

Improving Facial Expression Recognition in Children with Autism Spectrum Disorder:
Effectiveness of a Computer Assisted Intervention

by

Patrick N. Murphy
B.A. (Honours), Bishop's University, 2013

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Supervisory Committee

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Abstract

Evidence suggests that computer assisted interventions (CAI) have advantages over other types of instruction when teaching children with Autism Spectrum Disorder (ASD). A growing number of technology based tools for use in educational settings have been developed to address specific deficits associated with ASD; namely poor facial expression recognition. Given the proliferation of CAIs, there is an urgent need to test their application in real world and clinical settings. Based on previous research on the success of CAIs to support children with ASD in this area, this research was developed as a small scale pilot study to explore the feasibility and potential educational benefits of the relatively new CAI; *Let's Face It! Scrapbook (LFI!)*. This study examined the viability of the *LFI!* program in a clinical setting in which two groups of children with ASD worked one-on-one with behavioural interventionists to develop necessary life skills. The experimental condition (n=3) which received natural environment teaching (NET) of emotions plus *LFI!* exercises performed better on tasks of facial expressions recognition in post-tests than the control condition (n=3) which received only natural environment teaching. Participating behavioural interventionists reporting on their experiences using the app. preferred this method of teaching citing the greater available teaching material, the enriched level of engagement required between client and interventionist, and the fun nature of the program. Though small in nature, the results of this pilot study would suggest that the *LFI!* program is a viable tool for use when training facial expression recognition with clients with ASD in clinical settings.

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Dedication

I am grateful to the staff and management of Stepping Stones Therapy Inc. for all their support. Their dedication to their practice and devotion to teaching children has been a constant source of inspiration that has guided me through my own learning. Their hard work to bring hope to their clients and their families is to be commended. Without them, this project would not have been possible.

Chapter 1

Introduction

The ability to read facial expressions is a required skill for learning (Wass & Porayska-Pomsta, 2013) and successful social interactions (Ploog, Scharf, Nelson & Brooks, 2013) which are associated with positive developmental outcomes (Hartup, 1989). Research shows that children with autism spectrum disorders (ASD) have deficits in their ability to recognize facial expressions in themselves and others (Harms, Martin & Wallace, 2010) which can cause issues in the interpretation of the dynamics of social interactions (Rice, Wall, Fogel & Schi, 2015; Tanaka, Lincoln & Hegg, 2003) potentially resulting in social rejection (Rao, Beidel & Murray, 2008). Social networks are considered to be an important resource in child development (Lev-Wiesel, Sarid & Sternberg, 2012) and adolescents with ASD report wanting more social interaction from their peers (White, Keonig & Scahill, 2007). While it is yet unclear if deficits in facial processing affect social outcomes or social deficits influence emotion recognition (Tell, Davidson & Camras, 2014), the development of social skills help children with ASD integrate into social networks (Webster, Feiler, Webster & Lovell, 2004) and can mollify associated deficits in other areas of their lives (White, Keonig & Scahill, 2007).

As a behavioural interventionist working with children with ASD, how best to teach these skills becomes a daily question. When it comes to autism intervention, early and intense interventions are often recommended (Linstead et al., 2016; McIntyre & Zemantic, 2016) and with current education policies emphasizing high quality education (Odom et al., 2006) I am always considering how best to approach my practice in a way that delivers on both these factors. When working with a child with ASD, I always try to incorporate *fun* with the teaching

material so that the child gets enjoyment out of our interactions while developing life skills. This often requires a consideration of the children themselves and their own interests; what activities do they prefer? Very often, and with increasing frequency, that preferred activity is the use of an electronic device. Children with ASD find electronic devices highly engaging and actually respond better to and prefer computer assisted interventions over traditional styles of teaching (Hetzroni & Tannous, 2004; Odom et al., 2015). The need to deliver efficient intervention and train social skills, starting with recognition of facial expressions in a way that is fun for the child necessitates a consideration of their preferred method of learning. Incorporating a CAI into an emotions training program would have to meet some requirements; it would need to deliver enough exposure of the material that would benefit learning (Linstead et al., 2016) while also being fun, motivating, reinforcing and engaging.

The reasoning to integrate CAI and emotions training is argued with previous research showing that CAIs are highly fitting for children with ASD; addressing deficits identified in traditional styles of teaching (Hertzroni & Tannous, 2004; Pennington, 2010). Their multisensory aspects can increase motivation (Ploog, Scharf, Nelson & Brooks, 2013) are more efficient in presenting material (Odom et al., 2015) and can be highly reinforcing (Pennington, 2010). Several CAIs have even been shown to improve emotion recognition (Rice, Wall, Fogel & Shic, 2015) and social skills (Silver & Oakes, 2001) in children with ASD. Finding a suitable CAI for a younger demographic also required *fun* elements such as games and bright visuals. The iPad app. *Let's Face It! Scrapbook (LFI!)* seemed to meet these requirements, however, being relatively new at the time of this research it was untested in the field. Though promising as a

supplementary tool, *LFI!* like any other intervention strategies must be evaluated (White, Keonig & Scahill, 2007) before being fully incorporated into a curriculum.

This project was designed as a small scale pilot study to test the viability of the *LFI!* app. as a CAI to help teach recognition of facial expressions of emotion in a clinical setting. Because previous research into CAIs and emotions training have been criticized for only using high-intensity or exaggerated expressions in their measures (Smith, Montagne, Perrett, Gill & Gallagher, 2010), this research included training of subtle expressions which are significantly more difficult for children with ASD to recognize (Smith et al., 2010; Tell, Davidson & Camras, 2014). Included in the analyses are the pre- and post-test scores of facial expression recognition and *LFI!* preference, testing how much participants actually enjoyed using this CAI.

Additionally, because educator reports are useful in evaluating a program (White, Keonig & Scahill, 2007), interventionist reports on their experiences implementing this program with participants was also included in the analysis. The viability of *LFI!* in a clinical setting as well as limitations of the program are discussed. As a pilot study, this research cannot be generalized to the broader population, but can instead be considered a first step towards examining the *LFI!* program in its intended area of use. Rather than looking solely at learning outcomes, this project examined the implementation of a CAI as a supplementary tool to learning within the boarder context of an intervention program. With learning outcome scores and through interventionist feedback, a deeper understanding of the value of *LFI!* was brought to light for consideration.

Chapter 2

Literature Review

Autism spectrum disorders

According to the DSM-IV-TR (2000), ASD is a diagnosis that encompasses autistic disorder, Asperger's syndrome and atypical autism (Larcroix, Guidetti, Rogé, & Reilly, 2014). In 2013, with the release of the DSM-V, these diagnoses were merged into a single diagnosis of autism spectrum disorder (APA, 2013). ASD's are pervasive developmental disorders (Wolf et al., 2008) which appear in childhood and include core symptoms in the realms of social communication (APA, 2013; Myers, 2013) and restricted and repetitive behaviours and interests (APA, 2013; Gural & MacKay-Chiddenton, 2016). Furthermore, in order for a diagnosis to be made, three other criteria must also be met: a lack of social and emotional reciprocity (APA, 2013, Hallahan, Kauffman, McIntyre, & Mykota, 2010; Rice, Wall, Fogel, & Shic, 2015) which includes deficits in processing of emotional information (Larcroix et al., 2014), impaired non-verbal communication, and difficulty developing and maintaining relationships (APA, 2013). The DSM-5 (2013) diagnosis also specifies ASD with or without accompanying structural language impairments as individuals on the spectrum can also show deficits in verbal communication. Though these are the most characteristic features of ASD, a range of other associated symptoms can be seen across the spectrum (Schultz, 2005; Wolf et al., 2008) with DSM-5 specifiers replacing the old separate diagnoses.

Symptoms of ASD can be detected as young as three years old (APA, 2013; Santrock, 2012) usually by an inattention to the faces of others (Dalton et al., 2005) and a lack of

engagement in social behaviour typical for their age (APA, 2013). A steady decline of eye fixation in early infancy has been witnessed in children later diagnosed, but not typically developing (TD) counterparts. This decline, seen from the ages of 2 to 6 is the earliest known predictor of ASD and other social deficits (Warren & Klin, 2013). It is estimated that 1 percent of both U.S. and non-U.S populations has an ASD. With 1 in 200 children being diagnosed rates are on the rise in many Western countries (Gural & MacKay-Chiddenton, 2016). Though the argument for environmental factors as an influence still has its supporters (Myers, 2013), there is strong evidence that ASD's are heavily influenced by genetic factors (Bölte & Poustka, 2003; Neves et al., 2013; Santrock, 2012) with anywhere from 300-500 genes influencing etiology (Warren & Klin, 2013). The probability of being diagnosed increases 50-200 times when an immediate relation also has ASD (Hallahan et al., 2010). Twin studies report a likely diagnosis between 50-70% for the second twin if one is already diagnosed (Myers, 2013). Even without a diagnosis, family members of those with ASD are more likely to exhibit autistic-like characteristics at a subclinical level (Hallahan et al., 2010; Neves et al., 2011). One study found that the biological parents of children with ASD perform more poorly in areas of deficit common to ASD when they had more children with a diagnosis, suggesting a stronger genetic component (Bölte & Poustka, 2003). Along with robust evidence of genetic factors, research has shown a significant role of neurology and the development of brain growth, organization and function (Hallahan et al, 2010; Wolf et al., 2008).

Biological Markers

Among possible causes of ASD, there is the strongest evidence of biological markers as causes of ASD (Anderson, 2009, as cited in Santrock, 2012). The major brain structures

concerned in the social impairments are the prefrontal cortex, the amygdala and the fusiform gyrus (FG) (Hallahan et al., 2010; Rogers & Dawson, 2010; Schultz, 2005). Together these structures form the social brain network (SBN) which is active when processing social and emotional information and behaviour (Rogers & Dawson, 2010). The FG specializes in face perception (Dalton et al., 2005) and is responsible for recognition of facial expressions and identities (Schultz, 2005; Kanwisher, McDermott, & Chun, 1997, as cited in Tanaka & Sung, 2015) while the amygdala assigns emotional value to the stimuli (Rogers & Dawson, 2015; Tanaka & Sung, 2015). The SBN of individuals with ASD show atypical functioning while damage to these structures in TD individuals result in abnormal social behaviour (Rogers & Dawson, 2015).

In TD persons, activity in the FG increases when shown facial stimuli (Schultz, 2005), however, this is not so in individuals with ASD (Tanaka & Sung, 2015). Dalton et al., (2005) examined both ASD and TD groups under an MRI while they were asked to look at photos of human faces. In both groups, the FG showed greater activation when participants were asked to look at the eyes of the face in the photo. The researchers conjectured that hypo-activation of the FG in ASD was due to differences in facial scanning in which they naturally avoid looking at the eyes. Utilizing eye-avoidance facial scanning techniques means the FG is not appropriately activated when processing faces (Bölte et al., 2006). Eye-avoidance, the hall-mark symptom of ASD (Warren & Klin, 2013) is referred to as the eye-avoidance hypothesis which proposes that for individuals with ASD, eye-contact is perceived as socially threatening resulting in a heightened physiological response (Tanaka & Sung, 2015) as measured by activity in the amygdala (Dalton et al., 2005). A TD amygdala shows increased activation when eye-contact is

made (Kliemann, Dziobek, Hatri, Baudewig, & Heekeren, 2012) as it places emotional value on the facial stimuli (Rogers & Dawson, 2010). However, in people with ASD, this response is associated with an even greater level of activation than seen in TD counterparts (Dalton et al., 2005; Kliemann et al., 2012).

In their 2005 study on gaze fixation, Dalton et al. (2005) found that over arousal of the amygdala in the ASD group was associated with longer periods of eye contact. Consistent with the eye-avoidance hypothesis, these researchers suggested that the negative state of arousal brought on by eye gaze results in the tendency of eye aversion seen in the ASD population to mollify the negative physiological response (Dalton et al., 2005; Kliemann et al., 2012). The associated negative physiological reaction makes looking at faces less intrinsically rewarding or motivating (Young & Posselt, 2012). The resulting lack of eye-contact then decreases activity in the FG when processing facial stimuli (Schultz, 2005). The neurological abnormalities in the brain that contribute to eye and face avoidance means the development and achievement of typical social milestones are delayed (Dalton et al., 2005; Rogers & Dawson, 2010) which further contribute to the characteristic social deficits of ASD (Williams, Gray, & Tongue, 2012; Young & Posselt, 2012).

Social deficits of ASD

The eye region is essential for processing of both identity and emotional expression (Tanaka & Sung, 2015). When tasked with recognizing identity or emotional expression a typically developing person will fixate their gaze just below the eye region (Peterson & Eckstein, 2011, as cited in Tanaka & Sung, 2015) and research shows greater disruptions to these tasks when the eyes and eyebrows are concealed (Sekuler, Gaspar, Gold, & Bennett, 2004, as cited in

Tanaka & Sung, 2015). The innate aversion to attending to this area in individuals with ASD (Halliday, MacDonald, Sherf, & Tanaka, 2014; Tanaka et al., 2010) subsequently leads to a lack of experience and exposure to various facial expressions (Harms, Martin & Wallace, 2010). This causes problems in the recognition of both facial identity and expression (Baron-Cohen, Wheelwright, & Jolliffe, 1997; Neves et al., 2011; Rice et al., 2015). This is thought to be the underlying factor that contributes to the overall social deficits of ASD (Silver & Oakes, 2001; Williams, et al., 2012) appearing as challenges in the realms of communication, social interaction and social reciprocity (APA, 2013; Neves et al., 2011). While the manifestation of symptoms varies greatly across each individual (APA, 2013), social deficits often include a lack of eye contact (Hallahan et al., 2010; Schultz, 2005), use of facial expressions, interest in others and overall poor ability to read social cues (APA, 2013). These impairments, along with an associated aversion to social interaction (Hallahan et al., 2010) can negatively impact the day to day life of people with ASD (APA, 2013; Ramdoss et al., 2012).

Sachse et al., (2014) compared facial expression recognition (FER) abilities of individuals with ASD and schizophrenia (SZ) who show similarities in both symptoms of eye-avoidance and possible biological causes. Their findings showed that although the ASD group showed impaired recognition of both basic and complex emotions, the SZ group was comparable to the TD controls. A possible explanation for this difference despite the similarities between the groups is the differing age of onset for their conditions. While SZ typically shows onset in the late teenage years, ASD is present from birth (APA, 2013) indicating that symptoms of eye-avoidance from a young age has developmental consequences on facial recognition skills (Sachse et al., 2014).

Though some studies examining the relationship between ASD and emotion recognition yield contradictory findings (Harms et al., 2010; Ramdoss et al., 2012), the preponderance of evidence points to a significant association (APA, 2013; Bölte et al., 2006; Myers, 2013; Larcroix et al., 2014). The conflicting findings of whether children with ASD do indeed show deficits in identity and expression recognition is likely the result of the variation seen within this diagnosis (Willson, Brock & Palermo, 2010). However, research against the association for expression recognition have used high-intensity expressions (extreme emotional expressions) in their measures (Smith et al., 2010). To date, few studies researching FER skills in children with ASD have included low-intensity expressions (subtle emotional expressions) in their testing (Tell, Davidson, & Camras, 2014). To address this gap in the research, Smith et al., (2010) conducted an emotion recognition study that compared children with ASD to TD controls on their ability to recognize emotional expression across three levels of intensity; low, medium and high. Their results showed that children with ASD displayed significant recognition deficits for low intensity expressions of disgust, surprise and anger, medium intensity expressions of disgust and anger and high intensity expressions of disgust. These results indicate that while high intensity expressions are easily recognizable to children with ASD, significant difficulty is experienced when judging low and medium intensity.

