Introducing the Let's Face It! Scrapbook app: Social eye processing training for improving face-to-face social interactions in autistic youth

by

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Abstract

Interpreting facial expressions, establishing and maintaining eye contact, and following the eye gaze of others are key social eye processing abilities. Deficits are associated with social dysfunction, clinical disorders, and particularly with autism spectrum disorder (ASD). A critical question is whether social eye processing abilities can be trained for improving face-to-face social interactions.

The current study utilized a pre-test/post-test control group switching replications design. In active training, 12 autistic youth received 4.5 hours of *Let's Face It! Scrapbook app: Social Eye Processing Training (LFI - SEPT)* over 3 weeks. Active training included participation in weekly small group learning sessions where research facilitators introduced and modeled social eye processing abilities. The research assistants then facilitated autistic youth to record their own social eye processing abilities into the *Let's Face It! Scrapbook* app. Over the remainder of the week, autistic youth played from the *Let's Face It! Scrapbook* app games in designated gameplay sessions. In Control Training, autistic youth completed weekly small group learning activities and engaged in social gaming using educational apps.

The results revealed that relative to Control Training, autistic youth improved significantly after completing *LFI - SEPT.* Autistic youth experienced significant gains in interpreting subtle changes in facial expressions. In addition, autistic youth were shown to engage establishing and maintaining more eye contact in a story reading and conversation assessment. Parents reported further enhancements in social competency for understanding faces in the home environment. Collectively, the results provide optimism that social eye processing abilities can be improved through direct training using a mobile app.

Keywords: autism, social eye processing abilities, training

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This work is dedicated to my beloved brother, David Sung.

~

Forever Be, Peter Pan!

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Introduction

Social interactions are described as dynamic exchanges between two or more people. An important aspect of mediating social interactions is the ability to interpret facial cues, particularly pertaining to the eyes. Faces display who we are, how we are thinking, and what we intend to do. We observe a wealth of facial information to distill an individual's identity, race, class, gender, emotions, and inner mind. Most individuals qualify as face experts, recognizing faces naturally, accurately, and automatically (Tanaka, 2001). Our face expertise is based on a specific subset of social eye processing abilities, defined here as interpreting facial expressions through the eyes, establishing and maintaining eye contact, and following the eye gaze of others.

Autism spectrum disorder (ASD) is a lifelong neurodevelopmental disorder, characterized by persistent deficits in social communication (APA, 2013). Individuals with ASD are found to display restricted and repetitive patterns of behaviours and interests (APA, 2013). As a spectrum disorder, ASD is heterogeneous, encompassing vast individual differences across verbal and non-verbal abilities. Epidemiological studies vary by region, but recent prevalence estimates indicate that ASD is found in about 1.5% - 2.2% of children worldwide (Baio, 2014; Kim et al., 2014; Lyall et al., 2017). Persons with ASD are found to experience significant difficulties in interpreting human faces (Jemel et al., 2006; Weigelt et al., 2012), leading to downstream social and communication challenges (Dawson et al., 2005; Sasson, 2006). Deficits in social eye processing abilities are increasingly being reported in persons with ASD across the spectrum. (Le Couteur et al., 2003; Lord et al., 1999).

The current study developed and implemented a social eye processing training program for autistic youth. A review of the literature will first describe the role of social eye processing abilities in regulating face-to-face social interactions. Computer-based training programs will be

highlighted for identifying an existing transfer gap found in the literature. The methods section then introduces *LFI - SEPT* as an innovative approach. The results from the study found that when compared with Control Training, *LFI - SEPT* led to significant improvements. Autistic youth were shown to demonstrate significant gains in social eye processing abilities and across measures assessing performance in daily face-to-face social interactions. The closing discussion will inform for future refinement of the evidence base.

Literature Review

The Role of Social Eye Processing Abilities in Regulating Face-to-Face Social Interactions

Interpreting facial expressions through the eyes. A person's facial expression contains the emotional state they wish to convey, representing an outward manifestation of one's internal emotional state (Ekman & Friesen, 1971). Hence, interpreting facial expressions is key in maintaining successful social interactions with others. The six basic facial expressions include happy, sad, angry, disgusted, surprised, and afraid (Ekman et al., 1969). Evidence suggests that as humans, we interpret facial expressions primarily through the eyes. Research from eye tracking studies demonstrates that individuals typically spend more time attending to the eyes and eyebrows, rather than the nose and mouth areas (Beaudry et al., 2014). Laboratory experiments reveal that while participants are unable to accurately identify the basic six facial expressions from photographs of mouths and noses (Sullivan et al. 2007), they identify the basic six facial expressions instantly when viewing from the eyes and eye-brows condition only (Sadr et al., 2003). In their *Eyes Test*, Baron-Cohen et al. (1997) demonstrated that typical adults immediately recognize wide-ranging complex facial expressions in photographs of faces revealing only the eyes, eyebrows, and forehead. Interpretation of facial expressions from the

eyes region alone was found to be as informative as viewing the face in its entirety for reaching correct judgements regarding guilty, flirty, and bored facial expressions.

We process configural changes in the eyes for determining how others are feeling (Itier & Batty, 2009). Eyes with squinted configuration universally express disgust (Ekman & Friesen, 1978). Eyes wide open with greater volume of sclera (the whites of the eyes) exposed is indicative of fear or surprise (Whalen et al., 2004). Sadness is conveyed through the eyes in a particular downwards-trodden gaze (Ekman & Friesen, 1978). Expressing anger is especially eye focused, with the emotion paired with accentuated eyebrow frowning configuration (Calder et al., 2000; Smith et al., 2005). While recognition of happy expression is highly dependent on the degree of smile in the mouth region (Schyns et al., 2002), attention to the eyes refines interpretation of happiness, such that it can be determined if a happy smile is genuinely posed or feigned (Duchenne, 1990).

Moreover, the emotional intensity of any given facial expression is primarily interpreted through the eyes. In a drama performance recitation task, Kimble and Olszewski (1980) found that actors express their most happy and most angry facial expressions when engaging in eye contact for heightening the feeling of emotions. Using a 7-point Likert scale, Adams and Kleck (2005) required participants to rate *"how likely the actor depicted in the photograph"* is expected to be experiencing sadness or afraid emotions. Raters provided the highest emotional ratings for actors posing sad and afraid facial expressions, based on the direction of their eyes (e.g., looking downward or away) and by their engagement with eye contact. Such studies demonstrate that attention to the eyes is essential in guiding interpretation of facial expressions and regulating face-to-face social interactions with others.

Establishing and maintaining eye contact. Face-to-face social interactions are regulated by eye contact because eye contact between two individuals focuses their attention on each other. Eye contact, as defined here, occurs when our eyes are locked in attention with someone else's eyes in direct gaze (Senju & Johnson, 2008). Human beings naturally attend to the eyes as a key mechanism of social attention. This has been demonstrated from numerous peripheral object location tasks. In a study conducted by Senju and Hasegawa (2005), the researchers explored the effects of eye contact in slowing participant attention towards surrounding objects. University students were required to push a computer spacebar as soon as they noticed a fixation cross target appearing on screen. The fixation cross target could appear on either the right-or-left hand-side of the screen, while a face was always situated at center. Peripheral object detection by the participants was slower when the central face displayed eye contact in the time preceding presentation of the fixation target cross. Peripheral object detection was faster when participants observed the central face in the eyes-closed condition, before the fixation target cross appeared on screen. The detection of object fixation cross target was slower in the eye contact condition, because the participants selectively attended to the eyes, thus distracting them from the peripheral object location task.

More studies demonstrate that eye contact is foundational in priming our social attention for engaging in face-to-face social interactions with others. Von Grunau and Anston (1995) designed a viewing paradigm where participants attempted to identify target individuals from distractor persons in a crowd. Distractor persons were displayed in an eye contact avoiding condition (e.g., eyes looking away in left-averted or right-averted gaze), while target individuals appeared either posing eye contact or avoiding eye contact. Participant reaction time for picking out target individuals was determined to be faster when targets were presented posing eye

contact, and slower when targets appeared void of any eye contact (e.g., eyes were averted in left or right gaze). In similar eye contact versus averted gaze observation tasks, faces appearing within the eye contact condition are consistently found to be viewed for longer than faces appearing without eye contact (Palancia & Itier, 2012). Individuals are found to label facial expressions more quickly when eye contact is pre-established (Adams & Kleck, 2005).

The evidence clearly indicates that eye contact is a key mechanism in regulating our face-to-face social interactions with others. Impression rating studies have documented that individuals sharing eye contact are perceived as being more physically attractive (Kleinke et al., 1973), intelligent (Wheeler et al., 1979), and trustworthy (Bayliss & Tipper, 2006). When someone is directly looking into our eyes, we are their primary focus of attention and vice versa (Bertenthal & Boyer, 2015). Eye contact signals the intention to communicate (George & Conty, 2008; Senju & Johnson, 2008), activating brain systems that modulate social interaction (Pelphrey & Morris, 2006), theory of mind (Frith & Frith, 2006) and empathy towards others (Singer, 2006).

In face-to-face conversation, listeners frequently make eye contact with the speaker, and the speaker intermittently makes eye contact with the listener (Argyle & Cook, 1976). In humans, eye contact conveys willingness to interact and converse (George & Conty, 2008; Senju & Johnson, 2008; Frischen et al., 2007). As a speaker begins, they tend to disengage eye contact in speech, but re-engage once nearing the end of utterance (Vertegaal et al., 2001). Confirming understanding, the speaker's and listener's eyes meet. The speaker further elaborates to the listener; or alternatively, a switch in speaker ensues with a conversation turn taking place (Kendon, 1967). Conversation is not simply following a chain of spoken words. It invokes

complex social interpretation of an integrated message communicated within visible acts, including eye contact (Bavelas et al., 2002).

Following the eye gaze of others. We naturally interpret the direction of someone's eyes, towards other people, objects, and locations (Bertenthal & Boyer, 2015; Frischen et al., 2007). This social eye processing ability is commonly referred to as gaze following. Object recognition tasks have illustrated that gaze following results in either a cueing or interference effect (Xu & Tanaka, 2015). In these studies, the task typically begins with eyes first displaying eye contact and subsequently shifting left or right in averted gaze. Next, a target object is presented, appearing either congruently within averted eye gaze, or incongruently to the opposite side of the eye gaze.

In such experimental protocols, there are differences in response times when locating target objects, isolated to the effects of gaze following. The body of data indicates that as a strong cueing effect, participants find target objects quickly (almost reflexively) when appearing congruently within direction of eye gaze (Frischen et al., 2007; Langton & Bruce, 1999; Schilbach, 2015). An interference effect is also demonstrated with the time to locate target objects being slower when presented incongruently from eye gaze direction (Driver et al., 1999; Friesen & Kingstone, 1998; Langton et. al, 2000). This interference effect occurs because the direction of eye gaze cues the participant to search the incorrect target location first.

Additional studies have demonstrated the limited capacity of participants to stop this typical gaze following behaviour. In studies by Friesen et al. (2004); Posner et al. (1982), and Tipples (2008), the researchers repeatedly instructed participants that eye gaze congruency would not be held constant for improved locating of target objects. Participating persons should have logically ignored the direction of eye gaze for improving their search performance. Yet,

results from these studies indicate the contrary. Across the three studies, participants were found unable to inhibit their natural inclination to follow the eye gaze of others.

We follow eye gaze, not only for the purpose of locating other people, objects, and locations; but also, for interpreting the social intentions of others (Becchio et al., 2008). For example, Baron-Cohen et al. (1995) have demonstrated that eye gaze stimulates theory of mind for changing the favorite chocolate selection in young children. After viewing a piece of paper displaying four selections of chocolate, children first declared their most favorite based on personal preference. However, after an animated face was introduced into the background scene, children began changing their favorite chocolate to the one now being viewed (Baron-Cohen et al., 1995). Children ignored their original favorite based on social interpretations made from naturally following the eye gaze of the animated face. Bayliss et al. (2006) might describe this as similar to their reported, "*I like what you look at* effect". In their study with typical adults, common household items gazed at within congruent eye gaze were consistently rated as being preferable over items appearing incongruently, opposite from any eye gaze. The "*I like what you look at"* effect was found to be remarkably reliable, reported in 22 of 24 (92% of) participants.

Following eye gaze is critical because it provides mental scaffolding for sharing joint attention with others. Joint attention occurs when two or more individuals attend to a common aspect in their visual environment during a social interaction (Tomasello, 1995). As shared attention between social partners (Tomasello, 1995), joint attention is heavily regulated and sustained by interpreting eye gaze (Mundy & Newell, 2007). Solely by orienting the eyes, typically developing infants, by the time of their first birthdays, are already initiating joint attention bids with attachment caregivers. Infants learn they can recapture the waning attention of weary parents by simply winking their eyes (Hood et al., 1998).

Joint attention is widely studied in the early childhood literature, highlighting the importance of gaze following in reaching early social communication milestones (Mundy, 1995). Early language acquisition is highly dependent on the ability to interpret eye gaze when linking objects and events with words and sentences (Baldwin, 1991). Language requires the coordination of multiple forms of communication and develops primarily within joint attention in face-to-face social interactions (Tenenbaum et al., 2015). The amount of attention that an infant pays to their caregiver's eyes is found to be predictive in tracking the development of early language abilities (Brooks & Meltzoff, 2008; Carpenter et al., 1998; Young et al., 2009). Brooks and Meltzoff (2005) report a strong positive correlation between an infant's eye gaze following behaviour at 10 to 11 months old and their assessed language scores at 18 months.

More studies suggest the ability to follow eye gaze to body parts, gestures, and actions is foundational in a toddler's ability to learn by imitation. (Meltzoff, 2002). Youngsters acquire a whole repertoire of skills by imitating others (Over & Carpenter, 2012). Young children possess enormous mental scaffolding for mapping behaviours in others and then imitating these behaviours in their own social development (Meltzoff & Moore, 1977). Collectively, the evidence portrays that successful gaze following is predictive of joint attention quality. Following the eye gaze of others is found critical in the development of social communication skills, from early infancy and beyond.

