Collaboration	75%	20
Barriers		
Lack of multi-disciplinary understanding, acceptance or support	25%	7
Inconsistent team	41%	12
Poor communication	18%	5
Enablers		
Collaboration between implementers	70%	19
Collaboration between specialists	22%	6
Senior Leadership Support	70%	19
Barriers		
Do not assist in planning and provision of essential resources	33%	9
Lack of senior leadership understanding, acceptance or support	22%	6
Poor communication	33%	9
Enablers		
Plan and problem solve for successful implementation	25%	7
Promote the model	30%	8
Provide essential resources	22%	6
Perception that model implementation enhances job performance	25%	7
Early intervention is a priority	30%	8
Good communication	37%	10

Findings from Secondary Coding

Classroom Culture

The most frequently discussed theme by almost all interviewees (96%) was that of classroom culture. Positive classroom culture in this study relates to educational teams sharing a common understanding and appreciation for the model. Interviewees discussed how staff values, beliefs and practices of the educational team can impact successful implementation. For example, a teacher explained the model was compatible because their team "*want to try and work towards academic work, and without having the behaviour support in place and all these prerequisite skills, it's not going to enable us to move on. We want to see the impact going up the school, so when the children do arrive in top of foundation and key stage 2 and onwards that those behaviours have been phased out."*

When there is a positive classroom culture, teams were willing to "*buy-in. We've all had to be participating in it and taking it on. I think it's really made us more consistent*" (Teacher). 59% of respondents said the model requires mental effort *"when it's first implemented but as time goes on, it becomes more natural"* (Teacher). With experience of implementing the model and support from the behaviour analyst, teams were able to "*discuss quite frequently about what's happening"* (Teacher) and learn how to problem solve successfully. When there was a positive classroom culture teams were willing to work towards model success and interviewees felt the benefits of the model are enhanced over time as educational teams have practiced problem solving and can make independent decisions to benefit students.

55% of interviewees noted that during the initial stages of implementation, having staff who were willing to implement strategies was essential for success. As stated by one department head "*It's not going to work unless you've got staff who can absorb training and*

are willing to change their methods and give it a go, and to take on feedback. So I would definitely say it's something that could work in any school, in terms of children and the classroom, but you need the right team around it." A positive classroom culture was not always present from the outset. However, even if initial buy-in was not present it was achievable if staff "*give it a few weeks and see the results, what I was doing with his 1:1 ABA, he's actually doing it in class now, or he's doing it out in the playground now. And they're transitioning these skills that they're learning within their 1:1 ABA to the rest of the body of the school*" (Teacher). Seeing this progress led to teams being more open to following recommendations made by behaviour analysts "*I think they've really got on-board and I think they've been reinforced seeing the pupil's progress, seeing challenging behaviour decrease and seeing them starting to learn. It makes them think, I want to carry on with it. Whereas before, I think it was disheartening if you're not seeing progress, you're not seeing what's coming out of your work.*" (Behaviour Analyst).

Working collaboratively with the behaviour analyst from the outset was important as it enhanced understanding of the model from an early stage. 66% of interviewees discussed the importance of implementers understanding that the model was an approach to be applied across the day in different environments. Implementers who understood this were more likely to plan for generalisation of targets taught during 1:1 instruction, by incorporating them into group activities. They also perceived components of the model as interrelated and progress is dependent on full implementation for example, one department head explained "*I think the fact that the behaviour plans are a real central part to all of this, you're having to take those with you wherever you're going. It's just essential. It is the model, isn't it? I think it's great because it's given us that whole child we want to develop. It's not just the DTT area but it's trying to bring it to every area that we're working on, whether it be on the yard or in the cooking. I think it's a great asset because, with not having the background in the ABA, it's*

interesting taking it on board, but then seeing how it can filter through and impact on other areas".

41% of interviewees noted teacher buy-in (acceptance of and willingness to actively support and participate in the model), understanding what the model entailed and their responsibilities was particularly important for day-to-day implementation. When the "*teacher is confident in understanding the programmes and understanding their role in monitoring implementation, you have that lead within class for ensuring implementation"* (Department Head). The teacher played a key role in creating a positive classroom culture, as "*without that, the accountability for the team would be difficult to maintain through the behaviour analysts"* (Department Head).

70% explained perceiving the model as a priority supported the development of a positive classroom culture, "*for my staff team, they really enjoy it and they think it's better to be doing it that way. They're fully 100% behind it and they enjoy it"* (Teacher). When it was prioritised teachers proactively prepared for success "*you need to make sure you're organised, and you've got everything around you so you can check up on everybody"* (Teacher). This prioritisation and preparation enabled the day-to-day implementation of the model, as teaching assistants had the necessary resources and direction from the classroom lead. When teachers did not proactively prepare, staff had to interrupt lessons to gather resources. Interviewees explained these interruptions derailed a teaching session and time was spent redirecting students back to task rather than teaching.

37% of interviewees discussed how a lack of understanding can impact implementation. For example, some interviewees perceived the model as only conducting DTT during allocated times rather than strategies to be used across environments. A teacher

in one of these settings explained *"it felt like more responsibility on me because the other staff weren't implementing it".*

66% of interviewees explained implementation can be affected by conflicting beliefs and practices. For example, interviewees discussed how some team members can view proactive strategies within Function-Based Behaviour Support Plans as "*rewarding for something he should just learn*" (Teaching Assistant). Some interviewees explained this was caused by a misunderstanding of how proactive strategies teach skills and ultimately work to reduce students' need to engage in challenging behaviours. Reactive strategies were sometimes also misunderstood, respondents explained other team members and staff in the school had prevented them from following plans "*I am asking him to stand, but someone else comes along and picks him up but he has been refusing to stand for that reaction"* (Teacher).

41% of interviewees discussed that the model was implemented successfully when teams understood how it complimented and enhanced educational provision. Behaviour analysts collaborated with teachers and teaching assistants to help them understand the significance of using evidence-based strategies. Teams understood when the behaviour analyst recommended strategies, it was because consideration and research had gone into identifying what was most appropriate and effective.

In addition to classroom culture, 41% of interviewees discussed the impact school culture, values and beliefs of effective behaviour management had on implementation. To achieve the necessary teamwork for implementing the model, respondents felt that educating the school community (e.g., head teachers, department heads, teachers, and teaching assistants) about the basic principles and strategies of the model would be beneficial. Although in-depth training of how to implement strategies and plans may not be necessary, it

would provide important information to others that would enable implementers to follow plans without interference throughout the school.

Continued Development and Support for the Team

Many interviewees (92%) discussed the importance of continued professional development and support for teams implementing the Classroom-Based ABA Model. Interviewees conveyed that training and support is especially important in the initial stages of implementation as many team members were unfamiliar with model strategies. Initial formal training provided teams foundational knowledge of the model. 48% of interviewees felt subsequent support and informal/in-situ training by the behaviour analyst helped them progress from foundational knowledge to more advanced understanding of its application. "*There's no doubt. It's a huge advantage to the school and to the children. It's also upskilling the staff because they're having in-house training through the behaviour analyst and regular meetings and going through things with the behaviour analyst, be it a behaviour plan or a certain task or the way we're directly teaching. We're giving them such an input. Most of the staff have never had that kind of background before. It's so totally new to them*" (Department Head). 78% of interviewees felt that successful implementation is achieved through behaviour analytic support. "*It's a do what I do model, rather than understanding all of the principles and things like that. I think it's quite important that we're in class quite a lot to answer questions*" (Behaviour Analyst). 37% of interviewees expressed fidelity and efficient problem solving was impacted when behaviour analysts were not regularly on-site and available for support. 51% felt that not having time dedicated for teams to receive training and support impacted their ability to implement the model successfully.

Multidisciplinary Collaboration

70% of interviewees discussed the need for multidisciplinary collaboration to achieve successful implementation. In successful settings, teachers and behaviour analysts worked closely with one another to identify appropriate learning and behaviour targets for students. For example, teaching students required teachers, teaching assistants and behaviour analysts to collaborate and plan how to implement 1:1 instruction in the classroom given the resources available. Successful multi-disciplinary collaboration was not always achieved immediately. All members of the team must learn new ways of working, for example, one teacher explained "*We've always been, as class teachers, the ones implementing the weekly IEPs. That's different. At the beginning, that was a bit strange because it's almost like handing it over. But then, because we give feedback on what's going on and if we feel something is maybe not working, having that discussion and going, "Do you think that's appropriate? Is that something we should be working on? Or, he's got that and we need to move on." So, I think it's having to let go, but for the benefit of the model. It's a weird thing, isn't it, because I think, as teachers, sometimes you can be really controlling. It's your classroom, it's your persistence, it's your way of doing things".*

For the day-to-day implementation of the model teachers felt being able to delegate tasks to teaching assistants was crucial to success. Successful delegation required a consistent team trained in the strategies. 41% of interviewees discussed the negative impact staff changes and absences had on implementation "*There was a lot of absenteeism. There were different members of staff coming in, and then you'd have to go through what you want each to do, and then I went off* (absent) *myself. It just got confusing really, because other staff didn't understand why we were implementing different techniques"* (Teaching Assistant).

22% of interviewees discussed how incorporating the behaviour analyst into the school's multi-disciplinary team resulted in all professionals working towards unified goals that coincided with the aims of the model. 25% of interviewees explained that when multi-

disciplinary collaboration was not achieved it resulted in confusion and inconsistency amongst the team "*I think it clashed with Occupational Therapy and Speech and Language Therapy, they both had their own ideas for what we should be doing so you didn't know which route to take"* (Teaching Assistant). Collaboration between professionals both within and outside of the school enhanced implementation success *"It's nice to have links with the university and be able to discuss what we're doing and discuss problems we're having and looking at other schools using the model and what they're doing and exchange ideas. I think it has improved performance*" (Behaviour Analyst).

Senior Leadership Support

70% of interviewees discussed the effects senior leadership support or lack of support had on implementation. Whilst members of senior management are not involved in direct implementation, they were responsible for the decision to adopt and sustain the model over time. 25% of interviewees indicated supportive senior leadership was important to help achieve successful implementation. For example, to encourage a positive classroom culture one department head explained they had chosen teaching assistants for their model classroom who would "*follow the teachers lead"* and addressed disagreements directly by "*sitting down with the classrooms"* to problem solve. Supportive senior leaders were encouraged by seeing the positive changes both in students and staffs. When explaining why they thought senior leadership felt the model was advantageous, a behaviour analyst explained "*they've commented that they were walking down the corridor and heard lots of cheering which is really nice, and they popped their heads round and seen what was going on. I think they're quite encouraged by that*".

30% of interviewees explained supportive senior leaders promoted the model, which enhanced a positive whole school culture towards it. "*The head teacher had a lot of staff*

requests to move into one of the ABA Model classes which is really nice especially because pupils in these classes are really quite challenging compared to some other classes" (Behaviour Analyst). To disseminate best practice and model strategies, supportive leadership arranged for teachers and behaviour analysts to deliver training to other teams which enhanced acceptance "*a lot of other staff in the school were asking advice after seeing how we approach the situation, how we motivate children. It's opened their eyes*" (Teacher).

Supportive leadership also encouraged a positive school culture because "*they realise it's really important and they want it to be part of their school ethos. They want early intervention. They know the benefit of it and having the model makes that easier"* (Behaviour Analyst). Implementers in these settings perceived the model as advantageous and compatible because the model was perceived as the educational approach senior leadership wanted early year's teams to take. Supportive leaders enquired and acknowledged the efforts and successes of the teams implementing the model. They requested updates on progress and incorporated the model into their school development plans and reports *"I can feel confident in the outcomes for the pupils because that's evident in their assessment results and any bits of research. In some ways, it makes my job a lot easier because I've got evidence that I can rely on, but I don't have to generate it myself"* (Department Head).

22% of interviewees explained supportive leaders ensured teams had enough support for example, behaviour analytic input, especially in the beginning of implementation when it is new and unfamiliar. They understood implementation success "*does rely on having expertise within the school and if we didn't have the expertise it would be much more difficult to implement"* (Department Head). As such, they invested in and provided a behaviour analyst to teams as they felt *"it's really supportive to have the model here because being for example, a newly qualified teacher, it's a cushion around you and support because you're having input"* (Department Head). Supportive leadership arranged for behaviour analysts to

deliver training on inset days which aided implementation. 37% of interviewees explained senior leaders communicated regularly with behaviour analysts "*While senior leadership are very committed, they're reliant on us to say what's going well, what's not going well and what needs to be improved*" (Behaviour Analyst). Senior leaders also supported behaviour analysts when they had to mediate staff's expectations for students' behaviour change. For example, ensuring staff understood behaviour change takes time, but consistency is essential to achieve change.

