Using CentralReach: Technology as a tool to improve educator and parent experiences in early childhood intervention therapy for children with ASD

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ABSTRACT

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Jesse Dumas

Applied behavioural analysis (ABA) therapy is one of the most widely used techniques for early intervention therapy with children with autism spectrum disorder (ASD). Its two components – (i) parent involvement in therapy and (ii) accurate and efficient data collection and progression monitoring – are crucial to improve children's overall skill acquisition. However, barriers exist preventing these components from functioning to their highest potential, such as miscommunication and lack of time. Technological innovations such as *CentralReach*, an online software allowing educators to collect data and track child progression simultaneously while giving parents access to this data, provide an interesting alternative to current methods. The purpose of this project was to examine the implementation of CentralReach in an early intervention center that delivers ABA therapy to children with ASD, through the perspectives of parents and educators using a mixed-method approach. Results from a between-subject comparison between 20 ABA therapists – 10 educators using CentralReach and 10 educators using pen and paper methods – revealed no differences between perceived accuracy of the two methods, but that educators perceived CentralReach as being more efficient than pen and paper methods. A pre-post single-case design was used for three participating parents to examine the impact of formal training in CentralReach on their involvement in their child's therapy. Parent perspectives of the role CentralReach plays in their involvement and ability to impact their child's learning are discussed. Trends in the data revealed that increases in factors of involvement, such as perceived self-efficacy, coincided with increased involvement following the CentralReach workshop.

Acknowledgements

This thesis would not have been possible without the unwavering support of Dr. Sandra Chang-Kredl who supervised and mentored me throughout this project. I would equally like to thank my ABA clinic director who inspired me to explore this area and brought me into contact with the clinics that were used for participant recruitment, as well as the members of the Chang-Kredl lab, and my committee members Dr. D'Amico and Dr. Petrakos for all of their feedback and support. Lastly, I would like to thank my husband Eric who diligently listened to my brainstorms in their earliest forms, and to my mother Francisca and sisters Emily and Kim who have continued to support me in all of my academic endeavors.

Jesse Dumas

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Autism Spectrum Disorder (ASD) is a developmental disorder that affects 1 in 66 youth in Canada (Ofner et al., 2018). The American Psychiatric Association (2013) defines ASD as follows:

> persistent deficits in social communication and social interaction across multiple contexts, including deficits in social reciprocity, nonverbal communicative behaviors used for social interactions, and skills in developing, maintaining, and understanding relationships. In addition to the social communication deficits, the diagnosis of autism spectrum disorder requires the presence of restricted, repetitive patterns of behavior, interests or activities (p. 50).

I first became invested in working with these youth when I was trained as an Applied Behavioural Analysis (ABA) educator at an early intervention therapy clinic for children with autism. Due to the intensive nature of the therapy we carry out, the child's time at the center each day is structured and fast-paced. As I completed my training and began working with multiple families at the clinic, I noticed how I often only had a couple of minutes with parents as they picked up their child, making it difficult to summarize the child's daily progress in a way that was both accessible and useful to the parents. Throughout my training, I was also told of the importance of accurate data collection as well as precise progression monitoring in order to inform intervention decisions. However, I was surprised to find out that the children's clinical data was still being recorded and analyzed using pen and paper, along with how much time was devoted to data collection during a child's session.

This lack of time seemed to be a resounding issue with other staff members as well, one that I thought could perhaps be alleviated by integrating the use of technology at the clinic. My thoughts were reciprocated when the clinical supervisor mentioned that we would soon be integrating the CentralReach software at our center. CentralReach is a software built specifically for ABA therapy with the capacity to collect behavioral monitoring data during therapy sessions, share information with parents, and automatically track and create graphical representations of child progress and skill acquisition (CentralReach, 2018). When I learned of this software, I was interested in examining the effect of its implementation on both educators and parents. This inquiry formed the basis of my current project.

A large amount of research on ASD has been conducted over the years that has explored the various intervention strategies used with children with ASD. As ASD is a neurodevelopmental disorder, early identification has been deemed of utmost importance in order to commence early intervention therapy and provide children with the aid they need to progress as much as possible in terms of brain development (Pierce, Courchesne & Bacon, 2016). Early one-on-one intervention therapy has been considered one of the most effective approaches (Landa, 2018), and research is being conducted to evaluate early intervention techniques (French & Kennedy, 2018). Studies have varied in exploring aspects which can affect the intervention process such as the method of delivery and parent involvement (Landa, 2018), as well as attempting to isolate components that may drive the success of an intervention, including availability of resources and interventionist commitment (Vivanti et al., 2018).

As intervention programs continue to evolve, novel approaches to therapy need to be explored cautiously in order to gather evidence of their efficacy before becoming well established in the field (Vivanti et al., 2018). The areas currently being researched in the field of

ASD are vast and have become highly specialized. As a result, the collection of research on certain topics remains quite sparse as certain niches, like those examined in this research, continue to grow. The following section will serve as a review of the selected areas relevant to the current project in order to inform the reader of the present research, namely the importance of parent involvement in early intervention, traditional practices in behaviour monitoring, and new approaches to data collection through technology.

Early Intervention Therapy

In order to manage the symptoms of ASD, there has been a consensus in the field that early intervention during preschool years provides the best support for development and learning (Ziviani, Boyle & Rodger, 2001). Globally, it can be said there is strong empirical support for the effectiveness of early intervention therapy for children, where it has been found that programs have prevented any further decline in children's cognitive skills or adept behaviors (Guralnik, 2011). In fact, research such as the meta-analysis of 14 studies using early intervention programs conducted by Makrygianni and Reed (2010) found that early intervention programs have shown to improve children's skills in many domains. Several factors are considered crucial in order for therapy to be successful, such as therapy length, parent training, child age at therapy onset, as well as therapy intensity (Makrygianni & Reed, 2010). The conclusions of another meta-analysis of 13 studies, conducted by Reichow and Wolery (2009), concur with those of the above authors, where the researchers found that a high number of hours of therapy at a high intensity were vital to the child's success. Further findings have sought to elaborate on the specific developmental aspects that are improved during therapy. Eldevik and colleagues' meta-analysis (2009) extended the work of Reichow and Wolery stating that children showed significant positive changes in IQ as well as in adaptive behaviors following therapy. This finding has been replicated in other

studies (Dawson et al., 2010; Virués-Ortega, 2010), with therapy also having positive effects on language acquisition, communication and overall daily living skills (Virués-Ortega, 2010).

As the efficacy of early intervention therapy has been established, research has been conducted demonstrating its long-term effects. Such results are central to the field to determine whether early intervention therapy has lasting effects in the lives of the children with whom it is implemented (Vivanti et al., 2018). Estes and colleagues (2015) examined 39 children with ASD two years after completing their early intervention therapy (started at age four) and found that all cognitive, communication and social gains had been maintained. Likewise, another study that examined children who received intervention between ages two and four, followed up six years post-treatment and found that behaviors altered during intervention were equally maintained over time (Pickles et al., 2016).

Applied behavioral analysis therapy

The most widely used of these early intervention techniques is Applied Behavioural Analysis (ABA) therapy. ABA therapy applies principles of behaviorism, such as operant conditioning, to specific behaviors with the goals of understanding their origins and instill any changes (Baer, Wolf & Risley, 1968). By collecting detailed data, trained ABA educators have used the process to predict and manipulate certain behaviors (Baer et al., 1968; Cooper, 1982). This form of therapy is normally carried out on a one-on-one basis by specialized educators across several environments such as the home, school or specialized clinics (Anagnostou et al., 2014). Of course, in order for any therapy to succeed it must adhere to certain standards. One set of standards as described by Guralnick (2011) is that early intervention therapy be sensitive to the child's environment, including home life and daily routines. External influences, such as parents and other family members, can affect the child's learning environment. ABA

educators must therefore be conscious of the child's environment outside of therapy and engage the support and involvement of parents in the therapy process in order to ensure that both parties are aware of the child's ever-changing situation. In terms of clinical standards, accurate and detailed data collection is a crucial facet to effective ABA. Trained observational data collection has thus far been the most reliable technique to inform therapy progression (Baer et al., 1968). It is important to have a fundamental understanding of the state of parent-educator relationships as well as therapy monitoring as they currently exist in the therapy world. The next section will contain a review of the literature on behaviour monitoring and data collection approaches, followed by a discussion of parent involvement in ABA therapy.

Early Intervention Behavior Monitoring

As mentioned prior, a component of ABA therapy is collecting detailed and accurate data about exhibited behaviors (Baer et al., 1968; Cooper, 1982). By collecting data on each child, it allows for individualized programs to be created that best address each child's skill level and needs (Buzhardt, Walker, Greenwood & Heitzrnan-Powell, 2012). During a given session, interventionists typically collect data on specific learning objectives, in addition to problematic behavioural incidences (i.e. causes, duration and content of tantrums, and frequencies of aggressive behaviors), which can often occur simultaneously. To ensure reliability, detailed data is ideally collected and reported immediately after a particular incident or demonstration of learning. However, this is often not possible and studies have shown that reliability of data can be compromised when educators are forced to report data *retrospectively*, either because they are busy implementing complex protocols that require their undivided attention (Vollmer, Sloman & St Peter Pipkin, 2008), or when trying to work with challenging behaviors from the child (Madsen, Peck & Valdovinos, 2016).

A study by Andersen (2017) that examined data collection methods used by ABA educators showed that educators often were forced to pause during sessions to allocate time to recording data due to the complex and demanding nature of the data collection process, taking away valuable intervention time from the children. If educators fail to collect data this can have negative consequences for the integrity of the interventions being put in place, as well as possibly hindering the child's progress (Koegel, Ruso & Rincover, 1977; Vollmer et al., 2008). Therefore, accurate and efficient data collection methods are needed in order to correctly inform intervention decisions, as well as devote as much time as possible to the active therapy process (Buzhardt et al., 2012). The following sections will serve first as a review of the behavioral monitoring methods currently being used in the field, as well as a presentation of studies that have sought to compare traditional methods (pen and paper) to newer methods that are technology based. Examples of the use of technology as a tool to improve parent involvement in intervention programs have also been included.

Current methods in practice. The most widely used data collection method in early intervention therapy as of 2010 is the traditional pen and paper method (Tarbox, Wilke, Findel-Pyles, Bergstrom & Granpeesheh, 2010). Due to its low cost, it is understandable that so many practices with financial restrictions maintain this method. Pen and paper data collection can be considered quite flexible and easy to use, with the opportunity for educators to write qualitative observations at any time and make notes as they see fit on the pages (Tarbox et al., 2010). Still, pen and paper data sheets must be printed and stored, and often are time-consuming to create and fill out (Tarbox et al., 2010). It can be argued that electronic data collection has the potential to be more efficient, collecting and storing data simultaneously with one touch. It can equally be stated that electronic data collection can alleviate the many hours spent on graphing and

analyzing data crucial to monitoring intensive interventions, allowing more time to devote to intervention preparation and implementation and staff training (Madsen et al., 2016; Tarbox et al., 2010).

Research comparing behavior monitoring methods. Kahng and Iwata (1998) conducted a preliminary study examining the various software systems available for real-time data collection for behavioral intervention services. All software reviewed by the authors were found to have the basic capabilities necessary for ABA therapy data collection such as collecting behavior durations, frequencies, and intervals. The majority of these softwares were also able to perform the calculations normally done manually by educators, such as calculate percentages automatically, create graphs, and keep track of cumulative acquired skills (Kahng & Iwata, 1998). More recent research has shown that behavioural data collection tools have maintained the necessary capabilities associated with ABA data collection and progress monitoring such as automated calculations and graphical representations of data (Buzhardt, 2012). Although Kahng and Iwata in their review presented electronic data collection methods as being able to improve data accuracy and reliability, to the best of our knowledge only two studies (i.e. Tardox et al., 2010; Andersen, 2017) comparing traditional pen and paper versus electronic data collection methods have since been conducted.

In Tarbox and colleagues' (2010) study comparing pen and paper with technology-assisted data collection, educators reported that pen and paper took less time during sessions than the electronic method. However, the electronic method saved educators time *outside* of sessions because of its ability to graph child progression automatically (Tarbox et al., 2010). Andersen (2017) found similar results, where the electronic data collection method initially was slower than the traditional pen and paper method, but that the software did save time for monitoring

child progression (Andersen, 2017). Additionally, the educators in Andersen's study reported that there was a learning curve to the tablet system and that they became more proficient with the electronic data collection method over time, diminishing their time spent on data collection beyond what was the norm with traditional pen and paper methods. It is important to note that little empirical research has been conducted to examine the difference between these methods, and what does exist can be considered dated. In order to put things into perspective, consider that one of the first tablets on the market came out in 2002, and cost approximately 2000$, making it accessible mostly in industrial and military markets. Tablet technology first became user accessible with the release of the iPad in 2010. Since then, technology has made significant leaps in capabilities, user-friendliness, and cost accessibility. There is a current gap in the literature examining how current modern technology can be a tool in the field. In addition to being a tool for educators in a clinical setting, technology paired with growing access to the internet can be considered a promising avenue to promote parent involvement and faster and more accurate communication between families and clinical teams (Buzhardt, 2012).

Technology Use in Parent Involvement

As discussed earlier, parents play a vital role in early intervention therapy as they act as one of the principal interventionists in the child's natural environment (Buzhardt, 2012). In order for parents to be able to carry out their role, communication between educators and parents about the child's developing capabilities and skills is key. Sharing data through technology can facilitate faster and more effective communication, allowing for a more cohesive parent-educator team environment (Buzhardt, 2012).

One example is *Telehealth*, a video-conferencing program that helps parents complete interventions with their child with the help of live, online certified educators (Wacker et al.,

2013). Studies examining the use of Telehealth have found that it can be a useful tool for reaching families with limited resources or difficulties coming into the clinic itself (Vismara, Young & Rogers, 2012; Wacker et al., 2013). Furthermore, it has been found that parents who used Telehealth reported increased acquisition rates for their child's language, motor imitation and social skills, as well as reductions in problematic behavior displayed by their child (Wacker et al., 2013), suggesting that Telehealth provided parents with effective resources to create more teachable moments in the home (Vismara et al., 2012). Further research conducted by Law, Neihart, and Dutt (2018) replicated Vismara and colleagues' study. It was also found that parents showed significant improvements in their abilities to carry out interventions following the use of Telehealth and that their children also showed significant improvements in language acquisition (Law et al., 2018).

Another example with a similar structure to Telehealth is the *Parent-Implemented Communication Strategies (PiCs)* program. This program also taught parents intervention skills through video modeling, such as how to prompt verbal communication which allowed parents to learn the necessary strategies to manage their child's behavior across various settings (Meadan, Meyer, Snodgrass & Halle, 2013). Another feature of PiCs as outlined in a review of the program was its ability to provide clear, objective data on the child's progress in their various programs (Stoner, Meadan, Angell & Daczewitz, 2012). Programs such as Telehealth and PiCs show how crucial it is to provide parents with the proper resources to understand and properly execute intervention strategies with their child in the home.

The components of early intervention therapy are always centered around the child's *developmental progression.* In terms of clinical interventions, accurate behavior monitoring must be carried out in regards to the child's behaviors and skills in order to inform intervention

programs (Buzhardt et al., 2012; Koegel, Ruso & Rincover, 1977; Vollmer et al., 2008). Various studies have attempted to determine whether a superior data collection method exists by comparing traditional pen and paper versus electronic data collection methods, though the results remain mixed (Andersen, 2017; Tarbox et al., 2010). Moreover, data needs to be accessible and objectively presented for parents to present an unbiased depiction of their child's progress in order for there to be clear communication between educators and parents (Guralnick et al., 2008).