Social Eye Processing Predicts Quality of Face-to-Face Social Interactions

Interpreting facial expressions through the eyes, establishing and maintaining eye contact, and following the eye gaze of others are pivotal social eye processing abilities in regulating our face-to-face social interactions. Reduced social eye processing is associated with mental health conditions that negatively impact social functioning. For example, the over-interpretation of

angry and hostile facial expressions is found to be an underlying contributor to social phobia, where individuals can become emotionally overwhelmed, even within seemingly normal social situations (Kolassa & Miltner, 2006). Individuals with social anxiety disorder, characterized by experiencing extreme social discomfort, also exhibit less eye contact during conversations when compared with non-diagnosed persons (Langer et al., 2017). While eye contact between parents and children typically precedes the development of love, attachment, and empathy; children with oppositional defiant disorder and callous and unemotional traits commonly display a significantly reduced response to parent eye contact (Dadds et al., 2012). Moreover, compared with typically developing peers, adolescents with bipolar disorder report enhanced challenges in sustaining their eye contact (Goldstein et al., 2006). Diminished social eye processing is further cited in the schizophrenia literature, as demonstrated by persons with schizophrenia not locating target objects faster within the congruent eye gaze condition (Dalmaso et al., 2013). Finally, individuals with advanced Alzheimer's often fail to acknowledge who is looking, limiting their initiation of joint attention bids with attending family members (Insch et al., 2017). Synthesizing the overall social eye processing evidence, deficits are associated with mental health conditions and wide-ranging social deficits. Interpreting facial expression through the eyes, establishing, and maintaining eye contact, and following the eye gaze of others are all foundational social eye processing abilities in shaping the development of healthy social communication across the human lifespan.

Social Eye Processing Abilities in ASD

Individuals with ASD have difficulties interpreting facial expressions through the eyes. Clinical studies have long established that persons with ASD struggle with interpreting facial expressions. In a naturalistic study, Hobson (1986) required children to select drawn and

photographed facial expressions, matched with videotaped vignettes of the researcher posing happy, sad, angry, and afraid facial expressions. When children with ASD, developmental delays, and typically developing children were compared, the ASD group showed the most difficulty in recognizing facial expressions. In comparison to age-matched typically developing peers and those with developmental delays, Celani et al. (1999) found that teens with ASD had more difficulty recognizing the same facial expression (e.g., happy) being posed across 12 different adult, and 12 different child actors. Observing photographs depicting female facial expressions, Gross (2004) reported that children with ASD experienced challenges in labeling happy, sad, angry, surprised, and neutral facial expressions, in comparison to children with language delay, developmental delay, and typically developing children.

Poor interpretation of facial expression continues to be linked with deficit social eye processing abilities in ASD. Pelphrey et al. (2002) investigated to what degree adults with and without ASD pay attention to the eyes, nose, and mouth when identifying face photographs containing emotion. In the typically developing group, five adult males demonstrated visual scanpaths evidencing a strategic pattern of attending to the eyes. By contrast, within the ASD group, five high-functioning male adults did not readily fixate their visual attention towards the eyes. Rather, visual scanpaths from the ASD group revealed a shared pattern of repetitive behavior, fixating much more frequently towards external facial features in the ear, on the chin, and over the top of the hair. Concurrently, the ASD group was found to make more errors in recognizing facial expressions from photographs, with this specific deficit not being reported in the typically developing group.

Subsequent studies have continued to posit that individuals with ASD pay minimal attention to the eyes; instead fixating greater attention towards the mouth and jaw region of the

face (Jones et al., 2008; Klin et al., 2009). In an eye tracking study designed by Kliemann et al. (2010), individuals with ASD and typically developing individuals were required to emotionally label faces as being happy, fearful, or neutral (e.g., posed without any obvious expression), while a fixation point dot appeared in either the upper-or-lower-half of the face. When the fixation point dot appeared in the upper-half of the face, individuals with ASD did not pay greater perceptual attention to the upper-face, whereas typically developing individuals did. Instead, persons with ASD rapidly shifted their attention away from the fixation point dot and were found to primarily focus on the lower-half, mouth-part of the face. When the fixation point dot appeared in the lower-half of the face, individuals with ASD continued attending primarily towards the mouth in the lower-half of the face, whereas typically developing individuals quickly shifted their attention back to the eyes in the upper-half of the face. The key interpretation here is that individuals with ASD were not collectively interpreting facial expressions through the eyes.

In addition to the paradigms described above, consider the previously introduced *Reading the Mind in the Eyes Task* (Baron-Cohen et al. 1997), where typically developing individuals demonstrate an ability to determine how someone is feeling by simply looking into the eyes. In their study using the *Reading the Mind in the Eyes Task* with typically developing individuals, Baron-Cohen et al. (1997) included a second study group for investigating adults with high-functioning ASD, and a third study group for examining adults with Tourette Syndrome. Examining 25 photographs of facial expressions in which only the eye/brow region was visible in the face, participants were asked to match facial expressions to one of two emotional labels (e.g., concerned, or unconcerned). While all typically developing adults and all adults with Tourette Syndrome were found to correctly read the language in the eyes above chance levels, only 50% of adults with high-functioning ASD were able to do so. Given the comprehensive

evidence surrounding individuals with ASD, who are not effectively interpreting facial expressions through the eyes (Baron-Cohen et al., 1997; Pelphrey et al., 2002; Norbury et al., 2009), it is not unreasonable to predict these individuals will continuously struggle in regulating broader face-to-face social interactions with others.

Persons with ASD have impairments in establishing and maintaining eye contact. Lack of eye contact is described as one of the earliest manifestations of ASD, observable in the first year of life (Baron-Cohen et al., 1996; Zwaigenbaum et al., 2013). While ASD is usually diagnosed in children over the age of 3 years (Guthrie et al., 2013), retrospective and prospective studies including children at high-risk for ASD confirm poor eye contact as an early red flag. In one retrospective study, Osterling et al. (2002) recruited 5-year-old children with diagnoses of ASD, children with cognitive delays, and typically developing children. The researchers observed home videotapes from first-year birthday parties, attempting to isolate specific behaviours that might be predictive of children having ASD. Remarkably, infants who were subsequently diagnosed with ASD exhibited considerably less eye contact with other children and adults, compared to children with cognitive delays and typically developing children, whose eye contact was found to be comparable (Osterling et al., 2002).

Additional early childhood studies using prospective approaches confirm that infants at high-risk for ASD do not establish and maintain eye contact as readily as those considered to be low-risk. The goal of such prospective studies is to observe early social behaviors in high-risk infants for identifying the types of behaviors that predict an ASD diagnosis in later childhood. Siblings of children diagnosed with ASD are of particular interest in these prospective studies, given genetic sibling concordance rates of 20% (Ozonoff et al. 2011), which is 13 times higher than the ASD concordance rate from the general population.

In an eye tracking study by Jones and Klin (2013), high-risk infants were assessed for eye contact while observing videos of caregiver faces. Caregivers looked directly into the camera while speaking expressively, displaying inviting facial expressions. Analyses from visual scanpaths revealed that eye contact in infants who were later deemed to be typically developing rose steadily from 2 to 9 months old and remained stable by age 2 years. In contrast, the infants later diagnosed with ASD exhibited eye contact similar to typically developing infants at 2 months old, with a continual regression thereafter. By the age of 24 months, infants who were later diagnosed with ASD were making half as much eye contact as their same-age peers. This finding is particularly noteworthy as it contradicts previous research reporting that social eye processing deficits are found to be congenital in autism, with symptomology established right from the start at birth (Geschwind & Galaburda, 1987; Kanner, 1943; Klin, et al., 2002).

Indeed, developmental studies suggest that the reduced eye contact found in infants who later develop ASD only further decreases with age. In a study conducted by Charwarska and Shic (2009), the researchers compared eye contact across four study groups including 2-year-olds with ASD, 4-year-olds with ASD, and two groups of age-matched typically developing peers. Children's cumulative time holding eye contact was determined by examining eye fixation patterns from photographs displaying neutral facial expression being posed by female actors. Neutral facial expressions were posed for the purpose of controlling for any extraneous eye contact effects occurring from viewing different types and intensities of expressions. Amongst typically developing children, 2-year-olds and 4-year-olds spent comparable time making frequent eye contact. Within both ASD groups, the 2-year-olds and 4-year-olds with ASD spent considerably less time sustaining eye contact than their age-matched typically developing peers.

The critical finding was that the 4-year-olds with ASD spent considerably less time sustaining eye contact than the younger 2-year-old ASD children.

Moreover, studies assessing adults with ASD continue to demonstrate that poor eye contact in infancy remains stable beyond childhood, persisting well across the lifespan. Klin et al. (2002) recorded eye tracking scan paths from 15 adult males with ASD and 15 age-matched typical controls as they watched video clips from the Edward Albee (1966) feature film, *Who's Afraid of Virginia Wolf?* Scenes were selected based on a close-up presentation of the actor faces. Eye contact was the one behavioral variable capable of correctly classifying participants as either having ASD or not. All participants with ASD were found attending significantly less to the actor faces. When they did attend to faces, participants with ASD fixated their visual attention primarily towards the mouth region, as opposed to the eyes. This atypical performance of increased attention to the mouth as opposed to the eye region has been well replicated in numerous autism facial recognition studies since the late 1970s (Langdell, 1978; Neumann et al., 2006; Tanaka et al. 2012).

Individuals with ASD struggle in following the eye gaze of others. Poor infant eye contact manifests in atypical social eye processing ability found across the autism spectrum. With respect to following the eye gaze of others, one might expect that individuals with ASD would demonstrate less of a congruent cueing effect (e.g., whereby targets are found faster in search tasks when placed in line of eye gaze) and less of an incongruent interference effect (e.g., where targets are found slower in search tasks when located in the opposite direction of eye gaze). However, in highly controlled laboratory experiments, individuals with ASD have been shown to demonstrate both intact congruent cueing and incongruent interference effects (Kylliainen & Hietanen, 2004; Senju et al., 2004; Swettenham et al., 2003.). For example, in an

object recognition task study by Bedford et al. (2012), infants assessed as being at-risk for having ASD were compared with infants assessed as being low-risk. At 7-months-old and at 13-months-old, no significant differences were found between at-risk and low-risk infants when following a model's gaze to left or right positioned target objects.

Yet, despite these surprising findings, other highly controlled studies demonstrate that eye gaze following is indeed atypical in ASD. Compared with low-risk infants, Bedford et al. (2012) noted that at 13 months, at-risk infants for having ASD showed reductions in sustained looking attention when following eye gaze towards congruent target objects. Thorup et al. (2016) questioned whether infants with ASD were following head turns, rather than attending to the eyes. The researchers devised an object recognition task assessing eye gaze following within an eyes-only condition, versus an eyes-within-a-head-turn condition. The results indicated that 10-month-old high-risk infants who later received an ASD diagnosis performed significantly more poorly in following eye gaze in the eyes-only condition. The 10-month-old high-risk infants who did not later receive ASD diagnosis showed no performance discrepancy across the two conditions.

Moreover, studies using alternative and naturalistic methodologies continue to align, in demonstrating rigid eye gaze following deficits found across the lifespan in persons with ASD. Riby et al. (2014) explored eye gaze following abilities in children with ASD and in typically developing peers, matched by verbal ability. Children were presented with photographs where actors gazed congruently at a target object surrounded by distractor objects appearing incongruently from the eye gaze. The typically developing children followed eye gaze seamlessly, requiring very little time in scanning the actor faces before spending most of their time examining correct target objects. Children with ASD spent much more time attending to the

actor faces yet had difficulties following their eye gaze to congruently gazed at target objects. As a result, the children with ASD spent much more time fixating on incorrect distractor objects than did typically developing children.

Birmingham et al. (2017) investigated the ability to follow naturalistic gaze shifts in adolescents with ASD and typically developing adolescents. In their experiment, participants were seated on a couch with a card game and a board game set up on a coffee table in front of them. Participants played the card game and board game with a female experimenter, who was seated in a chair behind the coffee table, with the participant and experimenter sitting directly across from one another. As the participant and experimenter played the card and board games, in one condition the experimenter pseudo-randomly made head turns, shifting eye gaze to congruently look at peripheral target objects set up to the left or behind the experimenter. In a second condition, the female experimenter pseudo-randomly attended to a second female observer playing the role of a third-person social target, seated to the right of the experimenter. Results indicated that during game play with the experimenter, participants with ASD had difficulty following the direction of the experimenter's head turns and averted eye gaze. Participants with ASD were also slower than typically developing peers when first attending to spontaneous shifts in the experimenter's head turns and eye gaze towards peripheral target objects or the third-person social target. The adolescents with ASD were found spending more time looking at the experimenter than typically developing youth, who seamlessly shifted attention between the experimenter, peripheral target objects, and the third-person social target.

Finally, Baron-Cohen et al. (1995) have demonstrated that children with ASD do not display a typical *"I like what you look at effect"* (Bayliss et al., 2006). Recall that typically developing children selectively prefer objects displayed congruently within eye gaze, as

previously exemplified in the Baron-Cohen et al. (1995) study exploring children's favourite chocolates. The Baron-Cohen et al. (1995) study also included a group of children with ASD. Failing to interpret affective eye gaze, children with ASD did not change their selection of favorite chocolates after the animated face was introduced in assessment. Meanwhile, typically developing peers were shown to modify their favorite chocolate selections based on following the eye gaze of the animated face towards their new favourite selections.