Supportive Leadership aided sustainability of the model through the provision of staff cover so behaviour analysts could deliver continuous training during school hours. Supportive senior leaders facilitated continued support as "*it makes accountability clear because there is such necessity for clear and specific training, there's constant monitoring of implementation and cycles of review for children, which reflects the work of the staff. It has a positive impact in terms of performance. It makes clear what's expected of staff at any given point, their accountability becomes easier because it's structured. Once training is in place, it makes clearer to staff, what is expected"* (Department Head).

The consensus was senior leaders needed to engage in planning, promotion of the model and provision of essential resources to assist successful implementation and sustainability.

Enablers and Sustainability

Researchers sought to investigate if settings with higher fidelity and discussion of enablers, sustained the model for over three years. Researchers therefore compared the proportion of interviewees who discussed enablers at each setting, and whether the model had sustained beyond three years.

All of the interviewees at Bowfell and Snowden discussed enablers. Both settings had high fidelity for implementation of FBBSPs and have sustained the model beyond three years (Table 5). Despite high fidelity and 62% of Glyders respondents discussing enablers, the model has not sustained. One reason for this may be a barrier that emerged at this setting during the coding process. This school did not have a head teacher who was invested in early intervention or continued development and support because "*they're given five days a year which isn't enough cause you've got to do your statutory training. All this that and the other. Then, before you know it, you've only got two days left for the higher-level stuff. I consider this to be higher level"* (Head Teacher). Classroom Tryfan was in the same school as Glyder therefore experienced the same barriers relating to a lack of senior leadership support and did not sustain the model.

Enablers were primarily discussed at Grassmoor by the implementers (Teacher, Teaching Assistant and behaviour analyst). There was a positive classroom culture towards the model, however a lack of senior leadership support. The teacher felt leaders were inflexible with expectations on documentation for student progress "*there needs to be more refining of the processes around the model if it is going to be long-term, about how it fits into school procedures, because we're having to double-up and still do school planning as well as model planning documents".* Senior leaders at this setting did not facilitate continued development and support, the teacher explained the team *"stayed, sometimes, so we can catch up with things but that's more than what's expected"* and they "*were never given time for training".* The model in this classroom did not sustain. Crag was in the same school as Grassmoor and therefore experienced the same barriers regarding senior leadership support and support for continued development. Unlike Grassmoor however, the model failed at the implementation stage and had to be withdrawn. This was due to the lack of a positive classroom culture when discussing the teaching assistants' perceptions, the teacher in the

class explained *"a lot of staff are, like, "I don't like it." That they (students) should just learn to sit at the table or they should just learn to sit and do a task, but the way our children learn, they need that motivation and that skill. But yeah, a lot don't like it".* Teaching assistants in this setting struggled to follow function-based behaviour plans due to conflicting beliefs. When speaking about an aspect of a behaviour plan one teaching assistant explained *"The children knew, by the picture, where everything went. And to not be able to say to them, "Pick them up." I found that really hard. It went against everything I'd been doing for 40 years nursery nursing".* Crag classroom had an inconsistent team due to teacher and teaching assistant absenteeism, as a result the teacher found it difficult to delegate tasks as supply staff had no previous training in behaviour plans. As this setting had a consultation model, the behaviour analyst was not on-site and only allocated half a day per week for this class, it impacted their ability to collaborate effectively *"having the two classes, it was only a morning in here and a morning in there, or less than because technically all the office stuff was meant to be in the day as well. So it wasn't working at the beginning. Yeah, I think, again, hindsight, I needed to be present more often because I think I'm not in the school I can't just nip down".* The absenteeism in this class and a lack of a classroom lead made it difficult to implement the model "*The teacher went off, as well, for quite a while. So it was left to me to try and implement*" (Teaching Assistant). Despite not implementing the model successfully, Crag had 24% of interviews coded for discussing enablers. Implementers at this setting felt it was beneficial for students, but the barriers within the classroom culture, multi-disciplinary collaboration, continued development and support and lack of senior leadership support hindered implementation.

Gable and Garn were in the same school and both had 49% of interviews coded for enablers with medium and low fidelity respectively. Both classrooms sustained the model despite not achieving high fidelity. These settings had barriers related to classroom culture.

The teachers struggled to collaborate effectively with the behaviour analyst which may have impacted fidelity. However, this school did have supportive senior leadership who invested in and promoted the model. It has therefore sustained beyond three years.

Settings Ben and Aran were in the same school and had the lowest coding's for enablers; Ben (22%) and Aran (20%) with medium and low fidelity respectively. Despite this both settings have sustained the model beyond three years. At the time of data collection for this study, Ben and Aran were experiencing senior leadership changes. Since the data were collected new senior leaders have been appointed who are invested in the model. Classroom Ben had a classroom lead (Teacher) who was invested in early intervention and model implementation. In Ben, the model was implemented with medium fidelity. The teacher explained until recently they had been absent for a couple of months. This classroom was therefore in the beginning stages of implementing the model. For Aran fidelity was low, possibly due to interviewees demonstrating a lack of understanding that strategies should be used throughout the day *"we still have time to extend things or put our twist on things. You know, still going off and doing different science activities or cookery activities, PE"* (Teacher). However, they did express they were learning how to go about incorporating strategies across the day for example, *"transferring some of the terminology to other lessons, and I think that's helped"* (Teacher).

Table 5. The proportion of interviewees at each setting who discussed enablers. Data for each settings' implementation fidelity and sustainability of the model for more than two years is also presented.

Setting	Proportion of Enablers	Fidelity	Sustained >2 years
Bowfell	100%	95% (high)	Yes
Snowden	100%	89% (high)	Yes
Glyder	62%	92% (high)	No
Grassmoor	58%	31% (low)	No
Tryfan	53%	75% (med)	No
Gable	49%	63% (med)	Yes
Garn	49%	53% (low)	Yes
Crag	24%	0% (low)	No
Ben	22%	56% (med)	Yes
Aran	20%	37% (low)	Yes

Table 6. The proportion of interviewees at each setting who discussed barriers. Data for each settings' implementation fidelity and sustainability of the model for more than two years is also presented.

Setting	Proportion of Barriers	Fidelity	Sustained >2 years
Tryfan	91%	75% (med)	No
Crag	83%	0% (low)	No
Grassmoor	83%	31% (low)	No
Glyder	82%	92% (high)	No
Gable	74%	63% (med)	Yes
Ben	72%	56% (med)	Yes
Garn	66%	53% (low)	Yes
Aran	62%	37% (low)	Yes
Snowden	20%	89% (high)	Yes
Bowfell	0%	95% (high)	Yes

Discussion

This study sought to investigate if settings with positive perceptions of the model had higher rates of implementation fidelity and if settings with higher fidelity and positive perceptions would sustain the model. Data analysis revealed the two settings that had been implementing the model the longest (Bowfell and Snowden) both had high fidelity. Bowfell

had implemented the model for over two years and Snowden over five years. However, Glyder which had been implementing the model for less than a year also had high fidelity. Three settings implemented the model with moderate fidelity (Tryfan, Gable, Ben). Tryfan and Gable had implemented the model for less than a year and Ben less than two years. Four settings implemented the model with low fidelity (Garn, Aran, Grassmoor, Crag). Garn, Grassmoor and Crag had implemented the model for less than a year and Aran less than two years. These results suggest settings which implemented the model for longer do have higher fidelity. However, Glyder implemented the model for a shorter duration yet still scored high for fidelity. Ben and Aran had implemented the model for longer than Glyder but scored low for fidelity. To investigate this further we also examined the positive perceptions of settings towards the model and their scores of fidelity (see fig.1.) which may explain why a setting that implemented the model for a shorter duration scored higher on fidelity than others. Systematic coding according to pre-determined definitions of relative advantages and compatibility resulted in identification of the proportion of interviews the two attributes were discussed in across settings. Respondents at settings Bowfell, Glyder and Snowden discussed compatibility and advantages the most. Given these settings had the highest fidelity, these results suggest Rogers, (2003) theory is correct in that successful implementation is achieved in settings where stakeholders perceive an intervention is compatible and advantageous. If positive perceptions influence fidelity it may explain why Glyder had high fidelity despite only implementing the model for less than a year. The remaining settings had moderate to low fidelity and discussed compatibility and advantages less than the three high fidelity settings. Crag discussed the two attributes the least and scored lowest for implementation fidelity.

We also wanted to explore if settings with higher fidelity and positive perceptions would sustain the model. Snowden and Bowfell had higher fidelity, positive perceptions and

have sustained the model post three years. However, Aran, Garn, Ben and Gable also sustained the model despite not having high fidelity and having variable results for positive perceptions of the model. Moreover, Glyder which had high fidelity and positive perceptions did not sustain the model post three years. To explore what situational variables prevented successful implementation and sustainability of the model further analysis was conducted.

To understand the contextual variables that might affect implementation and sustainability of the model we conducted secondary coding of data using an inductive approach. Four themes and their associated enablers and barriers were identified. These themes were Classroom Culture, Continued Development and Support, Multi-Disciplinary Collaboration and Senior Leadership Support. All respondents at settings Bowfell and Snowden discussed enablers of the model (Table 5.). None of the respondents at Bowfell discussed barriers for model implementation and just 20% of respondents at Snowden discussed barriers (Table 6.). At Glyder 82% of respondents discussed barriers for model implementation and 62% discussed enablers. This may indicate at Glyder there were positive perceptions of the model and staff implemented it with high fidelity, but contextual barriers such as lack of leadership support were present at this setting which prevented the model from sustaining. For settings that had moderate fidelity and positive perceptions of the model such as Aran the discussion of barriers (change in leadership and absent teacher) may indicate the presence of these contextual variables are what affected fidelity negatively but the presence of enablers (teacher investment and subsequent supportive senior leadership) is what facilitated sustainability (Table 5. and 6.).

Similar to findings in previous literature (e.g., Fixsen et al., 2005; Odom et al., 2013; Tseng & Foundation, 2012), findings in this study indicate the presence or absence of no one variable seemed to be responsible for successful implementation and sustainability. In asking participants about the perceived advantages and compatibility of the model, barriers and

enablers emerged for its implementation in the applied setting. Similar to findings by Bambara et al., (2012) the most frequently discussed theme by 96% of respondents was that of Classroom Culture and its associated barriers and enablers. Having a supportive classroom culture was perceived as an enabler to model implementation. Under the theme of supportive classroom culture, respondents described enablers as having teachers and teaching assistants who understand the model is an approach to be applied across environments and understand strategies recommended by the behaviour analyst are purposefully chosen and important to implement. Additional enablers entailed having teachers and teaching assistants who treat the model as a priority and prepare for implementation (Klingner et al., 2003) and understand it might take time to see the benefits of implementation but are willing to try even when strategies are new and unfamiliar to them. Under the theme of classroom culture associated barriers to model implementation stemmed from a combination of staff not understanding the goals and purpose of strategies within the model such as behaviour plans and not having a lead within class who promoted and monitored daily model implementation. Similar to findings by Bambara et al., (2012) and Bambara et al., (2009) perceived barriers of model implementation presented when staff misunderstood the purpose and practices of the model, such as teaching prerequisite skills and when staff in the rest of the school interfered with implementers following plans. Strategies identified by respondents to promote a supportive classroom culture and overcome barriers included having frequent discussions as a team to problem solve collaboratively, ensure staff understand it may be difficult initially but over time and with experience implementation gets easier (Vaughan et al., 2000), have frequent behaviour analytic support in class (Klingner et al., 2003), ensure the teacher understands the model so they can lead teaching assistants (Watkinson, 2008) and basic education on the model for the school community so implementers could follow plans without interference throughout the school (Bambara et al., 2012).

The second theme and its associated enablers and barriers discussed by 92% of respondents was that of Continued Development and Support. Development and support for implementers of interventions has been frequently cited in literature as an enabler for successful implementation and as a barrier when it is not provided (Bellg et al., 2004; Fixsen et al., 2005; Tseng & Foundation, 2012; Weinkauf, Zeug, Anderson, & Ala'I-Rosales, 2011). Having scheduled trainings (formal and informal) for classroom-based ABA model implementers was perceived as essential for implementation success. Respondents also felt having the behaviour analyst available for support (especially during initial implementation stages when staff are learning) was important. Not having dedicated time for trainings or the behaviour analyst on site for support was perceived as a barrier that impacted successful implementation (Klingner et al., 2003) through for example not being given opportunities to educate staff on underlying principles and correct misconceptions.