Parent Involvement

Studies have shown that children and their families who devote large amounts of their time to early intervention therapy tend to have the best outcomes, often showing superior improvements in intellectual, social and behavioral skills (Lang, Hancock & Singh, 2016; Osborne, McHugh, Saunders & Reed, 2008). Additionally, research has shown that these effects are heightened when the parents are highly involved in their child's therapy and extend the intervention techniques into their home life (Levy, Kim & Olive, 2006; Strauss et al., 2012), as current research stipulates that having a combined parent and clinical delivery of therapy is most effective (Landa, 2018). Extensive parent involvement increases the total hours of intervention a child is able to receive, creating more opportunities for learning and increasing the chances for success (Ozonoff & Cathcart, 1998). Such has been the trend across the literature, where it had been found that parents who receive and implement intervention training with their children with ASD significantly reduce the number of problem behaviors displayed by their child (Lang et al., 2016; Levy, Kim & Olive, 2006).

A longitudinal study by Kim, Bal and Lord (2018) in which they observed the skill levels of children with ASD periodically from ages 2 to 18 showed that parent involvement played a

key role in the cognitive development of their children, providing them with heightened skills often comparable to their typically developing peers at the elementary school level. Parent participation in their child's programs was associated with higher academic achievement in areas such as math and reading at ages 9 and 18 (Kim, et al., 2018). Strauss and colleagues (2012) further noted that parent training gives parents more confidence in regards to their skills as interventionists, where it has been found that parents, trained properly, can deliver therapy of a similar quality to those of professionals.

Barriers to involvement. Given the importance of parents' involvement in their children's treatment, some of the barriers to their effective participation should be addressed.

Perception of skills. In an article by Solish and Perry (2008), the authors questioned 48 parents about their experiences surrounding their involvement in their child's therapy, investigating whether variables such as perceived self-efficacy, belief in behavioral therapy, knowledge about autism, perception of child's progress, and stress affected parental involvement. The most significant results of the study were that parents' perception of their efficacy as interventionists as well as the degree of confidence they had in their own skills predicted their level of involvement in their child's therapy (Solish & Perry, 2008). The authors equally found that there was a significant correlation between parental involvement and their knowledge about autism. The authors concluded that parents with heightened levels of knowledge about their child's diagnosis most likely understand the importance of the therapy and thus are more involved as a support system (Solish & Perry, 2008). These results suggest that there is a need for thorough intervention training for parents in order to increase feelings of self-efficacy, as well as the need to have more knowledge resources in order to create a community of more confident, knowledgeable and involved parents (Solish & Perry, 2008).

Communication and collaboration. Due to the intensive nature of ABA therapy, children can often learn new skills quickly, making frequent advances in their development. Parents too need to be constantly adjusting their interactions with their children in order to appropriately respond to their child's current skills (Guralnick, Neville, Hammond & Connor, 2008). In other words, parents and educators need to be continuously working together towards the same objectives. This requires an immense amount of communication and collaboration between both parties, which may be challenging. An early source of research conducted by Kholer (1999) collected information from parents regarding their perspective on the quality of services being delivered to their children with ASD. In Kholer's study, parents reported that due to parent-clinic collaboration issues, they often felt that one or more of the services offered at the clinic were in fact not meeting their child's needs. It was also reported that parents felt they had minimal involvement in their child's programs, having few opportunities to observe the work of educators with their child and being unsure of the progress being made (Kholer, 1999).

Kliebard and Bobbitt (1975) stipulate that in order for a successful parent-educator collaboration to take place, parents and educators need to be on the same track in terms of understanding the child's skill levels. Obstacles can be encountered when parents are either not aware of their child's skills, or sometimes refuse to understand their child's capabilities. Barriers to parent-educator communication can hinder the parents' ability to be receptive to their child, and work towards other skills in a constructive manner in order to aid their child to progress developmentally. Kliebard (1975) argued that in these moments, educators communicating *why* a certain skill is significant would be an influential factor in improving mutual understanding between the home and the clinical team. If educators and parents do not agree on the reasons a certain skill is significant, there are risks that the skill could be lost should it not be maintained

through practice in the home environment. Parents also have the unique opportunity to apply intervention strategies to home routines otherwise not touched upon in the clinical setting (e.g. bath/bedtime routines, events/outings). While research has shown that parents are eager to learn the necessary skills to apply intervention techniques with their children in their everyday environment (Lang et al., 2016), it is evident that clear communication between the ABA team and parents is a vital component to creating developmentally appropriate and consistent intervention programs for children with autism. Communication is also necessary in order to provide parents with updates to programs as well as acquired skills. However, research has shown that high levels of parental stress can often impede the communication process, putting the child's progress at risk (Strauss et al., 2012).

Stress. According to research by Davis and Carter (2008), being a parent of a child with an ASD diagnosis can be demanding and highly stressful due to the nature of autism (e.g. general behavioural issues, issues with excessive rigidity or compliance with parent requests). Parents often experience compounding stress in various aspects of their lives which can have an effect on their own health, in turn having an effect on how they interact with their child (Benson, 2006). For example, after interviewing a sample of parents of children with ASD, Benson (2006) reported that parent stress was a significant predictor of parent depression. As mentioned previously, having high levels of parental involvement in intervention programs is important to a child's success, however, it has been found that parent stress can hinder the intervention efficacy and progress overall (Osborne, McHugh, Saunders & Reed, 2008; Strauss et al., 2016). More specifically, studies have found that children with parents who reported high stress levels made less progress in their programs even when the parents were highly involved (Bagner & Graziano, 2012; Osborne et al., 2008). Preliminary research has shown that having proper parent support

(Benson, 2006), as well as knowledge and feelings of self-efficacy as an interventionist decreases stress and improves parent well-being (Ozonoff & Cathcart, 1998). Nevertheless, it is clear that steps still need to be taken to decrease parent stress in order to help parents fulfill their interventionist role to provide children with the best opportunities for learning and to improve their overall quality of life as parents.

It is clear that high levels of parent involvement in early intervention programs have significant effects on children with ASD's development (Lang et al., 2016; Levy et al., 2006; Osborne et al., 2008; Ozonoff & Cathcart, 1998; Strauss et al., 2012). However, many barriers exist to parent involvement such as their perception of their abilities to carry out therapy (Solish & Perry, 2008), perception of collaboration with the clinical team (Kholer, 1999), and stress (Bagner & Graziano, 2012; Benson, 2006; Osborne et al., 2008; Strauss et al., 2016). Software such as Telehealth and PiCs have attempted to alleviate some of these barriers by providing opportunities for video-modeling from educators of intervention strategies for parents to carry out in the home (Wacker et al., 2013). Such programs have demonstrated the ability to significantly improve parent fidelity to intervention procedures, as well as show significant improvements in child skill acquisition (Law et al., 2018; Vismara et al., 2012).

CentralReach

CentralReach is another example of a program that has the potential to have similar opportunities to improve parent involvement, while equally having the possibility of being a tool to improve behavior and progression monitoring for educators involved in early ABA intervention. In addition to being a more efficient data collection tool for educators, CentralReach's parent network feature presents the potential to improve parent involvement in therapy. On one level, the software allows parents to communicate with educators in a daily log

(see Figure 1), and to keep track of upcoming tasks and appointments. It also acts as a platform for the clinical team to share documents and videos with parents to help describe and model certain techniques that can be used. The main feature, the child's "learning tree" (see Figure 2) which details the child's individualized programs, allows parents to view all of their child's programs and read their methodology plan to learn about the techniques and strategies used to execute the interventions. Parents are also able to track which targets their child is working on and view their child's daily progression at the clinic (see Figure 3) (CentralReach, 2018). Unlike previously researched programs (i.e. Telehealth and PiCs) which focused mainly on visually modelling teaching techniques to parents, CentralReach's capabilities reach beyond one single element of the therapy process, providing information on intervention techniques, video-modelling, and real-time updates on child skills and progression taking place in the clinic. Therefore, it is important to explore whether one tool has the potential to affect multiple components such as parent involvement, parent awareness of child progression and educator data collection and progress monitoring, which together could have benefits to therapy quality overall.

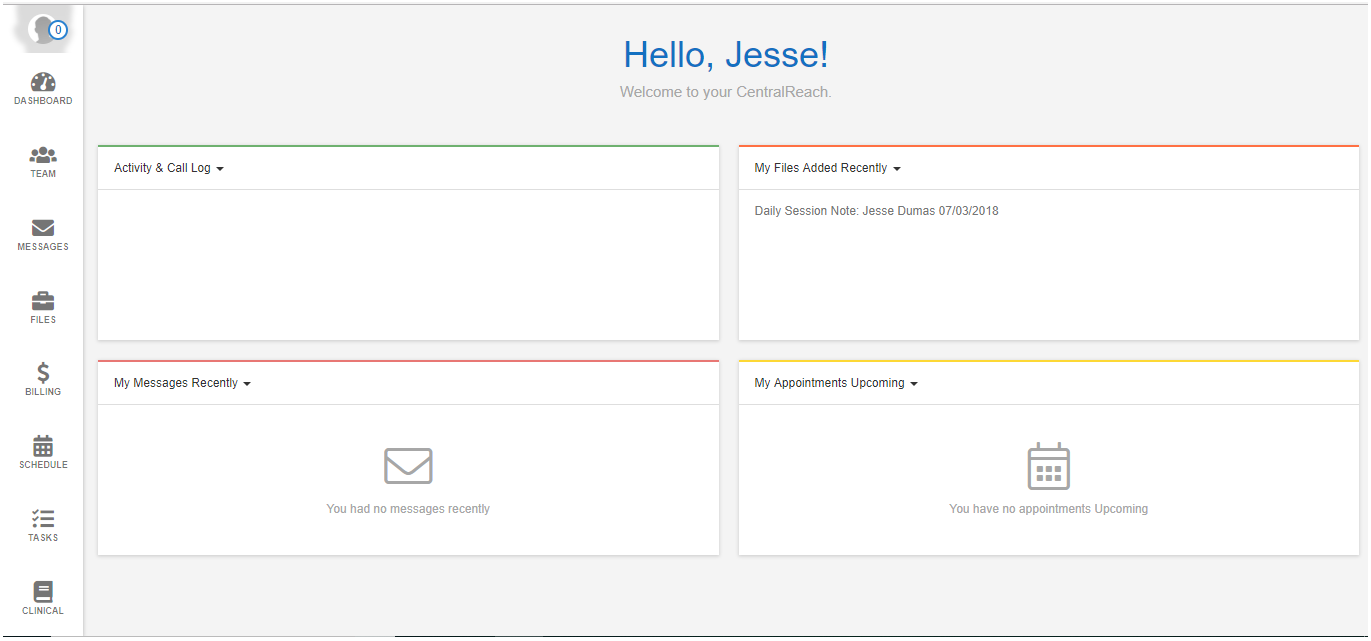

Figure 1. CentralReach Parent Dashboard

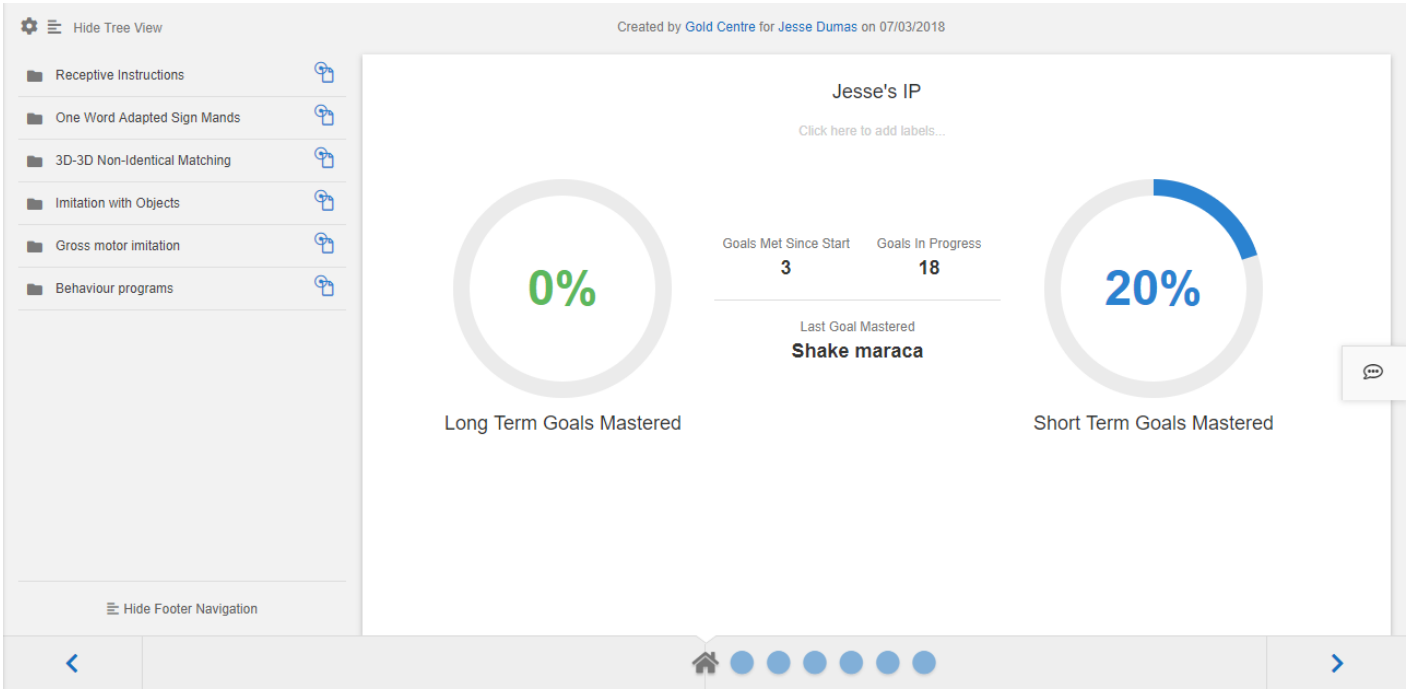

Figure 2. CentralReach Child Learning Tree

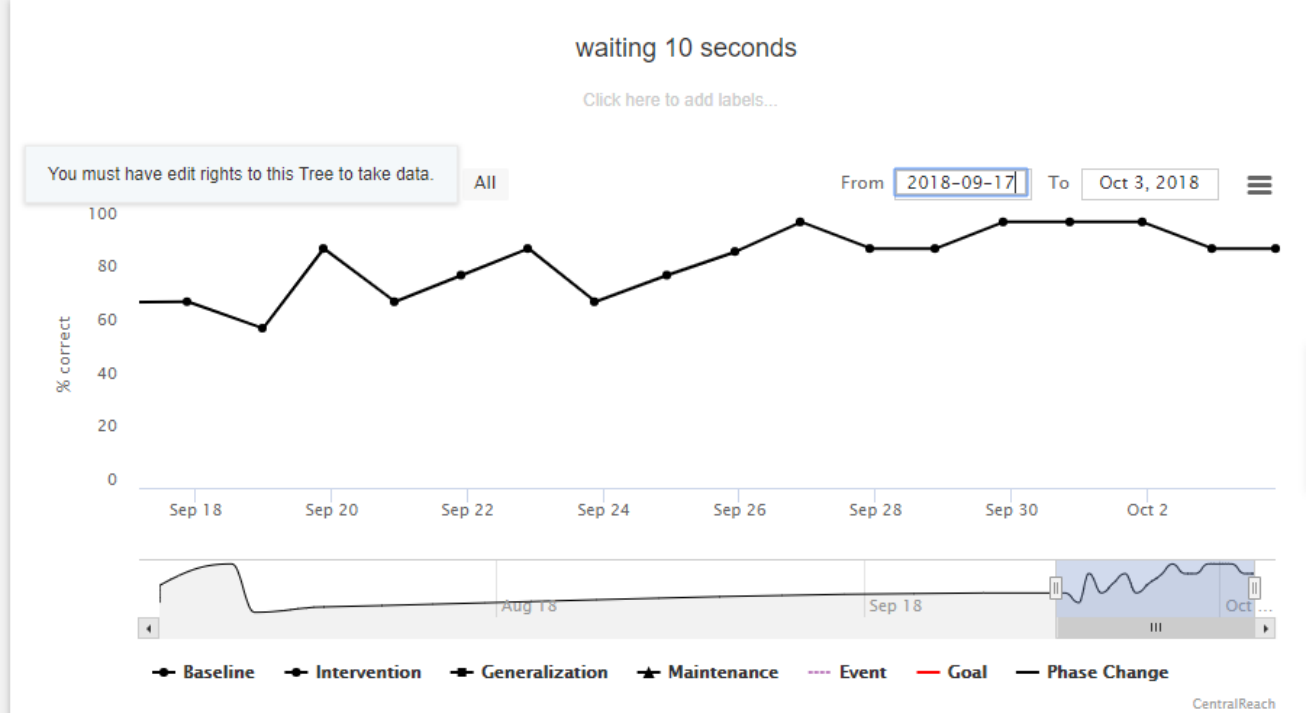

Figure 3. CentralReach Progression graph

The Current Project

The current project will seek to examine the impact of the implementation of CentralReach in an early intervention therapy center that delivers ABA therapy to children with ASD. Perspectives of both educators and parents will be explored in terms of their experience with the software and how it affects the various aspects of the intervention experience. The project will also compare perspectives from educators in a center that does not use software-based methods. The project will be centered around the following research questions:

(1) Are there significant differences in educators' perceived accuracy and efficiency of data collection and progress monitoring methods, when comparing traditional pen and paper to CentralReach?