Social Eye Processing Deficits Are Predictive of Impairments in Face-to-Face Social Interactions Across the Lifespan in ASD

Inattention to the eyes is one of the core diagnostic features of ASD (Guthrie et al., 2013; Lord et al., 1999). In the first formal description of ASD, Kanner (1943) described autism as a childhood disorder of affective contact. Early social eye processing deficits are attributed to disruptions in the typical development of social, communicative, and mentalizing skills - contributing to the behavioral phenotype of ASD (Sasson, 2006; Shultz, 2005). Dawson et al. (2004) compared emotional response to distress in 3-year-old children with ASD, developmental delay, and typically developing children in a play-based joint attention task. In the task, children started playing with a toy before an examiner joined in, feigning injury while sharing use of the toy. Through multiple trials, the researchers carefully manipulated the examiner's facial expressions, eye contact, and eye gaze. Compared to children who were typically developing or had developmental delays, children with ASD demonstrated severely reduced joint attention, displaying emotions that conveyed a lack of empathy for the experimenter feigning injury.

Charwarska et al. (2013) designed an eye-tracking study for 2-year-old toddlers, in which youngsters viewed a video of an actor being surrounded by four different toys and different ingredients for making a sandwich. In one scene, the actor did not engage with any of the toys or

sandwich ingredients and spoke directly into the camera while maintaining eye contact throughout. The researchers found that in comparison with typically developing toddlers and those with developmental delays, toddlers with ASD paid significantly less attention to the actor's face.

In their structured video modelling task, Vivante & Hamilton (2014) explored the role of eye contact in facilitating imitation social behaviour in 3-year-old children, with and without ASD. An experimenter was video recorded first making eye contact, and then engaging with several different play objects. Children were required to imitate the experimenter playing with the objects. Observational analyses concluded that children without ASD diagnoses viewed the video and seamlessly reciprocated eye contact with the experimenter before correctly imitating with play objects. In contrast, children with ASD diagnoses made less eye contact with the experimenter and did not readily imitate social actions (Vivante & Hamilton, 2014).

Beyond the numerous infant and early childhood studies, research continues to link significant social eye processing deficits with atypicalities in how individuals with ASD interpret human faces. One review suggests that some high-functioning youth and adults with ASD, including persons with higher language and cognitive abilities, may be able to employ compensatory strategies to effectively pass facial recognition tasks (Jemel et al., 2006). However, when performance is restricted to interpreting faces from the eyes alone, individuals with ASD persistently exhibit ongoing facial processing deficits (Tanaka & Sung, 2016; Weigelt et al., 2012).

In summary, the clinical evidence strongly indicates that persons with ASD experience significant challenges in social eye processing abilities, leading to deficits in face-to-face social interactions across the lifespan. In John Elder Robison's (2008) autobiography entitled, *Look Me*

In The Eye, the author portrays his own social eye processing deficits quite eloquently. “I don’t really understand why it’s considered normal to stare at someone’s eyeballs.’’ And yet, Robison’s (2008) insight reveals the full depths of his social exclusion. Robison recognizes that others do not trust him, simply because is uncomfortable looking them in the eyes.

Computer-Based Training for Improving Social Eye Processing Abilities in ASD

Given the established evidence linking social eye processing deficits with broader face-to-face social interaction impairments, the call for developing new effective training tools is urgent, necessary, and now! One method demonstrating promise is by means of computerized face training. Incorporating face training within a computerized gaming format may serve as an effective learning platform for individuals on the autism spectrum, given their preferences and motivations for seeking screen-based media (Shane & Albert, 2008). Computerized interventions provide explicit rules, clear expectations for success, and direct immediate feedback, making them highly effective teaching tools (Heimann et al., 1995) for supporting mastery learning (Bosseler & Massaro, 2003). Research has shown that children with ASD, who tend to be inflexible and repetitively routine-bound, show favorable preferences towards the fair, rule-bound predictability of computerized training (Moore & Calvert, 2000).

For instance, Massaro and Bosselor (2006) developed *Baldi* as a computer-animated tutor, finding that children with ASD showed greater gains in language acquisition after learning together with *Baldi* in specific vocabulary lessons. Mitchell et al. (2007) used virtual café and bus scenes for teaching social understanding related to personal space, in a procedure benefiting six teens with ASD. Teens observed café and bus videos and were required to identify the correct place where they should sit from each social scene. Naive raters determined that from both the café and bus videos, teens with ASD improved significantly in their social interpretations,

demonstrating better understanding of personal space after computerized training.

In recent years, online training programs such as *The Social Express* (Brighten Learning, 2021) have become popular learning options for children with ASD and their families. In *The Social Express* (Brighten Learning, 2021), children learn social understanding while viewing 81 webisodes, where four animated characters problem solve using social skills such as attentive listening, conflict resolution, critical thinking, group participation, and self-management.

There is increasing interest in adapting computerized training protocols for improving facial recognition skills in ASD. The goal of such studies has been to train persons with ASD to better recognize faces and facial features across different individuals and facial expressions. In *Emotion Trainer* (Silver & Oaks 2001), face training consists of five separate levels. Each level contains 20 affective scenarios in which a digital photograph of a face, scene, or object is shown, along with a short accompanying text. With the goal of improving emotion understanding, the scenarios train children with ASD to better recognize facial expressions. In a randomized group study, 22 children with ASD (ages 10-18 years) completed the program in ten half-hour training sessions over 2 to 3 weeks or received no such training in a control condition (Silver & Oaks 2001). Children with ASD who played *Emotion Trainer* significantly outperformed control children at post-assessment on the administered *Recognition Cartoons* task (Silver & Oaks 2001) and *Strange Stories* assessment (Happé, 1994).

In *Frankfurt Training of Facial Affect Recognition* (Bolte et al., 2002), users acquire and strengthen their affective vocabulary by matching faces with emotional labels. Faces are presented on the computer presenting a selection of seven possible emotions. Correct responses are reinforced by comic strip displays, for further contextualizing the emotions. Comparing 10 teens and adults between the ages of 16-40 years who were diagnosed with ASD, five individuals

who received 10 hours of *Frankfurt Training of Facial Affect Recognition* (Bolte et al., 2002) over 5 weeks showed significant gains in using faces and eyes to correctly identify facial expressions on the *Frankfurt Test of Facial Affect* (Bolte et al., 2002). Improvements were not seen in the five control participants who did not receive active training.

Mind Reading (Golan & Baron-Cohen, 2006) is described as an interactive guide to emotions and mental states. In total, 24 emotions are defined and demonstrated over six silent films featuring faces, accompanied by additional voice recordings and written passages. The software includes an *Emotion Library* of faces, *Learning Center* with lessons, quizzes and rewards, and a *Game Zone* consisting of interactive face games. In a comparison group study, 19 adults with ASD (17-52 years old) completed 20 hours of *Mind Reading* (Golan & Baron-Cohen, 2006) instruction, with active training ranging between 10 to 15 weeks. A matched control group of 22 adults with ASD were assessed without having received any intervention. Pre-and-post test results on the *Reading Mind in the Eyes Task* (Baron-Cohen et al., 2001) indicated that users of *Mind Reading* (Golan & Baron-Cohen, 2006) significantly improved in their ability to recognize complex emotions and mental states from faces, relative to the control group.

The Transporters (Golan et al., 2010) is an animated children's DVD, designed to enhance emotion comprehension. The series includes 15 short episodes featuring eight animated vehicular characters, all of whom possess grafted human faces. Cars, buses, and boats interact as animated vehicular characters, as these vehicles tend to be of high interest to many individuals on the autism spectrum (Baron Cohen, 2002). As the animated vehicular characters go about their days, they experience wide-ranging social challenges for eliciting targeted facial expressions. In a randomized group training study (Golan et al., 2010), 20 children with ASD (aged 4-7) watched *The Transporters* every day for 10 hours over 4 weeks. Children's

recognition of facial expressions was assessed before-and-after using the *Situational Facial Expression Matching Test* (Golan et al., 2010). Children's performance in active training was compared with two control groups where no training was provided. One control group included matched children with ASD (n=18) and a second control group compared performance of typically developing peers (n=18). The study authors reported three main findings. First, in both ASD and typically developing control groups, children showed no significant improvements from pre-to-post-testing in their recognition of facial expressions. Second, children with ASD were found significantly improved on the *Situational Facial Expression Matching Test* (Golan et al., 2010) after viewing *The Transporters* (Golan et al., 2010). And third, the study concluded that after active training, children with ASD had improved so significantly in recognizing facial expressions that their performance at post-test was almost comparable with typically developing peers. The researchers suggested that facial expression recognition skills in children with ASD had been enhanced to almost normative levels after completing *The Transporters* (Golan et al., 2010) training.

While the *Emotion Trainer* (Silver & Oaks 2001), *Frankfurt Training of Facial Affect Recognition* (Bolte et al., 2002), *Mind Reading* (Golan & Baron-Cohen, 2006), and *The Transporters* (Golan et al., 2010) programs have all demonstrated the ability to improve facial expression understanding in ASD, only two computerized face training efforts to date have specifically focused on boosting specific social eye processing abilities. *Let's Face It!* (Tanaka et al., 2010) and *FaceSay* (Hopkins et al., 2011; Rice et al., 2015) are two computerized face training protocols designed for individuals with ASD. These programs include designated social eye processing training for better interpreting facial expressions through the eyes, establishing and maintaining eye contact, and following the eye gaze of others.

Both *Let's Face It!* (Tanaka et al., 2010) and *Face Say* software (Hopkins et al., 2011; Rice et al., 2015) are PC-based learning games, programmed to be played on stand-alone desktop and laptop computers. *Let's Face It!* (Tanaka et al., 2010) consists of seven interactive, arcade-style games: *Two of a Kind, Eye Spy, Zap It, Face Maker, Find a Face, Search Party,* and *Splash It.* Each game includes engaging real face graphics, an original music track, and at least 24 levels of gameplay that steadily increase in difficulty and complexity (Tanaka et al., 2010). Hierarchical training across the *Let's Face It!* games is structured to address specific facial recognition deficits found in ASD, including inattention to the eyes, impaired recognition of facial expressions, and difficulty recognizing identity across changes in facial expressions, viewpoints and features (Tanaka et al., 2010). With respect to the training of social eye processing abilities, the *Eye Spy* game consists of two separate modes for improving both user eye contact and eye gaze following. In its *Eye Contact* mode, multiple faces appear on screen and players must click on the faces holding eye contact. In its *Eye Gaze Following* mode, a face appears in the center of the screen with eyes gazing at peripheral target objects, and users must click on the correctly gazed at target objects to advance to higher levels.

Similarly, *FaceSay* (Hopkins et al., 2011; Rice et al., 2015) provides three arcade-style face training video games. In *Band Aid Clinic*, users fix and band-aid together parts of faces by attending to facial features (e.g., eyes, mouth, and nose). In *Follow the Leader*, users are forced to attend to the eyes of avatar characters for improving facial expression recognition. Like the *Eye Spy* game in *Let's Face It!* (Tanaka et al., 2010), the *Amazing Game* in *Face Say* (Hopkins et al., 2011; Rice et al., 2015) is specifically designed for improving eye contact and eye gaze following. In the *Amazing Game*, a central face appears on screen, surrounded by peripheral

objects, numbers, or faces. The central face is always presented making eye contact first before the eye gaze is averted and the user must then click on which targets the central face is gazing at.

Both *Let's Face It!* (Tanaka et al., 2010) and *Face Say* (Hopkins et al., 2011; Rice et al., 2015) have been evaluated for effectiveness in boosting facial recognition skills amongst children with ASD. Evaluating the *Let's Face It!* program, Tanaka et al. (2010) included 79 children with ASD in a randomized waitlist control design. In the active training condition, 42 children with ASD (34 males and 8 females) participated with mean age of 10.5 years (SD = 3.8) and mean Full Scale IQ of 93.6 (SD = 22.1). These children completed 20 hours of face training, playing from the suite of *Let's Face It!* games (Tanaka et al., 2010). In the waitlist control group, 37 age-and-IQ matched children with ASD (28 males and 9 females) were provided with the *Let's Face It!* program following completion of the study (Tanaka et al., 2010). All participants were assessed pre-and-post training utilizing the *Let's Face It! Skills Battery* (Wolf et al., 2008). The results indicated that children in the active training group demonstrated significantly more improvement than children in the waitlist control group on one of the *Let's Face It! Skills Battery* (Wolf et al., 2008) subtests, the *Parts/Whole Identity Task* (Tanaka et al., 2010). The researchers reported that children with ASD experienced gains in their facial recognition of mouth features, and in their enhanced holistic recognition of faces based on eye features.

Hopkins et al. (2011) evaluated the efficacy of the *FaceSay* software in 49 children (6-10 years old) with ASD. Children were assigned to one of four study groups: a severe ASD training group (n=11), a severe ASD control group (n=14), a mild ASD training group (n=13), and a mild ASD control group (n=11). In the active training groups, children played *FaceSay* twice a week for 6 weeks, in sessions lasting between 10 to 25 minutes. In the control groups, children utilized *Tux Paint* (Tux Paint, 2010), an open-source children's drawing program, over the same duration

of time. Pre-and-post-testing established that playing *FaceSay* significantly improved recognition of facial expression in both severe and mild ASD groups, relative to children participating in the control groups (Hopkins et al., 2011). In addition, the researchers assessed if playing *FaceSay* at school would lead to any perceived gains in social skills demonstrated in the home environment. As a group, severe children with ASD received higher parent scores on the *Social Skills Rating System* (Gresham & Elliott 1990) following completion of *FaceSay* training (Hopkins et al., 2011). However, this boost in social skills rating was not observed in parents of children with mild ASD (Hopkins et al., 2011). As a second social measure, Hopkins et al. (2011) utilized a self-designed playground observation for determining if children with ASD in the *FaceSay* training condition showed improvements in their social interactions during recess at school. Research assistants coding for social behaviours found that the children with ASD who played *FaceSay* (Hopkins et al., 2011) demonstrated significantly improved playground interactions with their peers at recess, compared with children with ASD who showed no such improvements playing *Tuxpaint* (2010).