Biological abnormalities present from birth (Sachse et al., 2014) decrease eye-contact throughout development (Young & Posselt, 2012) reducing children with ASD's exposure to facial stimuli. The lack of facial experience causes the impairment of facial processing skills essential for the recognition of identity (Wilson, Brock & Palermo, 2010) and expression (Sachse et al., 2014). The impaired ability to recognize facial expressions at lower intensities (Smith et

al., 2010) is further associated with greater deficits in social interactions (Williams & Gray, 2012). This negatively impacts social-development (Gural & MacKay-Chiddenton, 2016) as can be seen in the lower frequency and poorer quality of social interactions of children with ASD (Williams & Gray, 2012). These deficits contribute to the difficulty experienced in developing and maintaining relationships (Brown & Faragher, 2014; Schultz, 2005) which can lead to isolation.

Children with ASD have pronounced difficulties in recognizing the emotions of others, and consequently show impairments in attributing mental states to others (Myers, 2013; Rice et al., 2015). This ability, known as the theory of mind (TOM) (Baron-Cohen, Golan, & Ashwin, 2009; Young & Posselt, 2012) is the capability to not only recognize the mental states and emotions of others but also to respond to them appropriately (Baron-Cohen et al., 2009; Hallahan et al., 2010). Impaired language and executive functioning skills associated with ASD (APA, 2013) further weaken an understanding of TOM (Kimhi, 2014) and the poor development of FER in early childhood (Sachse et al., 2014) hinders the ability to express emotions, exacerbating the difficulties they experience in social interactions (APA, 2013; Golan, Ashwin, Granader, McClintock, Day, Leggett, & Baron-Cohen, 2009). Both the reading and expression of facial language is crucial for successful social interaction and the development of social skills (Lacroix et al., 2014). Without intervention, the deficits described can result in social rejection and isolation, poor academic and occupational achievement and other mental health problems (Ramdoss et al., 2012). Given the importance of the contribution of facial expression and emotion recognition in the development of TOM and social skills (Golan et al., 2009; Silver &

Oakes, 2001; Williams, et al., 2012), the question of whether children with ASD can be taught more effective facial expression recognition skills is of considerable importance.

Computer assisted interventions

With the abundance of research detailing the deficits associated with ASD and the importance of early learning, research into how best to teach essential skills has developed. One method of teaching that has become the focus of much research to address children with ASDs unresponsiveness to traditional methods (Ramdoss et al., 2011; Whalen et al., 2010) is CAI. A diverse number of CAIs have been successful in improving facial recognition, spatial orientation and planning, vocabulary, reading and speech (Grynszpan, Weiss, Perez-Diaz, & Gal, 2013). Computer technology, no longer limited to desktop computers, now includes a variety of devices from laptops to tablets to smartphones (Sansosti, Doolan, Remaklus, Krupko, & Sansosti, 2015) all of which can be productively integrated into teaching curriculum and intervention to facilitate learning. The dynamic visuals offered by computer technology have been found to be highly appealing to children with ASD (Wetherby & Priznat, 2000; Whalen et al., 2010) so much so that intervention and teaching strategies that incorporate these methods are considered by many to be best practice (Sansosti et al., 2015). This preference towards computer based instruction (Bölte et al., 2006; Shane & Albert, 2008; Silver & Oakes, 2001; Wass & Porayska-Pomsta, 2013) was demonstrated by Moore and Calvert (2000) who found that children with ASD pay more attention to computer instruction than regular teacher instruction.

The use of computers as a medium for interventions is on the rise (Whalen et al., 2010). Despite the absence of a strong research foundation for CAIs (Grynszpan et al., 2013; Sansosti

et al., 2015) several effective CAIs have been developed for teaching children with ASD a variety of skills including object labeling, literacy, and social skills (Sansosti et al., 2015; Whalen et al., 2010). CAIs can address many of the concerns seen in traditional teaching methods. Many children with ASD are easily sidetracked by irrelevant stimuli (Quill, 1997). Computer screens can reduce distraction by displaying only relevant information (Grynszpan et al., 2013; Silver & Oakes, 2001) while at the same time remaining engaging and motivating by incorporating sound effects and graphics that help processing (Ramdoss et al., 2012; Rice et al., 2015). CAI's also provide consistent and predictable stimuli, well defined expectations and require reduced social demands, all of which are more attractive to these young learners (Grynszpan et al., 2013; Silver & Oakes, 2001). These programs also have the added capability of being able to be tailored to the unique requirements of the individual's interventions (Rice et al., 2015; Wass & Porayska-Pomsta, 2013). Children with ASD show greater benefits from well structured, individualized intervention (Hallahan, Llyoyd, Kaufmann, Weiss, & Martinez, 2005, as cited in Hallahan et al., 2010) which is addressed in the form of CAI.

There is a growing number of CAIs created with the goal of enhancing FER in children with ASD (Grynszpan, et al., 2013; Sung, et al., 2015). In recent years several CAIs have demonstrated their effectiveness in yielding improvements in the processing of facial expressions with children with ASD (Rice et al., 2015). CAIs for emotion recognition teaching has taken many forms in recent years, from DVDs (Golan et al., 2009) to computer programs and interactive games (Rice et al., 2015). One such program known as 'The Transporters' was developed to enhance emotional understanding by creating a cast of characters that are highly appealing to children with ASD (Baron-Cohen et al., 2009). As an example of CAI's ability to be

tailored to the interests of targeted demographics, the characters of this series had human faces which the children would naturally avoid looking at, however, to increase motivation to attend to them, the characters were developed as vehicles which are more appealing to children with ASD (McArthur, 2007). The series includes fifteen five minute episodes that explore a different basic or complex emotion. In the original study, the researchers sent copies of the program home with families and instructed parents to allow their children to watch at least three episodes a day for four weeks. The FER tasks on which they were assessed after viewing showed significant improvements for the experimental group but not for the control which were instead given episodes of Thomas the tank engine (Golan et al., 2009). Other studies examining The Transporters effectiveness found that the program was effective for enhancing FER in high functioning ASD groups (Young & Posselt, 2012) but not for lower functioning groups (Williams et al., 2012).

Research suggests that computer based programs are more motivating than a television series, showing that children prefer mediums with higher interactive properties (Silver & Oakes, 2001). In their research, Silver and Oakes (2001) tested the effectiveness of the computer program 'Emotion Trainer' on its success as an educational tool. Divided into two groups of twelve, the subjects were instructed in the use of the program over ten sessions as the experimental condition while the control group went through normal school lessons. The content of the Emotion Trainer program revolved around teaching the user to recognize emotional expressions, emotionally arousing situations, emotions tied to mental state, and emotional reactions based on the outcomes of choices. Though the program involved a simple point and click interface, it was reported that participants were motivated enough to go

through the computer program more than the required amount. On all tasks of emotion recognition, the experimental group showed significant positive changes from time one to time two while no changes were observed in the control group. These findings highlight the motivational and educational benefits of interactive computer assisted intervention programs.

Yet another innovative computer based program that has yielded positive results is the 'Let's Face It!' intervention (Tanaka et al., 2010). The Let's Face It! program integrates seven games designed around a theoretical hierarchy of facial processing to skills (Tanaka, Lincoln & Hegg, 2003) such as eye contact, facial identity recognition and holistic face perception. Organized into three domains, the hierarchical model describes fundamental face processing abilities:

Domain I: The ability to attend to and process faces.

Domain II: The ability to recognize facial identity (IIa) and facial expressions (IIb).

Domain III: The interpretation of social cues to communicate ideas and emotions in context.

The success of each of the domains is dependent on the mastery of the ones that come before it. In their study, forty-two participants were given copies of the Let's Face it! game to use at home and were allowed to progress through the levels at their own pace. Once each participant had completed twenty hours of gameplay, they were assessed on their facial processing abilities which were compared to pre-intervention scores. The researchers found that twenty hours of training was enough to show improvements in the processing skills of children with ASD.

Recently, the Let's Face It! program has moved from the computer, to the iPad medium in the form of a free downloadable application. The newest incarnation of Let's Face It! known as '*Let's Face It! Scrapbook*' (*LFI!*) has evolved to be more flexible and dynamic in its potential applications. While other programs are presented in passive mediums such as television series or use pre-programed facial stimuli that do not exist in the user's social world, *LFI!* requires the involvement of the user at every stage. *LFI!* enables users to customize the material presented by allowing them to take photos of stimuli in their social environments. The use of familiar faces makes the learning of the content recognizable, relatable and relevant to the user. Though the *LFI!* Scrapbook app has many potential applications to teaching, interventions targeting facial processing are at the forefront of its design.

Built into the app are four teaching programs disguised as games, making the teaching that occurs diverse and multimodal. *LFI!* Scrapbook incorporates key elements for successful teaching with children with ASD; repetition, predictability, slow progression towards more difficult tasks and interaction from the user (Rice et al., 2015; Silver & Oakes, 2001). The client is also given the option to keep track of high scores which serve to motivate progression and learning (Wass & Porayska-Pomsta, 2013). In most cases, the best results of CAI programs are seen when used in conjunction with one-on-one interactions with teachers or parents (Silver & Oakes, 2001; Wass & Porayska-Pomsta, 2013). As with the original Let's Face It! program (Tanaka et al., 2010), *LFI!* Scrapbook is also intended for use as a tool in tandem with one-on-one intervention. Though promising, *LFI!* Scrapbook's efficiency as a tool for teaching FER in children with ASD had yet to be tested.

Role of the Interventionist

It is important for the healthy development of the child to form relationships with their care givers (Santos & Levitt, 2007; Shimoni & Baxter, 2014), few more important than those with their therapists (Rait, 2000) or interventionists who are especially capable of assisting development (Rose, 2006). Therapists rely heavily on the relationships they form with their clients (Rait, 2000; Shimoni & Baxter, 2014) and the success of any session is dependent on the flexibility shown by both parties (Myers, Spencer, & Jordan, 2012; Simon, 2012). While therapists focus on therapeutic concerns and care-givers on engagement and healthy development, the role of the interventionist encompasses responsibilities associated with both of these roles. As an interventionist my responsibilities are a meeting place of these two roles where I must engage with clients with a balance of therapeutic responsibility, healthy development and play. Such a balancing act is not as easy as it sounds, for while each of these aspects can be displayed separately, to merge them together, to blend play, therapy and development is a difficult task. Yet, an interventionist practiced in this skill will not help their client meet with success if they disregard their relationship with their client.

Even experienced interventionists who have developed strong rapport with their clients can be faced with problem behaviours that interfere with the delivery of a program. However, Kodak, Fisher, Clements and Bouxsein (2011) report that the implementation of CAI is associated with a decrease in negative behaviours. The ability to draw on such a potentially motivating tool can have a drastic impact on the learner. Though they describe that even inexperienced interventionists quickly learn to implement CAI programs with 90 – 100% accuracy it is not enough simply to rely on technology. To implement an intervention with a

client is to get to learn about them; their motivators, their feelings, and their responses to the material. In the same way, the client learns about the interventionist and a relationship is formed.

Whatever the type of intervention, be it a curriculum, a technology based tool or toys, the interventionist will judge its performance not merely on outcome learning, but also its ease of implementation, its efficiency and how it impacts the relationship with the client. As school and clinical settings alike are seeking out CAI (Whalen et al., 2010), this method of teaching is becoming more wide spread (Sansosti et al., 2015, Whalen et al., 2010) with evidence pointing towards a benefit to teaching (Golan et al., 2009). However, most studies that examine CAI, focus primarily on terms of outcome results with few having examined the use of CAI from the perspective of interventionists working on the front lines with these programs.

Rationale for Current Research

The argument for the importance of early and intensive intervention for children with ASD can be made by examining the outcomes. Once a diagnosis is suspected, intervention is recommended to start immediately (McIntyre & Zemantic, 2016). Though there are many approaches to intervention with children with ASD, those using applied behavioural analysis, which is eclectic in its approaches (Downs & Downs, 2010), yield the strongest evidence for positive outcomes (Odom, Boyd, Hall & Hume, 2010). Early intervention is associated with gains in IQ, functioning, language and social interactions (Warren et al., 2011) with more positive effects seen in children who receive more intensive therapy from a younger age (McIntyre & Zemantic, 2016).

Children under six years of age receive twenty-two thousand dollars a year from the government of British Columbia to put towards intervention strategies. However, once a child turns six, that funding is cut to six thousand dollars a year (Province of British Columbia, 2017). The reasoning for this funding reduction is that when children with ASD start attending school, the education system becomes their primary service provider (Brookman-Frazee, Baker-Ericzén, Stahmer, Mandell & Haine, 2009) and thus benefit from in-school programs and services (Province of British Columbia, 2017).

As a behavioural interventionist working with young children with ASD, I have seen several cases in which the child's funding is reduced due to their age. This results in children who desperately need intensive intervention services coming for therapy sessions once a week rather than three or four times a week. The time and funding that children under six have in which to learn important life skills before they attend school is incredibly vital. One area of critical importance to teach during the early years are social skills (Rao, Beidel & Murray, 2008). Children with ASD experience difficulty interpreting social cues (Weiss & Harris, 2001) causing significant problems in their relationships and peer rejection (Church, Alisanski & Amanullah, 2000; as cited in Rao, Beidel & Murray, 2008), thus it is important to begin social skill development as early as possible. Yet, I've often witnessed children making this transition to school settings without the essential skills to function socially. How then, do we best use the time they have to maximize their learning of these skills?

As discussed earlier, there are many stages and aspects of social skills (Tanaka et al., 2010) that must be taken into consideration. One such aspect is the training of emotion recognition, which is a program in and of itself that is essential to mollify social deficits that can

persist into adult hood (Rao, Beidel & Murray, 2008). Working to teach clients on the spectrum to identify and recognize facial expressions of emotions, I try to maintain a degree of flexibility in sessions. Every child, with a diagnosis of ASD or TD, are all different in their learning and each require individualised services and supports for the best outcomes (Iovannone, Dunlap, Huber & Kincaid, 2003). Thus, I find it necessary as an interventionist, to be constantly on the look out for new methods and mediums for teaching with my clients these skills.

Having a strong relationship with the client is essential for fostering positive change and learning (Mahoney, 2006; Rayment, 2006) and critical when implementing new methods of teaching. Knowing that many of the children I work with prefer activities that are engaging, colourful and repetitive led me to explore the option of training emotion recognition skills via the iPad. The *LFI!* Scrapbook app. seemed to meet all the criteria; engaging, colourful, sound effects, personalization, a diversity of games and a flexibility to be tailored for use in different ways depending on the curriculum. The iPad medium of the program was also so drastically different from the typical natural environment teaching programs of emotion recognition I had used previously that I hoped it would bring a new enthusiasm and motivational drive from the clients.