The third theme and its associated enablers and barriers discussed by 70% of respondents, was Multidisciplinary Collaboration. Enablers identified under this theme were when there was collaboration between implementers (70%) and specialists (22%). Collaboration between the teacher and behaviour analyst was noted by respondents as essential for success (Kasari & Smith, 2013). Teachers and teaching assistants needed to work collaboratively to achieve successful implementation (Watkinson, 2008). Teachers needed to delegate tasks to teaching assistants and being able to do so was necessary to successfully implement all strategies and plans within the model (Watkinson, 2008). Collaboration between the behaviour analyst and other specialists such as Occupational Therapy, was important to ensure implementers were consistent in strategies they implemented with students (Brownell, Adams, Sindelar, Waldron, & Vanhover, 2006). Barriers identified by respondents under the theme of multidisciplinary collaboration included a lack of understanding, acceptance and support by professionals from other

disciplines (25%), inconsistent team (41%) and poor communication (18%). Respondents explained professionals from other disciplines may not have supported the model because they did not understand it as there hadn't been opportunities to communicate effectively about it (Brownell, Adams, Sindelar, Waldron, & Vanhover, 2006). When there was an inconsistent team (due to turnover and absences) teachers felt less able to delegate tasks to teaching assistants which prevented successful implementation (Miller, Murnane, & Willett, 2008; Norton, 1998). To achieve multidisciplinary collaboration for the benefit of the model, respondents explained that professionals need to be open to changing the way they worked, such as relinquishing control of behaviour management plans and working collaboratively (Bambara et al., 2012, 2009). They also explained that incorporating the behaviour analyst into the schools' multi-disciplinary team may help facilitate collaboration between professionals across different disciplines.

The final theme was Senior Leadership Support. Respondents explained that when senior leadership helped plan and problem solve (25%), promote the model (30%) and provide resources (22%) for implementation, this enabled staff to implement the model successfully (Forman, Olin, Hoagwood, Crowe, & Saka, 2009). Respondents felt that senior leadership support was provided because leadership felt staffs job performances were enhanced through model implementation (25%) and leadership prioritised early intervention for students (30%) (Aarons, Ehrhart, & Farahnak, 2014; Ehrhart, Aarons, & Farahnak, 2014; Ganz, 2010). Associated barriers under this theme included leadership not assisting in planning or provision of resources (33%), poor communication (33%) and these stemmed from senior leadership not understanding the aims of the model (Aarons, Ehrhart, & Farahnak, 2014; Ehrhart, Aarons, & Farahnak, 2014; Bambara et al., 2009). Having senior leadership support increased the likelihood enablers would be present within other themes. Respondents explained that when leaders assisted in planning and problem solving for model

implementation this helped cultivate a positive classroom culture. For example, they may deliberately place staff in model classrooms who would follow the teachers lead. Supportive leaders invested in behaviour analytic expertise so that it may be available to implementers when needed and facilitated the behaviour analyst being incorporated into multi-disciplinary teams which aided collaboration. Respondents shared suggestions to help achieve leadership support. They suggested if leaders were educated on and understood the goals of the model support may increase. Respondents explained senior leaders do not need to know specific components of the model, but when helping to overcome barriers for example, establishing the behaviour analyst as part of a multi-disciplinary team, they need to understand how the provision of behaviour analytic support and input can complement school goals.

Findings within this study lend to the argument that fidelity is not just influenced by the duration and quality of training and support delivered to implementers (Rogers, 2003; Allen, 1998; Barat et al., 2001) it may also be a reflection of the perceptions implementers have of an intervention (Martens, Van Assema, Paulussen, Schaalma, & Brug, 2006; Ringwalt et al., 2003) and the contextual variables present within an applied setting (Bambara et al., 2012, 2009). Settings Grassmoor, Garn, Crag and Aran implemented behaviour plans with low fidelity, and the model was withdrawn from Crag as it experienced all of the identified barriers for model implementation. The other settings experienced a combination of barriers and enablers related to model implementation. Some respondents expressed remembering individual behaviour plans was challenging. When this challenge combined with barriers such as lack of continued development and support for implementation, the fidelity with which plans were implemented was compromised. To address this, the primary researcher developed behaviour management strategies designed to be less demanding for staff than numerous behaviour plans which will be described in chapter four.

While fidelity measures provided rich cross-site data, it is not clear the extent to which fidelity was achieved when members of the research team were not observing the classrooms. Future research should seek to collect fidelity data on other components of the model, as this study only collected fidelity on behaviour plan implementation. For example, in a study evaluating the effects variables have on child outcomes during EIBI delivery, Strauss et al., (2012) collected fidelity data on the accuracy of implementers data recording, facilitated play, discrimination training and interspersal of new targets during DTT with mastered targets. Data collection was conducted in settings that were participating in a funded trial of the classroom-based ABA model. Because we wanted to conduct interviews with implementers of the model, we relied on a respondent pool made available to us by schools participating in the trial. Thus, the representativeness of the sample and generality of findings may be limited. Related to this, there may have been selection bias by schools over the implementers put forward to participate in this study. Although understanding implementers perspectives is important, respondent perceptions about their experiences and the perceived impact of variables may not correspond with actual practices and events. Given the design of our interview sought to explore perceptions of advantages and compatibility of the model, we were therefore unable to examine in depth the differential influence context variables had on implementation and sustainability of the model across settings. Future research may wish to gather more information on implementers experiences implementing the model relative to the barriers and enablers identified in this study for a finer analysis of their impact. Any of these variables may differentially influence implementers perceptions and successful model implementation and sustainability. Whilst this study included fidelity data for implementation, there is no outcome data of student progress across settings. Future research may seek to include student outcome data to evaluate whether settings with higher fidelity result in better outcomes for students.

Despite these limitations, this study provides initial findings on variables perceived by implementers to be problematic and helpful for implementing the classroom-based ABA model. This study contributes to the literature base as no previous research has been conducted for the classroom-based ABA model focused on understanding the variables that affect successful implementation and sustainability. This may be extended on in future research by continuing to document and measure barriers, while also measuring implementation fidelity (McIntosh, Filter, Bennett, Ryan, & Sugai, 2010) and ultimately student outcomes (McIntosh, Horner, & Sugai, 2009)

As Rogers (2003) noted finding a program acceptable to all stakeholders is difficult because of different needs, values and beliefs. However, future research may also evaluate if findings from this study can contribute to a method where the model can be reviewed in the context of values, perceived needs and the norms of a school, prior to implementation. This may help implementers anticipate barriers and collaborate proactively with stakeholders to overcome these so the model may have a better contextual fit. Future research may also wish to explore perceptions and fidelity of the model from initial stages of implementation to sustainability to identify whether positive perceptions and fidelity increase over time. For example, whilst Gable and Garn had moderate fidelity and positive perceptions they have sustained the model. It would be informative to investigate if positive perceptions and fidelity have increased with experience of implementation. Respondents discussed how implementing the model initially was difficult, but it gets easier with experience. This may be an important consideration for educators looking to adopt the model; as more support initially will lend towards successful implementation (Rogers, 2003).

Whilst findings within this study are preliminary, they do provide useful information for educators who want to implement the classroom-based ABA model in their school. Findings suggest that for the model to be successfully implemented and sustained, you need

implementers (teachers and teaching assistants) who are willing to try new ways of working with students and a consistent team that can follow a teacher's lead within class. To ensure adequate support for implementers a behaviour analyst should be incorporated into the multi-disciplinary team within the school so the behaviour analyst can provide training and support to implementers. Time for the behaviour analyst to plan and problem solve with teachers and other professionals involved in students programming is important and you need leadership who are supportive of the model and its implementers. Leadership need to communicate to the school community model implementation is a priority and the school community needs to understand strategies from the model will be applied across environments.

Chapter 4: Study 1, Evaluation of the Response to Intervention decision making framework in a maintained Special Educational Needs School in the UK

Introduction

Children with autism and learning disability are at risk to develop challenging behaviour (NICE, 2015), which can interfere with learning and place a student at risk of school exclusion (Department for Education, 2019). The National Institute For Health and Care Excellence (NICE) (2013) and National Health Service (NHS) (2017) recommend the use of function-based interventions with students whose behaviour challenges. In the UK, the process for developing function-based intervention usually follows a referral for existing challenging behaviour (NICE, 2013). By the time a functional assessment and intervention begin, the student likely has an established history of reinforcement for the behaviour which can result in it being more persistent and harder to change (Murphy et al., 2005; Taylor, Oliver, & Murphy, 2011). Preventing problem behaviours is perhaps more important than waiting until they are serious enough to merit serious intervention.

The Response to Intervention (RtI) model is a decision making framework used to triage interventions for a population (Lisa et al., 2010). The RtI model can be conceptualised as a pyramid. At the bottom of the pyramid are universal supports, in school these are interventions that are applied to the entire population and designed to prevent the development of challenging behaviour. These Tier 1 interventions will benefit about 80% of all students. The remaining 15-20% of students may require additional supports. At the middle tier, Tier 2, students may benefit from small group, manualised interventions. A small minority of the population will require individualised, function based, Tier 3 interventions.

The RtI model has been successfully applied to mainstream schools as Positive Behaviour Support in Schools (PBiS) (Horner, Sugai, & Anderson, 2010; Horner, 2000; Horner & Sugai, 2015). When teaching staff implement universal behaviour interventions, students engage in fewer instances of challenging behaviour, and the teaching staff spend

less time addressing problem behaviours, allowing them to focus more on teaching (Ervin, Schaughency, Matthews, Goodman, & Mcglinchey, 2007). Fiscal analysis at a maintained primary school in an urban area of North America identified annual savings of $9,106.92 (£7266.68) in the first year and $10,667.74 (£8512.11) in the second year of implementing Tier I interventions (Scott & Barrett, 2004). Furthermore, when a school successfully implements Tier I supports, most of the necessary conditions are present to ensure Tier III success enabling better fidelity of function-based interventions. If most students responded to less intensive support, fewer students may require more expensive bespoke interventions (Grosche & Volpe, 2013).

Despite the evidence for RtI in mainstream schools, we cannot find any literature to support its use in Special Education Needs (SEN) Schools. In this paper we ask if universal strategies can be effective at reducing challenging behaviour for children in a classroom in a SEN school. If universal strategies are effective for most children, it will reduce the number of students who develop serious challenging behaviour and require more expensive, individualised supports.

In the RtI model, school staff are encouraged to respond consistently to student behaviour. School staff should acknowledge and reinforce adaptive behaviours, respond quickly and consistently to problem behaviours, and identify and teach the skills students need to succeed in the classroom. (Walker et al., 1996; Appelbaum, 2009). The positive and proactive approaches to achieve behaviour change at Tier I are designed to be efficient and adaptable for the varying environments within a school. Their efficacy requires each member of the educational team to commit to consistent application across all students and settings (Colvin, Kameenui and Sugai, 1993; Lewis and Sugai, 1999).

Some children will require additional support following universal interventions and may require a functional assessment and function-based behaviour plan. In the classroom-based ABA model all students were provided function-based behaviour support plans (Foran et al., 2015) (FBBSP). However, the resources required to provide FBBSPs are taxing and as identified in chapter three, managing several behaviour plans can be difficult for teachers and teaching assistants. To develop a FBBSP, a Functional Behavioural Assessment (FBA) needs to be conducted which will inform and ensure the effectiveness of FBBSP's for individuals with challenging behaviour (Gage, Lewis, & Stichter, 2012). An FBA helps a practitioner identify the environmental stimuli that evoke and maintain behaviours. Following an FBA, the process for developing an effective FBBSP involves defining the target behaviour, conducting assessment for support planning, designing the plan to ensure technical and contextual adequacy, training and supervision to ensure fidelity and monitoring to facilitate adaptations as appropriate (Crone, Hawken, & Horner, 2015).

To successfully implement and maintain FBBSPs, a school needs to have sufficient staff who are invested in the process and a qualified and experienced behaviour analyst to develop the plan (Scott, Anderson, & Spaulding, 2008). A behaviour analyst receives education and training in the application of behaviour analytic principles to effect behaviour change in socially significant ways. Behaviour analysts can become board certified behaviour analysts (BACB, 2018) (BCBAs). BCBAs qualify by taking 310 hours of post-graduate coursework, completing 2000 hours of supervised fieldwork and passing a qualifying exam. The completion of an FBA requires skilled and experienced personnel and can take a significant amount of time to conduct (Nelson, Roberts, Rutherford, Mathur, & Aaroe, 1999). The provision of a behaviour analyst to conduct an FBA and train staff to develop the necessary conditions to facilitate provision of FBBSPs requires financial investment by schools. Iemmi, Knapp, & Brown, (2016) compared the weekly costs of supporting children

with intellectual disabilities and behaviours that challenge with services that facilitate FBBSPs to costs of alternative support packages available in England. Their analyses discovered that services which provide FBBSPs have long-term savings through reducing the need for more supportive settings e.g., residential care. Initially however, they can increase a child's total education, health and social care costs from £1209.0 to £1909.1 per week. This may present a barrier to successfully implementing FBBSPs in schools. Acquiring a behaviour analyst to provide effective FBBSPs may be difficult given the quantity of students who present with challenging behaviour to merit them (Allen et al., 2013). There has been a reduction in UK government spending in education as a share of Gross Domestic Product from 5.8% in 2010 to 4.2% in 2017, which further affect schools abilities to provide and successfully implement FBBSPs (UK Public Spending, 2019).