(2) How does formal training with CentralReach impact parent involvement in their child's ABA intervention program?

Method

Participant Recruitment

Parent and educator participants were recruited from two separate behavioral therapy clinics, where participation in the study was done on a voluntary basis. Educators were recruited from both a public government funded clinic and a private clinic, whereas the parents were only recruited from the private clinic. Due to the time constraints that accompany a master's thesis, the decision was made to recruit participants from two different locations in order to comply with accessibility limitations imposed within the government and private sectors respectively. Parents and educators were recruited via a distributed letter inviting them to participate, and only interested individuals were contacted with further information. Participants were then contacted and sent all survey links through email. The total number of participants in the parent group (3) ended up being much smaller than the educator group (20). Although a higher number of parent participants was expected, parents perhaps chose not to participate based on their availability to commit to a two-month long research project. In contrast to the participant pool of educators, restrictions applied to recruiting family clients in the government sector for research also prevented additional parent recruitment from the second clinic used in this study. However, the small sample size allowed for a more descriptive case study approach to the parent data.

Educators

Participants. A total of 20 educator participants were recruited – 10 from a government clinic who used traditional pen and paper methods for data collection and progression monitoring, and 10 from a private clinic who used CentralReach. To begin, the participants were mostly female ($N = 17$). The pen and paper and CentralReach groups had comparable backgrounds with the majority (65%) of the participants between 25-34 years old, 25% of the

participants were between 18-24 years old, and 10% were over the age of 35. Educators in the pen and paper group either held a bachelor degree ($N = 6$), master's degree ($N = 2$) or a high school diploma ($N = 1$). Educators in the CentralReach group had a similar distribution with either a bachelor degree ($N = 5$), master's degree ($N = 2$), some university but no degree ($N = 1$), CEGEP degree ($N = 1$) or a high school diploma ($N = 1$). In terms of years of experience in ABA, educators reported that they either had 0-3 years (60%), 3-5 years (20%) or 5-7 years (20%). It can be noted that the recruited samples included almost the full team present at each clinic, therefore the descriptive data depicts the variability in background among the team members.

As this project was examining the impact of technology on data collection methods, it was of interest to understand the educators' years of experience in data collection itself prior to entering the field of ABA therapy. Educators reported either to have no prior experience (20%), 0-1 year of experience (40%), 1-3 years (25%) and 3+ years (15%). Experience with technology was also explored, with educators reporting a range of perceived skill levels in technology (see Figure 4). In terms of actual usage, educators reported either accessing technology multiple times a day (55%) or on an hourly basis (45%), with a variety of devices (see Figure 5), the most common being smartphones ($N = 18$), laptops ($N = 17$) and tablets ($N = 9$).

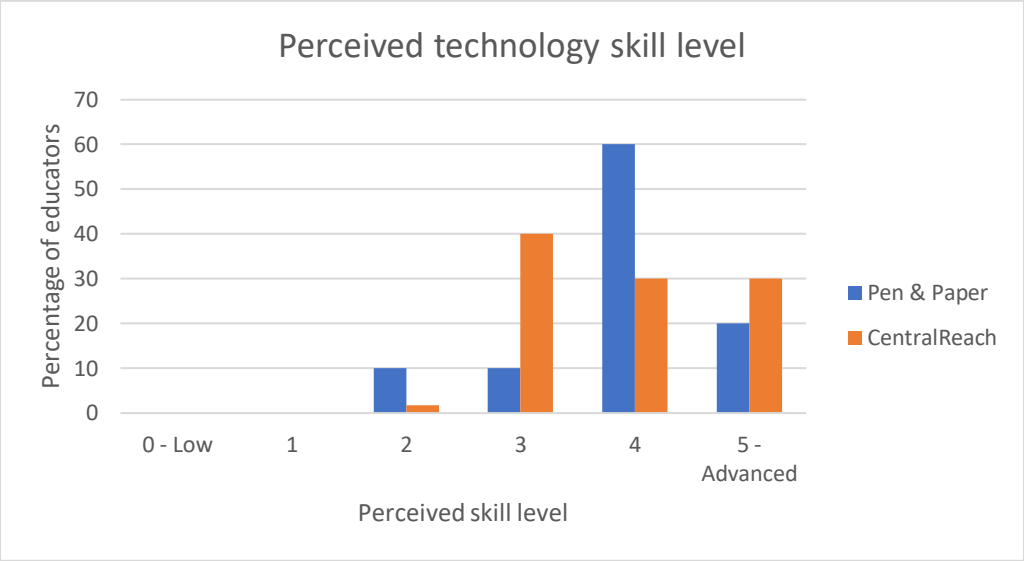

Figure 4. Comparison of educators' perceived technology skill level

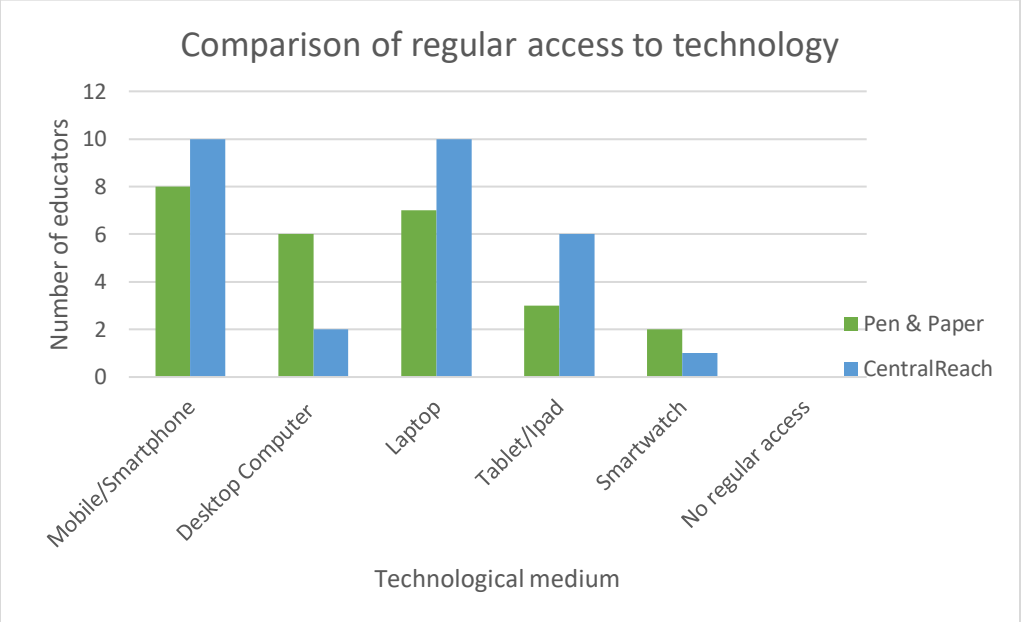

Figure 5. Comparison of regular access to different technology mediums

Design & Procedure. The educator component of the study followed a between-group design to compare educator perspectives on data collection and progression monitoring methods. The perspectives of educators who currently use the traditional pen and paper method were compared to those of the educators who use CentralReach to explore whether there were

significant differences in perceived accuracy and efficiency of the two methods. The educators' perspectives were collected using an online survey. The researcher collected the completed consent forms, and once all of the educators confirmed their interest in participating, they were contacted via email and sent a link to an online survey to complete. Educators were emailed individually in order to ensure anonymity among participants. Once data collection was complete the responses were downloaded and transferred to an excel spreadsheet. All participant emails and data throughout the collection and analysis phases were stored in password protected documents.

Measures. For the initial assessment, pen and paper educators completed a 21-item questionnaire written by the author for the purpose of the project (see Appendix A). Surveys collected educator demographic information and assessed their perspectives on the accuracy and efficiency of the traditional pen and paper progress monitoring and data collection methods. Examples of questions addressing these variables included asking educators how confident they were in taking error-free data or how much time they felt they devoted to either process. The CentralReach educators completed a 22-item questionnaire which contained the similar items assessing perceived accuracy and efficiency, with additional items pertaining to their perception of CentralReach compared to the traditional pen and paper methods, as well as their long-term satisfaction with the software (see Appendix A). All questions were answered on a five-point Likert scale. Qualitative feedback was also collected, giving educators the opportunity to voice any comments, concerns or suggestions they had in regards to their respective methods, allowing the researcher to gain insight on specific experiences educators were having.

Data analysis. To score the data, perceived accuracy scores and perceived efficiency scores were obtained by summing the Likert-scale responses, where higher scores indicated a

higher perceived accuracy (see Appendix C for a detailed description). Independent sample Mann-Whitney U tests were used to explore whether there were significant differences between educators using pen and paper versus CentralReach in terms of their perceived accuracy and efficiency of their current data collection and progress monitoring methods. Data were examined for normality through skewness and kurtosis, the Shapiro-Wilk test, as well as Q-Q plots, all depicting results in an acceptable range. In terms of qualitative analysis, the open-ended comments collected in the feedback section of the surveys were analyzed for trends related to the educators' current methods.

Parents

Design. The design of the parent component of the study was a pre-post, A-B single-case design with three parents. The design was partially based on Buzhardt and colleagues' research (2011) which used a pre-post survey design to examine satisfaction with an online progress monitoring system for children enrolled in an at-home Head Start program. Accordingly, this section followed a pre-post design, seeking to explore the perspectives of parents prior to the implementation of CentralReach, and after its implementation. In this field of work, there remains a struggle to have the intervention staff and financial resources to keep up with the high demand for early intervention therapy. Due to these restrictions, there is often a limited number of parents engaging in therapy at one time. To manage the small sample sizes, an A-B single-case design was employed similar to those used in health-related interventions (cf. Barakat et al., 2017). A-B single case designs involve collecting numerous points of data on one or a small group of subjects during an initial assessment phase and then continuing with multiple assessments following an intervention. With the ability to measure the dependent variables on multiple occasions, this methodology was useful for gathering high densities of continuous

information on an individual level (Morgan & Morgan, 2009). In the case of the current project, the above-mentioned design was employed in order to obtain a representative depiction of the participants' current experiences as well as of their changes in experiences and perspectives over time following the formal training on how to use the software.

Procedure. The researcher collected the completed consent forms of interested families. The three participants were then sent a link to their online surveys via email. Emails were sent individually to ensure anonymity between participants. Parents first completed a pre-test survey followed by four weekly "check-in" surveys meant to assess their perspectives on their awareness of their child's progression, communication with the clinical staff, involvement in their child's intervention plans and stress for a given week.

Next, the researcher worked with the participants to schedule their one-on-one workshops based on common availability. The researcher also received permission from all three parents to use their actual portals during the workshops in order to access the most individualized and thus informative experience possible. Parents attended the workshop either alone or as a couple where they were given the opportunity to explore the software with the researcher. The workshops were delivered for one hour in a conference room at the private clinic that the family attends for therapy. During the workshop, the researcher first began by asking the parents to describe how they currently felt about the software to gain insight into their level of proficiency with the software. The researcher then presented the central features of the software pertinent to their child's behavioral intervention plan with the use of a PowerPoint presentation, as well as a live demonstration of the parents' actual portal. Finally, the workshop ended with the researcher asking the parents how they felt following the workshop and learning more about CentralReach. The workshops were recorded as qualitative data on the parents' concerns and feedback in

regards to the new software. Following the workshop, parents completed another four weekly "check-in" surveys meant to assess the same variables mentioned prior, as well as their use and proficiency with the software following the workshop. Lastly, they completed a final post-test survey to explore their experience overall. All surveys were completed online, and responses were downloaded and transferred to an excel spreadsheet. All participant emails and data throughout the collection and analysis phases were stored in password protected documents.

Measures. To further explain the measures used to examine the three parent perspectives, an adapted version of the validated *Parent Involvement Questionnaire* (Solish, Perry & Shine, 2015) was used with the permission of the author (see Appendix A). The questionnaire was adapted through the removal of extraneous questions associated with the current project, as well as through the addition/modification of certain questions[1]. The questionnaire examined three different types of involvement: agency involvement (communicating with the clinical staff), direct involvement with the child's programs (carrying out interventions in the home and monitoring the child's skill progression), and training involvement (attending workshops) (Solish et al., 2015).

The questionnaire also addressed various factors that could affect involvement such as stress and perspectives of self-efficacy (Solish et al., 2015). The initial assessment was a 45-item adapted version of the Parent Involvement Questionnaire containing additional questions examining each parents' perspectives on technology use. The weekly check-in surveys occurring prior to as well as following the software introduction were a 10-item questionnaire comprised of a selection of questions from the Parent Involvement Questionnaire (see Appendix A), as well as

[1] Questions related to the following topics were removed due to being unrelated to the variables of the current project: *perception of knowledge of autism and ABA compared to the general population, belief in ABA therapy, knowledge assessment of autism,* and *questions on parent positive and negative impact from the Parent Stress Index.* Questions on technology use and use of CentralReach were written by the author.

questions assessing the parents' use of CentralReach. Lastly, the post-assessment was a similar 47-item adapted version of the Parent Involvement Questionnaire, including questions addressing the parents' experience with CentralReach. All questions were answered on a five-point Likert scale.

The comment sections in the questionnaires allowed parents the opportunity to contribute any qualitative feedback they felt pertinent to their survey responses. Furthermore, the audio recordings of the CentralReach workshops provided qualitative data to explore parent feedback and perceptions associated with the software. The workshops were loosely structured in order to encourage parents to provide feedback at any point and to capture the true "voice" of each parent. As well, each parent was asked two formal and open-ended questions – at the beginning and end of the workshop – about how they felt about their current state either with the software or daily updates at the clinic.