Though it is important to test new methods of teaching, simply introducing a program without empirical evidence to support it is not considered best-practice. Thus, to assess the potential of the *LFI!* Scrapbook app., a small scale pilot test using the program as a supplementary tool in teaching FER was conducted at Stepping Stones Therapy Inc., Victoria. The potential of the program as a teaching tool with children with ASD was examined with the help of the interventionists employed at Stepping Stones. Their experiences using the app. in

their daily sessions with their clients was also investigated to unveil another aspect of program implementation. Overall, this research examined one of the many possible uses of *LFI!* in the context of a program as a whole; examining not only learning outcomes, but also the perspectives of the interventionists on the front lines of therapy.

Chapter 3

Methodology

Research Questions. The goal of this research was to test the potential of the *LFI!* Scrapbook app (see Appendix 1) as a supplementary tool to be used with the existing emotions training curriculum of a therapy center dedicated to providing intensive behavioural therapy for children with autism spectrum disorders. With the current emotions training program at Stepping Stones, high intensity or exaggerated facial expressions are used in teaching, which neglects the child's learning of the full range of emotional expression. This research in part sought to test if *LFI!* could enhance children's recognition of emotions across a greater array of intensities compared to natural environment teaching (NET) on its own. It also sought to gather insight into how interventionists perceived using *LFI!* as a complimentary tool to their daily intervention sessions while following the curriculum developed for this project.

The research questions within this study relate to the *LFI!* program as a whole; its educational potential, its appeal to its target demographic and its standing as a supplementary program to be used by interventionists. Is the training of emotion recognition enhanced when using *LFI!* as a supplementary tool to NET of emotions? Do children with ASD enjoy using *LFI!* over other preferred activities? How do interventionists regard use of a CAI in their daily emotions training with children with ASD?

Setting. Stepping Stones Children's Therapy Center in Victoria British Columbia, generously made its site and resources available to this study. Stepping Stones, drawing from applied behavioural analysis (ABA), provides children diagnosed with ASD one-on-one therapy sessions with trained behavioural interventionists. The most successful methods for treating

children with ASD are based off of behavioural theories (Steele, Elkin & Roberts, 2008), of which, ABA is one of the most recognized and effective (Gural & MacKay-Chiddenton, 2016). Using knowledge about behaviour and learning (Fisher, Piazza, & Roane, 2011), ABA uses patient observations to assess functional behaviour which are then used to formulate intervention plans that target the development of verbal, motor and social behaviours (Steele et al., 2008).

The Verbal Behavioural Milestones Assessment and Placement Program, the Denver Model and the Assessment of Basic Learning and Language Skills programs are practiced at Stepping Stones to teach a variety of skills in developmental sequence (Foran et al., 2015), from following instructions, to making eye contact in interactions, to play skills and language. Many of these learning opportunities take place through NET in which the motivation and interest of the moment are used to facilitate learning (Rogers & Dawson, 2010). The goal of ABA approaches is to use the most discreet prompt possible to elicit the desired behaviour from the child, then positively reinforce said behaviour (Foran et al., 2015; Myers, 2013). Typically, the positive reinforcements used at Stepping Stones are preferred toys or activities and social praise.

During a given session at Stepping Stones, there can be between six to eight other children at the center, each working with their own behavioural interventionist (BI). This environment provides the clients with individualized support while allowing for learning to occur in social interactions with their peers. These interactions help the children build a framework on which to base their future interactions with others outside of the clinical setting.

Through NET and with the support of their BI's the clients at Stepping Stones are taught skills and tools essential for their development that will assist them throughout their lives.

Participants and consent. The nature of this research necessitated a purposive sample; one in which all participants involved share a common experience (Kruger, 1988) or in this case, a common diagnosis of ASD. As this research was designed to better understand teaching methods with children with ASD, purposive sampling was essential “to ensure that certain types of individuals (...) displaying certain attributes are included in the study” (Berg & Lune, 2012, p. 52). The participants in this study were eight clients at Stepping Stones who had been referred to the centre with a diagnosis of ASD by the Vancouver Island Children’s Assessment Network which adheres to standards of assessment established by the government of British Columbia (Dua, 2003). Though this organization conducts assessments with standardized tools such as the childhood autism rating scale, the autism diagnostic observation schedule, and the autism diagnostic interview to assess social and communicative behaviour, the particular assessments for each participant were not available. The participants were between the ages of three and seven and were considered a potential participant if they required an emotions learning program as decided by the lead Board Certified Behaviour Analyst (BCBA) at Stepping Stones. Clients who had previously completed the emotions program were also considered for the study to enhance their sensitivity to emotional expressions. The Stepping Stones BCBA was responsible for third party recruitment of potential participants. Prior to the commencement of the intervention, two of the participants turned six and their funding to attend therapy was reduced. Their sessions were cut from twice a week to once a week and because the nature of the intervention was to host two sessions of *LFI!* each week it was necessary to remove those

two participants from the study. Other participants who were six or above received private funding in addition to government funding, allowing them to attend twice a week. The final pool of participants consisted of six children aged 3-7 ($M = 4.6$, $SD = 1.3$) (five male and one female), all of whom were able to communicate verbally and who had been attending Stepping Stones for a period of at least four months. They were randomly assigned to either the control condition ($n=3$) (two males and one female) or the experimental condition ($n=3$) (three males). Information regarding their specific diagnosis, level of functioning and IQ, were not available.

Participants have a right to know the purposes and consequences of the research to which they are contributing (Berg & Lune, 20120; Christians, 2012). Thus, upon subsequent approval by the University of Victoria Human Research Ethics Board, the BCBA sent a letter of invitation via e-mail (see Appendix 2) to client parents which disseminated information regarding the project. Due to the underage and at risk status of the required participants (Franck, Winter, & Oulton, 2007; Kuehn, Hotho, & Prunty, 2016), interested parents were asked to sign consent forms (see Appendix 3) for their children to take part in the research. This provided active parental consent, having required parents to sign and return a copy in order for child participation (Kuehn, et al., 2016). In keeping with ethical codes, this form outlined the measures by which their children were protected by any potential harm, the confidentiality of any personal information obtained, their right to a full debrief of the findings upon completion of the project (Myers, 2013) and their right to withdraw their child at anytime during the research (Cuskelly, 2005). The participating children were asked to provide verbal assent before using the *LFI!* app. (see Appendix 4).

Behavioural interventionists working at Stepping Stones were asked to participate in the study. Upon the studies approval by the University of Victoria Human Research Ethics Board, the BCBA at Stepping Stones sent a letter of invitation via e-mail (see Appendix 5) to all interventionists. Interventionists were also contacted in person by the principal investigator who explained the nature of the project and their potential roles (see Appendix 6). Interventionists interested in participating were asked to sign a form of consent (see Appendix 7) before being enrolled in the study. Nine interventionists consented to participate in the study, however, due to the small client participant pool, only five were able to partake in the actual intervention while the remaining interventionists contributed their facial expressions to the project. Participating interventionists had been with Stepping Stones for at least six months and had worked with their participant clients since they began attending sessions at Stepping Stones. All interventionists had been trained by the BCBA of Stepping Stones in applied behaviour analysis techniques used at the centre. Other specific training and qualifications were unavailable.

Ethical considerations. It would have been unethical to ask parents to consent to research in which their child would be randomly assigned to a condition in which they may or may not receive a potentially beneficial intervention. Ethical codes provide a description of an organizations values, beliefs and morals while conducting its practice (Forster, Loughran, & McDonald, 2009). All codes of ethics hold the best interests of the child (or client) as paramount (Corey, Corey, Corey, & Callanan, 2014) which would be considered impeded should they be withheld from developmentally constructive programs while others were not. It would also serve to tarnish the reputation, moral and ethical codes of the organization where this research

was conducted (Banks, 2003). As it is the duty of any therapeutic centre to enhance its ability to serve those in its care (Sellick, Delaney, & Brownlee, 2002) and a transgression of the code of ethics and morals at Stepping Stones to do otherwise, the control condition would be given the opportunity to engage in *LFI!* exercises should there be gains observed in the experimental condition.

Materials and intervention. The intervention that both experimental and control conditions used were the NET of emotions used at Stepping Stones. This curriculum takes advantage of naturally occurring situations that elicit an emotional response to teach facial expressions. This is often supplemented with children's books that focus on emotions and contrived situations when appropriate. According to the Assessment of Basic Learning and Language Skills (ABLSS) outline, in order for a child to master this program, they must independently identify a particular emotion three times across three sessions. The ABLSS is a universally recognized assessment tool which provides detailed information of over 500 skills from areas such as language, socializing and motor function used for teaching children with ASD (Parington, Bailey & Parington, 2016). For the emotions program of the ABLSS to be completed, the child must have mastered the recognition of ten emotions, usually consisting of the six basic emotions (Ekman, 1999) plus four complex emotions.

The children in the experimental condition received the NET curriculum, paired with exercises using *LFI!*. A single iPad was assigned for *LFI!* exercises that all clients in the experimental condition used. Facial stimuli from the client's family, their BI's and their peers at Stepping Stones were incorporated into the teaching of both facial expression as well as expression intensity. Using familiar faces was intended to make the material more relevant to

the learning client as they were naturally exposed to similar stimuli throughout their sessions at Stepping Stones, as well as at home. To compliment this, each participant had their own albums in the app with photos that were tailored to their social network.

It was believed that *LFI!*, being a flexible and dynamic program would motivate and interest clients in different ways, thus it was up to the individual BI to use the program in a way that complimented their sessions and relationship with their clients, and the clients interests. The curriculum developed clocked each *LFI!* session at roughly 20 minutes so that the participants in the experimental condition should have used the *LFI!* app. at for at least 160 minutes or just under three hours during the 4-week intervention. However, some sessions may have taken longer depending on the participant. Duration data was not recorded. Because research has shown that children with ASD have significant difficulties recognizing low and medium intensity expressions of disgust, surprise, anger (Smith et al., 2010) and fear (Tell et al., 2014), these were the target emotions taught in the intervention. The training of these expressions were divided into two, 2-week periods to provide particular attention and focus in training. The first two weeks of the intervention focused on training the expressions anger and fear with happy expressions mixed in to act as distractors. The second two weeks of the intervention focused on training the expressions surprise and disgust with sad expressions mixed in to act as distractors. A four-week training period was chosen as the duration for this research due to time constraints. Previous research in facial recognition training have also used a four-week training period (Baron-Cohen, Golan, & Ashwin, 2009) while others have set intervention training at 20 hours of use (Tanaka et al., 2010). Each participant attended eight sessions during the four-week period amounting to between 16 to 20 hours of Stepping Stones

intervention depending on the length of their sessions which lasted for two or two and a half hours, while participants in the experimental condition used *LFI!* for a minimum of 2.6 hours in this time. Because participants were attending sessions for government funded therapy and they had other therapeutic activities to complete, more time could not be allotted to *LFI!*.

Pre-tests occurred on the earliest sessions participants attended during the first and third weeks of the research while the post-tests occurred on the latest sessions participants attended during the second and fourth weeks of the research. As each pre- and post-test took roughly 8-minutes to complete each participant spent roughly 32-minutes in assessment over 4-weeks. As the NET component was worked into sessions as often as could be, duration data could not be ascertained. The daily *LFI!* exercises took roughly 20-minutes to complete and thus, each participant in the experimental condition completed 2.6 hours of *LFI!*.

Measures. The measures (see Appendix 8) used in this research directly targeted the tasks trained in the experimental condition. The tasks were developed to ascertain whether expression recognition would transfer outside of the iPad medium. By using faces not known by the participants, generalization across identity was measured, however, because these measures were presented in the same way as the *LFI!* exercises, generalization across task was not. Four tasks acted as pre- and post-tests for both the experimental and control conditions. The final post-test also included a generalizing task of an expression not explored in the *LFI!* exercises. Data was also taken on the experimental conditions preference for using *LFI!*. The photographs in these tasks were developed using models not seen in the training material and administered by the interventionists working with their participant clients. All measures were experimental and not validated.

- 1) High intensity emotion identification: This task assessed facial expression recognition of high intensity emotions. A photograph of a model was shown expressing an extreme emotional expression. The client was asked how the person feels and their response recorded as correct or incorrect.
- 2) Low intensity emotion identification: This task assessed facial expression recognition of low intensity emotions. A photograph of a model was shown expressing a subtle emotional expression. The client was asked how the person feels and their response recorded as correct or incorrect.
- 3) Expression matching: This task assessed the client's ability to identify an emotional expression across varying intensities and identities. Photographs of two models expressing four levels of intensity of a target emotion were presented with eight distractor stimuli of expressions from the same two models. The client was asked to sort the photos so that all expressions of the target emotion were in a single pile.
- 4) Expression intensity ordering: This task assessed the client's ability to recognize varying intensities of target emotions from least to most. The client was presented with four cards with four different intensity levels of a single emotion. They were asked to order them from 'least' to 'most' in terms of intensity.
- 5) Emotion generalizability: This task tested the ability of clients to apply their learning to non-trained emotions. At the end of the training session, clients were presented with four cards with four different intensity levels of a single emotion not used in their *LFI!* training. They were asked to order them from 'least' to 'most' in terms of intensity. This task was completed only on the on last day of testing.

6) *LFI!* preference: This measure tested the clients level of preference for using the *LFI!* Scrapbook app. Before each use of the *LFI!* app., the client was asked which activity they would prefer to start with, *LFI!* or another favoured activity.

Upon completion of the project, the manager and participating interventionists were asked to complete a brief survey on their experiences using the program with their clients (see Appendix 9). This survey sought to gather information regarding their perspectives of the value of *LFI!* as a CAI used to help their daily interventions. This survey was created by the primary researcher with questions chosen to gain insight into how the interventionists perceived their experience using *LFI!* starting from their training with the app., to implementation of the intervention.

Data Collection. Data collection of the assessments were conducted by the BI's working with their client participants. Four sets of data were collected: a pre- and post-test before and after the first round of emotions training and a pre- and post-test before and after the second round of emotions training. Materials and instructions for assessments were provided prior to each session to ensure proper delivery. The primary researcher walked through the delivery of the assessments with each participating interventionist before the commencement of the research, and again at anytime if they had any questions about the project. The data sheets with completed scores were placed in sealed envelopes and marked with an identification code unique to each participant. The data was then stored in a secure place at the primary researcher's home.

Procedure. After parental consent was given, participants were randomly assigned to either the experimental condition to receive NET of emotions supplemented with the use of the

LFI! Scrapbook app or the control condition to receive only NET of emotions. The BI's were informed of the nature of the research, purpose of the *LFI!* app. and given information and instruction regarding its use in therapy sessions. Both conditions were then tested for baseline FER and intensity recognition using the assessments developed for this research. As all interventionists had agreed to participate, it was made possible for the participants to work with their regular BIs during the intervention. This potentially benefited the project in that it negated the necessity for interventionists unfamiliar to participants from having to implement a new learning strategy without first taking the time to develop a relationship with them. The strong relationships that are essential for effective therapy (Rait, 2000; Santos & Levitt, 2007; Shimoni & Baxter, 2014) are clearly visible between the interventionists at Stepping Stones and their clients. These strong bonds of trust help establish an environment of comfort, safety and fun that are indispensable when working with children with ASD. Thus, the transitions to introduce *LFI!* to client participants was simple and comfortable for all involved.