In a replication study by Rice et al. (2015), *Face Say* was again found to be effective in boosting facial recognition and social skills in children with ASD. The *FaceSay* training study (Rice et al., 2015) was implemented with 31 elementary school students with ASD, ranging in ages from 5-11 years. Active *FaceSay* training was provided for 16 elementary school students, with an additional 15 elementary school students participating in a control group using *SuccessMaker (*Savvas, 2014*)*, a popular classroom K-8 reading software. All participants received 10 weeks of training and participated in weekly research sessions running for approximately 10 to 25 minutes. Pre-and-post assessments determined that elementary school students using *FaceSay* (Rice et al., 2015) outperformed controls in recognizing child facial

expression photographs from the *NEPSY-II Affect Recognition* subtest (Korkman et al., 2007). The *FaceSay* training (Rice et al., 2015) also yielded significant gains in participant mentalizing abilities on the *NEPSY-II Theory of Mind* subtest (Korkman et al., 2007). Finally, elementary school students who underwent *FaceSay* training (Rice et al., 2015) made greater gains in their social skills performance as rated by educators on *The Social Responsiveness Scale, 2nd edition* (Constantino & Gruber, 2002), compared to control children receiving *SuccessMaker (*Savvas, 2014*).* The two *FaceSay* evaluations by Hopkins et al. (2011) and Rice et al. (2015) provide evidence for adapting use of computerized face training platforms, ultimately for improving social communication functioning in ASD.

Although the above noted studies show some evidence of transfer or generalization through gains on behavioral report measures, a pressing question in the current literature is whether computer-based training readily transfers to children's everyday lives within face-to-face social interactions. Broadly put, transfer of learning involves prior learning affecting new learning or performance (Marini & Genereux, 1995). The ability to transfer a learned behavior acquired during a training activity to another similar or related activity is a major challenge identified in the general training research and found particularly challenging in autism training studies (Koegel et al., 2001). Applied to computerized face training in ASD, the transfer findings are inconsistent across the conducted studies, placing into question whether computerized face training readily generalizes to real-situated environments.

For example, in the case of *The Transporters* program (Golan et al., 2010), Williams et al. (2012) re-examined the software to determine if computerized face training would lead to any improvements in children's theory of mind and or enhancements in demonstrated social skills. Their study consisted of 55 children (ages 4-7 years) with severe ASD, randomly assigned to a

training group or control group. In the training group, 28 children spent on average 11 hours viewing *The Transporters* (Golan et al. 2010) over 4 weeks (Williams et al., 2012). In the control group, 27 children spent on average 7.4 hours watching episodes from *Thomas the Tank Engine* (Gullane Entertainment, 1998) over the same 4-week period (Williams et al., 2012). Relative to the control group, gains from viewing *The Transporters* were found limited. Children with severe ASD significantly improved in recognizing angry facial expressions yet did not experience significant growth in the mind reading, theory of mind, or social skill tasks administered (Williams et al., 2012).

Another critical limitation has been a failure by researchers to deliver more naturalistic computerized face training; with a clear omission of real-world outcome measures in assessing face-to-face social interactions in ASD. For example, in the testing conducted for evaluating the use of *Let's Face It!* (Tanaka et al., 2010) and *Face Say* (Hopkins et al., 2011; Rice et al., 2015), there were no measures included for assessing children in eye contact or eye gaze following abilities. Without direct assessment, there remains a gap in the current literature as to whether computer-based training can improve social eye processing abilities in persons with ASD.

The rapid development of new mobile devices is holding promise for delivering computerized training paradigms that are far more meaningful, authentic, and personalized. Next generation training has potential for bridging the conventional transfer gap existing between small-screen learning and big-world performance. Offering extraordinary accessibility options (Fager, 2011) and Universal Design for Learning (Rose & Meyer, 2002) features, smart phones and tablet devices can be leveraged as social learning tools for improving the lives of persons with ASD. In a review paper, Sung et al. (2016) examined new mobile apps for teaching facial emotion skills to children on the autism spectrum. The review paper indicated that while most

apps to date lack formal empirical validation, there is optimism for developing improved learning platforms given tremendous technological advancements in accessibility, portability, and engagement features.

Introducing the *Let's Face It! Scrapbook* App.

The *Let's Face It! Scrapbook* (The University of Victoria, Centre for Autism Research, Technology, and Education, 2016) app was designed as a free download available from the App Store (Apple, 2016). In the original *Let's Face It!* program, (Tanaka et al. 2010), gamers completed their face training drawing from stock character faces. Face training was not personalized to match the individual's everyday social life or social interactions with others, raising the question as to whether the small-screen training gains would readily transfer to user big-world experiences.

In closing the gap between small-screen learning and big-world outcomes, the *Let's Face It! Scrapbook* app is an innovative extension of the original *Let's Face It!* program. Within the virtual learning environment of the *Let's Face It! Scrapbook* app, users first capture, label, and sort through self-generated photographs and short (2-second) video clips; with this user driven content serving as the active training stimuli in a suite of engaging face training games. Deviation from using stock gaming content provides an authentic training experience, fully imbued within natural social context.

Individuals use the *Let's Face It! Scrapbook* app by first capturing photographs and recording short 2-second video clips via the iPad's camera. Users are able to photograph, and video record their own faces, as well as the faces of friends, family, peers, classmates, and or teachers at school. After capturing photographs, the app requires that users label each photograph and video clip. Users are given the discretion to apply any label of their choosing. For example,

an individual can take a photograph of their friend and label the photograph by name (e.g., Bill), or can choose to label the photograph by emotion (e.g., happy). Once photographs and video clips have been captured and labeled, they instantly appear within the game app's working bench. Here, users can sort through their captured content, either by browsing and reviewing individual photographs and video clips within a depicted film roll, or by drag-and-dropping content into category albums. For example, an individual can review their photograph of someone (e.g., Bill) smiling and sort it into a *My Friends* album, or alternatively can sort it by placing it into a *My Feelings* album.

After capturing, labeling, and sorting user photographs and short video clips, individuals can then engage in playing from one of the four *Let's Face It! Scrapbook* app training games. In both *Splash*, and *Name Game*, users match labels appearing at top of screen with their captured photographs and short video clips appearing on screen. The *Memory* game requires users to match labels appearing at top of screen with occluded playing cards depicting captured photographs or short video clips on their backsides. For creating new composite faces in *Fuse*, the screen is split in two vertical panes. Within each pane, users scroll horizontally to review previously captured content. Selecting one upper-half (e.g., eye-part) photograph and aligning it with a separate lower-half (e.g., mouth-part) photograph produces entirely new faces in an engaging gaming experience.

In each of these *Let's Face It! Scrapbook* app training games, labels from the photographs and short video clips captured by individuals may be tapped and read aloud using the *Let's Face It! Scrapbook* app text-to-speech function. The *Let's Face It! Scrapbook* app games follow behavioural learning principles so that initial training is errorless, yet becomes increasingly difficult as users progress. Games begin by displaying only one text label, and one

captured photograph or short video clip, whereas more advanced levels include multiple labels with many competing distractor photographs and short video clips. Through repetitive matching of labels, the goal is for players to improve in their accuracy, fluency, and automaticity when recognizing and interpreting faces.

As an open-source learning platform, the *Let's Face It! Scrapbook* app encourages users to constantly generate newly personalized content. Using the *Let's Face It! Scrapbook* app, individuals are provided with endless opportunities for improving in daily face-to-face social interactions. Compiling photographs and short video clips from a user's everyday life, the *Let's Face It! Scrapbook* app provides a unique social gaming experience that continues to grow and evolve with each training session. While taking someone else's picture may seem overwhelming at first, especially for persons with ASD, the act of taking pictures and engaging in photography provides additional scaffolding for improving in daily face-to-face social interactions.

As a critical feature, the *Let's Face It! Scrapbook* app ensures that users can capture photographs and short video clips from multiple viewpoint camera angles. For example, in the real world we often observe our friend (e.g., Bill*)* with his head turned to the side, with his eyes directed away, or looking up at the sky. None of these are ideal camera poses included in traditional face training efforts but provide for a much more diverse and authentic training experience. In capturing a user's big-world face-to-face social interactions and implanting them into small-screen gameplay, the *Let's Face It! Scrapbook* app offers targeted social eye processing training that is personalized to each user's own lived experience.

While the *Let's Face It! Scrapbook* app was designed to be a personalized training app, it is equally fun and engaging as an effective learning platform. The app is gamified (Sung et al., 2015) for maximizing user engagement, with elaborately designed background settings, use of

vivid graphics, and inclusion of original audio files. The text-to-speech capacity further supports using the *Let's Face It! Scrapbook* app with pre-readers for maximizing engagement of individuals across the vast spectrum. Ensuring access to training for all, *Universal Design for Learning* features include a touch-screen interface, organizing symbols, and multiple input modes (Rose & Meyer, 2002). By its design, the *Let's Face It! Scrapbook* app is fully inclusive and accessible to a wide range of diverse learners.

Due to the flexibility of training stimuli that can be captured (e.g., cars, birds, trains, and faces) and generated, the *Let's Face It! Scrapbook* app can be hypothetically applied to improving recognition skills across any category. One potential category is eye stimuli, with the research evidence suggesting that social eye processing training may further extend to enhancing face-to-face social interactions in ASD.

Purpose of the Study with Research Hypotheses

The purpose of the current study was to develop, implement and evaluate a social eye processing training program for autistic youth, using the *Let's Face It! Scrapbook* app platform and its *Splash*, *Name Game*, *Fuse,* and *Memory* games. *LFI - SEPT* was designed by the principal investigator and focused on enhancing the social eye processing abilities of autistic youth. Active training was delivered over 3 weeks. Interpreting facial expressions through the eyes was emphasized in week 1 training. Establishing and maintaining eye contact was targeted in week 2 training, Following the eye gaze of others was introduced in week 3 training. Controlling for maturation, practice (test-retest) effects, and time spent with research facilitators and a training coach, a Control Training program was developed to equate for key learning variables inherent in *LFI - SEPT*.

First, it was hypothesized that after receiving *LFI - SEPT*, autistic youth would show significant gains in their social eye processing abilities, as evidenced by improvements in interpreting facial expressions through the eyes, establishing and maintaining eye contact, and following the eye gaze of others. These improvements in social eye processing abilities were not hypothesized to replicate in the designed Control Training.

Second, it was hypothesized that after completing *LFI - SEPT*, autistic youth would experience transfer of learning by demonstrating significant enhancements in daily face-to-face social interactions. This would be established by autistic youth posing improved facial expressions, increasing in their social competency in understanding faces, and experiencing enhanced friendships. Transfer of learning was not expected from the Control Training analysis.

Third, it was hypothesized that any improvements demonstrated from *LFI - SEPT* would be significantly greater than any gains reported from Control Training. This hypothesis was to evaluate if *LFI - SEPT* was significantly more effective than Control Training in raising social eye processing abilities and improving daily face-to-face social interactions in autistic youth.

Method

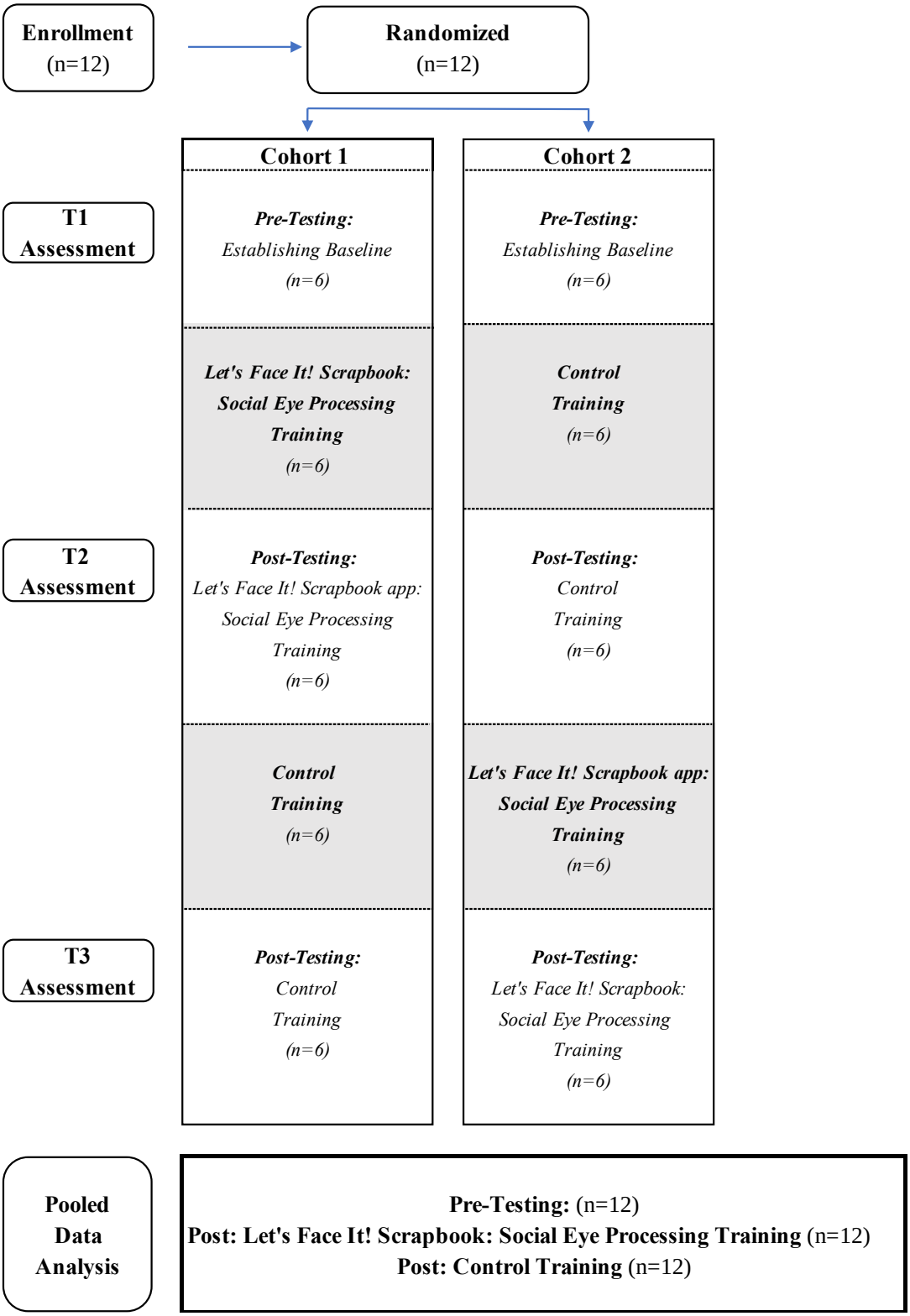
This study was approved by the University of Victoria *Human Research Ethics Board* in accordance with Tri-Council principles. The study procedures were fully explained to autistic youth and their parents before obtaining written informed consent, which could be withdrawn at any time.