Data analysis. As the perspectives of only three different parents were collected, a detailed exploratory analysis of each parents' perspective on a more individual level was conducted, as well as at the group level. First, the individual parent reports were descriptively analyzed to explore any changes in perspectives of CentralReach and comfort using a technology-based software over time. The qualitative survey comments and audio recordings of the CentralReach workshops were analysed to identify any trends in the parents' feedback on the software. Feedback was analyzed and coded according to which variable it was associated with and used as evidence to support the descriptive analysis. A visual analysis of each parents' longitudinal data presented in the figures was conducted as per the common standards of single-case analysis (Morgan & Morgan, 2009). It is important to note that the use of the A-B single-case design with the parent sample resulted in having a total of 15 observations for both the pre

and post assessment respectively for the parent involvement, perceptions of self-efficacy and stress variables, allowing for a more in-depth analysis to take place.

To obtain the scores for these variables, scores for agency involvement, direct involvement, training involvement, and perspectives of self-efficacy were calculated by summing the Likert-scale responses of certain questions (see Appendix C for a detailed description). The parent involvement score was calculated by summing the scores for agency (e.g. reviewing clinical progress notes), direct involvement (i.e. carrying out interventions in the home) and training involvement (e.g., attending parent coaching sessions). Wilcoxon signed-rank tests were used to examine whether formal training with CentralReach significantly improves parent involvement in ABA early intervention across all three parents. Data were examined for normality using Q-Q plots, values of skewness and kurtosis and the Shapiro-Wilk test where it was observed that all values fell within the normal range. A correlation analysis was also conducted to assess whether factors such as stress and perceived self-efficacy as a parent interventionist, are significant factors that account for variance in parent involvement. Hedges' g (*corrected*) effect size was also calculated (see Appendix B for equations) for the variables in both the parent and educator components as it is generally deemed appropriate for small sample sizes (Lakens, 2013).

Results

Educator

Perceived accuracy. There were no statistically significant differences in the perceived accuracy score for data collection methods between pen and paper ($M = 7.0$) and CentralReach ($M = 7.9$), $U = 67.0$, $p = 0.218$, $g = 0.53$. There were also no significant differences in the perceived accuracy score for progress monitoring methods between pen and paper ($M = 7.5$) and CentralReach ($M = 8.6$), $U = 69.0$, $p = 0.165$, $g = 0.68$. In addition, the results of the qualitative analysis revealed interesting findings supporting the lack of significant differences in the perceived accuracy of data collection between methods (see Appendix D for full transcripts). The educators using the traditional pen and paper (PP) methods described issues such as lack of proper resources and working with difficult clients that require complex protocols. For example, Educator 1/PP stated that, "When working with more challenging clients, it is difficult to collect precise data since many behaviours happen and there isn't always the time to write the data down." Another barrier to accurate data collection mentioned by several educators was the fact that there is some subjective interpretation of behaviors on the educators' parts: "Some data may be biased depending on an instructor's perception of problem behaviour" (Educator 1/PP). Educator 5/PP voiced: "As we rely on pen & paper data collection and graphing procedures, the team would definitely benefit from ongoing training and monitoring of data collection to ensure consistency across the team and data integrity," pointing to issues of ambiguity that often exists due to subjective interpretations of data and skill progression.

CentralReach (CR) educators also reported several issues in data collection accuracy, however, they were quite specific to the software itself. Several of the educators spoke about the barrier of the software being online and its reliance on a consistent Wi-Fi connection. Problems

with data collection accuracy were reported to be related to the software refreshing and losing data. Educator 3/CR outlined this problem stating, “Central Reach has significant potential for data collection but suffers from many issues. Glitches in the system and a lack of app cause serious issues during sessions. Without an app, we must use a browser and it is constantly refreshing. I have lost data as a result of this”. Other educators in the same group echoed these feelings, stating that, “The only improvement I would suggest going further is to consider developing an application that doesn't require to use Wi-Fi” (Educator 2/CR) and “the start timer and stop button are not sensitive enough and when the page refreshes it changes the duration data making it inaccurate” (Educator 6/CR). It is clear from these statements that there are improvements to be made with the software itself in order to improve overall accuracy and performance.

Although perceived accuracy of progress monitoring did not show statistically significant differences between groups, it is interesting to note that the perceived accuracy score for CentralReach was higher than pen and paper, indicating a possible trend towards greater satisfaction with progress monitoring accuracy compared to traditional pen and paper methods. This was equally reflected in the statements from the pen and paper educators: “One fault is that, like in everything else, mistakes can be made. If mistakes are made and not found right away, it can skew the data” (Educator 3/PP), and “I still feel that from time to time I may make some mistakes” (Educator 5/PP). The concern with making errors that can ultimately affect a child’s therapy progress are mitigated with the use the software since progression through pre-defined steps of a program are automated, and was also supported by the lack of concern about progress monitoring errors from CentralReach educators.

Perceived efficiency. Efficiency refers to how much work from the educator is required to complete each process, with higher scores reflecting that a method is perceived as more efficient. CentralReach had significantly higher perceived efficiency scores for data collection ($M = 11.4$) than pen and paper ($M = 9.0$), $U = 77.5$, $p = 0.035$, $g = 1.01$. In terms of progress monitoring methods, the results demonstrated a trend towards significant differences in perceived efficiency scores, $U = 76.0$, $p = 0.052$, $g = 0.98$ with CentralReach ($M = 8.2$) having a higher score than pen and paper ($M = 6.2$). The qualitative analysis of the feedback from the educators also provided support for the differences in the perceived efficiency of each group's respective methods. Educators using CentralReach expressed overall satisfaction with its efficiency, stating that, "When it comes to collecting cold probe data or graphing and analyzing graphs central reach is more efficient than using paper and pencil" (Educator 6/CR). Educators also stated that "I find Central Reach to be a great method of collecting data, monitoring the child's progress and also communicating with the parents" (Educator 2/CR), and that "overall, it saves time in terms of graphing" (Educator3/CR). These excerpts highlight how educators perceived the technology-based methods to be highly efficient.

In contrast, educators using pen and paper felt it was less efficient. For example, Educator 3/PP explained the following situation: "If a child masters an objective on a Monday (and graphing is Friday), that objective won't be updated (considered mastered and a new objective would be put into teaching) until Friday. In this case, we had worked on a mastered objective for a week which can waste time to teach something new." This example emphasizes the barrier associated with manually having to update program progression, and how it can actually lead to wasted therapy time. Educator 5/PP supported this line of thinking saying that, "I

think that if we had computer-based programs for monitoring child's progress it would be a lot faster and more efficient to monitor each child's progress."

Parent

A case analysis of each of the three parents was conducted in order to present a comprehensive image of each parents' involvement in their child's therapy, as well as how various factors affected their involvement. The single-case design was useful for this purpose as it not only allowed for a high density of information on each individual to be collected but allowed a representative picture of patterns and trends in involvement to emerge over time. The following analysis will consist of a presentation of each parent individually including descriptive characteristics, changes in involvement, self-efficacy, and stress as well as changes in their perceptions and use of CentralReach, followed by the overall group findings. Transcripts of the workshop can be viewed in Appendix E.

Parent 1: Kate. Kate is a mother of a child with ASD born in France whose first language is French but reported having a bilingual French-English household. She holds a graduate degree and currently works as a homemaker. She is married to her Canadian husband who is an English native speaker. He also holds a graduate degree and currently works as a sound engineer. His work status was not reported. They have been participating in therapy with their son since October 2017 and were a part of the transition from the traditional pen and paper methods to CentralReach at the clinic. Kate perceived herself as having an intermediate technology skill level and reported having regular access to a TV, mobile phone, desktop computer, laptop and tablet.

Prior to the CentralReach workshop that Kate and her husband attended, Kate reported that she agreed that she would be comfortable using a tech-based system to monitor her child's

progress and that she strongly agreed that CentralReach could be a significant improvement to the traditional pen and paper methods. She also agreed that CentralReach was an efficient tool to communicate with staff and strongly agreed that it was efficient to monitor her child's progress. At that time, she reported that she used the software almost daily. Although she recognized the software's potential, it was revealed during the workshop that she felt limited by her lack of understanding of how to use it. At the beginning of the workshop, when asked how she felt about the software so far, she said: "Well, I feel like we're communicating, but for the rest, I'm a bit confused. I feel like we're using 30 percent of its potential". She also explained how she did not understand how to use the learning tree component, where the progression graphs are located.

By the end of the workshop, Kate and her husband stated that they felt much better about CentralReach and that they could now use the software more. They also brought up an important point that the formal training was helpful, "I think the transition [to CentralReach] was bumpy… And then getting used to that, I don't think we ever took the time". This shows how for Kate and her husband having the opportunity to be taught how to use the software was helpful in comparison to being responsible to learn independently. Following the workshop, Kate's use of CentralReach increased from almost daily to daily, and she perceived herself as even more comfortable using a technology-based system to monitor her child's progress.

In terms of Kate's perception of CentralReach's effect on her involvement in her child's therapy, she strongly agreed that CentralReach was an efficient tool to display her child's therapy progression, as well as agreed that it played a role in providing her with the necessary information about her child's skills to carry out interventions in the home. In addition, she strongly agreed that CentralReach played a role in helping her promote the generalization of her child's skills to the home environment, and in turn allowed her to extend her child's learning.

These endorsements were also supported by Kate's increase in involvement scores and perceived-self-efficacy scores following the workshop (see Figure 6). It can be observed that

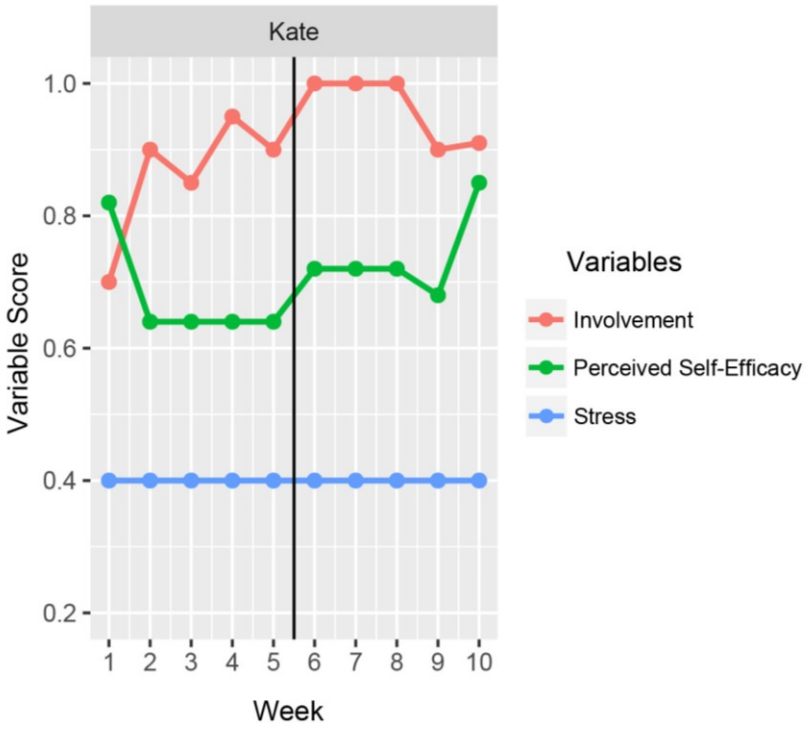

Figure 6. Kate's involvement, perceived self-efficacy and stress over time
Note. The vertical black line represents the CentralReach workshop

Kate's perceptions of self-efficacy and involvement appear to be related, with increases in perceived self-efficacy coinciding with increases in involvement during a given week. Kate's stress levels seemed to be unrelated to her involvement, as she consistently reported a low to medium stress level over time.

Parent 2: Mary. Mary is an English-speaking Canadian mother who holds a technical diploma in early childhood education and currently works as a homemaker. Her English-speaking husband is also Canadian, has a graduate degree and works full time as a chartered accountant. Their son who only speaks English in the home has been in therapy the longest compared to the two other families, as he started therapy in March of 2015. Mary reported that

she felt she had a low to intermediate technology skill level and regularly accessed a TV, mobile phone, desktop computer and a tablet.

Before the workshop, although Mary believed that CentralReach could be an improvement to the old methods by being a more efficient tool to track progress, she reported that she did not feel comfortable using a technology-based system to monitor her child's progress and never accessed the software. She voiced these sentiments again at the beginning of the workshop stating that, "I think that part [having regular access to the data] is fantastic. That they just put things in right away", however, emphasized that "I haven't gone on it very often, I just don't have the time. But when I do go, I like to look at my graphs when I understand which ones I'm looking at". Following the workshop, Mary stated that she was feeling "much better" regarding CentralReach and her understanding of the graphs. "At least I understand them and I can be more visual and… [I can] look at them more and say oh yeah, it's more of a percentage and that's why it looks wonky because I'm thinking the other one is frequency versus that. So, I can appreciate that and I can understand that".

Following the workshop, Mary's use of CentralReach increased from "never" to occasionally. However, her comfort using the system did not improve. Additionally, she disagreed that CentralReach was an efficient tool to display therapy progression, and stated that CentralReach did not play a role in providing her with information to carry out interventions in the home and impact her child's learning. She did however endorse that she somewhat agreed that CentralReach played a role in helping her conduct formal ABA sessions at home. When analyzing these responses in conjunction with Mary's descriptive characteristics, two observations can be made. Firstly, due to her background in early childhood education, a possible explanation could be that she is already quite well-versed in techniques and strategies

for helping children learn, and thus CentralReach is not as critical as a tool for her. Furthermore, as she was very experienced with the traditional methods prior to CentralReach's introduction at the clinic, it could be that the transition was more difficult simply due to comfort with the previous methods.

Nevertheless, examining Mary's involvement compared to her perceived self-efficacy and stress ratings show interesting results. Her involvement appears to be related to her perceptions of self-efficacy, where increases or decreases in perceived self-efficacy are met with respective increases and decreases in involvement (see Figure 7). For Mary, stress was an

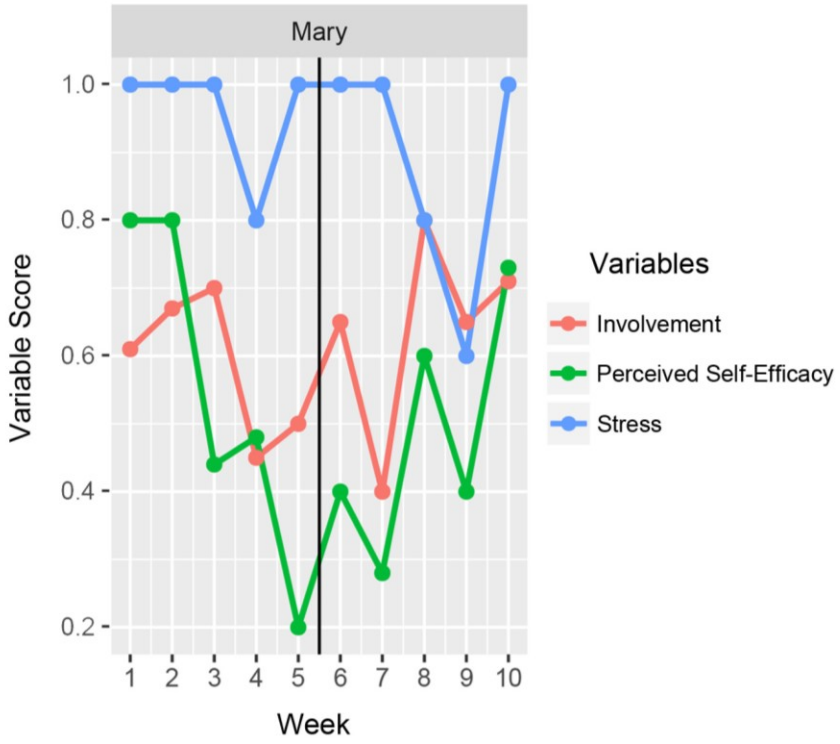

Figure 7. Mary's involvement, perceived self-efficacy and stress over time
Note. The vertical black line represents the CentralReach workshop

impactful factor on her involvement as well. Figure 7 shows how increases in stress correspond with decreases in both perceived self-efficacy and involvement, whereas stress decreases tend to coincide with increases in perceived self-efficacy as well as involvement. Comments obtained

from the weekly check-in questionnaires provide evidence for certain changes. For example, Mary stated at week 3 that it was "hard to follow through on ABA generalizations this week at home with so much other stuff going on", and that she was "quite busy this week" at week 4. Moreover, Mary commented at week 5, "really tough week. My son's scripting is out of control this week and I don't have the skills to help him. So very high stress level this week".