The current study aimed to deliver evidence-based strategies to students in a maintained SEN school in the UK guided by the RtI decision making framework. It aimed to develop universal proactive and reactive strategies to increase adaptive behaviours of students.

It was hypothesized that consistent implementation of Tier I universal supports across all students, would reduce challenging behaviour and increase appropriate, alternative behaviour compatible with the educational setting. It was also hypothesized that progress monitoring via the RtI framework will identify students who require intervention that is more individualised and intensive than is provided at Tier I. These students will be provided more intensive intervention at Tier II or III as appropriate.

In this study, researchers used a control group design to identify if implementing universal supports resulted in an increase of appropriate behaviour and reduction of problem behaviour. The researchers developed Tier I strategies to be implemented with all students in

the intervention group. Correct implementation data on staff were collected to assess feasibility of implementation across all students. Data were collected on student's appropriate behaviours and problem behaviours for the control and intervention groups both before and after the intervention.

Method

Participants and Setting

Two separate maintained SEN schools in the UK were contacted by the primary researcher, who explained the proposed study to them. One school was asked to facilitate RtI implementation, whilst one school was asked to be a control group. Both schools consented. The intervention group school requested their Key Stage 1 cohort be included in the study. The control group school consented for their Key Stage 1 group to be included in the study. The primary researcher prepared and disseminated consent forms and information sheets for parents and guardians. Consent was obtained for all pupils in the Key Stage 1 cohorts.

Participants included 27 students (11 girls and 16 boys. The number of participants in the control group (n=5) was smaller than the intervention group (n=22). Their average age at the beginning of this intervention was 74.5 months (range 72 to 85 months). All of the participants had a diagnosis of intellectual disability. Twenty-one students had additional diagnoses that included Autistic Spectrum Disorder, Global Developmental Delay, Down Syndrome, Spina Bifida with Hydrocephalus, Attention Deficit Hyperactivity Disorder and Profound and Multiple Learning Disabilities.

The average staff to student ratio in each classroom was 3:1. The classroom staff consisted of a qualified teacher and teaching assistants who held Level 2 to Level 4 qualifications from the National Certificate in Child, Health and Social Care (Department For Education, 2019).

Design

A pre-test post-test control group design was used for the first study.

Measures

Student Target Behaviour Measures

Data were collected using 30s partial interval recording on the following behaviours: Appropriate Requesting, Compliance with Requests and Challenging Behaviour before and after the intervention. See Table 2 for target behaviour definitions. Data were collected during academic group instruction, apart from Appropriate Requesting, which was collected during structured and unstructured activities. Individual students were observed at baseline for 10 minutes and post-intervention for 10 minutes. Baseline and post-test data were collected 10 weeks apart.

Two trained observers enrolled in an MSc of Applied Behaviour Analysis course in the UK and one Board Certified Behaviour Analyst (BCBA) collected the data.

Table 1. Operational Definitions for Student Behaviours

Behaviour Category	Behaviours Coded	Definition
Appropriate Requests	Mand	Student requested something they desired (e.g.; tangible, assistance, information).
Compliance with Requests Made	Independent Compliance	Engaged in response that matched instruction.
	Non-Compliance	Response did not match delivered instruction.
Challenging Behaviour	Disruptive Behaviour	Behaviours that were not related to the academic task and were disruptive to the learning environment (e.g; out of seat without permission, talking out of turn).
	Destructive or Dangerous Behaviour	Physical Aggression (e.g; hitting, kicking, head-butting, scratching, pinching, biting, pushing, hair pulling, Self-Injurious Behaviour). Object Aggression (e.g; throwing objects, breaking item, knocking over furniture).

Implementation Fidelity Data

Data were collected on the accuracy with which staff implemented the universal behaviour interventions (McGowan, McNally, & Vassos, 2017). Researchers collected frequency data by observing each student for thirty minutes at baseline and post-intervention and recording if the teachers or teaching assistants implemented the Tier I strategies correctly or incorrectly with the child. We did not collect individualised data about each staff member, but whether the staff team implemented the antecedent and consequent strategies with each child. Baseline and post-intervention observations for the intervention and control group were conducted 10 academic weeks apart.

Procedure

The goal of the intervention was to develop universal strategies to increase appropriate and to decrease inappropriate pupil behaviours. The behaviour analyst worked with the teaching staff to develop antecedent and consequent strategies that could be used with all the children in the classroom.

Researchers identified some of the common antecedents that typically preceded challenging behaviour from conversations with teaching staff and by conducting informal observations. Table 2 describes scenarios that frequently preceded problem behaviour, and the recommended universal strategies. The purpose of universal strategies was to manipulate environmental variables in order to reduce challenging behaviour and increase adaptive behaviours.

Table 2. Tier I Proactive and Reactive Strategies

Tier I Strategy focus:	Definition	Proactive Strategy	Reactive Strategy
Interrupt or Transition	*Interruption:* a peer or adult removed an item from a student. *Transition:* a student was instructed to terminate an ongoing activity and move to another activity or area.	Staff provided cues that included verbal prompts, countdown timers and Now-Next Boards before an interruption or transition. (Blair, Fox, & Lentini, 2010).	If the student engaged in challenging behaviour, staff repeated the instruction in a neutral voice every five seconds.
Academic Demands	A student was required to attend to a teacher, wait for their turn, or follow instructions.	Preferred activities were scheduled before and after academic demand sessions. Staff did not place demands during preferred activities. During demand activities, difficult or new tasks were interspersed with easy/mastered targets (Dunlap, 1984).	If students engaged in challenging behaviour, staff neutrally redirected them to the activity every five seconds. Access to other sources of reinforcement were limited. Staff delivered instructions in a neutral voice within the first four seconds of compliance.
Student asked for an item or activity that was unavailable	A student asked for an item that was unavailable.	If the student asked for something that was unavailable, the teachers offered the student an alternative before they denied access to a requested object or activity when possible, and/or the teaching staff placed a symbol of desired item on a visual schedule and explained when it would be available (Pritchard et al., 2011),	If the student engaged in challenging behaviour, they were reminded with a visual schedule that the item was not currently available and redirected to the planned activity.
Requesting Inappropriately	A student grabbed, tried to grab, or screamed for an item.	Preferred Items were offered non contingently throughout the day. Appropriately requesting was taught as part of the student's education plan. The teachers contrived opportunities for students to request appropriately.	If a student requested inappropriately. for example, they tried to grab an item, staff blocked access to the item and prompted the student to request appropriately. If a student engaged in challenging behaviour to access an item, the staff instructed the student to complete five high-probability responses (Davis, Brady, Williams, & Hamilton, 1992). When the high-probability responses were completed with no challenging behaviour, teachers stated; "*good job listening and being calm, now you can ask for (desired item)*". Prompts were provided if necessary for student to request appropriately. The student was then given the item.

Intervention Group

Staff Training: The behaviour analyst delivered a one-hour training to classroom staff about the universal strategies. Scenarios where different strategies were applicable were reviewed with the team, to help them understand what to do when, and why. The scenarios presented were developed from information gathered through direct observations, so that relevant scenarios related to their students were reviewed. For example, the behaviour analyst described an observation where a student engaged in challenging behaviour following staff's removal of an activity. The behaviour analyst explained how the interruption strategy could be implemented in this situation, and what to do if the student engaged in challenging behaviour. The staff team completed a quiz to assess their understanding of each strategy, and the correct answers were discussed as a group. Staff had an opportunity to ask questions and clarify any uncertainties they may have had. Each teacher and teaching assistant subsequently received 20 minutes of 1:1 in-situ training by a BCBA or BCaBA. During training, staff observed the behaviour analyst implementing behavioural strategies in the applied setting. The behaviour analyst identified the child's behaviour and explained to the staff why they chose a particular intervention. There were opportunities for staff to raise queries with the behaviour analyst and discussion around how they could be addressed. The behaviour analysts then observed staff using the strategies and provided feedback on their performance.

Control Group

The control group continued to receive treatment as usual. The communication and behaviour strategies used by the control group were the Picture Exchange Communication System (Bondy & Frost, 1994) and the Star of the Week Rewards.

Results

Student Behaviours

The universal behaviour strategies were designed to increase appropriate mands and compliance with requests, and decrease non-compliance, disruptive and dangerous behaviour. Paired samples t-tests were conducted to evaluate the difference of students target behaviour results from Time 1 to Time 2. For the intervention group, there was a statistically significant increase in mands and compliance and statistically significant decrease in Non-Compliance, disruptive behaviour, and destructive from Time 1 to Time 2. The eta squared statistic measures the magnitude of change of the dependent variable from Time 1 to Time 2. This produces an effect size for data analysed using paired samples t-tests. Using Cohens criteria for small, medium and large effect sizes, small to medium effect sizes were detected for all target behaviours (Cohen, 1988). See Table 3.

Table 3. Time 1 and Time 2 Means (SDs) and Effect Sizes of Target Behaviours for Intervention Group

	Time 1		**Time 2**				
Target Behaviour Intervention Group	**Mean**	**SD**	**Mean**	**SD**	**t**	**P**	**Effect Size**
Mands	1.59	1.843	2.86	1.754	-2.536	.019	.23
Compliance with Requests	2.91	2.810	7.23	3.531	-4.719	.000	.51
Non-Compliance	2.95	3.618	.55	.858	3.055	.006	.31
Disruptive Behaviour	5.00	4.619	.95	1.759	4.050	.001	.44
Destructive/Dangerous Behaviour	1.59	3.487	.14	.640	2.308	.031	.20

For the control group, there were no statistically significant differences from Time 1 to Time 2 for any target behaviours. The eta squared statistic indicated negligible effect sizes for target behaviours (Cohen, 1988). See Table 4.

Table 4. Time 1 and Time 2 Means (SDs) and Effect Sizes of Target Behaviours for Control Group

	Time 1		Time 2				
Target Behaviour Control Group	**Mean**	***SD***	**Mean**	***SD***	**t**	**P**	**Effect Size**
Mands	1.80	3.033	1.00	2.236	.483	.654	.01
Compliance with Requests	3.00	3.317	2.40	2.302	.287	.788	.00
Non-Compliance	2.40	1.140	3.60	2.510	-.910	.414	.03
Disruptive Behaviour	2.60	2.793	4.80	4.764	-.786	.476	.02
Destructive/Dangerous Behaviour	.00	.000	.00	.000	.00	.000	.00

Data from the target behaviours were analysed to evaluate if there was a significant difference between the intervention and control group before and after the intervention. Results of independent samples t-tests (two-tailed) showed no significant differences at baseline between groups (see appendix C). Following the intervention, the children in the intervention group engaged in higher rates of mands although not statistically significant (M = 1.00, SD = 2.236; $t(25) = 2.045$, $p > .05$). They did however engage in statistically significant higher rates of compliance with requests (M = 7.23, SD = 3.531; $t(25) = 2.896$, $p < .01$), and lower rates of non-compliance (M = .55, SD = .858; $t(25) = -4.835$, $p < .001$) and disruptive behaviours (M = .95, SD = 1.759; $t(25) = -3.110$, $p < .01$). There was not a statistically significant decrease for the intervention groups destructive/dangerous behaviour following intervention (M = .14, SD = .640; $t(25) = .470$, $p > .05$).