Study Design

The study utilized a pre-test/post-test control group switching replications design (Eagle & Barnes, 2009) for comparing training outcomes pertaining to *LFI - SEPT* and Control Training (See Figure 1). In this design, autistic youth were randomly assigned

Figure 1

Diagram of the Pre-Test/Post-Test Control Group Switching-Replication Design



to start in either *LFI - SEPT* or Control Training. Upon completing their initial training, autistic youth then switched training conditions to receive the alternate training condition. Completing both *LFI - SEPT* and Control Training, autistic youth served as their own controls. Autistic youth received assessments at three time points (T1, T2, and T3). Assessments were carried out prior to the autistic youth completing any trainings (at T1), after autistic youth had completed their first training (T2), and after autistic youth received their second training (at T3).

In the current study, gender-matched autistic youth were randomly assigned to one of two research cohorts. In Cohort 1, six autistic youth (five male, one female) completed *LFI - SEPT* first, before receiving Control Training. The Cohort 1 youth were supported in their training by two female undergraduate psychology student research facilitators (*Facilitator 1* and *Facilitator 2*) and were further split in two small groups. Half of the Cohort 1 youth (2 males, 1 female) received *LFI - SEPT* first with *Facilitator 1*, and then went on to complete Control Training with *Facilitator 2*. The remaining half of Cohort 1 youth (3 males) first received *LFI - SEPT* from *Facilitator 2,* before ending with the Control Training led by *Facilitator 1*.

In Cohort 2, six autistic youth (five male, one female) with ASD received training in reverse order. Cohort 2 youth underwent Control Training first, followed by their *LFI - SEPT.* The Cohort 2 youth were aided in training by two additional female undergraduate psychology student research facilitators (*Facilitator 3* and *Facilitator 4*) and were again further split up into two small groups. Half of the Cohort 2 youth (2 males, 1 female) completed Control Training first with *Facilitator 3,* before participating in *LFI - SEPT* with *Facilitator 4*. The remaining half of Cohort 2 youth (3 males) completed Control Training with *Facilitator 4,* and then subsequently received *LFI - SEPT* from *Facilitator 3*.

Participants

Inclusion. Participants included autistic youth residing in greater Victoria, a mid-sized city in British Columbia (BC), Canada. Autistic youth were recruited from a daily educational program held at Mosaic Learning Society of Victoria. This non-profit society offers daily small group instruction for autistic youth with diagnoses of ASD who are designated as home-school learners. All recruited autistic youth had prior ASD diagnosis, established under the B.C. Standards and Guidelines for assessment and diagnosis of ASD (Dua, 2003). The standards require the administration of the *Autism Diagnostic Observation Schedule* (ADOS; Lord et al., 1999), the *Autism Diagnostic Interview-Revised* (ADI-R; Rutter et al., 2003), a developmental assessment, and a measure of adaptive behaviour. All 13 home-school learners attending the Mosaic program were initially considered for study enrollment. One learner was excluded from the study as their educational program was being delivered off-site in the community and the learner spent no time at Mosaic.

Characteristics. As presented below (see Table 1), the study participants included 12 autistic youth (10 males and 2 females), with ages ranging from 10-18 years (M = 14.08, SD = .17). ASD diagnoses and symptom levels were confirmed using the *Gilliam Autism Rating Scale -Second Edition* (Gilliam, 2006). The form was sent home, completed by parents, and returned back to the research team prior to the start of the study. The youth *Autism Index* scores ranged from 70-100 (M = 80.2, SD = 9.4), confirming ASD diagnosis in all autistic youth who were assessed at or above the required cut-off score of 70. The intellectual ability of study youth was assessed using the *Kaufman Brief Intelligence Test – Second Edition* (Kaufman & Kaufman, 2005). The composite *IQ* scores ranged from 57-99 (M = 80.5, SD = 15.5). Non-verbal *IQ* scores extended from 55-108 (M = 85.1, SD = 17.6), Verbal *IQ* scores varied from 57-99 (M =80.5,

Table 1

Means, Standard Deviations, and Ranges in Participant Demographic Variables

Age (Years. Months)	14.1 *(2.2)* 10.0-18.1
GARS-II: Autism Index Score	80.2 *(9.4)* 70-100
Stereotyped Behaviors Standard Score	6.4 *(2.0)* (4-11)
Communication Standard Score	7.4 *(1.7)* (5-11)
Social Interaction Standard Score	7.0 *(1.9)* (5-11)
KBIT-II Composite IQ	80.5 *(15.5)* 57-99
Verbal IQ	80.5 *(13.9)* 57-99
Non-Verbal IQ	85.1 *(17.6)* 55-108

Note. N = 12. Standard deviations are presented in parentheses.

SD = 13.9). In addition, the parents of autistic youth completed demographic forms (see Appendix A), identifying 11 youth as Caucasian, with one youth identifying as Asian. All of the families reported English as the primary language spoken in the home. One family spoke Tagalog in the home.

Training Procedures

LFI - SEPT. The recruited study participants completed 4.5 hours of training, held over 3 weeks. *LFI - SEPT* included three small group learning sessions delivered once a week for 45 minutes each session. Research facilitators (who were undergraduate psychology students) introduced autistic youth to targeted social eye processing abilities, modeled each skill in-person, and then used the *Let's Face It! Scrapbook* app to photograph and video record the autistic youth demonstrating their own social eye processing abilities. *LFI - SEPT* also consisted of two to three designated gaming sessions held each week, ensuring that autistic youth played from the *Let's Face It! Scrapbook* app games for at least 45 minutes per week. The principal investigator coached and supervised autistic youth in these designated gameplay sessions, promoting transfer of learning between the small-screen instruction and big-world application of social eye processing abilities.

The training was manualized, with the principal investigator creating *The LFI - SEPT Lesson Plans* (see Appendix B), for the purpose of ensuring consistent training across the study and participants. The principal investigator trained research facilitators to carefully follow *The LFI - SEPT Lesson Plans* in three mock rehearsal sessions held prior to the start of active training. The small group training sessions, as described below, were run as laid out in *The LFI - SEPT Lesson Plans*. Research facilitators followed scripted instructions in providing manualized social eye processing training.

Small group learning sessions. In weekly 45-minute sessions, the research facilitators implemented 3 weeks of training following *The LFI - SEPT Lesson Plans*. The end goal was for research facilitators to use the *Let's Face It! Scrapbook* app to photograph and video record autistic youth displaying their newly trained social eye processing abilities. Engagement between

research facilitators and autistic youth promoted ongoing face-to-face social interactions. The small group learning sessions, whereby one research facilitator assisted a small group of three participants, provided for a naturalistic training context aimed at boosting face-to-face social interactions.

The primary theme for the small group learning sessions in week 1 was *Eyeing My Feelings*. Training was geared towards improving autistic youth in their ability to interpret facial expressions through the eyes. Instructions from the *LFI - SEPT Lesson Plans* (See Appendix B) directed the research facilitators to practice and then assist autistic youth in posing their own happy, sad, angry, surprised, disgusted, and afraid facial expressions. The research facilitators taught autistic youth that configural changes in the eyes moderate the type and intensity of emotion displayed in face-to-face social interactions. The research facilitators demonstrated production of each facial expression, and then trained autistic youth to modify their expression of emotional intensity by manipulating the configuration of their nose, mouth, and especially their eyes. The research facilitators guided autistic youth in posing their very own most, medium, and little: happy, sad, angry, surprised, disgusted, and afraid emotions. From these emotions, the research facilitators and autistic youth co-created an *Eyeing My Feelings* album within the *Let's Face It! Scrapbook* app.

Looking at My Eyes was the theme for small group learning sessions in week 2 of active training. Participants trained in establishing and maintaining eye contact. Following the *LFI - SEPT Lesson Plans,* the research facilitators introduced and modeled everyday social scenarios for establishing and maintaining eye contact. Using the *Let's Face It! Scrapbook* app, research facilitators aided the autistic youth in photographing and videorecording their own eye contact. Autistic youth were directed to maintain eye contact and pose as face actors depicting three

conditions from everyday face-to face-social interactions. Autistic youth maintained their eye contact while remaining silent, shared eye contact while posing facial expressions, and held eye contact while simultaneously talking aloud. In producing these three eye contact conditions, participants simulated eye contact by looking directly into the *Let's Face It! Scrapbook* app camera, while the other youth were directed to serve as bystanders looking away in averted gaze. The autistic youth were rotated so that each individual's unique eye contact was captured in co-creating a *Looking at My Eyes* album within the *Let's Face It! Scrapbook* app.

Following the Eyes was the final theme for the small group learning sessions in week 3 of *LFI - SEPT*. The research facilitators assisted autistic youth in following the eye gaze of others. The research facilitators followed the *Let's Face It! Scrapbook app: Social Eye Processing Lesson Plans* (see Appendix B) for highlighting the social significance of eye gaze, emphasizing that the eyes tell us where to look. The research facilitators rehearsed with the autistic youth as they acted out common social scenes demanding gaze following interpretation. The research facilitators used the *Let's Face It! Scrapbook* app to photograph and video record the autistic youth engaging in three gaze following conditions: with two autistic youth sharing eye gaze watching each other, with two autistic youth gazing at a third youth, and with all three autistic youth gazing left, right, up, or down in averted gaze. By the end of the small group learning session in week 3, the research facilitators had assisted autistic youth in creating a new "*Following The Eyes*" album within the *Let's Face It! Scrapbook* app.

Designated gameplay sessions. The training included autistic youth playing the *Let's Face It! Scrapbook* app games for at least 45 minutes each week. Gameplay took place across two to three designated gaming sessions held each week, with each session lasting roughly 15 to 20 minutes. The autistic youth played the *Let's Face It! Scrapbook app games* in their designated

gameplay sessions together with a social gaming partner, ensuring that face-to-face social interactions continued throughout the entirety of the *LFI - SEPT*. The autistic youth were paired from within their cohorts across the two small training groups to play the *Let's Face It! Scrapbook* app games together with a social gaming partner, though each autistic youth continued to play separately on their own iPad. By pairing autistic youth across their small training groups, autistic youth were able to compare training stimuli and gameplay across two separate iPads, each with their own unique *LFI - SEPT* content.

During the designated gameplay sessions, autistic youth played the *Let's Face It! Scrapbook* app games while the principal investigator continued to supervise and provide additional coaching. The coaching was intended for promoting ongoing face-to-face social interactions in active training. The principal investigator monitored *Let's Face It! Scrapbook* app gameplay, motivated autistic youth to continue playing the *Let's Face It! Scrapbook* app games over 3 weeks as intended and encouraged the continuous practice of social eye processing abilities. In doing so, autistic youth were permitted to play the *Let's Face It! Scrapbook* app games for more than the minimum 15 to 20 minutes required per designated gameplay session, if the app was found engaging and autistic youth wished to further enrich their training. As autistic youth began interpreting facial expressions through the eyes, establishing, and maintaining eye contact, and following the eye gaze of others within the *Let's Face It! Scrapbook* app games, the principal investigator encouraged extension of these social eye processing abilities to daily social interactions with friends, family, and loved ones. Through this coaching, the principal investigator attempted to bridge any transfer of learning gap between the participant's small-screen training and big-world experience.

At the end of each designated gameplay session, the principal investigator rewarded

autistic youth by giving them opportunity to pose their own unique social eye processing abilities into the *Let's Face It! Scrapbook* app. The autistic youth were creative and spontaneous in adding their own supplementary content. Enriching their *LFI - SEPT*, the principal investigator permitted free choice in expression, so long as the youth were posing their own renditions of social eye processing abilities trained that week. For example, in week 1, a youth photographed her own *Most Swag* facial expression, sharing it with her social gaming partner who laughed aloud. In week 2, a participant was cheered on by peers for importing a studious *Philosopher's Look.* In week 3, autistic youth gathered around in *Celebrity Watching*.

Autistic youth were unable to play the *Let's Face It! Scrapbook* app games outside of their designated gameplay sessions. There was no further outside gameplay using the *Let's Face It! Scrapbook* app. The principal investigator controlled access to the iPad devices at all times. Furthermore, there was never any home access to the iPad devices or the *Let's Face It! Scrapbook* app games.

Control training. The Control Training was designed to control for key variables inherent in *LFI - SEPT*. It mirrored the *LFI - SEPT,* albeit with one exception - there was no active social eye processing component. Autistic youth completed 4.5 hours of Control Training over 3 weeks, matching total time spent in *LFI - SEPT*.

In weekly 45-minute small group activity sessions, the research facilitators implemented 3 weeks of training following the *Control Training Lesson Plans*. Providing instructions for engaging autistic youth in general education activities, the *Control Training Lesson Plans* were created by the principal investigator for purposes of the current study (see Appendix C). The principal investigator trained research facilitators to follow the *Control Training Lesson Plans* in three practice sessions held prior to the start of active training.