A curriculum was developed for the BI's to follow to ensure that each aspect of assessment would be accounted for in training. The interventionists were shown how to take photos and videos using the app., how to label photos, create new albums and use the games. An explanation of what they were expected to do with each of the activities in the curriculum was given. They were asked to perform a walkthrough of these steps prior to the commencement of the research. These activities focused on expression identification and intensity discrimination in the photo albums created by the participants in which they swiped from photo to photo and were asked what expressions were being made or which pair of photos was feeling more or less of the target expressions. Separate albums were created in

which four photos of the same model expressing different levels of intensity of the expressions were used to teach intensity ordering. The interventionists were able to drag the photos into random order and would ask their participant clients to put them in order from least to most. Other exercises in the curriculum involved playing the four built in games with their clients. Through these games, expression recognition and matching were the primary focus. Though the elements of the app. were shared with the interventionists, how they decided to implement the activities with their participants was at their discretion as they conducted the teaching portion of this project. As the BIs explored *LFI!* with the participants, they needed to work collaboratively (Gergen, 2009; Madsen & Gillespie, 2014) to identify the most motivating elements for each child within the app. Though they tried to incorporate all elements of *LFI!*, preference was given to those that each child showed a predilection towards.

In the experimental condition, four of the six basic emotions (Ekman, 1999) that children with ASD have been shown to have difficulty recognizing (Smith et al., 2010; Tell et al., 2014) were the focus of teaching with happy and sad being mixed in as fillers. Over the four weeks of intervention, each participant was scheduled to attend sessions twice a week and participate in their regular therapy sessions while engaging in *LFI!* plus NET or just NET training of emotions. The NET component of the research in both groups required the interventionists to be aware of the social situation in Stepping Stones. Each interventionist is trained on the implementation of NET, making use of naturally occurring situations as learning opportunities. As an example, if the participating interventionist noticed that another client is becoming excited about an upcoming trip to the park, they would point this out to their own client first by asking them how they think that person is feeling. From there, they are prompted to provide a

correct answer and to attend to the facial expressions being made. This component explored any expression that the interventionists may have noticed during their sessions. The *LFI!* component in the experimental group set aside twenty minutes a session to complete the required exercises amounting to at least 120 minutes of *LFI!* exposure over the course of the four-weeks. Twenty minutes was the clocked time for each of the daily sessions and was only a minimum time required to complete the exercises. Likely, some of the participants went over this timing as they required more time to complete the exercises or requested to play the games additional times, however, no duration data was taken. Additionally, participants using *LFI!* were not required to complete all the exercises in one sitting but were allowed to complete them over the course of their sessions. Over the course of the project three participants (two in the control and one in the experimental conditions) were unable to attend their scheduled sessions. Due to these unforeseen circumstances, their scheduled activities were picked up on the following sessions. The two participants in the control group each had to make up one session while the participant in the experimental group had to make up for two sessions, however, all scheduled activities were conducted.

At the start and end of each two-week training interval, the BI's conducted the expression assessments with their clients. Each child participated in two pre-tests and two corresponding post-tests spread throughout the four weeks of teaching. The same assessments were conducted for the control condition at the same two week intervals while going through the normal Stepping Stones curriculum. The first pre- and post-tests in each group consisted of two high intensity emotion identification tasks (one for anger and one for fear), two low intensity emotion identification tasks (one for anger and one for fear), two emotion matching

tasks (one for anger and one for fear) and two emotion intensity ordering tasks (one for anger and one for fear). The last two pre- and post-tests were similar as above, but with the targets of surprise and disgust. The last post-test also incorporated an emotion intensity ordering generalizing task that used an expression not explored in the *LFI!* exercises. Both pre- and post-tests were clocked at taking roughly eight minutes to complete. The pre-tests occurred on the first day of the week that the participants attended sessions and before either NET or *LFI!* exercises began. The post-tests were completed on the last day of the week that participants attended sessions after NET and *LFI!* exercises had been completed. The use of NET exposed both groups of participants to a greater array of emotions than what would be explored with *LFI!* in the experimental condition. However, the *LFI!* exercises with the experimental condition only used the emotions of the week. In the control condition there was a lack of focus on any one emotion without the supplementary teaching tools.

It is often recommended that treatment be coordinated with the social environments of clients (National Scientific Council on the Developing Child, 2005). Parents are often encouraged to engage in proven interventions with their children at home as their involvement in treatment will further enhance the learning of the target material (Harrington & Maskey, 2008), ensuring the continuity of learning beyond the clinical setting (Shimoni & Baxter, 2014). However, due to the experimental nature of this intervention the parents of the participating clients were asked not to engage in any activities using *LFI!* at home. This served to limit exposure of the app. to sessions at Stepping Stones, ensuring each child used the program equally.

Upon completion of the emotions training, the BIs were asked to complete an anonymous survey regarding their experiences with the *LFI!* program. The survey was distributed via e-mail by the manager of Stepping Stones to the participating interventionists and upon request could be printed for them if they preferred to write out their answers. The completed surveys were returned to the manager and then passed along to the primary researcher and stored in a secure location. Upon analysis of the results of both the control and experimental conditions, the manager at Stepping Stones was asked to complete a survey regarding her perspectives of the program and its role within the daily interventions. Full debriefs were sent to both the client's parents and their BIs.

Analysis. It was originally intended that the analysis of the results would be done using simple t-tests, however, due to the small sample size of the research, any quantitative analysis of the data would have yielded insignificant power (Howell, 2008). In addition, with the individualized nature of many Autism interventions it was deemed that a one-to-one analysis of the results for each participant would be the preferred method. These descriptive statistics would provide a more individualized assessment of each participants learning while still comparing the results from the control and experimental conditions. Thematic analysis was used to examine the data collected from the surveys. Thematic analysis being unbound by theoretical commitments, offers a technique to analysis (Clarke & Braun, 2017) that can provide a detailed and intricate account of the experiences of the participants (Vaismoradi, Turunwn & Bondas, 2013). This technique identifies key features of data as they arise within and across data sets (Braun & Clarke, 2013) and from large to small (Clarke & Braun, 2017). The codes and

themes developed under a thematic analysis provide a purely qualitative account of the data (Vaismoradi, Turunwn & Bondas, 2013) that is interpreted by the researcher.

Chapter 4

Results

This section describes the changes in facial expression recognition scores for each participant. It will compare each measure from pre- and post-tests in the control and experimental conditions. Differences in learning were expected to occur between groups as children with ASD learn better when using computers (Whalen et al., 2010). Using thematic analysis, I will then examine the surveys that the interventionists filled out upon completion of the intervention.

Learning Outcomes

High Intensity Emotion Identification

The control conditions responses indicated little to no gains of high intensity expressions (see Table 1.1). On two occasions; when asked to identify the high intensity

Table 1.1 High intensity emotion identification response rates for control condition

Participant	Anger		Fear		Surprise		Disgust	
	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test
CP1	√	X	X	X	√	X	X	X
CP2	√	X	X	X	X	X	√	X
CP3	X	X	X	√	X	√	X	X

expressions of anger and surprise control participant 1 (CP1) provided correct responses for the pre-tests, but not on their post-tests. CP1 did not correctly identify pre- or post-test expressions of either fear or disgust. Similarly, control participant 2 (CP2) correctly identified pre-test expressions of anger and disgust, but not on their post-tests. CP2 did not correctly identify high intensity expressions of fear or surprise in either of their pre- or post-tests. While control

participant 3 (CP3) did not show any recognition of anger or disgust across their pre- and post-tests, they did show learning of high intensity expressions for fear and surprise.

The experimental condition showed greater gains in their high intensity expression identification across their pre- to post-tests (see Table 1.2). Experimental participant 1 (EP1)

Table 1.2 High intensity emotion identification response rates for experimental condition

Participant	Anger		Fear		Surprise		Disgust	
	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test
EP1	X	√	X	√	X	X	X	X
EP2	X	√	X	√	X	√	X	X
EP3	√	√	X	√	X	X	√	√

showed gains of high intensity expressions of both anger and fear, but not surprise or disgust. Experimental participant 2 (EP2) showed gains of high intensity expressions for anger, fear and surprise but not disgust. Experimental participant 3 (EP3) showed recognition of anger and disgust in their pre- and post-tests and showed gains for fear from pre- to post-tests, but not for surprise.

Interestingly, the control condition showed greater levels of ‘correct to false’ responses (from pre- to post-test) in their high intensity recognition skills than actual learning. This reverting trend from correct responses in the pre-test to incorrect responses in the post-test suggest differences between NET and *LFI!* ability to help maintain knowledge of expressions. While both CP1 and CP2 only displayed this reverting trend, CP3 showed a 50% improvement in their recognition skills for this task. Though the control participants showed 100% reversion of expressions identified in pre-tests, this trend was not seen at all in the experimental condition. Ultimately, the control condition showed 16% accuracy in identifying high intensity expressions in the post-tests compared to their initial 33% accuracy in pre-tests, a 17% decrease in correct

responses while the children in the experimental condition showed 66% accuracy in labelling the target emotions in post-tests compared to 16% in pre-tests, a 50% increase in accuracy. Additionally, the 100% reversion of correct to incorrect responses in the control condition compared to the 0% reversion of correct to incorrect responses in the experimental condition suggests that scheduled practice of expression recognition using *LFI!* twice a week, paired with NET was enough to maintain previously learned expressions, and facilitate gains in recognition of new expressions.

Low Intensity Emotion Identification

The control condition failed to identify the low intensity expressions of the target emotions (see Table 2.1). CP1 correctly identified surprise in the pre-test but not the post-test

Table 2.1 Low intensity emotion identification response rates for control condition

Participant	Anger		Fear		Surprise		Disgust	
	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test
CP1	X	X	X	X	√	X	X	X
CP2	X	X	X	X	X	X	X	X
CP3	X	X	X	X	X	√	X	X

and did not identify any of the other targets. CP2 did not correctly identify any of the targets in either pre-tests or post-tests and CP3 showed improvement only in their post-test for identification of surprise.

Similarly, the experimental condition showed few gains of low intensity expressions (see table 2.2). EP1 showed gains of a low intensity expression of fear, while neither EP2 nor

Table 2.2 Low intensity emotion identification response rates for experimental condition

Participant	Anger		Fear		Surprise		Disgust	
	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test	Pre-test	Post-Test
EP1	X	X	X	√	X	X	X	X
EP2	X	X	X	X	√	√	X	X
EP3	X	X	X	X	√	√	X	X

EP3 showed any gains of these intensities of expressions. Both EP2 and EP3 correctly identified low intensity expressions of surprise in both their pre- and post-tests indicating that *LFI!* exercises and exposure to facial expressions may have helped maintain expression knowledge.

A possibility for the lack of observable gains of low intensity expressions across both groups could be because children with ASD have difficulty recognizing low intensity expressions (Smith et al., 2010; Tell, Davidson, & Camras, 2014) and the duration of the intervention was not enough for them to learn this skill. During the intervention, it was noted that the low intensity expressions may have been too subtle for the participants. Even some of the interventionists expressed difficulty recognizing the lower intensity photos. This note was of interest as it was also reported that during the use of the *LFI!* app, all three of the participants in the experimental condition were correctly identifying low intensity expressions. The differences between the low intensity expressions used in *LFI!* and those used in the assessments may also have contributed to these scores. The *LFI!* photos were taken of the participating interventionists and clients who were asked to model these expressions resulting in more natural appearing faces. The assessment photos were created using the program Fantamorph in which a photo of a neutral face was merged with a face expressing a high intensity expression. This allowed me, as the primary researcher to create a spectrum of expressions from low to high intensity. This resulted in faces that may have looked unnatural

and indistinguishable to the participants, exacerbating their pre-existing innate disadvantage in identifying these expressions.

Expression Matching

The expression matching tasks were assessed on two factors; percentage of correctly selected target expressions and percentage of distractor expressions selected. For each expressions matching task, there were eight target photos and eight distractors with opposite values in scoring. If all target expressions were selected, the score of 100% would be perfect identification, while if all of the distractors were ignored, a score of 0% would be perfect disregard. An increase in percentage of correctly selected target expressions from pre-test to post-tests would indicate gains in expressions recognition. Conversely, a decrease in percentage of selected distractor expressions would also indicate gains; that participants could distinguish between target and non-target expressions.

For expression matching tasks with anger as a target, the participants in the control condition did not show improvement in their target selection or distractor disregard (see table 3.1). While both CP1 and CP3 identified the same number of both targets and distractors

Table 3.1 Expression matching of anger for control condition

Participant	Pre-test		Post-Test	
	<u>Target</u>	<u>Distractor</u>	<u>Target</u>	<u>Distractor</u>
CP1	50%	37%	50%	37%
CP2	62%	0%	50%	12%
CP3	50%	0%	50%	0%

between their pre- and post-tests, CP2 showed a 12% drop (from 62% - 50%) in correctly selected target expressions and a 12% increase (0% - 12%) in selected distractor expressions.

Comparatively, the experimental condition showed gains across all participants (see table 3.2).

EP1 showed a 25% increase (from 50% - 75%) in correctly selected target expressions

Table 3.2 Expression matching of anger for experimental condition

Participant	Pre-test		Post-Test	
	<u>Target</u>	<u>Distractor</u>	<u>Target</u>	<u>Distractor</u>
EP1	50%	0%	75%	12%
EP2	25%	0%	87%	0%
EP3	50%	0%	75%	0%

but also a 12% increase (0% - 12%) in selected distractors from pre-test to post-test. EP2 showed a 62% increase (from 25% - 87%) in correctly selected target expressions while EP3 showed a 25% increase (from 50% - 75%). Neither EP2 nor EP3 selected any distractor expressions during either pre- or post-tests.

While one participant in each group showed an increase in distractor selection, the other participants maintained their baseline distractor percentages. The differences in target selection between the control and experimental conditions suggests that *LFI!* exercises helped increase recognition of the expressions of anger in the participants in the experimental condition while solely NET was not enough to help improvement in the participants in the control condition.

For expression matching of fear, the control condition again showed little improvement (see table 3.3). While CP1 showed a 25% improvement (from 12% - 37%) in target expression

Table 3.3 Expression matching of fear for control condition

Participant	Pre-test		Post-Test	
	<u>Target</u>	<u>Distractor</u>	<u>Target</u>	<u>Distractor</u>
CP1	12%	50%	37%	62%
CP2	75%	0%	37%	0%
CP3	50%	50%	50%	50%

selection, they also showed a 12% increase (from 50% - 62%) in distractor selection. CP2 showed a 38% drop (from 75% - 37%) in their target selections from pre to post tests. CP3 showed no gains or losses from pre to post-tests in either target selection or distractor disregard. The participants in the experimental group showed a more positive trend between their pre- and post-tests (see table 3.4). While EP1 maintained the same score for both target

Table 3.4 Expression matching of fear for experimental condition

Participant	Pre-test		Post-Test	
	Target	Distractor	Target	Distractor
EP1	50%	0%	50%	0%
EP2	37%	0%	87%	25%
EP3	50%	0%	87%	0%

selection and distractor disregard, EP2 and EP3 both showed learning with a 50% improvement (from 37% - 87%) and a 37% improvement (from 50% - 87%) in target selection respectively. While, EP2 showed the greatest gains, they also showed a 25% (from 0% - 25%) increase in their selection of distractor expressions. While participants in both groups displayed gains, more were seen in participants in the experimental group at greater percentage of increases.