Staff Implementation Measures

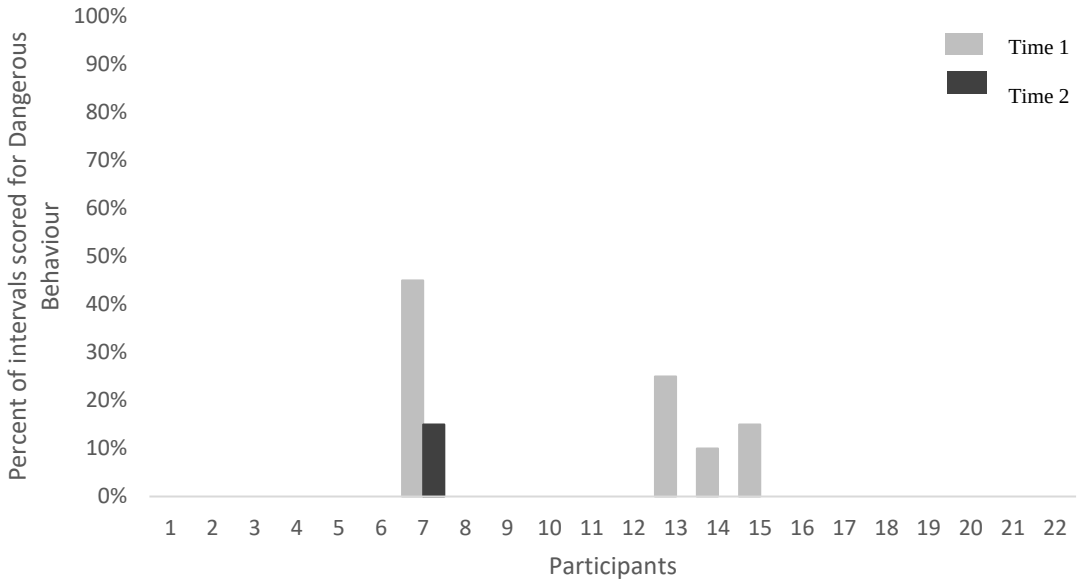
Paired samples t-tests were used to analyse the staff implementation fidelity data. The staff in both the intervention and control group behaviour were similar before the intervention. However, following training, the data showed that the intervention group significantly used the universal strategies more often than the control group (M = .05, SD = .213) to Time 2 (M =2.36, SD = 2.258), t (21) = -4.778, p <. 000 (two-tailed). The control group did not change on the observed measures in the same period. The eta squared statistic (.52) indicated a medium effect size.

A Chi Square test was used to analyse the distribution of challenging behaviour when strategies were implemented correctly and incorrectly to evaluate if the universal interventions correlated with a reduction of challenging behaviour. For the intervention group a reduction in challenging behaviour correlated with the implementation of Tier I strategies, x^2 (1) = 15.59; p < .001. The phi coefficient was calculated by, dividing phi by the square root of *df* as per Cohen (1988). Results indicated a medium effect size, Φ = .318; p < .001.

Individual Student Results

Individual student data were visually analysed as recommended by Johnston, Pennypacker, & Green, (2019). Before the intervention, 4 out of 22 students in the intervention group engaged in challenging behaviour (see Figure 1). After the universal supports were implemented, the frequency of three 3 participants' dangerous/destructive behaviours reduced to zero, but one student showed persistent challenging behaviour. Due to the seriousness of the behaviour (physical aggression towards peers and staff), it was deemed appropriate by the educational team for this student to receive an individualised, function-based intervention. Please see study two within this chapter for a detailed description.

Figure. 1: Percent of 30 second intervals Dangerous Behaviour was recorded for each participant in the intervention group. Of the 22 participants, 4 exhibited Dangerous Behaviour at Time 1. By Time 2 this reduced to zero for 3 out of 4 participants. Participant 7 continued to exhibit Dangerous Behaviour at Time 2.



Discussion

The aim of this study was to determine if universal behaviour strategies would result in a reduction of problem behaviour and increase appropriate behaviour for the majority of students in a maintained SEN setting. Before intervention, there were no significant differences between the intervention and control group for behaviours of interest. Following the implementation of Tier I strategies in this study, statistically significant increases in Mands and Compliance were detected for students in the intervention group. Statistically significant reductions of Non-Compliance, Disruptive and Destructive Behaviour were also observed for the intervention group. No significant changes were observed for the control group. There was a change in the intervention groups staff behaviour which was due to their increase in their correct implementation of Tier I strategies. Analysis revealed a reduction in

challenging behaviour when Tier I strategies were implemented correctly. Individual student data analysis revealed the Tier I strategies were sufficient to meet the behavioural needs of most students with the exception of one. Although there was a reduction in frequency, this student did continue to engage in Dangerous Behaviour following intervention.

Results confirmed the overall hypothesis that consistent implementation of Tier I universal strategies would reduce challenging behaviour and increase adaptive behaviour for most students. Through data collection on behaviours of interest and monitoring progress via the RtI framework, one student was identified who required more intensive intervention. This student was provided an individualised intervention which will be described in the second study within this chapter.

Successful implementation of Tier I supports requires consistent application by each member of the educational team across students and settings (Colvin et al., 1993; Lewis & Sugai, 1999). The increase in correct implementation indicates the training and support provided by the BCBA was adequate to affect change in staff's behaviour. Similar to findings in other studies, the consistent application of Tier I strategies reduced students engagement in behaviours targeted for decrease (Ervin et al., 2007). This study confirms that when teams correctly implement Tier I supports the behavioural needs of most students are met (Crone et al., 2015) which leads to fewer students requiring more individualised Tier II and III supports (Ardoin, Witt, Connell, & Koenig, 2005). When Tier I supports are implemented successfully, most of the school systems are conducive to ensure Tier III success (Grosche & Volpe, 2013)

The current study does have some limitations, the control group was small (N=5) and the Tier I intervention was not implemented for an extended period (10 academic weeks). A practical consideration to note is that the BCBA had prior experience in behaviour skills

training. Established behavioural consulting skills may be necessary to increase staffs correct implementation of behavioural intervention (McGimsey, Greene, & Lutzker, 1995).

Recommendations for future research include evaluating whether the RtI model is sustainable for a longer period in a maintained special educational setting. To achieve greater impact, researchers should assess its application on a school wide level. Future research should also seek a larger control group to enhance the demonstration of experimental control. Research has shown proactive classroom management enables effective learning environments that provide more learning opportunities and increased student achievement (Brophy, 1986; Abbott et al., 1998). Future research should investigate the impact behaviour change as a result of RtI utilisation has on academic engagement.

The Tier I proactive strategies implemented within this study facilitated proactive classroom management. The Tier I intervention considered the common contexts of challenging behaviour in the educational setting. This allowed for the development of strategies that alter antecedents, consequences and focus on teaching adaptive, contextually appropriate behaviours for most students.

Study 2 Evaluation of a Function Based intervention in a maintained Special Educational Needs School in the UK

As detailed in study 1, the Response to Intervention (RtI) model is described as having three layers, Tier I, Tier II and Tier III (Batsche et al., 2005). In an educational setting eighty to ninety percent of students can progress via Tier I supports. The other ten to twenty percent may require behavioural interventions at Tier II or Tier III (Appelbaum, 2009). One to five percent of students need to move to Tier III as they require more intensive and individualised intervention (Batsche et al., 2005). Progress monitoring of students via the RtI model facilitates the identification of those who need more focused or intensive support (Fox and Hemmeter, 2008). Functional communication training (FCT) might be classified as a Tier III intervention and has been shown to reduce challenging behaviour by teaching the individual an appropriate alternative behaviour that serves the same function as challenging behaviour (Carr and Durand, 1983; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997). In FCT, a behaviour analyst teaches the client to ask for what they want and then reinforces the requests immediately. While FCT is very effective, it can be challenging to run in a busy classroom because it is not always possible to reinforce every request immediately, and the learner may revert to challenging behaviour if they perceive the communication behaviour is no longer effective. The client in the current study was participant 7 from study 1. They were enrolled in a SEN classroom and did not have 1:1 support. Given the staffing ratio, and the complexities of a large classroom, it is almost certain that the school staff will not be able to accommodate all of his requests quickly, and the client may revert to challenging behaviour.

Recent advances to FCT include teaching a student to both ask for what they desire, and to tolerate delays and denials to the delivery of the reinforcement. Delays happen when the student needs to wait before their request can be reinforced, and denials are when the request cannot be accommodated. Recent research has demonstrated how building a chain of tolerance responses after the functional communication response (FCR) enabled researchers to extend the delay to reinforcement to naturally occurring situations with fewer supports.

Ghaemmaghami, Hanley, & Jessel, (2016) taught participants how to functionally communicate their wants and needs, and then taught them how to wait using progressive time and demands during delay procedure.

The aim of this study was to replicate Contingency Based Progressive Delay (CBPD) described in Ghaemmaghami, Hanley, & Jessel (2016). Researchers selected CBPD intervention for this student as they sought to extend the student's tolerance for delays to reinforcement to practical levels that included completion of demand and leisure activities, without the resurgence of challenging behaviour.

Method

Participant and Setting

Participant 7 from study 1 (Tom) was 6 years and 7 months old. Tom had a diagnosis of ASD and a learning disability. He continued to engage in physical aggression towards peers and staff following the provision a universal behaviour intervention, which suggested he needed an individualised, function-based intervention. Tom could follow simple vocal instructions, had good fine and gross motor skills, could echo some one-word phrases, and communicated using symbols, gestures, and word approximations. He had limited play and leisure skills.

Sessions were conducted in an area outside of the classroom that was equipped with child-sized table and chairs, academic and play materials as needed. Due to the nature of some of Tom's requests (swing located in classroom, table with car track) some sessions were also conducted in his classroom with classmates present. Sessions were run one day per week and lasted up to 40 minutes. Two to three sessions were run per day.

Design and Rationale

This study was a replication of Ghaemmaghami et al., (2016) and therefore comprised of a baseline, treatment, withdrawal and the progressive treatment conditions. The logic of changing-criterion design was used so that when stable responding was attained within each condition, the criterion for correct responding was increased to include the next response in the sequence of responses required to extend reinforcement delay to practical levels. Functional control was demonstrated by showing levels of aggression decreased and alternative responses (FCRs, tolerance responses and demand engagement) increased correspondingly.

Measurement and Interobserver Agreement

Data was collected on the frequency of aggression and alternative adaptive behaviours during sessions: see Table 1 for behaviour definitions. For analysis purposes, frequency data was converted into rate (responses per minute) per session (Cooper et al., 2019).

Trained BCaBAs and a BCBA recorded data using pencil and paper during sessions. Interobserver agreement was collected by an independent second observer across 20% of sessions. Interval-by-interval Agreement was calculated by dividing the number of intervals where the observers agreed by number of intervals of agreement plus number of intervals with disagreement, multiplied by one hundred. The IOA was 100% agreement.

Table 1. Operational Definitions for target behaviours

Behaviour Category	Behaviour	Definition
Aggression	Hitting	Contacting any part of another person's body with an open or closed hand from six inches or more
	Kicking	Contacting any part of another person's body using a foot from six inches or more. Propelling objects at least one foot from their original location by movement of foot or leg in the direction of another person.
	Hair Pulling	Fingers-to-hair contact with a pulling motion.
	Head Butting	Using the head or face to hit (make forceful physical contact) with another person.
	Pushing	Using any part of the body to forcefully contact another person's body.
Alternative Adaptive Behaviour	FCR	Saying "toy please" to access a preferred activity and "break please" to terminate adult instruction.
	Tolerance Responses	Saying "*okay*" in an appropriate volume within five seconds to being delivered a delay or denial cue.
Prompted Alternative Adaptive Behaviour	Prompted FCR	Least to most prompts when an FCR was not emitted within 5 seconds of demand presentation or preferred activity removal.
	Prompted Tolerance Responses	Least to most prompts when a tolerance response was not emitted within 5 seconds of a delay cue.

Procedures

Functional Behavioural Assessment: A Functional Behavioural Assessment (FBA) was conducted to determine the causes of Tom's aggression. An open-ended functional assessment interview (FAI) as described by Hanley (2012) was conducted with Tom's teacher to discover antecedent stimuli and reinforcers that may be maintaining aggression. The interview lasted one hour. Following the interview, ABC narrative and continuous recording were conducted during times when aggression was most likely. The results of the FAI indicated access to tangibles maintained aggression. During ABC observations aggression resulted in access to tangibles for 66% and escape for 33% of occurrences. It was

hypothesized that aggression was primarily maintained by access to preferred tangible items and secondarily for escape from demands.

Functional Communication Training. Before teaching a new Functional Communication Response (FCR), the adult provided noncontingent access to the target reinforcer for 60 seconds. Then the adult disrupted Tom's access to reinforcement for example the preferred item, and vocally prompted him to request the item. Following the FCR, the researcher gave Tom 30s access to the preferred item or escape from academic demand (Ghaemmaghami et al., 2016). Aggression was not reinforced. Following an initial full vocal prompt for Tom the adult used least to most vocal prompts (Libby, Weiss, Bancroft, & Ahearn, 2008) if Tom did not emit the FCR within 5 seconds of presentation of the evocative situation. These sessions served to establish a history of reinforcement for FCRs (Drifke, Tiger, & Lillie, 2020).