Control Training also consisted of two to three designated gameplay sessions held per week. Autistic youth engaged playing from a vetted list of educational app games for at least 45 minutes in each week of Control Training. In the designated gameplay sessions, the principal investigator monitored Control Training, ensuring that autistic youth played using the vetted educational apps over 3 weeks as intended. As during active training, the autistic youth were permitted to play the educational app games for more than the minimum 15 to 20 minutes required per designated gameplay session, so long as the apps were found engaging and autistic youth wished to continue playing. Matching the active training condition, the autistic youth were further coached by the principal investigator for promoting transfer between small-screen gameplay and big-world application. Coaching from the principal investigator continued in promoting ongoing face-to-face social interactions throughout Control Training.

Small group activity sessions. The purpose of the weekly 45-minute small group activity sessions in Control Training was for the research facilitators to maintain ongoing face-to-face social interactions with the autistic youth. It was necessary to control for the high degree of face-to-face social interactions autistic youth experienced during *LFI - SEPT.* As was the case in *Let's Face It! Social Eye Processing Training*, the research facilitators followed scripted *Control Training Lesson Plans* (see Appendix C), ensuring that all autistic youth received the same instructions in Control Training.

In week 1, the research facilitators followed the *Control Training Lesson Plans* for engaging autistic youth in completing a *Map of Canada* activity. In week *2*, the research facilitators and autistic youth folded paper airplanes, boats, and cranes to partake in an *Origami* activity." In week 3, the research facilitators challenged the autistic youth in a *Community*

Disaster Simulation, brainstorming the survival plans necessary for local community buildings (e.g., city hall, library, and animal shelter).

Designated gameplay sessions. In Control Training, participants experienced at least 45 minutes of designated gameplay per week. Gameplay was spread over two to three designated gaming sessions held each week, with each session lasting roughly 15 to 20 minutes. The autistic youth played from a vetted list of general education app games, including *Jigsaw Bug, Fun Maths, HangmanFree, Spell Mania, Chess, KidsDoodle, Animation Desk, Chicktionary, Mathblasters, Reading Eggs, Word Crush,* and *Sudoku*. Like the *Let's Face It! Scrapbook* app, these general education apps were all free and downloaded from App Store (Apple, 2016), and did not include any social eye processing training.

Mirroring *LFI - SEPT*, the autistic youth in Control Training played the general education app games together with a social gaming partner, in two to three designated gameplay sessions held each week. The autistic youth played general education app games matched in pairs across their Control Training small groups. Youth from each Control Training small group played the general education app games together, though each youth played separately on their own device. By playing the general education app games together with a social gaming partner, face-to-face engagement with peers was maintained throughout Control Training. This was a necessary control as face-face engagement had been promoted throughout the *LFI - SEPT* designated gameplay sessions.

The principal investigator continued to supervise and coach autistic youth throughout all designated gameplay sessions in Control Training. The principal investigator monitored youth experience and recorded total minutes played on each app. Linking small-screen gameplay with big-world interests, the principal investigator engaged autistic youth to verbally reflect on their

experience playing the general education app games. For example, in week 2 of Control Training, the principal investigator encouraged one participant, asking if they had ever considered a future career in animation. Coaching in this manner, the principal investigator continued to foster ongoing face-to-face social interactions with the autistic youth throughout the Control Training designated gameplay sessions, necessary for replicating degree of supervision and coaching inherent in the active *LFI - SEPT* designated gameplay sessions.

The principal investigator ended each designated gameplay session by rewarding the autistic youth with the chance of unlocking one more vetted app to play in the next Control Training session. This control ensured that gameplay continued to expand in each week of Control Training, as in the designated gameplay sessions during *LFI - SEPT*. In the active training condition, the principal investigator had afforded autistic youth the opportunity of adding in their own unscripted social eye processing photographs and video recordings at the conclusion of each designated gameplay session.

Assessment

Using the pre-test/post-test control group switching replications design (Trochim & Donnelly, 2007), participants were assessed at T1, T2, and T3. Assessment at T1 was a pre-test for determining baseline social eye processing abilities, with autistic youth completing additional measures in assessing face-to-face social interactions. Testing at T2 was carried out after each cohort had completed one training, and T3 assessment occurred after the cohorts had switched and completed the other training condition.

Autistic youth in Cohort 1 first received assessment at T1 pretesting. Assessment continued at T2, following Cohort 1 completion of *LFI - SEPT.* Cohort 1 autistic youth were finally assessed after finishing Control Training at T3. For Cohort 2 autistic youth, assessment

was first conducted at T1 pretesting. Testing continued after Cohort 2 autistic youth finished Control Training at T2. Final assessment of Cohort 2 autistic youth took place after *LFI - SEPT* was completed at T3.

The assessments at T1, T2, and T3 were administered by the principal investigator in classroom spaces at Mosaic Learning Society of Victoria during normal instructional hours. For the study participants, time to complete all measures at each assessment period was approximately 45 minutes. Assessments were completed over a 1 week period in brief 10-to-15-minute blocks. Assessments were kept brief for maximizing the focus and attention of study youth, while minimizing harms from fatigue and anxiety (Koegel et al., 1997). In addition, the T1, T2, and T3 assessments included study parents completing questionnaires from home. The parent completed questionnaires were returned to Mosaic Learning Society of Victoria and collected by the principal investigator.

Social eye processing measures.

The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017). The task was used for assessing autistic youth in interpreting happy, sad, angry, and disgusted facial expressions through the eyes. The test is not for recognizing different types of facial expressions (e.g., “find the happy face), but rather requires discrimination of just noticeable differences in the eyes for moderating facial expression intensity. The computerized task is run using *MATLAB* (MathWorks, 2016) software with the *Psychophysics Toolbox* (Psychtoolbox-3, 2016) program installed. The test stimuli include unique images of a single female actress depicting each happy, sad, angry, and disgusted emotion, across a scale of expressive intensity ranging from: 0%, 2%, 4%, 6%, 8%, 11%, 16%, 27%, 32%, 45%, 64%, 91%, and finally 100%. Each complete facial expression set for happy, sad, angry, and disgusted was created separately by taking a

photograph of the actress posing the 100% representative expression, and then morphing the image with the actress posing 0% (neutral) expression, using *Abrosoft FantaMorph* (Abrosoft, 2017) software.

During the computerized assessment, the autistic youth observed each facial expression set (e.g., happy, sad, angry, and disgusted) separately in individual trials. For each facial expression set, the autistic youth were presented with two photographs, with one located in the top-half and one situated in the bottom-half of the computer screen. The photographs were randomly counterbalanced with one photo displaying the actress posing 0% (neutral) facial expression, while the other photograph displayed one of the uniquely morphed images depicting the actress posing facial expression with ranging expressive intensity.

For each item on every facial expression set, autistic youth read (or were read) the instructions, "which face shows more expression." The autistic youth responded by answering *up* or *down*, or by pointing at their selection. *The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017)* is programmed so that *Item 1* in every facial expression set begins with autistic youth comparing the neutral 0% facial expression with the photograph displaying maximum 100% expressivity. When autistic youth responded correctly in identifying the photograph with more expression, autistic youth then proceeded to the next item comparing the neutral 0% facial expression with the slightly lesser, 91% expressive intensity; followed by 64%, 45%, 32%, 27%, 16%, 11%, 8%, 6%, 4%, until finally only 2% of facial expressive intensity was displayed. When autistic youth made an error in selecting *"which face shows more expression,"* then the facial expression in the next item was displayed showing greater expressive intensity, thereby reducing the interpretive difficulty.

In each happy, sad, angry, and disgusted facial expression set, *The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017)* utilizes this two-alternative, forced-choice, fixed step-size staircase procedure until the autistic youth completes 5 total errors, at which point the computer calculates a final *Just Noticeable Differences Face Task: Expression Recognition Threshold Percentag*e. The percentage represents the minimum perceptual threshold required by autistic youth in interpreting facial expression intensity through the eyes. In the current study, the four separate happy, sad, angry, and disgusted *Just Noticeable Differences Face Task: Expression Recognition Threshold Percentag*es were summed and averaged to create a singular *Just Noticeable Differences Face Task: Expression Recognition Threshold Percentages Composite Score,* used in analyzing autistic youth assessments at T1, T2, and T3.

The Just Noticeable Differences Face Task - Mosaic Version. In addition to the established *The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017),* autistic youth in the current study completed a secondary, *Mosaic Version* of the task. Developed by the principal investigator, the test stimuli included unique images of a familiar educator from Mosaic Learning Society of Victoria, posing happy, sad, angry, and disgusted emotions; across a scale of expressive intensity ranging from: 0%, 2%, 4%, 6%, 8%, 11%, 16%, 27%, 32%, 45%, 64%, 91%, and finally, 100%. *The Just Noticeable Differences Face Task - Mosaic Version* was conducted for the purpose of exploring if *LFI - SEPT* would improve autistic youth in interpreting the facial expressions of a familiar educator.

In creating the test stimuli for *The Just Noticeable Differences Face Task - Mosaic Version,* the principal investigator worked with the Educational Director at Mosaic Learning Society of Victoria to photograph her 0% (neutral) facial expression, and her most happy, sad, angry, and disgusted facial expressions set at 100% expressive intensity. The Educational

Director's facial expressions were photographed using a high-quality camera sitting atop a tripod, with the visual background and lighting being held constant. The photographs were subsequently edited, cropping out extraneous hair and ear features for refining high-quality images. The Educational Director's most happy, sad, angry, and disgusted facial expressions (set at 100% expressive intensity) were then morphed with the Educational Director's 0% (neutral) facial expression image, following the same procedures as Motta-Mena and Scherf (2017). The *Abrosoft FantaMorph* (Abrosoft, 2017) software was used to produce a unique set of images depicting the Educational Director posing happy, sad, angry, and disgusted emotions; across a scale of expressive intensity ranging from: 0%, 2%, 4%, 6%, 8%, 11%, 16%, 27%, 32%, 45%, 64%, 91%, and 100% of expressive intensity (see Figure 2).

Autistic youth completed *The Just Noticeable Differences Face Task - Mosaic Version* assessment on the computer using the same testing procedure reported by Motta-Mena and Scherf (2017). For each item on every facial expression set, autistic youth read (or were read) the instructions, "*Which face shows more expression?"* The youth responded by answering *up* or *down*, or by pointing at their selection. The computer followed the two-alternative, forced-

Figure 2

The Just Noticeable Differences Face Task - Mosaic Version, "Happy" Facial Expression Set

Note. Film roll depicting scale of "happy" expressive intensity ranging from: 0%, 2%, 4%, 6%, 8%, 11%, 16%, 27%, 32%, 45%, 64%, 91%, and 100%.

choice, fixed step-size staircase procedure until autistic youth completed 5 total errors, at which point the computer calculated a final *Just Noticeable Differences Face Task – Mosaic Version: Expression Recognition Threshold Percentage*. The percentage score represented the *minimum perceptual threshold* required by autistic youth for interpreting facial expression intensity through the eyes of a familiar Mosaic educator (see Figure 2). In the current study, the four separate happy, sad, angry, and disgusted *Just Noticeable Differences Face Task - Mosaic Version: Expression Recognition Threshold Percentages* were summed and averaged in producing a final *Just Noticeable Differences Face Task - Mosaic Version: "Expression Recognition Threshold Percentages Composite Score,"* for analysis of the T1, T2, and T3 assessment data.

The Story Reading and Conversation Task. This naturalistic observation measure was created by the principal investigator. The task assesses performance in establishing and maintaining eye contact and in following the eye gaze of others. In this task, an examiner reads a short children's story aloud to a pair of autistic youth and then engages in simple conversation questions. Throughout the task, the examiner takes designated pauses to check for comprehension; and in doing so, the examiner initiates and sustains eye contact with participants at set intervals. Subsequent video analysis and behavioural coding is then used to quantify the frequency and duration of participants engaging in social eye processing abilities by tallying:

1. The number of times that participants respond by establishing eye contact with the examiner.
2. The full duration of time participants spend maintaining eye contact with the examiner.
3. How frequently participants engage in following the eye gaze of the examiner gazing at the second participant.

4. The full duration of time that participants spend in sustaining their gaze following.

In the current study, administration of *The Story Reading and Conversation Task* was video recorded using a high-quality camera mounted atop a tripod (see Appendix D). The principal investigator sat facing two autistic youth in an equilateral triangle formation. The principal investigator began by reading Emily Gravett's (2017) *Dogs* at T1, Linda Kranz' (2013) *You Be You* at T2, and Carson Ellis' (2015) *Home* at T3. Each book was a comparable short children's story containing limited text (e.g., four to five words per page) and large picture illustrations. For each story, the principal investigator spent roughly 10 seconds reading two pages of the story out loud before pausing for 2 seconds in initiating eye contact with one youth; before flipping the page and reading the next two pages over another 10 seconds, before pausing to make eye contact with the second youth. The principal investigator completed six repetitions of this story reading procedure for initiating eye contact with autistic youth at six set intervals during T1, T2, and T3 assessments (see Appendix D).

The principal investigator then supplemented the story reading by asking autistic youth three scripted conversation task questions at T1, T2, and T3 administrations (see Appendix D). In conversing with the youth, the principal investigator always began by establishing eye contact and maintained the eye contact throughout each back-and-forth transaction. The principal investigator began by asking the autistic youth the scripted question (e.g., "do you like dogs?") and provided an opportunity to respond. The principal investigator then followed up the youth's answer with a reciprocating statement (e.g., "Oh, you have a dog.") and again provided time for the autistic youth to elaborate. The principal investigator then expanded the conversation with a final extension question (e.g., "what kind of dog do you have?"). After conversing with the first

autistic youth, the principal investigator then repeated the same procedure in conversing with the second autistic youth.

By asking the scripted question, following up with a reciprocating statement, in extending the conversation with a final question, each scripted conversation task question produced three set intervals for observing social eye processing abilities. Including the three conversation task questions, there were a total of nine set intervals for observing participants engaging in social eye processing abilities at each T1, T2, and T3 assessment.