Unlike anger and fear, the control condition showed improvements for expression matching of surprise (see table 3.5). CP1 showed a 13% increase (37% - 50%) in target selection

Table 3.5 Expression matching of surprise for control condition

Participant	Pre-test		Post-Test	
	Target	Distractor	Target	Distractor
CP1	37%	25%	50%	25%
CP2	50%	0%	62%	37%
CP3	12%	75%	25%	37%

and no change from distractor disregard. CP2 showed a 12 % increase (from 50% - 62%) in target selection, and a 37% increase in distractor selection (from 0% to 37%). CP3 improved in

target selection by 13% (from 12% - 25%) and distractor disregard by 38% (from 75% - 37%).

The participants in the experimental condition also showed improvements (see table 3.6). EP1 showed neither gains nor losses for target selection or distractor disregard. EP2 maintained a

Table 3.6 Expression matching of surprise for experimental condition

Participant	Pre-test		Post-Test	
	<u>Target</u>	<u>Distractor</u>	<u>Target</u>	<u>Distractor</u>
EP1	50%	0%	50%	0%
EP2	75%	62%	75%	0%
EP3	75%	12%	87%	0%

75% target selection across pre- and post-tests but showed a 62% improvement in distractor disregard (from 62% - 0%). EP3 showed a 12% increase in target selection (from 75% - 87%) and a 12% improvement in distractor disregard (from 12% - 0%). Interestingly, the participants in the control condition showed more gains for expression matching of surprise than the participants in the experimental condition. While gains in the experimental condition are seen primarily in decreases in distractor selection, it does maintain the trend for overall improved gains with these participants. The sudden increase in improvement between pre- and post-tests in the participants in the control condition may be due to exposure to this type of task over three weeks. Another explanation may be that within the second round of training, the participating interventionists may have become more adept at identifying teaching opportunities for the control condition. Additionally, while fewer gains are seen in the participants in the experimental conditions target selection tasks, strong gains are seen in their distractor disregard tasks which also shows learning.

As in the surprise expression matching tasks, the control condition showed improvement in their matching tasks for disgust (see table 3.7). CP1 showed a 38% increase in

Table 3.7 Expression matching of disgust for control condition

Participant	Pre-test		Post-Test	
	<u>Target</u>	<u>Distractor</u>	<u>Target</u>	<u>Distractor</u>
CP1	37%	0%	75%	25%
CP2	50%	0%	50%	0%
CP3	12%	62%	25%	25%

target selection (from 37% - 75%) while they also showed a 25% increase in distractor selection (from 0% - 25%). CP2 maintained their scores of both target selection and distractor disregard across both pre- and post-tests. CP3 showed a 13% increase in target selection (from 12% - 25%) and a 37% improvement in distractor disregard (from 62% - 25%). The experimental condition showed more improvements in both tasks (see table 3.8). EP1 showed a 63% increase in target

Table 3.8 Expression matching of disgust for experimental condition

Participant	Pre-test		Post-Test	
	<u>Target</u>	<u>Distractor</u>	<u>Target</u>	<u>Distractor</u>
EP1	37%	0%	100%	0%
EP2	50%	50%	100%	25%
EP3	87%	12%	87%	0%

selection (from 37% - 100%) and maintained a 0% for distractor disregard across tests. EP2 showed a 50% increase in target selection (from 50% - 100%) and a 25% improvement in distractor disregard (from 50% - 25%). While EP3 maintained an 87% target selection score, they showed a 12% improvement in distractor disregard (from 12% - 0%). While both groups of participants showed improvements, those in the experimental condition showed slightly larger increases in correct responses across both surprise and disgust, and much larger improvements (compared to the control participants) in tasks of expression matching for anger and fear.

On tasks of distractor disregard, the participants in the experimental condition displayed slight increases in distractor selection in the first round of training (for anger and fear), but not in the second (surprise and disgust), in which they only show improvement. Conversely, participants in the control condition would tend to select more distractors in their post-tests across both rounds. A potential explanation for this trend may be that while being tested on expressions of fear and anger, the distractors used were happy, sad, surprise and disgust, the latter two being relatively unknown and unpracticed. Without being able to properly identify them they got mixed in with their selections between pre- and post-tests. However, in the second round of training, the distractors used in the pre- and post-tests were a mix of happy, sad, anger and fear, expressions which were now familiar to them. The participants were then able to identify them for the expressions they were and disregarded them when the targets were surprise and disgust.

Ultimately, the experimental condition participants showed greater gains in both target selection and distractor disregard than the control condition participants. Gains were more immediate in the experimental condition as seen in the first post-test while moderate gains for control participants were not seen until the the second round of training. The differences in tasks of distractor disregard suggest that practice with *LFI!* helped participants to better identify expressions. While the experimental condition had the added benefit of *LFI!* exercises, the control condition was exposed only in natural environment settings which occur far more infrequently than planned exercises, indicating that increased practice with and exposure to expressions using *LFI!* exercises help children with ASD recognize facial expressions of emotion.

Intensity ordering and intensity ordering generalization

Neither group of participants preformed well on the intensity ordering tasks. While participating interventionists reported that the experimental condition preformed well during the exercises in *LFI!*, results indicated that both they and participants in the control condition ordered the photos randomly. As mentioned previously, the expressions used in the assessments were created using a computer program and the differences between each photo may not have been pronounced enough for the participants. The assessment photos were also significantly different from the teaching material and the subtleties between the expressions for this task may have stymied the results. As with the low intensity expression identification tasks, even the interventionists found difficulty recognizing in which order the expressions should be placed.

Though these results would indicate that neither NET nor NET plus *LFI!* are sufficient to teach intensity ordering, the results of the intensity ordering generalization task suggest otherwise. It was always intended to have an intensity ordering generalization task on the last post-test to see if this skill could be transferred across expressions that were not seen in the *LFI!* exercises. The expression used for this measure was 'shocked' and was not explored in any *LFI!* exercise. These photos were not generated through Fantamorph, but were taken of a model who was asked specifically to make this expression at four levels of intensity just like the photos used in *LFI!*. As with the initial intensity ordering tasks, the participants in the control condition seemed to arrange the generalization photos at random. However, all three participants in the experimental condition scored 100% accuracy on this task, correctly arranging the photos from least to most, indicating that some gains of expression intensity had

occurred but could not be adequately measured with the initial expressions developed for the intensity ordering task.

LFI! Preference

During the *LFI!* project the participants in the experimental condition completed exercises throughout their sessions. Each time interventionists would transition to using *LFI!* the participants were given the option to either do *LFI!* or another of their preferred activities first. The activities offered were known reinforcing activities based on the clients interests. These activities ranged from playing board games with peers to jumping on a trampoline to listening to music on the radio. Participants choices were honoured each time and recorded throughout the four weeks (see table 4.0). Each of the three participants were given a different number of

Table 4.0 *LFI!* preference for experimental condition

Participant	Percentage of <i>LFI!</i> first responses	Number of opportunities given
EP1	70%	24
EP2	43%	16
EP3	100%	12

opportunities to choose between *LFI!* or other activity based on how much of the scheduled exercises they could complete in each sitting. Both EP1 and EP3 showed a great liking for the app. and enjoyed the activities developed for the curriculum. Having worked with EP1 through these exercises I am able to offer anecdotes about their experience. EP1 thoroughly enjoyed all the games within the app. particularly, the matching games and the levels of ‘splash’ that used coconuts in the visuals. EP1 would come to the center and immediately say “I want to play *LFI!*” and when going through the exercises would ask “Can we play coconuts?” referring to the level

in which the faces are hidden behind coconuts. It was a pleasure to watch EP1 giggle with glee and a smile as they tapped the screen. EP1 would also ask to play matching, and at first I would bring them a card matching game to which I received the response “No, not that matching, matching on the iPad!” referring to the *LFI!* game. Unfortunately, I did not witness EP2 or EP3 in their sessions with *LFI!* however, their interventionists would tell me how their sessions played out. While EP2 enjoyed some of the games on the app. they chose other activities over using the iPad. While playing *LFI!*, EP2 was reported to have enjoyed the interaction with their interventionist through the games. Though it did not seem to be a strong reinforcing activity for EP2, they showed great gains in post-tests implicating the benefits of *LFI!* even when it’s not necessarily a favourite activity. The interventionists who worked with EP3 reported they took great enjoyment from playing with *LFI!*. Though EP3 did not request to use the app. independently, when given the option, they chose the app. over other activities 100% of the time.

While the goal of *LFI!* as a supplementary computer based teaching tool is to mask and mix learning with games, it must be remembered that each child, with ASD or TD have different interests and preferences. Though this goal seems to have been accomplished with EP1 and EP3, through preference choices and anecdotes from their interventionist, it seems EP2 still preferred other activities over *LFI!*. This isn’t to say that they did not like the app., nor that preference is required for learning outcomes, as EP2 showed pronounced improvement in their expression recognition skills. As with all programs and interventions, some clients are going to enjoy the process, while others may not. Yet, if it can still be used, and yield positive results as seen in each of the participants in the experimental condition, then it must still be considered.

The possible differences in post-test scores between the two conditions suggests that the *Let's Face It!* app. has a positive effect on teaching facial expression recognition in children with ASD.

Interventionist Reviews

Each interventionist who helped conduct the *LFI!* program filled out a five item survey upon completion of the intervention. Their responses were analysed using thematic analysis to identify common themes (Braun & Clarke, 2013) in their feedback. Units of data related to a potential theme were recorded for each question and then grouped into common units. The common units were linked into themes and patterns. The developed themes from the surveys were further interpreted (Vaismoradi, Turunwn & Bondas, 2013) to yield a new insight into the use of *LFI!* in a clinical setting.

Question 1: What did you like about the Let's Face It! app.?

Engagement. When asked to describe what aspects of the app. they liked, the level of engagement from both interventionist and participant was a clear theme. Research shows that children with ASD are more attentive to CAI's and are more easily engaged in learning processes that use technology (Ramdoss, et al., 2012). This was displayed during the current intervention where participants showed high levels of engagement with the app. and their interventionists. The ability for both members of the interventionist/participant dyad to be involved in every step made the process an engaging and collaborative learning experience, an aspect that is associated with more positive outcomes (Giangreco, Broer, & Edelman, 2001). Of the required set-up for folders in which participants had to collect photos of members of their social network at the site, one interventionist said "It was beneficial and enjoyable to the child to be able to take pictures of people in the child's life...", and another saying they liked the

program because of how “...engaging it was for the children and how they could be a part of the process...”. This theme of engagement seems to have been a cornerstone for the interventionists appreciation of the app., appreciating both the level and quality of engagement. As the interventionists at Stepping Stones teach primarily through play, through engagement with their clients, it is not surprising that an app. designed to be used through an educator/learner collaboration was quickly accepted.

Fun. Complimenting this idea of engagement was the theme of fun that was unanimously reported by the interventionists; “... the games were a lot of fun...”. The interventionists felt that the fun games incorporated into the app. made it a good teaching tool for use with the participants. Elements of fun were reported at every stage of the intervention from set-up, to game play, to the overall look of *LFI!*. On the games, one interventionist said, “The games were a fun way for the different emotions to be learned.”. On the ability to incorporate photos of their social network another said “It was fun seeing familiar faces...”. Referring to the graphics, yet another said, “I thought the bright colours and graphics were enticing for the kids and made them excited to play the games.”. Incorporating enjoyable activities into the curriculum not only enhances motivation, but also engagement with the material (Dunlap et al., 1994). Delivering the curriculum through the iPad was “highly reinforcing to kids who love technology.”. The ability to have a teaching method that engages young learners enriches our abilities as interventionists to optimise teaching opportunities (Rogers & Dawson, 2010). Indeed, the *LFI!* process would seem to be an enjoyable social interaction which is critical to the teaching of early social skills (Goldstein & Naglieri, 2013).

Client tailored intervention. Another element that influenced the interventionists reports was the ability to customize the albums and teaching material by taking photos of the participant's social network at the site. Interventionists described this feature of "use[ing] real pictures" as "useful", "beneficial" and "engaging". Howlin, Magiati and Charman., (2009) show concern over groups as diverse as children with ASD receiving identical interventions. *LFI!* is not a one-size-fits-all intervention program, as displayed in the amount of potential ways to play, the many levels of engagement, and the individualized teaching material. While not all children with ASD have the same skills or interests (APA, 2013) and as each case on the spectrum can vary, it is important that each intervention is tailored to the specific child (Ruble, Dalrymple, & McGrew, 2012). Tailoring can refer to the selection of one intervention over another, various degrees of support within a particular intervention and inclusion of familiar material. Each participant in this research engaged with their interventionists at different levels at different times depending on the level of support needed to succeed during the exercises. The ability to adapt the level of engagement not only between interventionist and participant, but between each member and the learning process helped modify the program to each participant. These three themes reported by the interventionists get to the soul of *LFI!* itself. Hands-on engagement using an app. that mixes fun and learning of socially relevant material have contributed to the interventionists perceptions of *LFI!* as a beneficial teaching tool.

Question 2: What did you not like about the Let's Face It! app.?

Technical Glitches. As with all relatively new programs, the *LFI!* app. displayed a glitch here and there. As reported by the interventionists, the glitches were seen primarily in the 'faceswap' game. In this game the top and bottom portions of two faces must be matched with

the presented labels. The interventionists found that often, “It was ... very finicky to line the pictures up properly.”, therefore not allowing the player to progress. Other times within the same game, the photos would be distorted into larger or smaller proportions and “... did not work properly.”, again stalling the players progress. In order to fix this issue, the app. would have to be shut down and each participant was reported to become quite frustrated when this occurred. During regular sessions, interventionists try to set clients up for success by prompting correct responses and reducing the amount of potential incorrect responses. This reduces negative side effects of wrong answers (Mueller & Palkovic, 2007) that could frustrate the client and throw off the session. With glitches in a program, the interventionists ability to prompt for success is diminished. Programs designed to be used by children with ASD should be as glitch free as possible to ensure success.

Question 3: Please comment on the overall usefulness of the training when it came to the delivery of the intervention.

Preparedness. From their reports, the interventionists appreciated the *LFI!* training sessions they received prior to the implementation of the project. Having been shown the ins and outs of the app. and walked through the tasks they were to conduct with their participants made the execution of the curriculum easier for the interventionists. One interventionist called the training “...very straight forward” saying that it was “...simple and helped when actually implementing the intervention as it made everything go smoothly.” As with any new curriculum or intervention, for the most successful outcomes, it is essential that interventionists as educators have some experience with their materials before implementation (Ruble, Dalrymple. & McGrew, 2012). The level of preparation of interventionists who teach children

with ASD is always a concern (Simpson, 2004), and an ill prepared interventionist will find it difficult to teach. A strong correlate of learning outcomes in children is educator preparation (Hamond, 2000). Interventionists as educators must also have adequate time to prepare before teaching, and this includes preparation in the understanding of the material and methods used to teach.