Intervention: Researchers used the function of the behaviour to inform a Contingency Based Progressive Delay (CBPD). The goal of the intervention was to increase engagement in alternative behaviour and increase his tolerance for delays to reinforcement and academic demands. The procedure involved teaching specific responses in a sequence (chained responses) by (a) teaching an FCR to access preferred items and escape from demands to replace aggression (Carr & Durand, 1985), (b) teaching the student appropriate ways to respond to cues for reinforcement, denial and delay and (c) teaching the student to engage in progressive amounts of academic demands during reinforcement delay (Ghaemmaghami et al., 2016; Hanley, Jin, Vanselow, & Hanratty, 2014).

FCR (Frequency Ratio 1) and Extinction: Treatment began with the adult removing the identified reinforcer from Tom. After Tom emitted the FCR, the researcher returned the item immediately at a frequency ratio of 1 and allowed Tom to keep it for 30s. The researcher did

not respond to problem behaviour. If Tom did not emit the response within 5 seconds of the evocative situation being presented the researcher prompted the FCR. There were at least three presentations of the evocative situation in each session. To progress to the next treatment condition, Tom was required to independently exhibit adaptive alternative behaviour in three consecutive evocative situations within a session and across three consecutive sessions (Ghaemmaghami et al., 2016).

Withdrawal: In the treatment withdrawal condition, researchers removed the reinforcer from Tom. The researcher did not respond to FCRs but provided 30s access upon the occurrence of aggression.

FCR, Extinction and Denial: The researcher introduced a denial after three out of five requests. Following an FCR, the adult indicated a denial (e.g., saying, "not now"), and then immediately gave Tom access to the requested reinforcer for 30 seconds. The other 2 of 5 trials were reinforced as above. The researcher pre-selected which trials would be reinforced prior to the sessions to ensure Tom could not predict when reinforcement would be delivered immediately or following a denial.

FCR, Extinction, Denial and Tolerance Response: Following an FCR, the adult stated a denial and Tom was required to vocalise a tolerance response, which was Tom saying "*OK".* The adult used least to most vocal prompts if Tom did not emit the FCR and/or tolerance response within 5 seconds of presentation of the evocative situation. The adult then immediately gave Tom access to the requested reinforcer for 30 seconds. FCRs were reinforced immediately on two of five randomly selected trials within sessions, pre-chosen by researchers.

FCR, Extinction, Denial, Tolerance Response and Demand 3: Following the removal of reinforcement, Tom was required to vocalise an FCR, tolerate a denial cue, vocalise a

tolerance response to the denial cue, and complete three academic demands taken from his Individual Education Plan (IEP). Tom was then permitted access to the reinforcer for 30 seconds. Similar to previous conditions, FCRs were reinforced immediately on two of five randomly selected trials.

FCR, Extinction, Denial, Tolerance Response and Demand 5: This condition was the same as above but Tom was required to tolerate 5 academic demands. FCRs were reinforced immediately on two of five randomly selected trials.

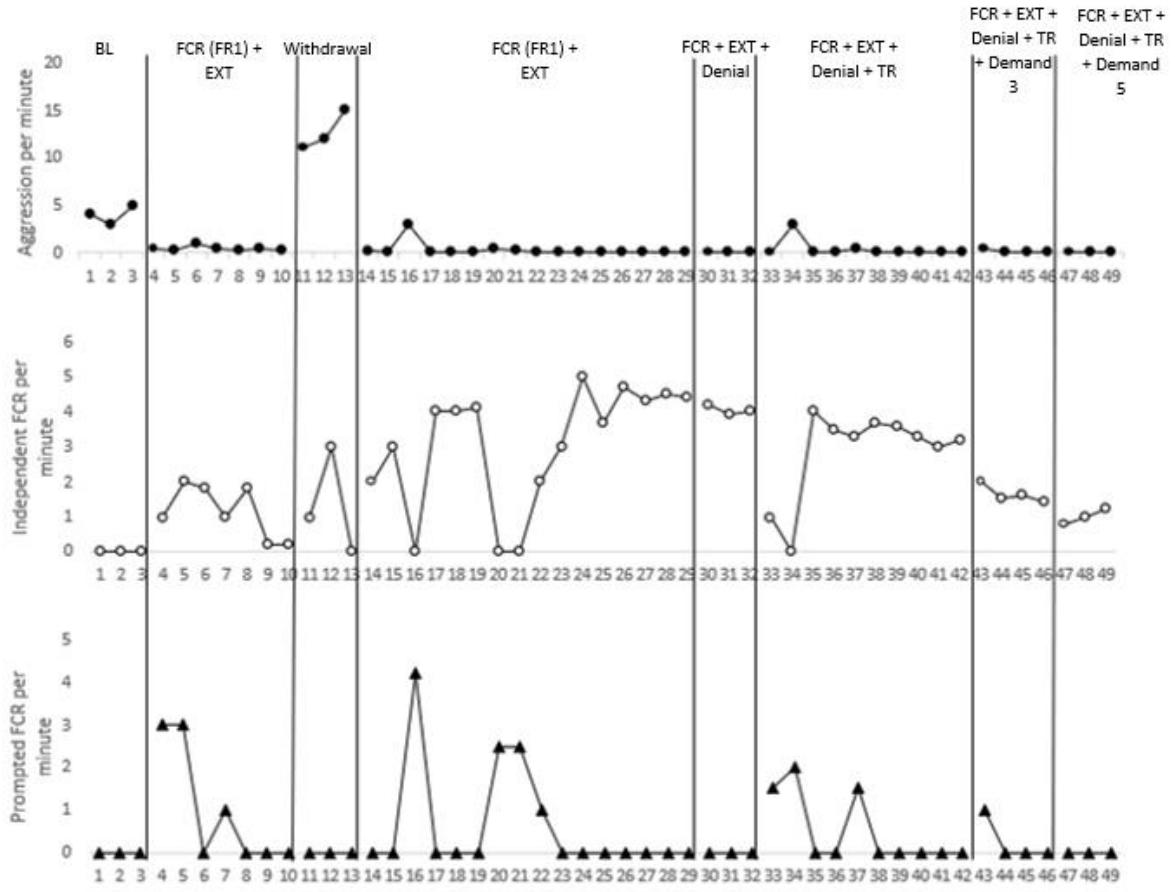
Analysis and Results

Toms' acquisition of the simple FCR of "*toys please*" and "*break please*" corelated with immediate reduction in the rates of aggression. Tom required prompts in the initial sessions to vocalise the FCR but responded independently by the end of the first treatment condition. See Figure 2.

Aggression was observed in the withdrawal condition. During the return to the first treatment condition an immediate decrease in aggression was observed. This condition was run until Tom engaged in a steady state of independent FCRs. In the denial treatment condition, the FCR response rate remained high and there were no instances of aggression. In the denial and tolerance response condition, Tom required prompts to initially produce the FCR and the tolerance response to denial. There is a slight increase in aggression in session 34 with no instances of independent FCRs. This treatment condition was extended until Tom exhibited a steady state of independent FCRs and tolerance responses. Steady states of responding are desirable in behaviour change as it implies that the behaviour will continue unchanged if the same reinforcement schedule is continued (Cooper et al., 2019). In the subsequent condition, the prompts were faded as Tom engaged in required FCRs, tolerance responses, and academic demands. This consistent responding continued into the next

condition where he was required to complete five academic demands in addition to FCRs and tolerance responses. As additional responses were being chained, the rate of FCRs decreased to more appropriate levels and aggression remained at near-zero levels. Control of the behaviour by the intervention was evidenced via the return of aggression in the withdrawal condition and by the reduction in aggression when treatment conditions were re-introduced. The duration of direct intervention provision is estimated to be 50 hours.

Figure 2. Results of the contingency-based progressive delay for Tom. The scheduled changes in contingencies are denoted by each phase line. BL = Baseline, FCR = functional communication response, FR1 = Frequency Ratio 1, EXT = Extinction, TR = Tolerance Response, Demand 3 = 3 academic demands, Demand 5 = 5 academic demands.



Study 2 Discussion

In study 1, Tom was provided universal strategies, however these were not sufficient to significantly reduce challenging behaviour. Due to the seriousness of his behaviour, he was provided with an individualised, function-based behavioural intervention, which successfully reduced aggression whilst increasing Toms engagement in appropriate responses to delays and denials for reinforcement (i.e., the tolerance response "*okay*" and compliance with academic demands). In addition, he learned multiple important skills such as accepting denials and waiting and engaging in non-preferred demands. Results in this study support previous findings that incorporating contingency-based progressive delays (providing an alternative activity during a delay and progressively increasing the duration or number of demand activities) to reinforcement can aid delay and demand tolerance (Dixon, Rehfeldt, & Randich, 2003; Hanley et al., 2014; Mischel, Ebbesen, & Raskoff Zeiss, 1972).

Initially the effort was low for Tom to be allowed access to reinforcement; he was prompted to say "*toy please*" or "*break please,"* and he was immediately given what had been requested. As a result, the rates with which he was requesting reinforcement was high and aggression was low. A goal of behavioural intervention is to support participants so that adaptive behaviour generalises to all settings, maintains across settings, and over time (Baer, Wolf, & Risley, 1987). The rates with which Tom was requesting reinforcement during initial treatment conditions would not have been sustainable in the natural classroom setting. The researcher increased the duration of delays and number of demands that were necessary before she gave Tom access to the reinforcement. The increase in delays and demands resulted in a reduction of the rate of FCRs within sessions to more sustainable levels, because he was provided an alternative activity during a delay and the duration of the activity was progressively increased.

The aim of the intervention in this study was to extend reinforcement delay to natural and practical levels that included completion of demand activities without resurgence of behaviour. Researchers intended to continue progressing through treatment conditions and plan for generalisation, so that Tom would exhibit tolerance for delays and demand engagement required in regular classroom programming. Unfortunately, due to reasons out of the researcher's control, treatment was suspended before this was achieved. Results however, suggest Toms aggression would continue to reduce when presented with evocative situations which historically resulted in challenging behaviour. If continuation were possible and systematic increases to delays and demands continued, it is expected his tolerance to delay and demands with an absence of aggression would have extended to natural and practical levels. Despite this, this study demonstrates the advantages of CBPD being its ability to establish patterns of adaptive behaviour whilst emulating scenarios that entail unplanned delays to reinforcement (Luczynski & Hanley, 2013). Future investigations should investigate procedural variations that may enhance the generality of the approach into maintained special educational needs settings.

An aim of function-based interventions is to support the recipient's progression towards functioning in naturally occurring situations with fewer supports. A qualified and experienced BCBA overseen implementation of the Tier 3 intervention from its conceptualisation to its systematic fading to more natural and practical levels of reinforcement. When implementing the RtI decision making framework, consideration must be given to whether the qualified personnel are available. Research indicates that when targeting challenging behaviour, optimum behaviour change is achieved when multicomponent interventions are implemented successfully (Shirley et al., 1997). In this study a BCBA and a BCaBA implemented the function-based intervention. In the educational setting where the student to staff ratio was on average 3:1, implementing this function-based

intervention by staff alone would not have been feasible. The treatment conditions required 1:1 implementation by an individual trained and experienced in procedures used, for example extinction. If this treatment continued to progress and fading to natural contingencies continued, it would have been possible to integrate staff as implementers due to it being less intensive. However, for this Tier III intervention a BCBA continuously monitored and tracked the students' progress to make amendments to treatment accordingly. Therefore, a consideration for the implementation of function-based interventions in applied settings would be whether the necessary resources and expertise are available. It has been highlighted teachers and administrators find the completion of FBAs challenging (Nelson et al., 1999). Schools need to consider financially investing in behaviour analytic expertise to support and train staff. This point also raises the importance of implementing Tier I interventions prior to Tier III. As demonstrated in study 1 the universal supports of Tier I addressed the behavioural needs of most students. Successful monitoring of student data can facilitate teams to identify when additional supports are needed and for which students. Three students exhibited dangerous behaviour prior to Tier I strategy implementation. However, following Tier I provision only one student needed Tier III support. As previously discussed acquiring qualified behaviour analysts to provide effective FBBSPs is unfeasible given the quantity of students who present with challenging behaviour (Allen et al., 2013). However, as demonstrated in this chapter if schools implement Tier I universal supports this may reduce the need for function-based intervention. Study 1 and 2 demonstrate the RtI decision making framework can help behaviour analysts and educational staff in maintained SEN settings develop effective universal supports and provide more individualised support when necessary for their students.