Parent 3: Jack. Jack is a Canadian English-speaking father who holds a technical diploma and works part-time in IT. His wife is also a French-speaking Canadian, holds an undergraduate degree and works full-time as a daycare operator. Jack reported that they live in a bilingual household and that they have been participating in therapy since September 2018. Jack rated his own technology skill level as advanced and reported having regular access to a TV, Mobile phone, desktop computer, laptop, tablet and a smartwatch. In contrast to Mary and Kate, Jack had no prior access to CentralReach before attending the workshop. Therefore, he predicted that he would be comfortable using a technology-based system and felt it would be an improvement to pen and paper methods.

At the beginning of the workshop, Jack discussed his experience with not having access to CentralReach. He said, "Often I'll get home and my wife will be like you know, how did it go today? And I'll be like, I forgot. Because either I'm stressed, or I'm driving home, or sometimes the educators are like, 'He had a great day, he had a great [day],' and repeating that to me six days in a row. I'm like okay, but I always push a bit [for more information]." This shows the issue with having only verbal feedback from the clinical team. Jack also mentioned the desirability of having a more permanent record of what's going on in the clinic.

Following his formal introduction to the software, Jack reported using CentralReach almost daily. He endorsed that he was comfortable using a technology-based system to monitor

his son's progress and that he felt it was an efficient tool to do so. He equally believed that CentralReach played a role in providing important information about his child's skills to use in the home, helping him conduct formal ABA sessions, promote generalization of skills and make an impact on his child's learning. "I already feel different…I'm excited…yeah, I can't wait to see how he's doing now. It's like, you know now I can, now I have a clearer window, right?" Jack's involvement scores compared to his perceived self-efficacy scores show a slight pattern of increased perceived self-efficacy generally coinciding with increased involvement. In contrast, Jack's stress scores do not follow the same patterns, almost seeming unrelated to his involvement and perceptions of self-efficacy (see Figure 8).

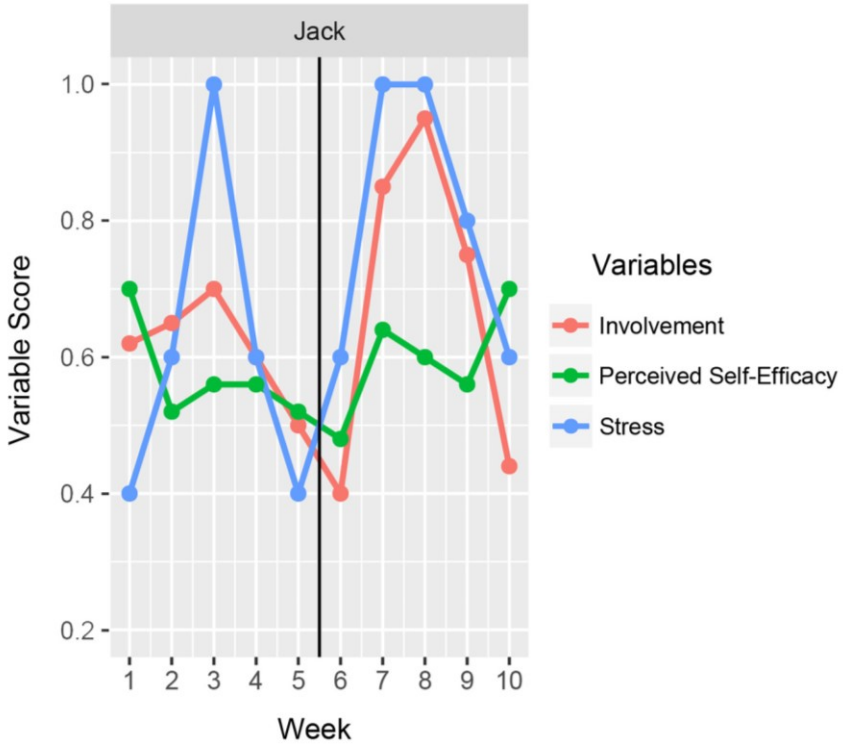

Figure 8. Jack's involvement, perceived self-efficacy and stress over time
Note. The vertical black line represents the CentralReach workshop

Group findings: Involvement in ABA therapy & its factors. While the main findings for parents are descriptive and individual, supplementary analysis of group findings were conducted. There were no statistically significant differences in parent involvement scores before the CentralReach workshop ($M = 0.68$) or after ($M = 0.72$), $T = 75$, $p = 0.85$, $g = 0.20$. Factors such as perceptions of self-efficacy were not significantly correlated to parent involvement prior to CentralReach training, $r = 0.34$, $p = 0.21$ nor after, $r = 0.41$, $p = 0.13$. Similarly, stress was not significantly correlated with parent involvement prior to CentralReach training, $r = -0.49$, $p = 0.07$, nor after, $r = -0.34$, $p = 0.21$. Although statistical significance was not found, the trends that can be observed from the data merit a discussion. The data for involvement, perceptions of self-efficacy and stress over the course of the project for all three parents have been summarized in Figure 9.

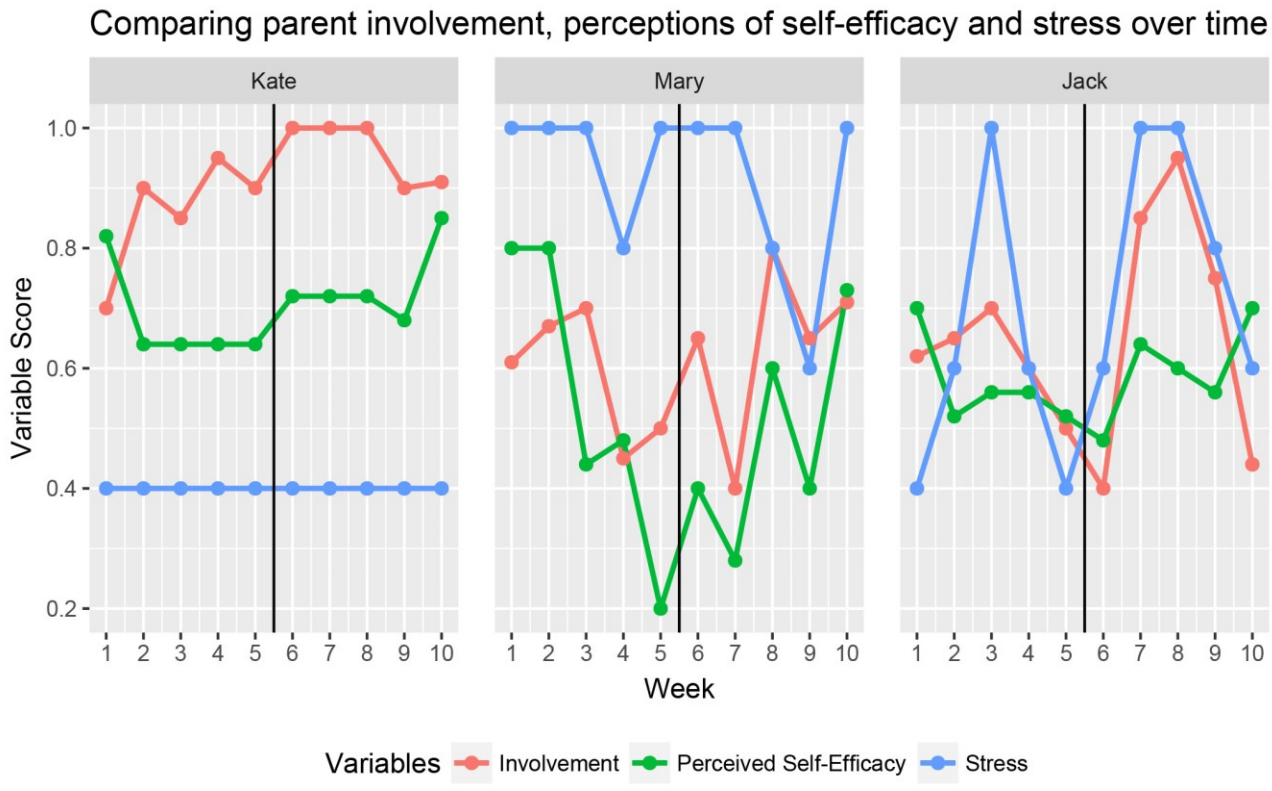

Figure 9. Parent involvement, perceptions of self-efficacy and stress over time.
Note. The vertical black lines represent the CentralReach workshop

Firstly, there was an overall trend towards an increase in involvement following formal training with CentralReach. Evidence found during the qualitative analysis of the CentralReach workshop transcripts described above provides support that the formal training was helpful and could have stimulated more involvement. The qualitative statements also tap in to the workshop possibly helping parents improve their perceptions of self-efficacy; feeling more confident and knowledgeable about understanding the information CentralReach presents and thus more likely to use it. There appears to be a trend that as perceptions of self-efficacy increase, there is an increase in parent involvement as well.

In terms of stress, the results are mixed. For Kate and Jack, stress seemed unrelated, whereas for Mary high levels of stress seemed to coincide with lower levels of perceived self-efficacy and involvement. Results from both the quantitative and qualitative data provide evidence for these varied findings. For example, all three parents reported that they felt starting ABA therapy with their child had an extremely big effect on their stress levels. However, when asked whether any changes in their stress levels were related to their use of CentralReach, Kate and Mary replied no ($N = 2$), with Jack reporting that CentralReach was playing a larger role in his changing stress levels. This variability provides clues that other elements may be at play, such as other commitments or different sources of stress unrelated to their child.

Discussion

Educator Perceived Accuracy and Efficiency of Methods

The first purpose of this project was to explore whether there were significant differences in perceived accuracy and efficiency of data collection and progress monitoring methods between traditional pen and paper methods versus technology-based methods such as CentralReach. In terms of *perceived accuracy*, the results did not show any statistically

significant differences between the two methods. Educators using pen and paper voiced similar concerns to those reported in the literature, that data collection accuracy can be jeopardized when dealing with difficult behaviors of a child or implementing complex protocols that disallow simultaneous data collection (Madsen et al., 2016; Vollmer et al., 2008). The lack of difference in perceived accuracy between methods was similar to the findings of Tarbox and colleagues (2010). Moreover, the researchers noted that the lack of difference seemed to be due to glitches in the system used in their project, where data was being lost through system errors (Tarbox et al., 2010). The similar note from the current findings exemplifies how with any new systems, glitches such as data being lost due to web browsers automatically refreshing, will hinder progress and continuous adaptations need to made in order to ensure systems are working to their maximum potential.

Although no statistical differences were found, the differences in the average perceived accuracy scores merit a discussion. Average perceived accuracy scores were higher for the CentralReach group for both data collection and progress monitoring, indicating a possible trend towards technology-based methods being perceived as more accurate. The calculated effect sizes, $g = 0.53$ and $g = 0.68$, for data collection and progress monitoring methods respectively are considered moderate, and therefore are an indication that future studies with a larger sample size would be of interest to conduct.

The results for *perceived efficiency* showed that educators using CentralReach perceived data collection and progress monitoring methods to be overall more efficient than educators using pen and paper methods. In this case, data collection or progression monitoring being more efficient means that less work from the educator is required to complete each process. When examining *data collection* specifically, the current findings are in contrast to Tarbox and

colleagues' findings (2010) that pen and paper data collection was more efficient. However, a possible explanation is that this discrepancy may exist because the participants in Tarbox et al.'s study were beginner users of the software, whereas the participants in this project were more experienced with the software, and thus possibly more proficient. Additionally, since Tarbox and colleagues' study in 2010, technology has made vast improvements in terms of ease of usage, with individuals also becoming more experienced users of technology overall. The finding of software-based *progression monitoring* trending towards being more efficient than pen and paper methods was in agreement with the findings of Tarbox et al. (2010). The current results also show similarities to the findings of Andersen (2017) who found that educators carrying out data collection and progression monitoring with a tablet software became more efficient with the technology-based method over time. It is important to note that the effect sizes for the difference in perceived efficiency of data collection, $g = 1.01$, and progression monitoring, $g = 0.98$ were large and indicate that a large amount of the change in perceived efficiency was accounted for by the method the educator was using.

Complementary findings. In addition to examining the differences in perceived accuracy and efficiency of the two methods, educators using CentralReach were surveyed to explore whether they felt the software was a significant improvement compared to traditional pen and paper methods. It was found that 50% of the educators strongly agreed, and 30% agreed and 20% somewhat agreed that CentralReach was a significant improvement for data collection, and 40% of the educators strongly agreed that learning to use the software to collect data during therapy sessions was easy. Furthermore, it was reported that 60% strongly agreed, 20% agreed, 10% somewhat agreed and 10% disagreed that CentralReach was a significant improvement compared to pen and paper for progression monitoring. It was also reported that 40% strongly

agreed that learning to use CentralReach for progression monitoring was easy. Therefore, although there remain some improvements to be made to the software and its use in the ABA environment, it appears that the majority of educators prefer the technology-based method to pen and paper.

When comparing educators' perceived technology skill level with their perception of how easy it was to learn the software (see Figure 10), it can be observed that the results generally follow a pattern, with higher perceived technological skill being associated more ease in learning how to use the software. As pen and paper educators had similar perceived technology skill levels, it can be assumed that they would have similar ease with learning how to use the software.