Teaching. Some of the interventionists interpreted this question on training as their teaching with the clients and spoke to their experience of teaching with *LFI!*. Describing the app. as "... definitely a preferred method for delivering this kind of material." and "... a great way to teach.", the interventionists praised the easy to use interface of the program for both members of the dyad. They seemed especially taken by how appealing the games were to their participants describing their reinforcing and motivating nature.

Question 4: How did the use of the Let's Face It! app. compare to other emotions training interventions that did not make use of the app.?

Diversity. The concept of diversity within *LFI!* was found on multiple levels that made it stand out from other tools. The diversity of the games allowed for multiple methods of learning the material. Able to choose between four games, the participants could explore the app. and find the one that most interested them. With these options, one interventionist stated; "Variety of activities used to teach concepts is good!". Each game had at least two variations and multiple levels of difficulty that could be unlocked through play. The diverse nature of the *LFI!* games kept things interesting, challenging and new for the participants; aspects that kept them excited to play more. This also allowed the interventionists to identify preferred games and use them as motivating tools to encourage participants to complete other tasks that had the double

benefit of being reinforcers and teaching opportunities. *Let's Face It!* was also diverse in required level of engagement between interventionist and participant. While each game can be played solo, they can easily incorporate a two player dynamic. During training sessions, two player games allowed for the interventionists to teach through engagement, while once a participant had enough experience they could play on their own to facilitate their own learning. When teaching and engaging with children we ASD, it is important to keep motivation for interaction by offering choices (Goldstein & Naglieri, 2013). The number of ways that *LFI!* could be played and at different levels of engagement allowed for participants to make choices frequently, and this made it stand out for the interventionists who were used to a very different method of teaching this material.

Teaching material. The interventionists also spoke to the amount and type of photos used in the training exercises. Because *LFI!* requires input from the users, the photos can be tailored to the specific social networks of the participants. One interventionist stated, "I found it helpful as the photos were much more realistic ... than photos I have previously used." Another said, "The app. was superior because there were many different pictures of each emotion...", and "... the more exposure a child has in learning emotions in a variety of ways the more the skills will generalize." A primary characteristic of the app. is to have multiple exemplars of an expression that build the learners concept of the emotion and at the same time generalize that knowledge using a diverse pool of photos. Though the interventionists use many facial expressions in teaching when using other methods, it is very limited compared to the amount that can be incorporated with ease when using *LFI!*.

Child led teaching. Paired with the unanimous reports of the participants having fun with the app., one interventionist called previous programs "... adult led, where this was child led / engaging.". It is unsurprising that a program that is fun by design and diverse in its potential uses had developed into a child led intervention; directing the interventionists how to engage with them in the app., asking to play, and playing on their own. By delivering this curriculum through games, it has the potential to become an enjoyable activity, providing simultaneous reinforcement (Keen & Pennell, 2015) which motivated participants to engage with *LFI!*. Though the results indicated that *LFI!* was only a preferred activity for two of the participants, all three participants in the experimental condition were reported to have enjoyed playing the games often leading the interactions with their interventionists and *LFI!*. While the role of the interventionists remained one of teaching, it was done alongside their participants rather than directing them. Indeed, one of the primary goals of the app. was to increase opportunities for social interaction within the users' social network, a goal that was displayed in the level of engagement participants were required to have with their interventionists. One of the participants in the experimental condition displayed child led teaching and heightened interaction as a direct result of using the app. When *LFI!* sessions were done, later in the day they would ask their interventionist to make a facial expression and would then try to guess what emotion that was made. This participant would ask "Make a face!, make another!", or "How about surprised? How about scared?" and laugh at the expressions when correctly identified. It was incredible to see this participant excited about exploring facial expressions outside of the official program schedule. This interaction displayed the promise of *LFI!* as a motivating force for the child to lead their own intervention and further their own learning.

Question 5: Do you have any suggestions for the app. developer?

Fix the Bugs. The few glitches found in the *LFI!* app. were enough to frustrate participants and interventionists alike. When presenting a program to participants with ASD, it is important to set clients up for success, however, when glitches arise, this throws a wrench into the works. Getting caught in a situation in which success is not possible due to program bugs can have negative effects on the course of a session (Mueller & Palkovic, 2007). Ensuring the games within the app. run smoothly, without bugs would help facilitate a successful session.

Additional Resources. The interventionists also voiced a desire for more structured activities outside of the four games. Though there are many potential uses and methods of teaching using *LFI!*, at the time of this document, there is currently no collection of possible activities for users. A resource book of other potential activities or methods of engagement could provide interventionists with more options than what was found in the current curriculum. Alternatively, the creators of the app. (CARTE) provide workshops to early childhood educators and other organizations interested in learning more about *LFI!*. At the time that this research was carried out, it was not possible to conduct a workshop through CARTE, though participating interventionists may have found it beneficial for their teaching.

First Steps to Teaching. The final theme that developed did not immediately relate to the survey questions, but rather emerged from the interventionists knowledge of program implementation. Their belief was that *LFI!* is "... a very good start..." to teaching emotions. When *LFI!* was first introduced to me by its creators, it was described as a "... get your feet wet app.", an introductory step into the complex world of emotions and their impact on social

interactions. The ability to recognize an emotional expression does not imply the ability to understand emotional reactions, and apply social knowledge to interactions (Silver & Oakes, 2001). Indeed, the curriculum designed for this research focused on building skills of recognition, but to gain a deeper understanding of emotions, teaching of context is required (Pennington, 2010). The skilled interventionists recognized *LFI!* as a first step to teaching tool because "... the pictures are not situational to give child context.", and expressed continuing emotions training by "Generalizing what the child has learned during the training (...) to real life situations...".

Ultimately, the small scale interventionist review of the *Let's Face It!* app. was largely positive. Despite minor glitches, the interventionists found the program easy to use and fun. Largely contributing to their enjoyment of using the app. was the required level of engagement with their participants, a factor that was predominantly self-motivated in the participating clients and their perception of the games. The diverse methods of teaching and teaching material found in the app. were highly appealing to the interventionists. This paired with the simplicity of implementation of the curriculum and the enjoyment seen in participants are only some of the elements that put this in view as a "... superior..." and "... preferred method..." of teaching emotion recognition.

Chapter 5

Discussion and Implications

This pilot project set out to answer three research questions regarding the viability of the *LFI!* program as a supplementary tool to an emotions training intervention with children with ASD. Through pre- and post-tests and feedback from educators, the research questions have been addressed. A discussion of the findings as they directly relate to these questions can inform alternate approaches to emotions training with children with ASD. The results of this project may provide further support to previous research that suggests there may be benefits to incorporating CAI in teaching children with ASD. The limitations of this research project and implications for future research will also be addressed.

Research Questions

Is the training of emotion recognition enhanced when using LFI! as a supplementary tool to the natural environment teaching of emotions? The results from the participants suggest that *LFI!* has strong potential as a supplementary tool to emotions training with children with ASD. Tasks of high intensity emotion identification and expression matching showed differences in the gains made between the participants in the experimental condition and those in the control condition. Examining the results of the high intensity emotion identification, it would seem that exercises using *LFI!* exposed participants to a vast array of exemplars of the target emotional expressions, enough to not only maintain expression knowledge from pre-test to post-test, but also to teach high intensity expressions of unknown emotions. Participants in the control condition showed a trend of ‘correct to false’ from the pre-tests to their post-tests, correctly identifying a high intensity expression in their pre-tests, but misidentifying the same

expressions in their post-tests. Because this trend was absent from the experimental condition, it suggests that when paired with NET, *LFI!* exercises have the potential to enhance pre-test knowledge of expressions, while NET on its own, did not. Participants in the experimental condition also showed greater learning of unknown high intensity expressions when compared to the control condition. While the control condition showed a 17% drop in correct responses from pre-test to post-test, the experimental condition showed a 50% increase in correct responses. These results suggest that *LFI!* exercises enhanced facial expression recognition skills in the participants in the experimental condition. On tasks of expression matching, participants in the experimental condition showed greater improvements on both target selection and distractor disregard. Differences in both these factors of the task suggest that when paired with NET, *LFI!* exercises enhanced the participant's ability to identify and distinguish between expressions. The results of the generalizability test, also suggest that participants in the experimental condition learned to some degree to distinguish between varying intensities of an emotional expression. The results of this small scale pilot study support the literature suggesting that training using CAI can be used to teach essential skills (Sansosti et al., 2015; Whalen et al., 2010) specifically emotion recognition (Matsuda & Yamamoto, 2012; Ramdoss, 2012; Rice, Wall, Fogel & Shic, 2015; Silver & Oaks, 2001) in children with ASD. It also supports findings that suggest CAI yield stronger learning outcomes than one-to-one training (Kodak, Fisher, Clements & Bouxsein, 2010). In line with previous research, the results of this small scale study suggests that the training of facial expression recognition was enhanced by using the CAI *LFI!* along side NET in a clinical setting.

Do children with ASD enjoy using LFI! over other preferred activities? LFI! was designed to captivate and motivate its users with exciting visuals, sounds and game play. Already on the highly reinforcing medium of the iPad, these features draw the users into the material. The preference measure showed that two of the three participants in the experimental condition preferred to use *LFI!* over other known reinforcing activities. While one participant chose to use *LFI!* less than half of the time, educator feedback during the project suggests that this participant enjoyed using the program. Research shows that the use of preferred activities increases motivation to engage in tasks (Keen & Pennell, 2015). *LFI!* as a preferred activity would help facilitate child-led learning but may not be the sole factor in motivating engagement. Enjoyment in using of the app. was seen in all three participants which seems to have been enough to motivate them during sessions. Though preference wasn't universal, learning outcomes indicate benefits to emotion recognition in all participants in the experimental condition. However, when preference was seen, heightened levels of child-led learning were evident. As mentioned earlier, EP1 continued to explore facial expressions outside of the scheduled exercises. *LFI!* then has the potential to become a preferred activity among users with ASD, enhancing learning outcomes. However, as with anything, preferences differ based on the individual and with the intended audience of special education programs, the variety of individuals is more complex (Odom et al., 2008). Likely, there will be those who love it and those who don't, but its potential is evident from these findings.

How do interventionists regard use of a CAI in their daily emotions training with children with ASD? Evaluating a new program must rely on more than learning outcomes in participants and extend further to understanding teacher perspectives (White, Keonig & Scahill, 2007). The

educator reviews of *LFI!* as a supplementary tool were largely positive. A large part of their perspectives of *LFI!* are due to the flexibility of the app. to be incorporated into current training of emotions. The themes identified from the surveys speak of a CAI that is engaging, fun to use and efficient. The theme that was identified the most across the different aspects of the program was that of engagement. This feature of the *LFI!* program was highly appreciated by the interventionists as it required the participants to further engage with those in their environment and the interventionists themselves, a goal that is of primary importance in early intervention. The benefits of heightened engagement between a teacher figure and learner are associated with higher motivation and engagement with the material (Carini, Kuh & Klein, 2006). *LFI!* has incorporated into its design several key factors for heightening engagement with students with ASD. Previous research has found benefits to the use of appealing visual supports and play-based curricula (Goldstein & Naglieri, 2013) in increasing engagement. Additionally, the use of preferred activities (Iovannone, Dunlap, Huber & Kincaid, 2003) and offering choices for activities (Dyer, Dunlap & Winterling, 1990) have been shown to increase motivation to engage. These factors that are embodied by the *LFI!* program assist in building a connection between educator, student and the material. The quotes from the participating educators mentioned earlier speak to the value they see in a CAI in an emotions training program. The impressions that “Overall it is an excellent teaching tool.”, “... it is definitely a preferred method for delivering this kind of material.”, and “LFI is a great tool (...) in combination with NET.”, is high praise for the *LFI!* program from educators on the front lines of early intervention.

Limitations.

Due to the small scale nature of this research, several limitations are evident in the methodology. While an attempt was made to keep things balanced between the groups and each participant, compromises of convenience had to be made. This section will describe the limitations and suggest methods of improvement for further research.

Sample. Due to the small pool of potential participants and the requirements of verbal communication and attendance, the sample size was considerably smaller than ideal. A larger sample sizes would allow for the generalization of the findings (Ploog, Scharf, Nelson & Brookes, 2013), however, as a small scale pilot study with a sample size of 6, generalization to the larger population is not possible (Howell, 2013). The sample was in part also a sample of convenience as it was restricted to one setting, as I had direct access to the site and communication with the managers, organizing a research project with the materials and pool of potential participants here simplified the process. Thus, as potential participants did not have an equal chance of being selected to take part, random sampling was not achieved. Future studies should strive to obtain a larger sample size with randomly assigned groups. Additionally, specific data regarding each participant such as IQ level, their level of functioning, demographic information, information regarding their previous and current interventions and specific information regarding their diagnoses were either not available or purposefully left out of the study for reasons of confidentiality. Pre-intervention expression recognition data was also unavailable. These omissions and any other pre-existing differences between the two groups which were not measured may detract from the quality of this study as these factors may have contributed to any results of the research. Each child participant had worked with their regular

interventionist during this research. The exact length of time of each of these relationships was not available, but may have had an effect on the delivery of this research based on how well the pairs knew and worked together.

Attending to faces. Tanaka, Lincoln & Hegg (2003) describe Domain I of the hierarchical model for face processing as the ability to attend to faces. Training for face attention should come before emotion or identity recognition. While the potential participants were selected based off the BCBA's recommendations, screening for this ability did not occur officially. While the BCBA's are well aware of their client's skills, an official screening may have enhanced the sample. Future research into emotions training should take into account the hierarchical model for face processing.

Sequencing. The capability to assess and order photos based on sequences of least to most may not have been present in all participants. If this was the case, participants in the experimental condition would then have an advantage over their control condition counterparts as they received this training during *LFI!* exercises. The participants in the control condition, without this knowledge may then have performed worse than their experimental condition counterparts as they lacked this training. Interestingly, the results of the generalization task indicated that while the participants in the experimental condition learned to sequence expressions based on intensity, those in the control condition did not. This suggests that *LFI!* exercises can also be used to teach this concept. Future research examining training of emotional intensity should consider the skills of the participants as they relate to the needs of the tests.

Confounding Variables. As a small scale pilot study with a sample of convenience, confounding variables are to be expected. Primarily that of the different educators teaching the *LFI!* exercises. While each educator received training with the *LFI!* program, they were encouraged to be flexible and creative with the app. during sessions and find a way to incorporate the CAI into their interventions that best fit with both themselves and their participants. Two of the participants in the experimental condition both had two educators implementing the *LFI!* exercises on different days. This was, again, for convenience as the program required two sessions of *LFI!* a week and the participant's schedules had them working with separate educators. The potential differences in teaching style between educators may have influenced learning of facial recognition. In addition to implementing the intervention, the interventionists also administered the pre- and post-test measures with their client participants. Though this was done to avoid issues with compliance associated when new interventionists place demands on clients, it also allowed for the potential of interventionist bias. As the interventionists knew which participants were in which conditions and were working with clients who they are close too, this is a possible limitation.