Chapter 5: General Discussion

This thesis has described how a classroom-based ABA model can be delivered in maintained UK SEN schools. In chapter 2 the replication study demonstrated that young students who received education via the classroom-based ABA model made significant gains in all subjects assessed by curriculum measures used by educators. Students also made significant gains on measures used by researchers for cognition, language and communication, daily living skills, and socialisation. In Chapter 3, the mixed-methods study investigated the experiences of implementers of the model across multiple settings. Findings suggest context variables can be attributed to positive perceptions, fidelity, and sustainability of the model. Preliminary findings may assist educators in identifying if the necessary conditions are present at their school if they want to implement the model. Chapter 4 investigated whether the behaviour plan component of the model can be adapted to reduce demands on school resources without a compromise to effective behaviour change for students. This study found universal strategies which are provided to all students are effective at reducing challenging behaviour and increasing adaptive behaviour for most students. Individualised function-based interventions can then be provided to the few students whom universal strategies are not effective. All studies and their outcomes are summarised in this chapter. The studies limitations, implications, and contributions to the field are discussed, along with recommendations for further research.

Chapter summaries and contributions to the literature

The aim of the study in chapter 2 was to replicate the classroom-based ABA model in a maintained SEN school in Wales and consider student outcomes using both curriculum measures typically used by educators and validated, normed-assessments used by researchers. Thirteen students aged between 4- to 6-years were assessed on measures of intellectual development and adaptive functioning at baseline and 10 months following intervention. After 10 months of intervention students made significant gains on measures of

language and communication, cognitive skills, daily living skills and socialisation. These results are promising as they demonstrate with the classroom-based ABA model, the application of behaviour analytic strategies can accelerate a student's learning in key areas of development. The participants were administered the Mullen Scales of Early Learning (MSEL) at baseline and ten months later at post-intervention. Gains made within ten months of intervention were greater than what one would observe over a 10-month period for a typically developing child. The mean gain in age equivalent months on the MSEL was 22.33 for Visual Reception, 12.49 for Fine Motor, 15.58 for Receptive Language and 11.02 for Fine Motor. In addition, changes in Developmental Quotients (DQ) across all four scales of the MSEL were detected. A student who was on a stable developmental trajectory would not show changes in DQ scores over ten months. Students who gain skills faster than expected will display an in increase in DQ scores, and students who learn at a slower rate than typical will show a decrease in DQ scores. The participants in this study demonstrated statistically significant increases in DQ scores, which indicates they gained skills faster than expected. The performances of participants in this study on curriculum and norm-referenced measures demonstrate their ability to generalise knowledge and skills taught during intervention across different assessments.

The results of this study are in line with the outcomes of previous studies which have demonstrated the classroom-based ABA model results in significant gains for students (Foran et al., 2015; Pitts et al., 2019). It has demonstrated teachers can be taught to use behaviour analytic strategies to prepare students with readiness for learning skills essential for accessing curriculum. The low intensity model which entailed collaboration between the behaviour analyst and teacher facilitated adaptation to a specific classroom setting. This clarifies the feasibility for implementing the classroom-based ABA model in similar settings. This study

also demonstrated how strategies based on the principles of ABA can complement educational provision in maintained SEN schools in Wales.

This study was limited by its small sample size and by the fact a design with greater experimental control was not employed such as a control group design. Unfortunately, it was not possible in this setting to adopt a control group design as senior leadership at the school requested all eligible students be participants, and their request was respected. Future research should try to include larger sample sizes and a control group design with random assignment if possible. Despite these limitations of the study it does provide considerable evidence for the effectiveness of the classroom-based ABA model for early learners in maintained UK SEN schools.

The second study in this thesis, the mixed methods study was conducted to explore if there is a correlation between settings with positive perceptions of the model and higher fidelity. It also wanted to investigate if settings with higher fidelity and positive perceptions sustained the model. Ten early years foundation phase classrooms participated in a university led trial of the classroom-based ABA model, and a subset of the Senior Leadership Team, teachers, teaching assistants and behaviour analysts from that trial participated in this research. 27 participants were interviewed from six schools. Quantitative measures investigated the fidelity with which each setting implemented function-based behaviour support plans (FBBSP). Qualitative measures derived from Rogers (2003) theory used a conceptual framework approach to investigate participants' perceptions of how advantageous and compatible they considered the model.

Findings within this study suggest multiple variables may affect successful implementation and sustainability of the model. The findings lend to the argument that successful implementation is not just influenced by the duration and quality of training and

support delivered to implementers (Rogers, 2003; Allen, 1998; Barat et al., 2001) it may also be a reflection of the perceptions implementers have of an intervention (Martens, Van Assema, Paulussen, Schaalma, & Brug, 2006; Ringwalt et al., 2003) and the contextual variables present within an applied setting (Bambara et al., 2012, 2009). This study contributed to the literature as no previous research has been conducted on the variables that affect implementation and sustainability of classroom-based ABA models. Initial findings within this study included the identification of enablers and barriers under four themes that can help or hinder successful implementation and sustainability of the model.

There were limitations to this study in that fidelity data was only collected on one component (behaviour plans) of the model. Whilst this study included fidelity data for implementation, there is no outcome data of student progress across settings. We relied on a respondent pool made available to us by schools participating in the trial. Thus, the representativeness of the sample and generality of findings may be limited. Respondent perceptions about their experiences and the perceived impact of variables may not correspond with actual practices and events. Finally, this study sought to explore perceptions of advantages and compatibility of the model. Interviews were therefore not designed to examine in depth the differential influence barriers and enablers had on implementation and sustainability of the model across settings. Future research may wish to collect fidelity on more components of the model, student outcomes and more information on implementers experiences implementing the model relative to the barriers and enablers identified in this study for a finer analysis of their impact. Future research may also wish to explore perceptions and fidelity of the model from initial stages of implementation to sustainability to identify whether positive perceptions and fidelity change over time.

Whilst findings within this study are preliminary, they do suggest for the model to be successfully implemented and sustained, implementers must be willing to try new ways of

working. The educational team needs to be consistent and willing to follow a teacher's lead within class. A behaviour analyst should be incorporated into the multi-disciplinary team within the school so they can provide training and support to implementers. Teachers and behaviour analysts need time to plan and problem solve. Leadership need to be supportive of the model and its implementers and communicate to the school community that model implementation is a priority. The school community need to understand strategies from the model will be applied across environments and to not interfere.

The first study in chapter 4 aimed to deliver evidence-based strategies to students in a maintained SEN school in the UK guided by the RtI decision making framework. It aimed to develop Tier I proactive and reactive strategies to increase adaptive behaviours of students. This control group study was the first of its kind in the UK to compare two groups of students who received either Tier I universal supports (n=22) or treatment as usual (TAU) (n=5). All students were aged between 6- to 7-years. Data were collected on appropriate requesting, compliance and challenging behaviour at baseline and 10 academic weeks following intervention. Baseline measures indicated the groups did not differ significantly. After 10 academic weeks, students in the group receiving Tier I universal supports made larger gains than those in the TAU group on measures of compliance. Non-compliance and disruptive behaviour decreased significantly more in the intervention group. Greater gains in the intervention group were detected for mands but these were not statistically significant. The reduction in dangerous behaviour was not significantly more than the TAU group. This was because no students in the TAU group exhibited dangerous behaviour at baseline or post-intervention. While dangerous behaviour did reduce in the intervention group at post-test, one student continued to engage in dangerous behaviour at lower rates. A function-based Tier III intervention was provided to this student and is detailed in study 2 of chapter 4.

Study 2 of chapter 4 aimed to replicate Contingency Based Progressive Delay (CBPD) described in Ghaemmaghami, Hanley, & Jessel (2016). CBPD was provided to the student from study 1 who continued to exhibit challenging behaviour following the implementation of Tier I universal strategies. Researchers selected CBPD Tier III intervention as they aimed to extend the student's tolerance for delays to reinforcement to practical levels that included completion of demand and leisure activities, without the resurgence of challenging behaviour. A functional behaviour assessment (FBA) was conducted for Tom who was 6 years and 7 months old. The FBA identified he exhibited high rates of aggression when denied access to preferred tangibles and presented with demands. Toms Tier III function-based intervention systematically taught him how to request appropriately, accept being told no, wait, and complete academic and leisure activities during delays to reinforcement. By the end of the study Toms aggression decreased to zero when he was denied access to preferred tangibles and requested to engage in demands.

There were some limitations for both studies within this chapter. In study 1 the control group was small (n=5) and the Tier I intervention was not implemented for a long period (10 academic weeks). In study 2 treatment was suspended before Tom achieved completion of demands and tolerance to delays in the natural environment without aggression. Whilst this was out of the researchers control, we had intended to continue progressing through treatment conditions and plan for generalisation. However, results suggest Toms aggression would continue to reduce when presented with evocative situations which historically resulted in challenging behaviour. If continuation was possible and systematic increases to delays and demands continued, it is expected his tolerance to delay and demands would have extended to the natural environment.

Overall the outcomes of study 1 and 2 are promising as they confirm that consistent implementation of Tier I universal strategies reduce challenging behaviour and increase

adaptive behaviour for most students in maintained UK SEN schools. This results in less students requiring individualised supports (Ardoin et al., 2005). Because the process for developing function-based interventions for students in the UK typically begins following a referral for challenging behaviour (NICE, 2013), the student will likely have a history of reinforcement for challenging behaviour which can make it more persistent (Murphy et al., 2005; Taylor et al., 2011). The processes for successfully implementing function-based interventions are complex and can require many resources (Bambara et al., 2009). For example, in study 1 the behaviour analyst provided a one-hour training to staff about the universal strategies and each teacher and teaching assistant received 20 minutes of 1:1 training by the behaviour analyst. The direct provision of training and support for universal strategies was significantly less than the estimated duration of Tier III provision for one student (50 hours).

Further investigation is necessary to evaluate the feasibility of the tiered approach to behavioural support. Future studies may wish to evaluate whether the RtI model is sustainable for a longer period in a maintained SEN setting and if it can be applied on a school wide level. Future research should also seek a larger control group to enhance the demonstration of experimental control and whether it can be incorporated into classroom-based ABA models as the behaviour management component.

Implementing positive and proactive universal strategies may be more sustainable for school systems rather than multiple individual behaviour plans, as they consider the behavioural needs of most students. As previously discussed, the processes for successfully implementing function-based interventions like FBBSP's are complex and can require many resources (Bambara et al., 2009). Implementing positive and proactive universal strategies may be less demanding for school systems as they consider the behavioural needs of most students. Schools need only consider the Tier I support when evaluating whether changes to

systems need to be made, as opposed to considering changes for multiple function-based interventions for many students.

The reduction of government spending in education may present a barrier to effective and recommended supports being provided to students (UK Public Spending, 2019). As demonstrated in this study and supported by peer reviewed literature, the RtI framework can organise evidence-based interventions to provide more sustainable early and effective support to students with learning and behavioural difficulties (Lisa et al., 2010; Sugai & Horner, 2008). As most students respond to Tier I support, fewer students require individualised interventions which aids cost efficiency and more resources being available to provide Tier III support (Grosche & Volpe, 2013). This may further lend to SEN settings being able to follow recommendations and provide Tier III support when required (National Health Service, 2017; National Institute for Health and Care Excellence, 2013).

ABA has had a significant impact on socially significant behaviour change, and students with conditions which affect development such as ASD have been primary beneficiaries of ABA practices (Peters-Scheffer et al., 2010). Although researchers have produced numerous effective ABA interventions, investigation into implementation in the applied setting has been insufficient which has led to a research-to-practice gap (Odom, Hall, & Suhrheinrich, 2019). In the field of ABA there has been a focus on fidelity of implementation (Gresham, Gansle, & Noell, 1993) as it is a critical area for ensuring recipients experience beneficial outcomes (Durlak & DuPre, 2008; O'Donnell, 2008). However, attention must also be given to the contextual fit of an intervention from the outset to ensure they are sustainable and will contribute to meaningful change for recipients. Researchers must acknowledge that each educational environment is unique and by working collaboratively with educators, flexibility in implementation and adaptations where

appropriate are achievable. This facilitates interventions being tested within the environments for which they are designed (Wong & Kasari, 2012).

The findings within this dissertation demonstrate ABA interventions can be successfully implemented and sustained in maintained SEN settings in the UK. Interventions within the classroom-based model and Tier I strategies were developed in collaboration with educational teams. This ensured the needs of staff and students were considered and adaptations could be made efficiently. Interventions were developed with the resources of the classroom in mind, so that staff could implement interventions successfully without needing additional resources. Schools looking to implement the classroom-based model or RtI tiered approach to behaviour management would need to invest in a behaviour analyst to train and supervise educational teams so they could implement strategies. While cost-benefit analyses would need to be conducted to determine conclusively no additional costs were incurred, implementing the ABA interventions within this dissertation resulted in no additional costs for schools which lends to the affordability of these ABA interventions. The additional costs and resource requirements of other ABA interventions such as Early Intensive Behavioural Intervention (EIBI) have been a barrier for its dissemination in the UK (Eikeseth et al., 2012; Peters-Scheffer, Didden, Korzilius, & Matson, 2012). Given the potential affordability of the interventions described in this thesis, this may persuade educators to adopt them at their schools. If maintained UK SEN schools adopt interventions such as the classroom-based ABA model, they would make available to all students who may benefit, evidence-based practices that are more effective than eclectic methods of teaching (Eldevik et al., 2006; Grindle et al., 2012; Pitts et al., 2019).