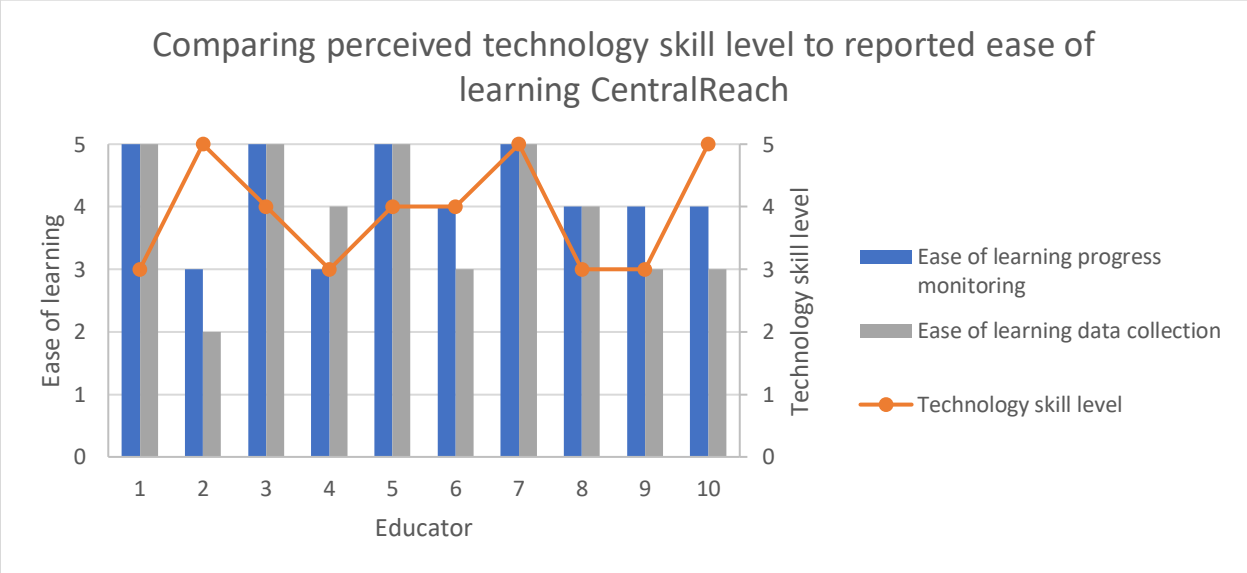

Figure 10. Comparing perceived tech skill level to ease of learning CentralReach
Note: Higher scores represent more of an ease of learning and a higher perceived technology skill level

Parent Perspectives of CentralReach and Involvement in Child's Therapy

The second purpose of this project was to examine whether formal training in how to use CentralReach would have an impact on parent involvement in ABA therapy. The parents' qualitative reports following the workshop showed overall increased enthusiasm, understanding and confidence towards using CentralReach, which may have played a role in their increased involvement.

Closer analysis of parent data indicated that perspectives varied based on the parents' level of comfort using the software and their perceived efficiency of the software. Findings showed that the parent who reported a lower perceived technology level and a higher discomfort using a tech-based software to monitor their child's progression maintained their discomfort even after receiving the formal training. It is interesting to note that this parent was also the most "experienced" parent, i.e. whose child had been participating in therapy the longest. It could be stipulated that perhaps they did not like the software based on the fact that they had been using the traditional methods for some time. This combined with their lower technology skill level could have been some of the factors underlying their dissatisfaction with the software.

Contrastingly, the two other parents showed high satisfaction with the software, reporting they felt that CentralReach was an efficient tool that helped them make an impact on their child's learning. Parents frequent use of CentralReach paired with these perspectives can equally help increase high-quality communication and collaboration with the clinical team, as parents that are more informed about their child's progression have the ability to ask better questions, and give relevant comments pertaining to the home environment. Research surrounding technology-based systems such as *Telehealth,* a software used to model intervention techniques to help parents, show similar results that software can help teach parents skills to improve their child's learning

due to increased accessibility to information about the child's skills and techniques to improve them (Law et al., 2018; Vismara et al., 2012; Wacker et al., 2013). Mainly, the qualitative analysis in the current project revealed how the formal CentralReach workshop helped excite parents about monitoring their child's progression more closely, as well as giving them the confidence to understand and interpret graphical representations of their child's skills and use them in a constructive manner.

Although there were no statistically significant differences in parent involvement in their child's ABA therapy, there was a positive trend towards an increase in involvement at the post-assessment following the CentralReach workshop. It should be noted that the effect size $g = 0.20$ can be considered small, meaning that only a small amount of the variance in involvement was due to the formal training in CentralReach. This is not surprising due to the small sample of observations that were used in the comparison, and it urges future research to use more robust samples in order to attempt to detect a larger effect. Regarding the barriers to involvement, perceptions of self-efficacy were not significantly correlated with involvement scores. However, a pattern emerged where higher perceived self-efficacy scores generally corresponded to higher parent involvement scores. This is similar to Solish and Perry's findings (2008) that perceptions of self-efficacy predicted higher involvement scores.

Results describing parent stress were similar to those in the literature, where it was found that higher stress levels had a negative effect on parent involvement (Osborne, McHugh, Saunders & Reed, 2008; Strauss et al., 2016). Although we can observe that stress had an impact on parent involvement, progression monitoring software may not necessarily be playing a role in alleviating this stress. Moreover, the variability in stress over time in the current project suggests that other factors may be at play that could be affecting parent stress (e.g. work and family

commitments, financial stressors) other than the variables explored in this study. Such can be viewed in conjunction with the statements of Benson (2006) that parents experience compounding stress from different areas of their lives. Consequently, further research exploring more specifically various sources of stress in the population would be of interest to conduct.

Limitations

The study had three main limitations, the first being its sample size. Due to the specific nature of this project, participant recruitment of parents and educators specifically using CentralReach was limited to one clinic that had recently implemented the software. Parents of children with autism are continuously both highly busy as well as in high demand from researchers, making them a difficult population to obtain large samples from in the first place. Research restrictions imposed by the public sector such as lengthy recruitment approval processes also limited the participant recruitment to the one private clinic in order to respect the time-constraints associated with a master's thesis. Although the single-case design allowed for an in-depth analysis of the parents over time, future studies should aim to expand this research with a large sample in order to create more generalizable results.

To add, time is the second limitation of this project. Although the researcher was able to survey parents at 10 different timepoints spanning across two months, it would have been even more favorable to collect parent perspectives over a larger amount of time. Perspectives can sometimes take time to change and develop, and perhaps future studies could look to collect data over a bi-weekly basis in order to capture changes that may take longer to progress. Because of the time constraints of a thesis, the clinics were selected based on the researcher's ability to quickly access them due to already having an established contact with the director. Having more

time to search for additional clinics carrying out ABA therapy either with pen and paper or software-based methods could have potentially allowed for more educators to be recruited.

The third limitation is the researcher bias that could have affected the analysis. Being an ABA educator in the field who is very comfortable with technology, the researcher has had certain experiences with both data collection and progression monitoring as well as with working with parents participating in ABA therapy with their child. Although the researcher attempted to remain as neutral as possible throughout the process, it is possible that some bias may have affected the interpretations and conclusions presented in this study.

Conclusion

Two of the most important components of ABA therapy are having accurate and reliable data about the child and their progression, as well as parent involvement in their child's therapy. The current project aimed to bridge some of the gap that exists in the literature comparing traditional pen and paper methods to modern technology-based methods for data collection and progression monitoring. Similar to the existing literature, educators using pen and paper methods continue to voice how complex protocols and child behavior can hinder data collection accuracy during sessions (Madsen et al., 2016; Vollmer et al., 2008). The educators' perceived accuracy of CentralReach did not differ from the educators' perceived accuracy of pen and paper methods in large part due to glitches that still exist within the software, which was also found in Tarbox and colleagues' work (2010). However, educators using CentralReach did show increased perceived efficiency overall compared to traditional methods, which is an improvement compared to existing findings only showing increased perceived efficiency for progression monitoring (Andersen, 2017; Tarbox et al., 2010). This shows how it provides an attractive alternative to save time both during therapy sessions as well as for monitoring progress. By increasing data

collection and progression monitoring efficiency, educators have more time to devote to the therapy itself, as well as aspects such as training and parent coaching.

Consistent with current research (Solish & Perry, 2008), an analysis of three parent perspectives revealed a trend towards increased parent involvement in therapy following increases in perceived self-efficacy. In contrast to existing studies that show stress has a negative impact on parent involvement (Osborne, McHugh, Saunders & Reed, 2008; Strauss et al., 2016), stress appeared to be an inconsistent influencing variable for the parents in this study, highlighting how future research examining more specific variables and origins of stress is needed. Research shows that high parent involvement in therapy allows parents to extend their child's learning into the home and create more opportunities for learning (Landa et al., 2018; Levy et al., 2006; Ozonoff & Cathcart, 1998; Strauss et al., 2012), Formal training in how to navigate a technology-based progression monitoring tool such as CentralReach gives parents the knowledge and tools they need to get excited and confident about monitoring their child's progression, in turn increasing their perceived self-efficacy and allowing them to become more involved in their child's therapy. Parent and educator reports thus reveal how technology-based software such as CentralReach have the potential to impact multiple elements of therapy at once and elevate its quality to a higher level.

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Appendix A: Parent & Educator Measures

Participant number _____

Parent Involvement Questionnaire

This questionnaire has several different sections. Each section has its own set of instructions. The first section is included to help us to understand the background of individuals who agree to participate in our study. In the case of a two parent family, one person can fill out the information for both partners. If at any point throughout the questionnaire you feel that a question does not apply to you, please feel free to write not applicable (n/a). If you write n/a we would appreciate if you could tell us why the question is not applicable. Feel free to add other comments if you wish.

Date questionnaire completed: _____

- Completed by/relationship to child:
  - ☐ Mother
  - ☐ Father
  - ☐ Female guardian
  - ☐ Male guardian

- What is your family constellation?
  - ☐Married/Common Law
  - ☐Single-Parent
  - ☐Other (e.g., grandparent or other family member living in the house) please describe:

_____

- What is the highest level of education you (and your partner) have completed?

Mother/female guardian	Father/male guardian
□Elementary school	□Elementary school
□Some high school	□Some high school
□High school	□High school
□Some college/university	□Some college/university
□College/technical diploma	□College/technical diploma
□Undergraduate degree	□Undergraduate degree
□Professional/graduate degree	□Professional/graduate degree

- What is your (and your partner's) occupation? (please be specific):

Mother/female guardian _____

Father/male guardian _____

- Do you (and your partner) work outside the home?

Mother/female guardian	Father/male guardian
□ Part-time	□ Part-time
□ Full-time	□ Full-time
□ No paid employment	□ No paid employment

- What is your (and your partner's) country of birth?

Mother/female guardian _____

Father/male guardian _____

- If applicable, what is your (and your partner's) date of entry into Canada?

  Mother/female guardian _____

  Father/male guardian _____

- What is your (and your partner's) first language?

  Mother/female guardian _____

  Father/male guardian _____

- What language(s) do you speak in the home? □ English
  □ English and _____
  □ _____ only

Please indicate the start date of your child's ABA therapy: _____

(DD/MM/YY)

PART I

*For questions **1-7** please indicate how often do you the following things:*

1. Communicate directly with your child's ABA program staff either on the phone or in person.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

2. Read and write in your child's communication book (corresponding with his/her ABA staff.)

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

3. Are updated about your child's progress in their current intervention programs.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

4. Feel you have the necessary information about your child's current skill levels in order to carry out interventions in the home.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

5. Watch your child in therapy sessions.

1	2	3	4	5
never		sometimes (on some occasions)		frequently (on every possible occasion)

6. Attend review meetings and have input into goal setting about your child's ABA program.

1	2	3	4	5
never		sometimes (on some occasions)		frequently (on every possible occasion)

7. Read material and do homework given to you by the ABA staff.

1	2	3	4	5
never		sometimes (on some occasions)		frequently (on every possible occasion)

Formal ABA sessions

*For questions **8-25** please circle the number/statement that is most applicable to you.*

8. To what extent do you do formal ABA sessions with your child? (e.g., trials of imitation tasks, matching and sorting tasks, picture naming, receptive and expressive language skills)

1	2	3	4	5
never		sometimes		frequently

*If never: why not_____

if never (1) skip to question 13

9. How *difficult* do you find it to conduct formal ABA sessions with your child?

1	2	3	4	5
not at all		moderately		extremely

10. How *effective* do you think you are at conducting formal ABA sessions with your child?

1	2	3	4	5
not at all		moderately		extremely

11. How *confident* do you feel conducting formal ABA session with your child?

1	2	3	4	5
not at all		moderately		extremely

12. How much do you feel your involvement in formal ABA sessions with your child *makes a difference* in his/her progress?

1	2	3	4	5
not at all		moderately		extremely

Generalization

13. To what extent do you try to promote generalization of skills your child is learning in ABA in daily life? (e.g. if your child is learning colours in formal ABA sessions, will you take your child to the grocery store and have him/her pick the blue or red item, or ask him/her to choose either the green or orange shirt when he/she is getting dressed)

1	2	3	4	5
never		sometimes		frequently

*If never: why not_____

if never (1) skip to question 18

14. How *difficult* do you find it to promote generalization of skills your child is learning in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

15. How *effective* do you think you are at promoting generalization of skills learned in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

16. How *confident* do you feel promoting generalization of skills into daily life?

1	2	3	4	5
not at all		moderately		extremely

17. How much do you feel your involvement in promoting generalization of skills into daily life *makes a difference* in your child's progress?

1	2	3	4	5
not at all		moderately		extremely

Problem Behaviours

18. If your child has problem behaviours (e.g., tantruming, self-injury, aggression), to what extent do you try to handle them in the same manner as the ABA program staff do?

1	2	3	4	5	n/a
never		sometimes		frequently	

if never (1) skip to question 23

19. How *difficult* do you find it trying to handle problem behaviours in the same manner as the ABA staff do?

1	2	3	4	5
not at all		moderately		extremely

20. How *effective* do you think you are at handling problem behaviours in the same manner as the ABA staff do?

1	2	3	4	5
not at all		moderately		extremely

21. How *confident* do you feel in your ability to handle problem behaviours in the same manner as the ABA staff do?

1	2	3	4	5
not at all		moderately		extremely

22. How much do you feel your involvement in handling problem behaviours in the same way as the ABA staff do *makes a difference* in your child's progress?

1	2	3	4	5
not at all		moderately		extremely

Stress

23. How would you rate your stress level **before** your child started his/her ABA program?

1	2	3	4	5
low		medium		high

24. How would you rate your stress level **now**?

1	2	3	4	5
low		medium		high

25. People's stress levels may change (up or down) for many reasons (e.g., financial problems, death in the family, increase in supports available, exciting child accomplishments). To what extent would you say that your change in stress level, if any, is related to your child's participation in an ABA program?