Behavioral coding. The principal investigator recruited and trained two additional research assistants, both who were undergraduate psychology students, to be coders in analyzing *The Story Reading and Conversation Task* videos. The coders were completely blind to the *LFI - SEPT*, Control Training, and to each other. The research assistants were trained to be coders by observing a pilot video where the principal investigator had practiced administering *The Story Reading and Conversation Task* with two graduate-level psychology students prior to the start of the study. In coding 100% of the pilot video in its entirety, the research assistants were trained to identify four specific social eye processing behaviors of interest: establishing eye contact, maintaining eye contact, following the eye gaze of others, and sustaining gaze following. Training continued until each research assistant and principal investigator shared an inter-rater reliability of a minimum .800 kappa-statistic for the combined eye contact variables (establishing eye contact and maintaining eye contact) and combined gaze following variables (following the eye gaze of others and sustaining gaze following). For the analysis of this study, the research assistants coded 100% of the task videos from *The Story Reading and Conversation Task* assessments at T1, T2, and T3. The research assistants followed a coding scheme designed by the

principal investigator for assessing eye contact and gaze following in study participants. (see Appendix E).

Establishing Eye Contact was the social eye processing ability identified in autistic youth making direct eye contact with the principal investigator. During *The Story Reading*, the principal investigator made six, 2-second pauses to initiate eye contact with youth. In the *Conversation Task*, the principal investigator initiated and maintained eye contact with autistic youth nine times within the three separate question/statement/question sequences. It was the task of the coders to observe and record if (yes/no) the autistic youth had engaged establishing direct eye contact with the principal investigator. The instances were tallied under separate *Story Reading: Establishing Eye Contact Scores* and *Conversation Task: Establishing Eye Contact Scores*, summing the total times when autistic youth engaged in *Establishing Eye Contact* in both *The Story Reading Task* and ensuing *Conversation Task.*

In addition, the research assistants coded *The Story Reading and Conversation Task* videos for analyzing autistic youth in *Maintaining Eye Contact*. Scores were coded for every 2-second increments when autistic youth continuously sustained eye contact. For example, if an autistic youth had never sustained eye contact for 2 seconds, the autistic youth received a score of 0; whereas, if an autistic youth had sustained eye contact for 6 seconds, a score of 3 was assigned. By summing each 2-second increment of continuously sustained eye contact, separate *Story Reading: Maintaining Eye Contact Scores* and *Conversation Task: Maintaining Eye Contact Scores* were determined for each study participant.

Following The Eye Gaze of Others was the social eye processing ability coded when autistic youth made eye contact in response to following the eye gaze of the principal investigator and the second youth. This behavior occurred when autistic youth were not directly

engaged but observing *The Story Reading and Conversation Task* transactions between the principal investigator and the second youth. *Following The Eye Gaze of Others* was coded (yes/no) when observed during *The Story Reading Task,* when the principal investigator made a total of six, 2 second pauses to initiate eye contact with the second youth. In the *Conversation Task*, *Following the Eye Gaze of Others* was observable (yes/no) when the principal investigator initiated and maintained eye contact with the second youth, nine times within the three separate question/statement/question sequences. Total observed instances were tallied under separate *Story Reading: Following the Eye Gaze of Others Scores,* and *Conversation Task: Following the Eye Gaze of Others Scores.*

Finally, the research assistants coded for autistic youth *Sustaining Gaze Following.* This social eye processing ability was coded for every 2-second increment of sustained eye contact, made in response to following the eye gaze of the principal investigator and/or the second youth. For instance, if an autistic youth sustained gaze following for only 1 second, the youth would have received a score of 0. If an autistic youth had sustained gaze following for 5 seconds, the youth would have received a score of 2. By summing each 2-second increment of continuously sustained gaze following, separate *Story Reading: Sustaining Gaze Following Scores* and Conver*sation Task: Sustaining Gaze Following Scores* were recorded for each youth. Below is a summary list of the social eye processing measures included in the study assessment procedure (see Table 2).

Face-to-face social interaction measures.

Facial Expressions Posing Task. The task was developed by the principal investigator for evaluating autistic youth ability in posing facial expressions. Autistic youth were instructed to pose their most happy, sad, angry, disgusted, afraid and surprised facial expressions at their T1,

Table 2

Summary List of the Social Eye Processing Measures

Measures	Description of Assessments
The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017)	Interpreting facial expression intensity through the eyes
The Just Noticeable Differences Face Task - Mosaic Version	Interpreting facial expression intensity through the eyes of a familiar individual
Story Reading and Conversation Task	Exploring eye contact and gaze following behaviors

T2, and T3 assessments. Autistic youth posed their facial expressions in a fixed order, as called out by the principal investigator. The posed facial expressions were recorded in 2-second video clips using the *Let's Face It! Scrapbook app*. Video recordings were always completed using the same iPad device, in the same room, with autistic youth posing their facial expressions from the same spot, under the same lighting – all carefully controlling for extraneous variables. The faces of autistic youth were required to be fully visible without any occlusion from hair or hats, with all faces centered in portrait view. Video clips capturing hand gestures, voices and sounds, or head movements were excluded, as autistic youth were required to pose expressions using only their faces.

Rating of the facial expression video clips. Undergraduate psychology students were recruited to serve as raters in evaluating the posed facial expressions of autistic youth. Age of the recruited raters (3 male, 18 female) ranged from 18-31 years (M = 20.7, SD = 3.4). The raters received course credit as compensation for their participation. All recruited raters were

completely blind to the *LFI - SEPT* and Control Training. The raters received no prior training and completed facial expression ratings based on subjective judgements.

Each rater was responsible for observing a total of 216 facial expression video clips, as posed by the 12 autistic youth at their T1, T2, and T3 assessments. With the large number of facial expression video clips, efforts were made so that the 216 posed facial expressions were not all rated in the same order, in which case, the ratings would have likely been seriously compromised due to human fatigue and error through order-effects. A random number generator was used to generate four separate test versions. The principal investigator then went through each test version, ensuring that no single autistic youth with ASD appeared in back-to-back video clips and that no facial expression was being presented back-to-back by different youth.

All ratings were completed on the computer using *MATLAB* (MathWorks, 2016) software with the *Psychophysics Toolbox* (Psychtoolbox-3, 2021) program installed. Each rating began with instructions on the computer screen reading, "Get ready…" After a 2-second delay, raters then viewed a 2-second video clip of an autistic youth posing their most happy, sad, angry, disgusted, afraid or surprised facial expression; however, the raters were uninformed of which facial expression the autistic youth had been asked to pose. Next, raters read the instructions, "Please rate the video now: How much happy, sad, angry, disgusted, afraid, and surprised emotions did you see?" Each facial expression video clip was rated for its quality in expressing happy, sad, angry, disgusted, afraid, and surprised emotion, with raters completing ratings based on a scale from 0-4 (0 = 0%, 1 = 25%, 2 = 50%, 3 = 75%, 4 = 100%). Averaging the percentages across raters produced six separate facial expression posing scores, evaluating autistic youth in posing happy, sad, angry disgusted, afraid, and surprised facial expressions at T1, T2, and T3 assessments. The six separate percentage scores (*Happy Facial Expression*

*Posing S*core, *Sad Facial Expression Posing Score, Angry Facial Expression Posing Score, Disgusted Facial Expression Posing Score, Afraid Facial Expression Posing Score,* and *Surprised Facial Expression Posing Score*) were then further combined and averaged to yield a *Facial Expression Posing Composite Score,* for the analysis of T1, T2, and T3 assessments.

The Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013). The *Multidimensional Social Competence Scale (Yager, & Iarocci, 2013)* is an assessment tool capable of measuring individual differences in social competency. Developed primarily for use with autistic youth, the parent/teacher completed rating scale includes 77 total items. The measure assesses social competence across seven domains in social motivation, social inferencing, demonstrating empathic concern, social knowledge, verbal conversation skills, nonverbal sending skills, and emotional regulation.

Assessing for social competency across broad domains, *The Multidimensional Social Competence Scale (Yager, & Iarocci, 2013)* contains nine specific items pertaining to face-to-face social interactions. These nine items were selected and compiled in the current study for creating an adapted *Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013).* The adapted task (see Appendix F) was designed for measuring participant social competency in understanding faces, before-and-after completing *LFI - SEPT.*

In the present study, the *Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013)* was completed at T1, T2, and T3 assessments by parents in the home. Parents were required to rate autistic youth for their social competency in understanding faces, on a scale ranging from 1 (*not true*) - 5 (*very true*). Parents completed the assessments blind to their child's training group. Parents completed *The Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013)* at home over a 1 week period and then

returned the form back to the principal investigator at Mosaic Learning Society of Victoria. While families were to ensure that *The Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013)* be completed by the same parent (e.g., either the mother or father) at each assessment; questionnaires from two youth (one male from Cohort 1 and one female from Cohort 2) included responses from both mothers and fathers over the course of T1, T2, and T3 assessments, and therefore, were excluded from the study.

Final data analysis from *The Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013)* included parent ratings from 10 autistic youth. Raw scores from the parent ratings were first averaged across each of the nine selected items at T1, T2, and T3 assessments, and then further combined and averaged in producing a *Social Competency in Understanding Faces Score* for data analysis of T1, T2, and T3 assessments.

***The Friendship Survey Task (Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011*).** This measure was included for examining whether autistic youth would experience any changes in friendships as a result of completing *LFI - SEPT*. The task has previously been used in school-based research studies exploring classroom friendships **(**Cairns & Cairns, 1994; Farmer & Farmer, 1996) and has been applied in research studies involving the social inclusion of students with ASD in typical classroom environments. (Kasari et al., 2011).

The Friendship Survey Task **(**Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011) measures friendships, both in terms of individual self-reported data, and by exploring peer-reported data; for the purpose of determining friendship reciprocity. This is a key methodological improvement from earlier ASD studies relying solely on self-reported friendship data. For example, investigating loneliness and friendships in high-functioning children with autism, Bauminger and Kasari (2000) found that while all 22 participating children with ASD

could self-report as having a friend, several reported friendships were later verified as being tutors, stepdads, or other atypical choices. In other studies, children with ASD have over nominated many children as being their friends, while their peers have failed to reciprocate these friendships (Chamberlain et al. 2007).

Autistic youth completed *The Friendship Survey Task* **(**Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011) at T1, T2, and T3 assessments (see Appendix G). Autistic youth were first instructed to list the names of their friends at Mosaic Learning Society of Victoria. Autistic youth then indicated if they had a best friend from this friend list by placing a star next to the individual's name. Autistic youth could only star one name in choosing a true best friend at Mosaic Learning Society of Victoria. Because it was recognized that autistic youth may also have existing friendships beyond their daily educational program held at Mosaic Learning Society of Victoria, autistic youth were also asked to list names of any other non-Mosaic friends in a separate friend list.

Friendship coding and scoring. The self-reported data and peer-reported data of autistic youth were coded and analyzed as determined by examining completed friend lists from *The Friendship Survey Task* **(**Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011). Autistic youth received a score of 1 for each of their *Self-Reported Friendships,* defined as the number of peers listed as friends at Mosaic Learning Society of Victoria. Furthermore, autistic youth were assigned a score of 1 for each time they had been *Nominated as a Friend* by a peer at Mosaic Learning Society of Victoria. Examining the *Self-Reported Friendships* and *Nominated as a friend* scores, autistic youth obtained a score of 1 for each of their *Reciprocated Friendships,* determined by the number of self-reported friendships where the peer had also confirmed friendship by in turn, nominating the autistic youth as their friend. In addition, autistic

youth were given a score of 3 for presumably reflecting deeper friendship quality if they self-reported *Having a Best Friend* at Mosaic Learning Society of Victoria. Finally, autistic youth were provided with a score of 3 for presumably reflecting deeper friendship quality for each of their *Is a Best Friend* nominations, occurring when a classmate at Mosaic had nominated the autistic youth as their best friend. By summing the *Self-Reported Friendships, Nominated as a Friend, Reciprocated Friendships, Having a Best Friend,* and *Is a Best Friend* scores, autistic youth were assigned with *Composite Friendship Score(s)* from their T1, T2, and T3 performance assessments. A final list of the face-to-face social interaction measures included in the study are presented below in Table 3.

Results

Data Analytic Plan

Statistical analyses were conducted using SPSS (IBM, 2021) software. Group was removed

Table 3

Summary List of the Face-to-Face Social Interaction Measures

Measures	Description of Assessments
Facial Expressions Posing Task	Evaluating participants in posing happy, sad, angry, disgusted, afraid and surprised facial expressions
The Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013)	Ratings completed by parents on nine items assessing participants in their social competency for understanding faces.
The Friendship Survey Task (Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011)	Determining friendship reciprocity from self-reported and peer-reported data.

as a factor in conducting a series of dependent t-tests on the autistic youth difference (*D*) scores (Gravetter & Wallnau, 2007). The *D* scores captured changes in autistic youth performance across the administered social eye processing and daily face-to-face social interaction measures, before-and-after receiving *LFI - SEPT* and the Control Training.

Statistical assumptions for completing dependent *t*-test analyses of autistic youth *D* scores were met on all the study measures (Gravetter & Wallnau, 2007). First, observations within each treatment condition were independent. Inside each treatment, scores were obtained from different autistic youth and were independent of each other. Second, all the autistic youth *D* scores following training were found normally distributed. *Shapiro-Wilk* statistics indicated no significant results violating normality. Third, no statistical outliers were found in the data following *z-score* conversion analyses.

The hypothesis testing required three separate t-tests for each outcome measure. The first dependent *t*-test assessed if autistic youth mean gain score after completing *LFI - SEPT* was statistically significant as hypothesized. A second dependent *t*-test was carried out for examining any performance effects after Control Training. It was hypothesized that none of the gains from Control Training would be found to be statistically significant. For making comparisons between the two trainings, a third and final dependent *t*-test was conducted. The dependent *t*-test analyzed if the autistic youth mean gain score from *LFI - SEPT* was significantly greater than the autistic youth mean gain score following Control Training. Any statistical significance established in this third dependent t-test would demonstrate a clear training effect supporting *LFI - SEPT* over Control Training.