A second confounding variable was the time spent on the iPad during *LFI!* exercises. To address the possibility that iPad time may have had an influence over learning, participants in the control condition should also have had an equal amount of time using the device during their sessions to mirror that of the experimental condition. However, as this was a clinical setting in which participants were attending to learn essential skills, time could not be afforded to simply play on the iPad or even use an educational app. that was not a part of their overall program. Especially considering the time spent using *LFI!* in the experimental condition, it

would not be ethical to detract so much focus from the control conditions sessions. These variables and their effects cannot be separated and we cannot adequately measure their impact on the final results (Howell, 2013).

It is impossible to disentangle the relationship between increased engagement with the interventionists during *LFI!* exercises and *LFI!* itself. Any potential gains could have been due to either of these factors; increased exposure to expressions in this method of presentation or the support and interactions with the interventionists. Future research should take steps to consider potential confounding variables and implement safeguards to reduce their influence.

Measures. As stated earlier, the photos used for assessments in the pre- and post-tests may not have been fitting for the task. The low intensity, artificial expressions were likely too difficult for the participants to adequately judge, influencing their results. Additionally, the educators themselves reported having difficulty identifying the correct order of the intensity ordering photos. The feedback and anecdotes from the interventionists as well as results from the generalization task, suggest that participants in the experimental condition could correctly order expression intensity when using more natural faces. Future research using photos of facial expressions should test the material before hand and use only those that are unanimously identified correctly. The curriculum used in the *LFI!* exercises and all measures of assessment were created by the primary researcher and are thus not validated nor reliable. Future research should seek out tested and validated measures. Furthermore, no fidelity data was taken on the exercises, to ensure adherence to the curriculum.

Duration. Because the duration of a program is related to learning outcomes (Grynszpan, Weiss, Perez-Diaz & Gal, 2013; Linstead et al., 2016) it is suspected that stronger

results would have shown had the training of both NET and NET plus *LFI!* run longer than the scheduled four weeks. NET sessions of emotions training often take months to teach and master, while NET plus *LFI!* currently have no adequate comparisons. With the results supporting the ability of *LFI!* to enhance learning of emotion recognition alongside NET, should it be used as a regular tool in sessions, it may shorten the time it takes to learn and master these skills. Additionally, the amount of time the experimental condition used the *LFI!* app. was not recorded. Differing amounts of exposure to the program may have influenced results. Neither were the amount of NET opportunities recorded. Differences in the opportunities for NET may have also impacted results.

Implications

Research into CAI is still a relatively new field and should be considered exploratory (Ploog, Scharf, Nelson & Brooks, 2013). The implications of the promising results of this research however, would suggest there is a place for *LFI!* in existing curricula. As a “get your feet wet” program, the goal of *LFI!* is to expose users to the base knowledge of the material. In this case, teaching users to recognize facial expressions. This skill alone is not sufficient to comprehend and apply the full range of emotional knowledge in real life situations (Silver & Oaks, 2001), thus, facial expression recognition must be considered but a single step in a hierarchy of steps. The hierarchical model for face processing (Tanaka, Lincoln & Hegg, 2003) would put the recognition of emotions as step two of three steps, being preceded by attention to faces and followed by comprehension of social cues and communication of emotional knowledge.

Fittingly, the educators at Stepping Stones recognized this concept and went so far as to offer suggestions for next step teaching of context of emotions which is an important skill for social development (Pennington, 2010). The teaching of expressions on the iPad without context makes the *LFI!* program a supplementary tool, with the context of expressions being taught primarily through NET sessions. *LFI!* then supports this material by providing more opportunities for users to learn the expressions that they are seeing. As users learn to identify emotional expressions more readily, NET sessions can then teach why others are feeling a particular way. There are concerns however, that CAIs by their nature isolate users (Pennington, 2010; Ploog, Scharf, Nelson & Brooks, 2013) from their social networks and for individuals with ASD who already suffer from social deficits, this can be concerning. Yet, by its design, *LFI!* is a social tool, requiring interaction with and input from members of the user's social environment. Working along side a teacher figure, the user can be supported as necessary and request help for completing tasks, increasing social interactions.

Teaching of emotions in context and how to communicate emotional information is a logical next step in this process. Since teaching social skills such as emotional communication is best done in group format (White, Keonig & Scahill, 2007), the creators of *LFI!* Scrapbook have developed a teaching guide to assist in this task. This curriculum requires participants to work together to input the learning material into the iPad and then play and learn together. A full curriculum using *LFI!* could conceivably be developed around the hierarchical model of face processing (Tanaka, Lincoln & Hegg, 2003) to teach each of the domains and enhance social skills of children with ASD. Embedding *LFI!* into existing programs that use NET will depend on the individual learner and their preferences. As we have seen, *LFI!* has the potential to be an

enjoyable if not preferred activity among its intended users. Interventions with children with ASD are suggested to be fun and engaging (Goldstein & Naglieri, 2013) to maximize motivation to learn (Dunlap et al., 1994; Keen & Pennell, 2015). *LFI!* does exactly that, providing learning through play, a system that compliments NET in everyway. Portrayed as a task or break activity, learners are provided with options, a feature that helps feel in control (Rogers & Dawson, 2010), to lead their own learning. *LFI!* enhances exposure to one aspect of the material of emotion recognition while NET focuses on the context of the emotional expressions explored using the program. Paired together, *LFI!* plus NET has the potential to benefit learning of emotional expressions and the context in which they arise resulting in enhanced social development in children with ASD.

While more research is needed, this project has shown the potential of *LFI!*, highlighted its strengths and uncovered some required bug fixes. Future research should carefully address the issues of the limitations mentioned earlier in this section. A rich and fully randomized sample should be grouped into CAI only, NET only, and CAI plus NET to measure the full effects of each of these important variables. Potential confounding variables should be carefully considered prior to the commencement of the research and steps taken to minimize their impact. The intricacies of therapy and a praxis that best serves our learners must also be considered throughout this process. Ensuring that all potential participants have the option to take part in developmental learning regardless of which condition they are randomly assigned to is necessary. As more educators take the approach of no child left behind, and equal opportunity to all, we must consider our research beyond the initial learning outcome phases in

which control conditions have yet to take part in new methods of learning and consider curricula development that benefits all children.

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Appendix 1
Screenshots of *LFI! Scrapbook* app



Patricks Anger Album

Patricks Emotion Album

Patricks Sad Album

Eyes

Samples

EYES

Joy	Joy	Joy
Joy	Surprise	Surprise
Surprise	Surprise	Fear
Surprise	Surprise	Surprise

Appendix 2
Letter of invitation to potential parents



STEPPING STONES THERAPY INC.

3388B TENNYSON AVENUE, VICTORIA, BC, V8Z 3P6

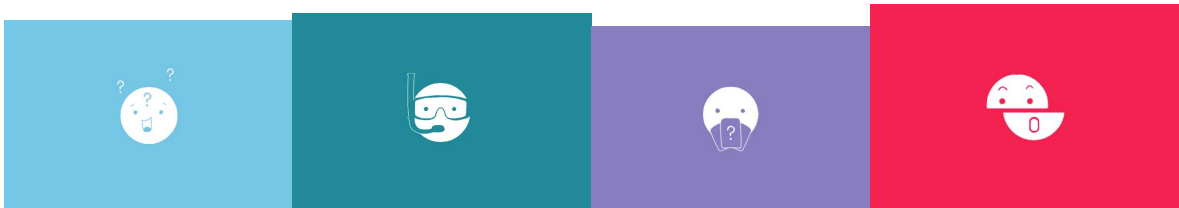
(250) 472-8304

STEPPINGSTONESVICTORIA@YAHOO.COM

Dear Parents, we are providing you with the following information about a new research opportunity being offered to children and families in our intervention programs at Stepping Stones Children's Therapy Center. We have partnered with the University of Victoria Centre for Autism Research, Technology, and Education (CARTE) and the School of Child and Youth Care to provide participating children with facial processing training in the area of emotion recognition using the mobile app 'Let's Face It! Scrapbook' (LFI). Members from CARTE have trained Stepping Stones interventionists in the use of the Let's Face It! Scrapbook app. and in the delivery of this new face processing training.



The purpose of this study is to explore the methods of emotions training in children with autism spectrum disorder. Starting in November, we will be offering intervention using Stepping Stones natural environment teaching method paired with exercises using the four built in games in the Let's Face It! app. for four weeks. With this, we hope to enhance emotion recognition abilities in participant clients. Your children will work with their regular behavioural interventionist at Stepping Stones during their regular scheduled intervention. Your participation is entirely voluntary.



For more information, please contact Shantelle.

Please note that not all interested families may be eligible to participate, and that Shantelle Soto, Board Certified Behaviour Analyst will determine eligibility.

Sincerely;

Shantelle Soto, M.A., B.C.B.A.
Behavior Analyst and Co-Owner of
Stepping Stones Therapy Inc.

Appendix 3
Parental consent form



School of Child & Youth Care
PO Box 1700 STN CSC
Victoria British Columbia
V8W 2Y2 Canada
Fax (250) 721-7218
Web www.cyc.uvic.ca

Undergraduate Programs
On Campus & Distributed Learning
(250) 721-7979/6278
Graduate Programs
(250) 472-4857

**Improving Facial Expression Recognition in Children with Autism Spectrum Disorder: Effectiveness of a
Computer Assisted Intervention**

Dear Parents,

Thank you for your interest in our research project investigating the effects of a mobile app. training program for enhancing facial processing skills in children with autism. Please read this study consent form carefully before signing or choosing not to participate.

This project is being conducted by Patrick Murphy who is a graduate student in the department of Child and Youth Care at the University of Victoria. Patrick is also a behavioural interventionist on the Stepping Stones team. As a graduate student, Patrick is required to conduct research as part of the requirements for his thesis in his masters degree. This project is being supervised by co-academic advisors Dr. Jennifer White, Associate Professor in the School of Child and Youth Care at the University of Victoria and Dr. James Tanaka, full professor in the Department of Psychology at the University of Victoria and director of the Centre for Autism Research, Technology, and Education.

Purpose, Objectives & Benefits

The purpose of this research project is to test the effectiveness of the iPad app. *Let's Face It! Scrapbook* (LFI!) in enhancing children with ASDs facial processing skills. This project will focus on teaching children to recognize and distinguish facial expressions of emotion across varying intensities (subtle and extreme expressions). While research shows that children with autism are efficient at recognizing expressions of high intensity they have significant difficulty when processing subtle expressions of anger, disgust, surprise and fear. If children with autism have difficulty processing subtle expressions of emotions, it is not surprising that they also struggle in their daily social interactions. It is crucial to determine if training can improve face processing and emotion recognition in children with autism and, ultimately, improve social outcomes. Studies have shown that intervention in this area is effective in improving facial recognition, peer and familial relationships, and social functioning in children with autism.

What is Involved

All children participating in this study will receive an emotions training program using the *LFI!* app over a four week period between November to December. In the initial stages of the study, the participating children will be randomly assigned to the either the Stepping Stones emotions training program or the Stepping Stones emotions training program plus *LFI!* app. intervention. After the first month of the study, participants in the regular program will also receive the *LFI!* intervention. The need for this delayed start is to enable us to determine the learning differences between these two programs. All sessions will be delivered at Stepping Stones Children's Therapy Center during the children's regular interventions. **Participating children WILL NOT NEED and WILL NOT USE their own iPads.** Instead, a limited number of iPads will be provided to children to use in sessions with their interventionists for the sole purpose of the research study.

First, children will be randomly assigned to the *immediate start* or *delayed start* emotions training programs. The immediate start group will begin their emotions training program with the *LF!!* app. in tandem with the natural environment teaching currently used at Stepping Stones. Over the course of four weeks, children will complete exercises designed to teach the six basic emotions anger, disgust, surprise, fear, happiness and sadness. During this time, the *delayed start* group will receive emotions training in the natural environment teaching currently used at Stepping Stones **without** use of *LF!!*. When this first stage of training is complete, the *delayed start* group will begin exercises using *LF!!*. Interventions using the *LF!!* app will be conducted twice a week for fifteen minutes during participants regular interventions.

The *LF!!* app. was developed by the Tanaka lab at the Centre for Autism Research, Technology, and Education (CARTE) at the University of Victoria (<http://web.uvic.ca/~carte/>). *LF!!* is a flexible and dynamic tool designed to teach facial processing skills to children with autism. The app. takes advantage of iPad technology to enable complete customization of the learning material. Using the built in camera, photos of peoples faces from the child's social environment (family, friends etc...) can be gathered and presented as teaching tools. This ability to use recognizable faces makes the learning of the content recognizable, relatable and relevant to the children involved. The three steps to using *LF!!* are *Capture*, *Sort*, and *Play*. In the *Capture* step, you, as a parent, the other children at Stepping Stones and the behavioural interventionists will be asked to pose various facial expressions to be included in your child's learning. In *Sort*, the collected photos and two-second video snippets are browsed, reviewed, labeled and drag-and-dropped into created folders. For example, the user can scroll through to find pictures of happy faces and place them in the 'happy-faces' folder. Alternatively, they can sort them according to the emotional intensity so that all 'very-happy' faces are in one folder while all 'a little-happy' faces are in another. In *Play*, children can choose from the four built in games *Name Game*, *Splash*, *Memory* and *Fuse* designed to improve attention to faces and understanding of facial expressions.

For children who participate in this study, we will be collecting information on their abilities at four points in time (once before and once after the first two weeks of the project and once before and once after the second two weeks of the project). All assessment activities will take place at Stepping Stones Children's Therapy Center with their regular behavioural interventionists and are not expected to take more than fifteen minutes each. These assessments will test children's ability to **a)** recognize extreme expressions **b)** recognize subtle expressions, **c)** match the same expressions at different intensities, **d)** order expressions from least to most (i.e. least happy to most happy) and **e)** their preference to using *LF!!* over another preferred activity.

Voluntary Participation

Before using *LF!!* your child will be asked if they are willing to participate in this project as a means of providing verbal assent. Child and family participation is entirely voluntary. Your informed consent for participation in this study can be withdrawn at any time without negative consequences from the research team from UVic, or from Stepping Stones Children's Therapy Center. Withdrawal from the study will not impact current or future opportunities at either Uvic or Stepping Stones. Should you not wish to participate, or should you wish to withdraw at any time, your child's regular therapy sessions will continue. You or your child may withdraw from this study at any time, without explanation, with all data collected being destroyed. There are no known or anticipated risks or adverse consequences to participating in or not participating in, or withdrawing from this research.

As your child's regular interventionists will be responsible for these programs, they will be in the best position to safeguard your privacy in regards to the face photos and videos that will be taken during the *LF!!* intervention. The Stepping Stones team will always remain in control of the data, as the iPads provided by CARTE will remain at Stepping Stones for the duration of the project. If any participant withdraws from the study, all iPads with their photos/videos will be seized immediately and cleared of that data. All photos/videos of all participants, their families and peers will be deleted upon completion of the project. The photos/videos used in the intervention will not be used in the assessment process.