1	2	3	4	5	n/a
not at all		moderately		extremely	no change

Training

26. *Please check 'yes' for **all** of the educational or ABA training sessions from a) to f) that you have participated in (see options below):*

For the **helpfulness** of training please use the following rating scale:

1	2	3	4	5	n/a
not at all		moderately		extremely	

EXPERIENCES WITH TECHNOLOGY IN ABA THERAPY

For **how often you use** what was learned in training please use the following rating scale:

1	2	3	4	5	n/a
never		sometimes		frequently	

Type of Training	Have you done it?	How **helpful** was the training? (1 = not → 5 =extremely)	How **often do you use** what you learned in training? (1 = never → 5 =frequently)
a) Individual training, coaching, and feedback from your child's ABA program staff	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
b) Attended recommended introductory group training sessions given by your child's ABA service provider	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
c) Behavioural parent training course with other parents and a group leader, other than that given by your child's ABA service provider	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
d) Multiple one day or half day workshops, other than those given by your child's ABA service provider	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
e) Intensive workshops (e.g. 3 days in a row) with an expert in the field (not given by your child's ABA service provider)	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
f) other (please specify)	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a

_____

What additional training or information about ABA do you feel that you **need/want**. Please comment:

_____

_____

_____

PART II

*For questions **27** and **28**, please use the following criteria to rate your child's abilities:*

- 1 (low) = nonverbal and delays in all areas
- 3 (medium) = some language and delays in many areas
- 5 (high) = verbal and some skills on par with children his/her age

27. How would you rate your child's functioning when he/she entered the ABA program?

1	2	3	4	5
low		medium		high

28. How would you rate your child's functioning now?

1	2	3	4	5
low		medium		high

*For questions **29 -33** please circle the number/statement that best corresponds with your child's progress:*

29. How would you rate your child's improvement in **social and play skills** since the ABA program began?

1	2	3	4	5

got worse	no improvement	slightly improved	somewhat improved	substantially improved

30. How would you rate your child's improvement in **academic skills** since the ABA program began?

1	2	3	4	5
got worse	no improvement	slightly improved	somewhat improved	substantially improved

31. How would you rate your child's improvement in **communication skills** since the ABA program began?

1	2	3	4	5
got worse	no improvement	slightly improved	somewhat improved	substantially improved

32. How would you rate your child's improvement in **self-help skills** since the ABA program began?

1	2	3	4	5
got worse	no improvement	slightly improved	somewhat improved	substantially improved

33. How would you rate your child's improvement in **problem behaviours** since the ABA program began?

1	2	3	4	5	n/a
got worse	no improvement	slightly improved	somewhat improved	sustantially improved	child has no behaviours

ABA

*Please circle either "True"(T) or "False"(F) for questions **34-40**. We encourage you to make your best guess, but if you are completely unsure of an answer you may circle "Don't Know"(DK)*

34. After a child has mastered a task with prompting, prompts should be faded

so that the child can eventually demonstrate the skill independently. T F DK

35. In ABA it is often best to teach the child a complex task by breaking it down into parts rather than teaching the task as a whole. T F DK

36. Some research has shown that 10 hours of a ABA a week is just as effective 20 hours per week. T F DK

37. Reinforcement of successive approximations to a desired target behaviour is known as fading. T F DK

38. In ABA, you should not vary the teaching materials or the wording of the instruction because this will just confuse the child. T F DK

39. The following terms are techniques of ABA: Reinforcement, Shaping, Fading, and Prompting. T F DK

40. At the start of therapy most children respond just as well to praise (e.g., someone saying "good job!") as to tangible reinforcers or rewards (e.g., candy). T F DK

Technology Use

*For questions **41 -45** please circle the number/statement that is most applicable to you:*

41. In my household, I have regular access to the following items (select all that apply):
() Tv () Mobile Phone () Computer () Laptop ()Tablet/Ipad ()Smartwatch

42. During a typical week, I use technology:

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

43. I would describe my technology skill level as:

1	2	3	4	5
Low		Intermediate		Advanced

44. I would be comfortable using a technology-based system to communicate with clinical staff about my child's intervention plan

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

45. I believe using a technology-based system to display information about child progression could be a significant improvement to the current methods being used

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

Please provide any additional feedback or comments you may have:

_____
_____
_____
_____

Thank you for taking the time to complete this questionnaire!

Parent [Pre] Weekly Check-in Questionnaire

*For the following questions please indicate how often do you did the following things **this week**:*

Date questionnaire completed: _____

1. Completed by/relationship to child:
   - ☐ Mother
   - ☐ Father
   - ☐ Female guardian
   - ☐ Male guardian

2. Communicated directly with your child's ABA program staff either on the phone or in person.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

3. Read and wrote in your child's communication book (corresponding with his/her ABA staff.)

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

4. Were updated about your child's progress in their current intervention programs.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

5. Felt you have the necessary information about your child's current skill levels in order to carry out interventions in the home.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

6. How *difficult* did you find it to promote generalization of skills your child is learning in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

7. How *effective* did you think you were at promoting generalization of skills learned in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

8. How *confident* did you feel promoting generalization of skills into daily life?

1	2	3	4	5
not at all		moderately		extremely

9. How much do you feel your involvement in promoting generalization of skills into daily life *made a difference* in your child's progress?

1	2	3	4	5
not at all		moderately		extremely

10. How would you rate your stress level **this week**?

1	2	3	4	5
low		medium		high

Thank you for taking the time to complete this questionnaire!

Parent [Post] Weekly Check-in Questionnaire

*For the following questions please indicate how often do you did the following things **this week**:*

Date questionnaire completed: _____

1. Completed by/relationship to child:

- ☐ Mother
- ☐ Father
- ☐ Female guardian
- ☐ Male guardian

2. Communicated directly with your child's ABA program staff either on the phone or in person.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

3. Read and wrote in your child's communication section of **CentralReach** (corresponding with his/her ABA staff.)

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

4. Monitored your child's progress in their current intervention programs through their learning tree.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

5. Felt that **CentralReach** provided you with the necessary information about your child's current skill levels in order to carry out interventions in the home.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

6. How *difficult* did you find it to promote generalization of skills your child is learning in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

7. How *effective* did you think you were at promoting generalization of skills learned in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

8. How *confident* did you feel promoting generalization of skills into daily life?

1	2	3	4	5
not at all		moderately		extremely

9. How much do you feel your involvement in promoting generalization of skills into daily life *made a difference* in your child's progress?

1	2	3	4	5
not at all		moderately		extremely

10. How would you rate your stress level **this week**?

1	2	3	4	5
low		medium		high

Thank you for taking the time to complete this questionnaire!

Participant number _____

Parent [Post] Involvement Questionnaire

This questionnaire has several different sections. Each section has its own set of instructions. In the case of a two parent family, one person can fill out the information for both partners. If at any point throughout the questionnaire you feel that a question does not apply to you, please feel free to write not applicable (n/a). If you write n/a we would appreciate if you could tell us why the question is not applicable. Feel free to add other comments if you wish.

Date questionnaire completed: _____

- Completed by/relationship to child:
  - ☐ Mother
  - ☐ Father
  - ☐ Female guardian
  - ☐ Male guardian

PART I

*For questions **1-7** please indicate how often do you the following things:*

1. Communicate directly with your child's ABA program staff either on the phone or in person.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

2. Read and write in your child's communication section of **CentralReach** (corresponding with his/her ABA staff.)

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

3. Monitor your child's progress in their current intervention programs through their learning tree.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

4. Feel you have the necessary information about your child's current skill levels in order to carry out interventions in the home.

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

5. Watch your child in therapy sessions.

1	2	3	4	5
never		sometimes (on some occasions)		frequently (on every possible occasion)

6. Attend review meetings and have input into goal setting about your child's ABA program.

1	2	3	4	5
never		sometimes (on some occasions)		frequently (on every possible occasion)

7. Read material and do homework given to you by the ABA staff.

1	2	3	4	5
never		sometimes (on some occasions)		frequently (on every possible occasion)

*For questions **8-25** please circle the number/statement that is most applicable to you.*

Formal ABA sessions

8. To what extent do you do formal ABA sessions with your child? (e.g., trials of imitation tasks, matching and sorting tasks, picture naming, receptive and expressive language skills)

1	2	3	4	5
never		sometimes		frequently

*If never: why not_____

if never (1) skip to question 13

9. How *difficult* do you find it to conduct formal ABA sessions with your child?

1	2	3	4	5
not at all		moderately		extremely

10. How *effective* do you think you are at conducting formal ABA sessions with your child?

1	2	3	4	5
not at all		moderately		extremely

11. How *confident* do you feel conducting formal ABA session with your child?

1	2	3	4	5
not at all		moderately		extremely

12. How much do you feel your involvement in formal ABA sessions with your child *makes a difference* in his/her progress?

1	2	3	4	5
not at all		moderately		extremely

Generalization

13. To what extent do you try to promote generalization of skills your child is learning in ABA in daily life? (e.g. if your child is learning colours in formal ABA sessions, will you take your child to the grocery store and have him/her pick the blue or red item, or ask him/her to choose either the green or orange shirt when he/she is getting dressed)

1	2	3	4	5
never		sometimes		frequently

*If never: why not_____

if never (1) skip to question 18

14. How *difficult* do you find it to promote generalization of skills your child is learning in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

15. How *effective* do you think you are at promoting generalization of skills learned in ABA into daily life?

1	2	3	4	5
not at all		moderately		extremely

16. How *confident* do you feel promoting generalization of skills into daily life?

1	2	3	4	5
not at all		moderately		extremely

17. How much do you feel your involvement in promoting generalization of skills into daily life *makes a difference* in your child's progress?

1	2	3	4	5
not at all		moderately		extremely

Problem Behaviours

18. If your child has problem behaviours (e.g., tantruming, self-injury, aggression), to what extent do you try to handle them in the same manner as the ABA program staff do?

1	2	3	4	5	n/a
never		sometimes		frequently	

if never (1) skip to question 23

19. How *difficult* do you find it trying to handle problem behaviours in the same manner as the ABA staff do?

1	2	3	4	5
not at all		moderately		extremely

20. How *effective* do you think you are at handling problem behaviours in the same manner as the ABA staff do?

1	2	3	4	5
not at all		moderately		extremely

21. How *confident* do you feel in your ability to handle problem behaviours in the same manner as the ABA staff do?

1	2	3	4	5
not at all		moderately		extremely

22. How much do you feel your involvement in handling problem behaviours in the same way as the ABA staff do *makes a difference* in your child's progress?

1	2	3	4	5
not at all		moderately		extremely

Stress

23. How would you rate your stress level **before** you started using CentralReach?

1	2	3	4	5
low		medium		high

24. How would you rate your stress level **now**?

1	2	3	4	5
low		medium		high

25. People's stress levels may change (up or down) for many reasons (e.g., financial problems, death in the family, increase in supports available, exciting child accomplishments). To what extent would you say that your change in stress level, if any, is related to your use of **CentralReach**?

1	2	3	4	5	n/a
not at all		moderately		extremely	no change

Training

*26. Please check 'yes' for **all** of the educational or ABA training sessions from a) to f) that you have participated in (see options below):*

EXPERIENCES WITH TECHNOLOGY IN ABA THERAPY

For the **helpfulness** of training please use the following rating scale:

1	2	3	4	5	n/a
not at all		moderately		extremely	

For **how often you use** what was learned in training please use the following rating scale:

1	2	3	4	5	n/a
never		sometimes		frequently	did not

Type of Training	Have you done it?	How **helpful** was the training? (1 = not → 5 =extremely)	How **often do you use** what you learned in training? (1 = never → 5 =frequently)
a) Individual training, coaching, and feedback from your child's ABA program staff	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
b) Attended recommended introductory group training sessions given by your child's ABA service provider	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
c) Behavioural parent training course with other parents and a group leader, other than that given by your child's ABA service provider	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
d) Multiple one day or half day workshops, other than those given by your child's ABA service provider	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a
e) Intensive workshops (e.g. 3 days in a row) with an expert in the field (not given by your child's ABA service provider)	□yes □no	1 2 3 4 5 n/a	1 2 3 4 5 n/a

f) other (please specify)	☐yes ☐no	1 2 3 4 5 n/a	1 2 3 4 5 n/a

_____

What additional training or information about ABA do you feel that you **need/want**. Please comment:

_____

_____

_____

PART II

*For questions **26** and **27**, please use the following criteria to rate your child's abilities:*

- 1 (low) = nonverbal and delays in all areas
- 3 (medium) = some language and delays in many areas
- 5 (high) = verbal and some skills on par with children his/her age

27. How would you rate your child's functioning when he/she entered the ABA program?

1	2	3	4	5
low		medium		high

28. How would you rate your child's functioning now?

1	2	3	4	5
low		medium		high

*For questions **29 -33** please circle the number/statement that best corresponds with your child's progress:*

29. How would you rate your child's improvement in **social and play skills** since the ABA program began?

1	2	3	4	5
got worse	no improvement	slightly improved	somewhat improved	substantially improved

30. How would you rate your child's improvement in **academic skills** since the ABA program began?

1	2	3	4	5
got worse	no improvement	slightly improved	somewhat improved	substantially improved

31. How would you rate your child's improvement in **communication skills** since the ABA program began?

1	2	3	4	5
got worse	no improvement	slightly improved	somewhat improved	substantially improved

32. How would you rate your child's improvement in **self-help skills** since the ABA program began?

1	2	3	4	5
got worse	no improvement	slightly improved	somewhat improved	substantially improved

33. How would you rate your child's improvement in **problem behaviours** since the ABA program began?

1	2	3	4	5	n/a
got worse	no improvement	slightly improved	somewhat improved	sustantially improved	

ABA

*Please circle either "True"(T) or "False"(F) for questions **34-40**. We encourage you to make your best guess, but if you are completely unsure of an answer you may circle "Don't Know"(DK)*

34. After a child has mastered a task with prompting, prompts should be faded so that the child can eventually demonstrate the skill independently. T F DK

35. In ABA it is often best to teach the child a complex task by breaking it down into parts rather than teaching the task as a whole. T F DK

36. Some research has shown that 10 hours of ABA a week is just as effective 20 hours per week. T F DK

37. Reinforcement of successive approximations to a desired target behaviour is known as fading. T F DK

38. In ABA, you should not vary the teaching materials or the wording of the instruction because this will just confuse the child. T F DK

39. The following terms are techniques of ABA: Reinforcement, Shaping, Fading, and Prompting. T F DK

40. At the start of therapy most children respond just as well to praise (e.g., someone saying "good job!") as to tangible reinforcers or rewards (e.g., candy). T F DK

CentralReach Use

*For questions **41 -48** please circle the number/statement that best represents your beliefs:*

41. During a typical week, I use CentralReach:

1	2	3	4	5
never		sometimes (once per week)		frequently (daily)

42. I feel comfortable using a technology-based system to communicate with clinical staff about my child's intervention plan

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

43. I believe using CentralReach is an efficient tool to display information about my child's progression

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

44. I feel **CentralReach** provided me with the necessary information about my child's *current skill level*s in order to carry out interventions in the home

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

45. **CentralReach** played a role in providing me with the knowledge to effectively carry out formal ABA sessions as a parent with my child in the home

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

46. **CentralReach** played a role in providing me as a parent with the knowledge to promote generalization of skills learned in ABA into daily life?

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

47. The information I obtained through **CentralReach** influenced me to seek to additional training in areas I felt my skills were lacking

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

48. **CentralReach** played a role in allowing me to extend my child's intervention training and make a positive impact on their skill acquisition

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

Please provide any additional feedback or comments you may have:

_____
_____
_____
_____

Thank you for taking the time to complete this questionnaire!

Participant code: _____

Educator [Pen & Paper] Questionnaire

Part 1

In this first section we ask to tell you a bit about yourself as an ABA therapist

1. What is your level of experience delivering ABA therapy?
    a. 0-3 year
    b. 3-5 years
    c. 5-7 years
    d. 7+ years

2. Prior to beginning your work as an ABA therapist, what amount of data collection experience did you have?
    a. None
    b. 0-1 year
    c. 1-3 years
    d. 3+ years

3. What is the highest degree or level of school you have completed? (If you are currently enrolled in school, please indicate the highest degree you have received.)

    a. High school
    b. Vocational Degree
    c. Cegep
    d. Some university, no degree
    e. Bachelor's Degree
    f. Master's Degree
    g. PhD
    h. Other: _____

4. What is your age?
    a. 18-24 years old
    b. 25-34 years old
    c. 35-44 years old
    d. 45-54 years old

5. What is your gender?
    a. Male
    b. Female
    c. Other: _____

Part 2

*For the next section, we're going to ask you to think about your experience with pen and paper data collection methods **during therapy sessions**. For questions **6-9** please select the statement that best describes your beliefs*

6. I feel that using pen and paper data collection is an *accurate* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

7. I feel that using pen and paper data collection is an *efficient* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

8. I feel confident about my abilities to take error-free data.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

9. It can be difficult to collect data when implementing complex intervention protocols.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

*For the next section, we're going to ask you to think about your experience with using pen and paper methods **during progress monitoring (graphing) sessions**. For questions **10-12** please select the statement that best describes your beliefs.*

10. I feel that graphing child progression using pen and paper is an *accurate* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

11. I feel that graphing child progression using pen and paper is an *efficient* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

12. I feel confident about my abilities to make error-free graphs, and accurately monitor child progression.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

*For the next section, we're going to ask you to think about how much **time** you devote to certain activities. For questions **13-16** please select the statement that best describes your beliefs.*

13. During a therapy session with a child, I feel I must devote a large amount of time **away from the child** in order to collect data.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

13.1. On average, please estimate how much time you spend **per session** away from the child collecting data: _____ minutes.