The interventions described in this thesis were implemented by regular teaching staff in the educational setting. When people in a student's natural environment implement ABA interventions, gains are maintained longer than if a tutor or specialist was specifically

employed to provide intervention (Kovshoff, Hastings, & Remington, 2011). Because staff were trained in the basic principles of behaviour and how these can inform teaching and behaviour change, they were more able to generalise strategies to different environments and unplanned learning opportunities. This skill is particularly evidenced in their implementation of Tier I universal strategies. To be able to apply Tier I universal strategies across students and environments, teaching staff need to discriminate between strategies under varying conditions.

An important feature of the classroom-based ABA model and the Tier I universal strategies is a behaviour analyst provided training and supervision to implementers. As respondents discussed in chapter 3, staff in maintained SEN settings often have no previous experience with ABA strategies (Dillenburger et al., 2014). Board Certified Behaviour Analysts (BCBA) qualify by taking 310 hours of post-graduate coursework, completing 2000 hours of supervised fieldwork and passing a qualifying exam (BACB, 2018). It is important that experienced and qualified behaviour analysts are employed by schools to oversee the implementation of ABA interventions. Relevant credentials and experience applying the principles of ABA have been evidenced to affect student outcomes (Dixon et al., 2016).

When implementing the classroom-based ABA model and/or the tiered approach of the RtI framework, it is important a behaviour analyst provides staff formal training in ABA strategies so there is consistency in knowledge across a team. However, subsequent in-situ training by the behaviour analyst is important to help staff translate theoretical knowledge to practice within the applied setting (Dimartino et al., 2018). As one behaviour analyst explained "*It's a do what I do model, rather than understanding all of the principles and things like that. I think it's quite important that we're in class quite a lot to answer questions*". Informal trainings provided staff an opportunity to ask the behaviour analyst for support in the individual ways they preferred. It provided the behaviour analyst an

opportunity to build rapport with staff and to reassure them or support them to correctly implement strategies. This was echoed by respondents in chapter 3 who expressed they preferred informal trainings by the behaviour analyst.

The behaviour analyst who overseen studies in chapter 2 and 4 was provided by the local university as a researcher. The school in which they overseen the implementation of the classroom-based ABA model and RtI tiered interventions did not need to financially invest in their services. As identified in the mixed-methods study of chapter 3, it is important that behaviour analysts are integrated into educational systems such as multi-disciplinary teams (MDT). Although the behaviour analyst and other specialists in this school collaborated as best they could without having designated time to do so, settings where the behaviour analyst was employed by the school did so more effectively. During implementation of the interventions in chapter 2 and 4 the researcher and teaching staff arranged times for trainings and meetings to be held, which were often after school and outside of the staffs' payment hours. This was difficult however, as long-term this would not be sustainable, and staff were not obligated to attend. Studies have identified that when the appropriate level of behaviour analytic support is not provided successful implementation may not be achieved and this can affect student outcomes (Eikeseth, Hayward, Gale, Gitlesen, & Eldevik, 2009). Therefore, educators interested in implementing ABA interventions such as those described in this thesis, must commit to investing in the appropriate levels of behaviour analytic expertise to support successful implementation and sustainability.

In the UK behaviour analysts need to integrate into the systems already in place in the educational sector. Interventions they identify as potentially beneficial for students may need to be adapted to meet the needs of the organisation employing them. The studies in this thesis demonstrate this can be done, whilst still achieving positive student outcomes. The classroom-based ABA model teaches regular staff to deliver teaching and behaviour

management strategies based on the principles of ABA versus employing ABA specialists to implement interventions. The Tier I strategies were designed to address a time consuming and resource heavy component of the classroom-based ABA model (function-based behaviour plans). The tiered approach of the RtI decision making framework may be an alternative approach schools can adopt, if hiring a behaviour analyst to oversee the implementation of the classroom-based ABA model is not possible. The tiered approach of the RtI model described in chapter 4 does not involve the provision of all the important components from the classroom-based ABA model such as individualised learning targets from a developmental curriculum. However, it may provide schools a feasible alternative if behaviour management is a priority and they cannot invest in a more comprehensive model.

Future studies may wish to conduct longitudinal studies to investigate if the rate with which students achieved gains is replicated in subsequent years of classroom-based ABA model provision. Previous studies have identified the rate with which students learn may not be as significant in subsequent years of intervention (Grindle et al., 2012). It would be informative to identify if increases in the complexity of learning targets such as focusing more on academic and functional daily living skills results in a slower rate of learning and identifying how the individualised approach to teaching within the model adapts to facilitate this. Future studies may seek to also investigate how this is reflected in curriculum measures. It would also be beneficial to identify if continued provision of behaviour analytic support is required to maintain gains, as it has been for other interventions such as EIBI (Smith, Hayward, Gale, Eikeseth, & Klintwall, 2019) and how this can be provided within the maintained UK SEN school context. Longitudinal studies for RtI Tier I strategies would be informative as the strategies will likely need to be adapted as students mature through school and environmental demands change.

Conclusion

This thesis described the evaluation of the classroom-based ABA model, the RtI decision making framework and the organisational variables that may affect the effectiveness of behavioural interventions in maintained SEN schools. Results of these studies indicate that ABA interventions can produce significant gains for participants. Further, effective collaboration between educational researchers and educational teams can result in the successful implementation and sustainability of evidence-based ABA interventions. Further areas to conduct research and implications for practice have been proposed across the areas investigated.

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APPENDIX

Appendix A: Sample Behaviour Plan

Target Behaviours: Student

- **Physical Aggression** Hitting, kicking, pulling hair of others. Throwing objects at others.
- **Environmental Aggression** Throwing items in the surrounding area or wiping materials from the table.
- **Self-Injurious Behaviour** Hitting own head with an open or closed hand

Function:

- Attention
- Access to preferred item/activity

Antecedent/Proactive Strategies:	Reactive Strategies:
Attention • Noncontingent Reinforcement (NCR) When the timer beeps every 5 minutes, staff should initiate interaction with student. E.g. if student is playing appropriately with a peer, deliver verbal praise and attention for 10 seconds. • If student is engaged in any other behaviour than the target behaviours deliver reinforcement for 30 seconds. You can use tangibles paired with your vocal praise. Tangibles student has shown preference for include: Bubbles with a peer • If student is exhibiting behaviour consistent with desiring attention (looking/smiling/moved to area of staff/peers) encourage him to appropriately initiate interaction e.g; least to most prompts to tap staff with hand to gain attention. Deliver praise and attention • Supervise when with peers **Access to items/activities** • If student is exhibiting behaviour consistent with wanting access to something (a toy a peer has, something in the choosing cupboard) encourage student to request what he wants with PECS, sign or vocally. • Deliver the item if possible, or an alternative which is reinforcing if not.	**Access to items/activities** **Attention** • If student engages in any of the target behaviours, ensure others are moved to safe place. • NEUTRALLY with minimal eye contact, tell student *"no (target behaviour) if you want something please ask for it".* • Wait for 5 seconds of student not engaging in target behaviours and then use least to most prompts to teach him how to request attention or toys with signs or verbal. • Staff provide the chosen activity for less than 10 seconds (important to give less time than if there had been no target behaviour). Remove the activity or attention and resume preventative approach.

Appendix B: Semi-Structure Interview Guide

A. *"As part of this research we are looking at how people implementing the model feel about it. I'm going to ask a few questions about how you feel about components of the model, and please feel free to discuss your answers for as long as you would like. I might ask you to provide some more details if I don't fully understand something. I hope that this is ok and if you have any questions or would like to take a break at any point please do just say".*

1. **Do you think implementing the model will have effective results at your school, or not make much of a difference?**

2. **Does the model effect your responsibilities at work? How?**

3. **Do you feel implementing the model effects your control over your work? How?**

4. **How do you feel the model effects students learning during the day?**

5. **Do you think implementing the model affects your job performance?**
   Probe: could you describe some of the changes you may have seen in your job performance (improvements/worsening)?

6. **Do you think the model effects your productivity at work?**

7. **Has the model affected the quality of work you do?**

8. **Overall, has using the model been a disadvantage or advantageous for your job?**
   Probe: could you explain how/why you think it has been advantageous or disadvantageous for your job?

9. **Do you think the model has had an impact on your effectiveness at work?**
   Probe: what has it changed (that has increased or decreased your effectiveness?)

10. **What opinion do staff (not involved in the model) in your school have of you when they see you implement strategies from the model?**
    Probe: Do you feel they think it is beneficial? Do you think they would like to learn and utilise the strategies?

11. **What opinion do senior staff (head teacher&assistant head) in your school have of you when they see you implement the model?**
    Probe: Do you feel they think it is beneficial?

12. **How do you feel other teachers and teaching assistants implementing the Model feel about the advantages and/or disadvantages of the model?**

13. **Do you think implementing the model has been advantageous for your students?**

14. **Do you believe the model is compatible with existing values and practices in your school?**

15. **Do you think strategies within the model is compatible with the needs of your students?**

16. **Do you think using the model is compatible or incompatible with some or all aspects of classroom work?**

    Probe: could you tell me which aspects it is incompatible/compatible with?

17. **How well does the model fit with the way you like to work/work style?**

    Probe: How do you like to work?

    Could you tell me what fits or doesn't fit with the way you like to work?

    Why do you think this is?

18. **Do you think the model can be cumbersome for you to use?**

    Probe: What aspects do you find most difficult?

    How do you think this could be resolved?

19. **How difficult or easy do you find it to remember strategies and interventions when working?**

20. **Do you feel using model strategies and interventions requires a lot of mental effort?**

    Probe: What strategies requires most effort and why do you think this is?

21. **Have you ever found using model strategies and interventions to be frustrating?**

    Probe: If yes, has this frustration maintained or abated?

    Why do you think it has maintained or abated?

22. **How clear and understandable is it to teach with model strategies and interventions?**

    Probe: What aspects have you found clear and understandable, or not….

23. **Overall, do you believe the model is difficult or easy to use?**

24. **How have you found it learning to apply the model?**

    Probe: Has it been easy or difficult?

25. **How have you found understanding the model? Has it been simple or complex to understand and/or implement?**

26. **Is it a priority for Head teacher and/or Deputy Head?**
    Are people held accountable for its implementation by the individuals listed?

27. **How do you think TAs feel about the about the model and its implementation?**
    Probe: is it a priority for them?
    Do they hold each other accountable for its implementation?
    Do they hold themselves accountable for its implementation?

28. **How do you feel about the training that has been provided to you, for implementing the model?**
    Probe: Has it been sufficient for IEPs, BSPs, organisation, DTT?
    Would you like more formal/informal trainings?
    Do you receive sufficient support and guidance from the BA to implement the Model effectively?

29. **Would you recommend the model to other school sites similar to your own?**

30. **What outcomes do you expect to see for your students from using the BESST Model?**

Appendix C:Time 1 and Time 2 Means (SDs) and Effect Sizes of student Target Behaviours for intervention and control groups statistics

	Control Group		**Intervention Group**				
Target Behaviour Time 1	**Mean**	***SD***	**Mean**	***SD***	**T**	**P**	
Mands	1.80	3.033	1.59	1.843	-.203	.841	
Compliance with Requests	3.00	3.317	2.91	2.810	-.063	.950	
Non-Compliance	2.40	1.140	2.95	3.618	.334	.741	
Disruptive Behaviour	2.60	2.793	5.00	4.619	1.106	.279	
Destructive/Dangerous Behaviour	.00	.000	1.59	3.487	1.005	.325	
Target Behaviour Time 2	**Mean**	***SD***	**Mean**	***SD***	**T**	**P**	**Effect Size**
Mands	1.00	2.236	2.86	1.754	2.045	.052	.93
Compliance with Requests	2.40	2.302	7.23	3.531	2.896	.008	1.64
Non-Compliance	3.60	2.510	.55	.858	-4.835	.000	1.62
Disruptive Behaviour	4.80	4.764	.95	1.759	-3.110	.005	1.07
Destructive/Dangerous Behaviour	.00	.000	.14	.640	.470	.634	.00