Anonymity & Disposal of Data

There are limits to children's and families' anonymity by participating in this study. Children, parents, and interventionists participating in the study will be known to each other as the intervention is scheduled to take place during each child's regular sessions at Stepping Stones. Non-participants who attend Stepping Stones will likely also become aware of the study and its active participants. However, the results of each child's assessments will be completely anonymous and identified with a numerical and alphabetical code rather than their names. These results will be secured and only Patrick Murphy, Dr. Tanaka, Dr. White and your child's regular interventionist will have access to them. The key to identifying code numbers with individual participants will be stored on a password protected computer and will be deleted once all assessments have been completed. The principal investigator will destroy all other relevant original paperwork five years following the completion of the study. Fully anonymous data with no identifying information will be stored on a password protected computer file indefinitely.

Dissemination of Results

The information gathered in this study may be used for publication in academic journals, but will include no identifiable information. You will receive a written summary of the findings about three months following completion of the study, outlining the results without any identifiable participant information.

Contacts

You may contact Patrick Murphy at (...) if you have any questions or concerns at any point during the project. This study has been approved by the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca) This research is being conducted through the School of Child and Youth Care and the Centre for Autism Research, Technology, and Education.

Please do not hesitate to contact us if you require further information or have any questions.

Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Sincerely,

Patrick Murphy, MA candidate
University of Victoria
School of Child and Youth Care

- Photos/videos may be taken of me and my child for: My child's intervention* _____

Other participants' interventions* _____

Name of Child/Youth Participant

Parent Signature

Date

*No names will be used, you [or your child] may be recognizable if visual images are shown in other interventions.

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix 4

Script to obtain child participant assent

Behavioural Interventionists:

Hello (child's name), today and for the next month we're going to learn about feelings. To help us learn, we're going to use the iPad and take pictures of mom and dad and your friends here at Stepping Stones. After that we're going to play a few games on the iPad with the pictures we take. Would you like to try?

Letter of invitation to behavioural interventionists



STEPPING STONES THERAPY INC.

3388B TENNYSON AVENUE, VICTORIA, BC, V8Z 3P6

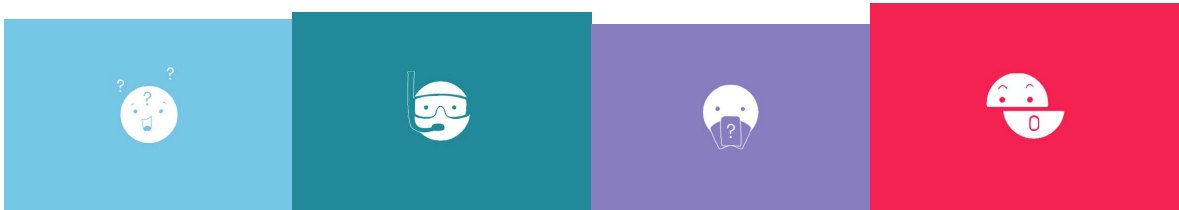
(250) 472-8304

STEPPINGSTONESVICTORIA@YAHOO.COM

Dear Interventionists, we are providing you with the following information about a new research opportunity being offered at Stepping Stones Children’s Therapy Center. We have partnered with the University of Victoria Centre for Autism Research, Technology, and Education (CARTE) and the School of Child and Youth Care Children to offer clients attending our intervention therapy programs face processing training using a new mobile app; Let’s Face It! Scrapbook.



The purpose of this study is to explore the methods of emotions training in children with autism spectrum disorder. Starting in November, we will be offering intervention using Stepping Stones natural environment teaching method paired with exercises using the four built in games in the Let’s Face It! app. for four weeks. With this, we hope to enhance emotion recognition abilities in participant clients. Your children will work with their regular behavioural interventionist at Stepping Stones during their regular scheduled intervention. Your participation is entirely voluntary.



All interventionists at Stepping Stones Children’s Therapy Center are eligible to participate in this training opportunity. Participation is completely voluntary and you should not feel pressured in anyway to participate.

For more information, please speak with Patrick Murphy or Shantelle Soto.

Sincerely;

Shantelle Soto, M.A., B.C.B.A.
Behavior Analyst and Co-Owner of
Stepping Stones Therapy Inc.

Appendix 6

Script to disseminate study information to behavioural interventionists

Principal investigator:

“As part of the requirements of my master’s degree in child and youth care at the University of Victoria I am required to conduct research in the form of a thesis project. My project is designed around using the mobile app. Let’s Face It! Scrapbook in teaching children with autism spectrum disorders to recognize subtle facial expressions of emotion. Research shows that children with autism have significant difficulties recognizing subtle expressions of disgust, fear, surprise and anger. These will be the emotions focused on in the planned intervention. Your role as behavioural interventionists will be to conduct natural environment teaching of emotions supplemented with exercises using the LFI! app with your participant clients. The study is set to run for four weeks with each participant in the LFI! condition doing exercises with the app. twice a week. You will also be responsible for conducting assessments of their emotion recognition skills at four points in time throughout the study. Prior to the LFI! intervention with participants, members from the Center for Autism Research, Technology and Education will train you on the use and capabilities of the LFI! app. Your participation in this study is completely voluntary. There are no known risks to participating or not participating in the study. If you don’t wish to participate, your regular sessions at Stepping Stones will continue. A decision to participate or not will not influence current or future opportunities at either Stepping Stones or at the University of Victoria.

If you are interested in participating, please speak with Shantelle Soto about consent forms.

Thank you for your interest.”

Appendix 7

Behavioural interventionist consent form



School of Child & Youth Care
PO Box 1700 STN CSC
Victoria British Columbia
V8W 2Y2 Canada
Fax (250) 721-7218
Web www.cyc.uvic.ca

Undergraduate Programs
On Campus & Distributed Learning
(250) 721-7979/6278
Graduate Programs
(250) 472-4857

Improving Facial Expression Recognition in Children with Autism Spectrum Disorder: Effectiveness of a Computer Assisted Intervention

Dear Behavioural Interventionists at Stepping Stones Children's Therapy Center,

Thank you for your interest in our research project investigating the effects of a mobile app. training program for enhancing facial processing skills in children with autism. Please read this study consent form carefully before signing or choosing not to participate.

This project has been approved by the University of Victoria and is being conducted by Patrick Murphy who is a graduate student in the department of Child and Youth Care at the University of Victoria. As a graduate student, Patrick is required to conduct research as part of the requirements for his thesis in his masters degree. This project is being supervised by co-academic advisors Dr. Jennifer White, Associate Professor in the School of Child and Youth Care at the University of Victoria and Dr. James Tanaka, full professor in the Department of Psychology at the University of Victoria and director of the Centre for Autism Research, Technology, and Education.

Purpose, Objectives & Benefits

The purpose of this research project is to test the effectiveness of the iPad app. *Let's Face It! Scrapbook* (LFI!) in enhancing children with ASDs facial processing skills. This project will focus on teaching children to recognize and distinguish facial expressions of emotion across varying intensities (subtle and extreme expressions). While research shows that children with autism are efficient at recognizing expressions of high intensity they have significant difficulty when processing subtle expressions of anger, disgust, surprise and fear. If children with autism have difficulty processing subtle expressions of emotions, it is not surprising that they also struggle in their daily social interactions. It is crucial to determine if training can improve face processing and emotion recognition in children with autism and, ultimately, improve social outcomes. Studies have shown that intervention in this area is effective in improving facial recognition, peer and familial relationships, and social functioning in children with autism.

What is Involved

All children participating in this study will receive an emotions training program using the *LFI!* app over a four week period between November to December. In the initial stages of the study, the participating children will be randomly assigned to the either the Stepping Stones emotions training program or the Stepping Stones emotions training program plus *LFI!* app. intervention. After the first month of the study, participants in the regular program will also receive the *LFI!* intervention. The need for this delayed start is to enable us to determine the learning differences between these two programs. All sessions will be delivered at Stepping Stones Children's Therapy Center during the children's regular interventions. **Participating children WILL NOT NEED and WILL NOT USE their own iPads.** Instead, a limited number of iPads will be provided to children to use in sessions with their interventionists for the sole purpose of the research study.

First, children will be randomly assigned to the *immediate start* or *delayed start* emotions training programs. The immediate start group will begin their emotions training program with the *LFI!* app. in tandem with the natural environment teaching currently used at Stepping Stones. Over the course of four weeks, children will complete exercises designed to teach the six basic emotions anger, disgust, surprise, fear, happiness and sadness. During this time, the *delayed start* group will receive emotions training in the natural environment teaching currently used at Stepping Stones **without** use of *LFI!*. When this first stage of training is complete, the *delayed start* group will begin exercises using *LFI!*. Interventions using the *LFI!* app will be conducted twice a week for fifteen minutes during participants regular interventions.

The *LFI!* app. was developed by the Tanaka lab at the Centre for Autism Research, Technology, and Education (CARTE) at the University of Victoria (<http://web.uvic.ca/~carte/>). *LFI!* is a flexible and dynamic tool designed to teach facial processing skills to children with autism. The app. takes advantage of iPad technology to enable complete customization of the learning material. Using the built in camera, photos of peoples faces from the child's social environment (family, friends etc...) can be gathered and presented as teaching tools. This ability to use recognizable faces makes the learning of the content recognizable, relatable and relevant to the children involved. The three steps to using *LFI!* are *Capture*, *Sort*, and *Play*. In the *Capture* step, you, as a parent, the other children at Stepping Stones and the behavioural interventionists will be asked to pose various facial expressions to be included in your child's learning. In *Sort*, the collected photos and two-second video snippets are browsed, reviewed, labeled and drag-and-dropped into created folders. For example, the user can scroll through to find pictures of happy faces and place them in the 'happy-faces' folder. Alternatively, they can sort them according to the emotional intensity so that all 'very-happy' faces are in one folder while all 'a little-happy' faces are in another. In *Play*, children can choose from the four built in games *Name Game*, *Splash*, *Memory* and *Fuse* designed to improve attention to faces and understanding of facial expressions.

For children who participate in this study, we will be collecting information on their abilities at four points in time (once before and once after the first two weeks of the project and once before and once after the second two weeks of the project). All assessment activities will take place at Stepping Stones Children's Therapy Center with their regular behavioural interventionists and are not expected to take more than fifteen minutes each. These assessments will test children's ability to **a)** recognize extreme expressions **b)** recognize subtle expressions, **c)** match the same expressions at different intensities, **d)** order expressions from least to most (i.e. least happy to most happy) and **e)** their preference to using *LFI!* over another preferred activity.

Role of Behavioural Interventionists

We are currently recruiting behavioural interventionists to deliver this program to participant clients. Participating interventionists will consent to three main roles in the study. First, you will consent to participating in a brief training sessions on the use of the *LFI!* program. Members from CARTE will hold one-on-one sessions with each participating interventionist during your regular sessions at Stepping Stones. Second, you will consent to posing a number of different facial expressions in photos and two-second video snippets. Your facial expression content will be included in the emotions training programs of your and other interventionists participant clients. Thirdly, you will consent to conduct assessments and deliver emotion training programs with participant clients. Each participating interventionist may work with multiple clients, however, these tasks will be shared between you and other participating interventionists.

Anonymity

There are limits to interventionists anonymity by participating in this study. Children, parents, and interventionists participating in the study will be known to each other as the intervention is scheduled to take place during regular sessions at Stepping Stones. Non-participants who attend Stepping Stones will likely also become aware of the study and its active participants. However, your privacy will be protected in the documentation of data. On forms of assessment, rather than using names, a mixed numerical and alphabetical code will be used to identify the obtained results. The key to identifying code numbers with individual participants will be stored on a password protected computer and will be deleted once all assessments have been completed. The principal investigator will destroy all other relevant original paperwork five years following the completion of the study. Fully anonymous data with no identifying information will be stored on a password protected computer file indefinitely. The

information gathered in this study may be used for publication in academic journals, but will include no identifiable information. You will receive a written summary of the findings about three months following completion of the study, outlining the results without any identifiable participant information.

Voluntary Participation

Your participation is entirely voluntary. Participant interventionists informed consent for participation in this study can be withdrawn at any time without negative consequences from the research team from UVic, or from Stepping Stones Children’s Therapy Center. Declining to participate or withdrawal from the study will not impact current or future opportunities at either UVic or Stepping Stones. Should you not wish to participate, or should you wish to withdraw at any time, your regular therapy sessions will continue. You may withdraw from this study at any time, without explanation, with your photos/video consent being deleted. There are no known or anticipated risks or adverse consequences to participating in or not participating in, or withdrawing from this research.

Contacts

You may contact Patrick Murphy at (...) if you have any questions or concerns at any point during the project. This study has been approved by the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca) This research is being conducted through the School of Child and Youth Care and the Centre for Autism Research, Technology, and Education.

Please do not hesitate to contact us if you require further information or have any questions.

Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Sincerely,

Patrick Murphy, MA candidate
University of Victoria
School of Child and Youth Care

Name of Interventionist Participant

Date

Email Address

Telephone Number

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix 8

Assessment card examples

Angry



A1

A2

A3

A4

Sad



S1

S2

S3

S4

Happy



H1

H2

H3

H4

Assessment 1 - 5 Data Collection:



STEPPING STONES THERAPY INC.

1) High intensity emotion identification: **(Target Emotion)**

Show the participant the provided photo of **(target emotion)** and ask “How is this person feeling?”.

Record response: Correct _____ Incorrect _____

1) Low intensity emotion identification: **(Target Emotion)**

Show the participant the provided photo of **(target emotion)** and ask “How is this person feeling?”.

Record response: Correct _____ Incorrect _____

2) Expression matching: **(Target Emotion)**

Provided are 16 photos of two models each expressing two emotions. Each set of four cards are a single emotion at four intensities. Place the photos in random order in front of the participant and ask “Can you put all the photos of people feeling **(target emotion)** in one pile?”

Record code on reverse of cards:

3) Expression intensity ordering: **(Target Emotion)**

Using four of the provided photos of the same model expressing the same emotion display them in front of the participant randomly. Ask “This person is feeling **(target emotion)**, can you put these pictures in order from least **(target emotion)** to **(most target emotion)**?”

Record the code on reverse of card in the order the participant has placed them:

4) Emotion generalizability: Silly

Provided are four photos of the same model making silly faces at the same intensity. Display them in front of the participant randomly and ask "This person is feeling silly, can you put these pictures in order from least silly to most silly?"

Record the code on reverse of card in the order the participant has placed them:



Assessment 6: Data Collection

STEPPING STONES THERAPY INC.

As part of this study we are measuring the participant's preference to using the Let's Face It! (*LFI!*) app. Before each use of *LFI!* give the participant the choice between using the app or another preferred activity. Because each participant has different interests and reinforcers, you may use your discretion in which alternative activity to offer. Understandably, each participant also has different levels of focus and the intervention may need to be broken down into segments throughout the session. Each time you return to the *LFI!* exercises, please provide the same choice and record all responses.

Please record an *LFI!* first choice with a (✓) and a *LFI!* second choice with a (X)