14. I often do not have time to monitor child progression during graphing sessions.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

15. Overall, I am satisfied with the amount of time I must devote to collecting data **during therapy sessions.**

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

16. Overall, I am satisfied with the amount of time I have to monitor child progression and skill acquisition.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

Part 3:

*For questions **17-21** please circle the number/statement that is most applicable to you:*

17. In my household, I have regular access to the following items (select all that apply):
() Tv () Mobile/Smart Phone () Computer () Laptop ()Tablet/Ipad ()Smartwatch

18. During a typical day, I use technology:

1	2	3	4	5
never		sometimes (once per day)		frequently (hourly)

19. I would describe my technology skill level as:

1	2	3	4	5
Low		Intermediate		Advanced

*For questions **20-21** please think about your perspectives on technology-based systems. That is, systems that rely on using technology and/or are exclusively available online.*

20. I would be comfortable using a technology-based system to collect data during therapy sessions and monitor child progression.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

21. I believe using a technology-based system to collect data and monitor child progression could be a significant improvement to the current methods being used.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

Please provide any additional feedback or comments you may have:

_____

_____

_____

_____

Thank you for taking the time to complete this questionnaire!

Educator [CentralReach] Questionnaire

Participant code: _____

Part 1

In this first section we ask to tell you a bit about yourself as an ABA therapist

1. What is your level of experience delivering ABA therapy?
    a. 0-3 year
    b. 3-5 years
    c. 5-7 years
    d. 7+ years

2. Prior to beginning your work as an ABA therapist, what amount of data collection experience did you have?
    a. None
    b. 0-1 year
    c. 1-3 years
    d. 3+ years

3. What is the highest degree or level of school you have completed? (If you are currently enrolled in school, please indicate the highest degree you have received.)

    a. High school
    b. Vocational Degree
    c. Cegep
    d. Some university, no degree
    e. Bachelor's Degree
    f. Master's Degree
    g. PhD
    h. Other: _____

4. What is your age?
    a. 18-24 years old
    b. 25-34 years old
    c. 35-44 years old
    d. 45-54 years old

5. What is your gender?
    a. Male
    b. Female
    c. Other: _____

Part 2:

*For questions **6-8** please circle the number/statement that is most applicable to you:*

6. In my household, I have regular access to the following items (select all that apply):

() Tv () Mobile/Smart Phone () Computer () Laptop ()Tablet/Ipad ()Smartwatch

7. During a typical day, I use technology:

1	2	3	4	5
never		sometimes (once per day)		frequently (hourly)

8. I would describe my technology skill level as:

1	2	3	4	5
Low		Intermediate		Advanced

Part 3

*In this section, we're going to ask you to think about your experience with using CentralReach as a data collection method **during therapy sessions**. For questions **9-12** please select the statement that best describes your beliefs*

9. I consider using CentralReach for data collection to be an *accurate* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

10. I consider using CentralReach for data collection to be an *efficient* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

11. I feel confident about my abilities to take error-free data.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

12. It was easy to learn how to use CentralReach as a data collection tool.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

For the next section, we're going to ask you to think about your experience with CentralReach ***during progress monitoring (graphing) sessions****. For questions* ***13-16*** *please select the statement that best describes your beliefs.*

13. I believe that graphing child progression using CentralReach is an *accurate* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

14. I believe that graphing child progression using CentralReach is an *efficient* method.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

15. I feel confident about my abilities to make error-free graphs, and accurately monitor child progression.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

16. It was easy to learn how to use CentralReach as a progress monitoring tool.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

*For the next section, we're going to ask you to think about how much **time** you devote to certain activities now that you use CentralReach. For questions **17-20** please select the statement that best describes your beliefs.*

17. During a therapy session with a child, I feel I must devote a large amount of time away from the child in order to collect data.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

18. I often do not have time to monitor child progression during graphing sessions.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

19. Overall, I am satisfied with the amount of time I must devote to collecting data **during therapy sessions.**

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

20. Overall, I am satisfied with the amount of time I have to monitor child progression and skill acquisition.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

*In the final section, please think back to when you were using the pen and paper methods, and think about how they now compare to Central Reach. For questions **21 &22**, select the statement that best describes your beliefs.*

21. For collecting data during sessions, compared to the pen and paper method CentralReach is a significant improvement overall.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

22. For monitoring and graphing child progression, compared to the pen and paper method CentralReach is a significant improvement overall.

1	2	3	4	5
Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree

Please provide any additional feedback or comments you may have:

_____
_____
_____
_____

Thank you for taking the time to complete this questionnaire!

Appendix B: Equations used for effect size calculations

Cohen's d

$$d = \frac{M_1 - M_2}{\sqrt{\frac{SD_1^2 + SD_2^2}{2}}}$$

Hedge's g correction:

$$g = d\,(1 - \frac{3}{4(n_1 + n_2) - 9})$$

Appendix C: Questionnaire Scoring Breakdown

*Note. Scores outlined below were calculated by summing the Likert-scale responses of the indicated question numbers. *Stared questions were reverse scored.*

Educator Questionnaires

Pen and Paper Group Pre-assessment questionnaire:

- Data collection: Perceived accuracy (#6, 8), Perceived efficiency (# 7, 13*, 15)
- Progression monitoring: Perceived accuracy (#10, 12), Perceived efficiency (#11, 16)

Weekly Check-in questionnaire

- Data collection: Perceived accuracy (#1, 2*), Perceived efficiency (#4)
- Progression monitoring: Perceived accuracy (#3), Perceived efficiency (#5)

CentralReach Group Questionnaire:

- Data collection: Perceived accuracy (# 9, 11), Perceived efficiency (#10, 17, 19)
- Progression monitoring: Perceived accuracy (#13, 15), Perceived efficiency (#14, 18, 20)

Parent Questionnaires

Note. The perspectives of self-efficacy scores were converted to a decimal as a common unit in order to exclusively account for perceived self-efficacy for the items each parent endorsed. The involvement scores were equally converted to a decimal in order to use a common unit for comparison.

Pre-& Post-assessment questionnaires:

- Parent Involvement: Agency involvement (#1-7), Direct involvement (#8, 13, 18), Training involvement (#26 included in pre-assessment only)
- Perspectives of self-efficacy (#9*-12, 14*-17, 19*-22)

Weekly Check-in questionnaires (pre and post):

- Agency involvement (# 1-5)
- Perspectives of self-efficacy (#6*-9)

Appendix D: Educator Transcripts

CentralReach Group

Question: Please provide any feedback you may have

E6 When it comes to collecting cold probe data or graphing and analyzing graphs central reach is more efficient than using paper and pencil. However when it comes to collecting data on mands, high frequency behaviors or duration data it is less efficient. For mands it is easier to have a clicker than to enter every mand on CR and the same applies for high frequency behaviours. For duration, the start timer and stop button are not sensitive enough and when the page refreshes it changes the duration data making it inaccurate. Overall though with the use of clickers and timers CR is a great tool. All the graphs and programs are in one place and easily accessible.

E2 I find Central Reach to be a great method of collecting data, monitoring the child's progress and also communicating with the parents. In addition, I find this software easy to learn and use on the job. The only improvement I would suggest going further is to consider developing an application that doesn't require to use wifi. I find that as a therapist I do visit Daycares and schools and they may not always have wifi or we may be outside and I can't connect to the wifi so my data doesn't graph or I have to take a pen and paper (or if I don't have access to that I have to count the data and remember in my head). Overall, I do think it's a great method used in my practice and I enjoy looking back on the data overtime to see the data collection on the kids I work with.

The implementation of centralreach gave me more time with the child and an easier understanding of their progress!

E3 Central Reach has significant potential for data collection but suffers from many issues. Glitches in the system and a lack of app cause serious issues during sessions. Without an app, we must use a browser and it is constantly refreshing. I have lost data as a result of this. Also, data input is sometimes not clear enough. We do not have options to add pertinent information (e.g for what the child was waiting). The interface is messy, we need a better way to organize the main screen (percentage by opportunity vs probe data should not be displayed the same way). Instructors have little to no opportunity to change the screen so that it works in our favour and it often takes time to find the correct program to input data. Running maintenance programs is not an option as well. Overall, it saves time in terms of graphing but can make individual sessions more frustrating.

Pen and Paper group

Question: What comments do you have about your perceived accuracy and/or efficiency of the data collection methods you use DURING therapy sessions, and during GRAPHING (progression monitoring) sessions?

E1 I find overall the data collection methods are accurate. However, when working with more challenging clients, it is difficult to collect precise data since many behaviours happen and there isn't always the time to write the data down. In addition, some data may be biased depending on an intructor's perception of problem behaviour.

E5 I feel like I am confident in my efficiency with data collection during therapy sessions. However, I personally have issues with collecting accurate data for problematic behaviours - I am always looking for an adequate timer after having misplaced my own and I therefore don't feel confident about my measures of said behavior i.e. duration of episode, etc. Also, as we rely on pen & paper data collection and graphing procedures, the team would definitely benefit from ongoing training and monitoring of data collection to ensure consistency across the team and data integrity.

E3 I find it is overall accurate. We have time to look over and update data in a quiet environment. In addition, we get the support from our coworkers. One default is that, like in everything else, mistakes can be made. If mistakes are made and not found right away, it can skew the data. Another default is that if a child masters an objective on a Monday (and graphing is Friday), that objective won't be updated (considered mastered and a new objective would be put into teaching) until Friday. In this case, we had worked on a mastered objective for a week which can waste time to teach something new.

E1 I would say that I am confident about my graphing skills. However, some of the graphs used at the workplace have an improper axis which can lead to some confusion when plotting and analyzing.

E3 I feel that 'the accuracy' of data collection during therapy sessions really depends on how well the therapist understands the behaviour that is being observed and measured. I feel that sometimes there are variations between therapists in how accurately they report their data and this is mainly because they don't completely understand what behaviour is being observed/measured. I feel that when I first started working as an ABA therapist my accuracy was very poor. I had to learn a lot about the different programs and procedures, and what behaviours were being measured for each child. I think it took me sometime to learn about each child's program and what I was suppose to measure. But now after having spend so much time with each child, I feel that overall I am a lot more accurate and efficient with my data collection during therapy sessions

E5 I feel that overall I am pretty accurate when it comes to calculating and graphing child's progress, and this is mainly because I like to work with numbers! However, I still feel that from time to time I may make some mistakes. I think that if we had computer-based programs for monitoring child's progress it would be a lot faster and more efficient to monitor each child's progress.

Appendix E: CentralReach Workshops – Excerpts from Parent Transcripts

Workshop 1: KATE

Q. How do you feel about it so far?

A: Well I feel like we're communicating, but for the rest I'm a bit confused. I feel like we're using 30 percent of its potential…

Q: how do you find it, viewing it on the tablet so far?

A: I feel like there may some [] compared to the computer

Q: And have you tried it on your phone?

A: No

Q: Use of scheduling feature, something you would be interested in?

A: Yeah

Q: Here we have the learning tree

A: Yeah I never understood how to go in there.

Q: Discussing the targets

A: Could I know which targets...?[child is working on]

Q: Yes

[showing various aspects to program]

P1: we missed out on alot

P2: yeah, well it wasn't 30 percent we knew, it was 5 percent.

Q: feel free to kind of play around with them.

A: Why were we scared about like, erasing stuff

Q: It's kind of, it may, at the beginning I think they had some issues with like, the permissions for the profiles, and I think at the beginning you guys had too much, and I think that's what caused confusion. And now they fixed it.

A: Because the therapists they log in the different

Q: Yeah it looks very similar but they have the ability to enter data. And even the administrators have the ability to edit the programs.

Q: Do you guys feel better?

A: We do. I do.

Q: Yeah, do you feel like you can use it a bit more?

A: yeah.

Q: Yeah, it's interesting. It's all about being able to give you guys more tools at home.

A: I think that what, cause we, when we started here last year. Uh, that wasn't part of the. And then we kind of, I think the transition was bumpy. You know? And then getting used to that, I don't think we ever took the time to just, you know?

Workshop 2: MARY

Q: You have access to this data so you can look at it, see what's going on and also the big part is view the program progression, kind of over time with all those graphs.

A: I think that part is fantastic. That they just put things in right away

Q: yeah, how do you feel about it so far?

A: you know what, like I said, I haven't gone it very often, I just don't have the time. But when I do go, I like to look at my graphs when I understand which ones I'm looking at. (laughs). But you know, and you can see like, because if I'm looking at it day by day, apart from my notes the day by the day graphs tell me nothing.

Q: right

A: because, uh, it doesn't tell me anything. But if I say okay, I'll open up the graph three weeks later, or in a month, well then, I can see that it's either this way, or that way, or that there was a little bit of a dip. Then I can say oh, oh yes. Okay, you know what they're working on something there, let me ask more questions when I see them. And it's like, what's happening with that, or why did we see a spike, and all of a sudden, we see a drop. Or we saw this, or we saw you know? So that's what I like. I like to that, over time…Um yes so that's something that I like about the

program. it's that, you know what, when I do need to know something. Like now our biggest issue with our child is scripting. So, I can go in at one point and see if there's been an increase or a decrease. I see it at home, so I get to see what they see.

Q: they're not using the calendar and scheduling feature right now, but they might be in the future. Would this be something you would be interested in?

A: if I can get it on my phone, then yes. But to go online, no. right, because to go on the computer, if I don't have enough time to check it now, I won't. so I usually just put in my appointments. I know I had to try to use their function of messaging back, or something like that. Sending them a message, and the supervisor never got it. So I don't know what happened.

Q: [discussing descriptions]

A: Here I spoke to her in person, but I was like what's ABC?

Q: [showing feature of zooming in on a specific time point for the graphs]

A: That's pretty cool

Q: the schedule, maybe in the future they're going to integrate it, maybe not? But you said it might be interesting for you especially for on the phone for you to have this information more, readily available?

A: yeah if it was through the phone for sure. On the computer, the thing is I don't go to check enough. If it's easier, of course, if it's easier to go through for sure.

Q: did you have any other questions?

A: no, it was mostly my graphs and understanding those.

Q: How are you feeling now?

A: yeah, no much better.

Q: Better? Good. Yeah, helpful?

A: At least I understand them and I can, I can be more visual and say, oh yeah, and look at them more and say oh yeah it's more of a percentage and that why it looks wonky because I;m thinking the other one is frequency versus that. So I can, I can I can appreciate that and I can understand that. So.

Q: great. I'm glad to hear that.

A: yeah.

Q: did we also want to put it on your phone?

A: oh yeah.

Workshop 3: JACK

Q: Introduction of calender function

A: Yes, I think it would be useful. Because now I'm getting emails, right.

A: Often I'll get home and my wife will be like you know, how did it go today? And I'll be like, I forgot. Because either im stressed, or I'm driving home, or sometimes the educators are like, he had a great day, he had a great. And repeating that to me six days in a row, and I was like okay. I always push a bit.

Q: …Yeah now you have time to go home and

A: have a record of it

Q: What do you think?

A: Maybe an overall graph, kind of like an aggregate. You know that would show, like is he progressing? I don't know. You have to look through a million things and make an assessment. Like a summary? I don't know if you can add that.

Q: I don't know, that's a cool suggestion though.

Q: I'm interested now for this part, to see the difference between how you were feeling before, and now how you're feeling after kind of like, delving into it

A: Oh I already feel different.

Q: Yeah? You already feel better?

A: I'm excited.

Q: That's good

A: yeah, I can't wait to see how he's doing now. It's like, you know now I can, now I have a clearer window, right?

Q: right, yeah. That's what I wanted to do.