Training Implementation Data

From LFI - SEPT. Data analysis verified that each autistic youth completed at least 4.5 hours of *LFI - SEPT* over 3 weeks (see Table 4). It was confirmed that all study autistic youth had completed their minimum 4.5 hours of Control Training over 3 weeks.

In *LFI - SEPT,* all autistic youth completed the three small group learning sessions lasting 45 minutes each week. Research facilitators followed the *LFI - SEPT Lesson Plans* in delivering 3 weeks of active training. The research facilitators introduced and modelled targeted social eye processing abilities, before using the *Let's Face It! Scrapbook* app to photograph and video record autistic youth demonstrating their own skills. In addition, it was confirmed that all autistic youth had played from the *Let's Face It! Scrapbook* app games together with a social gaming partner in the two to three designated gameplay sessions held in each week of *LFI - SEPT.* All youth had played the *Let's Face It! Scrapbook* app games for at least 2 hours and 15 minutes in the designated gameplay sessions (see Table 4). The sessions were supervised by the principal

Table 4.

Means and Standard Deviations from the Training Integrity Data

Training Integrity Variables	Active Training	Control Training
Number of small group sessions held	3.0 *(0)*	3.0 *(0)*
Total training minutes from small group sessions	135 *(0)*	135 *(0)*
Number of designated game play sessions held	10.00 *(1.35)*	6.92 *(0.79)*
Total training minutes from designated game play sessions:	168.08 *(29.19)*	141.00 *(9.06)*
Minutes/designated game play session	16.89 *(2.33)*	20.59 *(2.31)*

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.*

investigator who continued to provide additional coaching. Over the course of 3 weeks of *LFI - SEPT*, a few autistic youth far exceeded the minimum 2 hours and 15 minutes of required gameplay. The autistic youth logging the most gameplay had played the *Let's Face It! Scrapbook* app games for 3 hours and 40 minutes over the active training period (see Table 4).

From control training. The data verified that all autistic youth had been included in the three 45-minute *small group activity sessions* held once per week. Research facilitators followed the *Control Training Lesson Plans* for engaging autistic youth in 3 weeks of general education activities. The research facilitators continued maintaining ongoing face-to-face social interactions with autistic youth, controlling for the high degree of face-to-face social interactions experienced during active training.

Moreover, the data confirmed that all autistic youth had played the vetted educational app games for at least 2 hours and 15 minutes over 3 weeks of Control Training (see Table 4). All the autistic youth had played the vetted educational app games together with a social gaming partner, in the two to three designated gameplay sessions held each week. The designated gaming sessions were supervised and monitored by the principal investigator who provided additional coaching. The principal investigator engaged with autistic youth to orally reflect on their experiences playing the general education app games, linking small-screen gameplay with big-world interests and aspirations. In the Control Training designated gameplay sessions, one autistic youth had totalled 2 hours and 37 minutes of gameplay over 3 weeks (see Table 4). This was the maximum number of minutes recorded from the Control Training participants.

Social Eye Processing Measures.

The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017). A series of dependent-*t* test analyses were completed on autistic youth *Expression Recognition Threshold*

Percentages Composite Scores, examining for the effects of *LFI - SEPT*, the effects of Control Training, and for comparing the effects between the two training conditions (see Table 5). The average minimum threshold percentage required to distinguish the emotional intensity of facial expressions was found significantly reduced following *LFI - SEPT*, t (11) = -3.44, p = .006, with large effect size, d = 0.99. No significant reductions of any kind could be established from the Control Training data, t (11) = -2.15, p = .055. Comparing effects of the two trainings by analysis of yielded *D* scores, *LFI - SEPT* significantly outperformed Control Training for demonstrating a training effect in reducing autistic youth average minimum threshold percentage required to distinguish the emotional intensity of facial expressions, t (11) = -3.66, p = .004, with large effect size, d = 1.06.

Further post-hoc analysis was conducted for determining if the observed *LFI - SEPT* effect (for improving autistic youth *Expression Recognition Threshold Percentages Composite*

Table 5.

Means and Standard Deviations from The Just Noticeable Differences Face Task

	Active Training			Control Training		
Expression Recognition: Threshold Percentages	Pre	Post	Difference	Pre	Post	Difference
Expression Recognition Threshold Percentages Composite Score	29.0 *(15.0)*	16.1 *(5.9)*	-12.9* *(13.0)*	22.6 *(10.8)*	26.0 *(13.0)*	3.5 *(5.6)*
Happy	24.1 *(17.9)*	13.7 *(9.0)*	-10.4** *(11.8)*	14.9 *(9.3)*	17.2 *(12.8)*	2.3 *(13.3)*
Sad	31.6 *(18.3)*	18.9 *(7.9)*	-12.7 *(19.4)*	30.0 *(14.8)*	33.8 *(22.2)*	3.8 *(17.5)*
Angry	31.6 *(22.3)*	18.8 *(8.2)*	-12.8 *(24.1)*	23.2 *(17.1)*	28.5 *(17.4)*	5.3 *(13.9)*
Disgusted	28.6 *(17.1)*	13.0 *(5.1)*	-15.6*** *(16.0)*	22.1 *(12.4)*	24.5 *(11.0)*	2.4 *(11.1)*

* p = 0.006
** $p = 0.019$
*** p = 0.006

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.* Scores appear as percentages.

Scores) could be isolated to better recognizing more specifically, the emotional intensity of happy, sad, angry, or disgusted expressions. As reported in Table 5, the average minimum threshold percentage required to distinguish the emotional intensity of happy facial expression was found significantly reduced after *LFI - SEPT*, t (11) = -3.06, p = .019, with large effect size, d = 0.88. There were no happy facial expression improvements reported over the course of Control Training, t (11) = 0.60, p = .560. However, comparing effects of the two trainings by analysis of yielded *D* scores, no significant differences were found between *LFI - SEPT* and Control Training following Bonferroni-correction, t (11) = 2.32, p = 0.040. This suggests the study autistic youth had improved in their recognition of happy expression over time, practice, and or maturation effects, yet not due to a superior *LFI - SEPT* effect.

The average minimum threshold percentage required to distinguish the emotional intensity of disgusted facial expression was also found significantly reduced following *LFI - SEPT*, t (11) = -3.37, p = .006, with large effect size, d = 0.97. Control Training results did not yield any significant reductions, t (11) = 0.76, p = .047. Comparing the effects of the two trainings by analysis of yielded *D* scores, *LFI - SEPT* was superior to Control Training in demonstrating a significant training effect. The results highlight that compared to Control Training gains, *LFI - SEPT* significantly reduced the average minimum threshold percentage required by autistic youth to distinguish the emotional intensity of disgusted facial expression, t (11) = 3.19, p = 0.009, with large effect size, d = 0.92. The complete post-hoc analysis did not reveal any additional significant findings.

The Just Noticeable Differences Face Task - Mosaic Version. A series of dependent-*t* test analyses were completed on autistic youth *Expression Recognition Threshold Percentages Composite Scores*, examining for the effects of *LFI - SEPT*, the effects of Control Training, and

for comparing the effects between the two training conditions. The average minimum threshold percentage required to distinguish the emotional intensity of facial expressions being posed by a familiar educator, was discovered to be significantly reduced following *LFI - SEPT, t* (11) = -3.14, p = .009, with large effect size, d = 0.91 (see Table 6). Results from Control Training were non-significant, *t* (11) = 1.99, p = .072. Comparing the yielded *D* scores across the two trainings, *LFI - SEPT* significantly outperformed Control Training for demonstrating a significant training effect in reducing the minimum threshold percentage required by autistic youth to recognize the emotional intensity of facial expressions being posed by a familiar educator, *t* (11) = 3.18, p = .009, with large effect size, d = 0.92.

Supplementary post-hoc analysis was completed for determining if the observed *LFI - SEPT* effect (for boosting autistic youth *Expression Recognition Threshold Percentages Scores*) could be isolated to youth better recognizing more specifically, the emotional intensity of happy, sad, angry, or disgusted expressions being posed by a familiar educator.

Table 6.

Means and Standard Deviations from The Just Noticeable Differences Face Task - Mosaic Version

	Active Training			**Control Training**		
Expression Recognition: Threshold Percentages	Pre	Post	Difference	Pre	Post	Difference
Expression Recognition Threshold Percentages Composite Score	34.6 *(14.8)*	20.0 *(9.7)*	-14.7* *(16.2)*	28.6 *(12.4)*	35.4 *(15.1)*	6.7 *(11.7)*
Happy	32.5 *(13.8)*	18.6 *(10.4)*	-13.9** *(16.3)*	26.2 *(14.4)*	32.1 *(18.7)*	5.8 *(20.3)*
Sad	34.6 *(23.2)*	20.1 *(12.9)*	-14.6 *(27.1)*	27.0 *(13.1)*	35.9 *(22.2)*	8.9 *(16.5)*
Angry	39.3 *(20.9)*	24.5 *(14.6)*	-14.8 *(19.8)*	38.5 *(20.3)*	43.6 *(22.7)*	5.2 *(23.6)*
Disgusted	32.0 *(20.3)*	16.6 *(8.6)*	-15.4 *(20.6)*	22.9 *(11.2)*	29.8 *(13.4)*	6.9 *(11.7)*

* p = 0.009. ** p = 0.013

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.* Scores appear as percentages.

As presented in Table 6, the average minimum threshold percentage required to distinguish the emotional intensity of happy facial expression being posed by a familiar educator was determined to be significantly reduced following *LFI - SEPT, t* (11) = -2.95, *p* = .013, with large effect size, *d* = 0.85. Autistic youth did not demonstrate any significant improvements in Control Training, *t* (11) = 0.99, *p* = .341. However, comparing yielded *D* scores produced between the two trainings, no significant differences were found after applying Bonferroni-correction, *t* (11) = 2.35, *p* = 0.039. The finding suggests that while autistic youth had improved in recognizing happy facial expressions being posed by a familiar educator after their *LFI - SEPT,* their improvement had occurred due to possible time, practice, and maturation effects; yet could not be attributed to a specific *LFI - SEPT* effect.

***The Story Reading and Conversation Task*.** In the Methods section, it was previously established that the principal investigator had trained two research assistants to be coders for analyzing T1, T2, and T3 assessments. The research assistant coders were blind to each other and independently coded 100% of the task videos recorded at T1, T2, and T3 assessments. The research assistant coders analyzed *The Story Reading and Conversation Task* videos, coding for four social eye processing abilities of interest: *Establishing Eye* Contact*, Maintaining Eye Contact, Following The Eye Gaze of Others,* and *Sustaining Gaze Following.* Over the course of data analysis, three follow-up training sessions were held individually between the principal investigator and research assistant coders for preventing coder's drift. The interrater reliability data for the combined eye contact variables in establishing eye contact and maintaining eye contact (between the two research assistant coders; coding for 100% of the task videos from T1, T2, and T3 assessments) was *excellent* according to Gravetter and Wallnau (2007), based on the established *Cohen's Kappa* scores of: *0.85* (for T1), *0.88* (for T2), and *0.86* (for T3). In addition,

the interrater reliability data for the combined following eye gaze variables (following the eye gaze of others and sustaining gaze following), based on the two research assistant coders; coding for 100% of the task videos (from T1, T2, and T3 assessments) was equally reported as *excellent* by statistical standards according to Gravetter and Wallnau (2007), with *Cohen's Kappa* scores established at: *0.83* (for T1), *0.83* (for T2), and *0.84* (for T3).

After establishing the interrater reliability data, a series of dependent-*t* test analyses was completed on autistic youth *D* scores gathered from both *The Story Reading* and *Conversation Task.* Analysis was conducted for examining the effects of *LFI - SEPT*, the effects of Control Training, and for comparing the effects between the two trainings.

The Story Reading Task. A series of dependent-*t* test analyses were completed on autistic youth *Story Reading: Establishing Eye Contact Scores* (see Table 7). The number of instances when autistic youth engaged in establishing eye contact with the principal investigator during *The Story Reading Task* was found significantly increased following *LFI - SEPT*, t (11) = 2.93, p = .014, with large effect size, d = 0.85. No gains in establishing eye contact were identified from the Control Training data, t (11) = -0.84, p = .418. Comparing effects with the analysis of yielded *D* scores, *LFI - SEPT* was found superior to Control Training in demonstrating a clear training effect. Compared with the Control Training results, autistic youth significantly improved following *LFI – SEPT,* in the number of instances when they engaged in establishing eye contact with the principal investigator during *The Story Reading Task*, t (11) = 2.55, p = .027, with large effect size, d = .76.

Further dependent-*t* test analyses were completed on autistic youth *Story Reading: Maintaining Eye Contact* Scores (see Table 7). The results determined that *LFI - SEPT* did not enhance autistic youth to maintain more continuous eye contact during *The Story Reading Task*,

Table 7

Means and Standard Deviations from The Story Reading Task

	Active Training			Control		
Social Eye Processing Variables	Pre	Post	Difference	Pre	Post	Difference
Establishing Eye Contact Scores	2.0	3.4	1.4*	2.5	2.2	-0.3
	(1.5)	*(1.7)*	*(1.7)*	*(2.0)*	*(1.7)*	*(1.4)*
Maintaining Eye Contact Scores	0	0.1	0.1	0	0	0
	(0)	*(0.3)*	*(0.3)*	*(0)*	*(0)*	*(0)*
Following the Eye Gaze of Others Scores	1.3	2.1	0.8	1.8	1.5	-0.3
	(1.4)	*(2.4)*	*(2.1)*	*(2.1)*	*(1.4)*	*(2.0)*
Sustaining Gaze Following Scores	0.1	0.3	0.2	0.1	0	-0.1
	(0.3)	*(0.5)*	*(0.6)*	*(0.3)*	*0*	*(0.3)*

* p = .014

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.*

t (11) = 1.00, p = .339. Autistic youth did not improve in maintaining eye contact in Control Training either, t (11) = NaN, p = NaN. *LFI – SEPT* did not outperform Control Training, t (11) = 1.00, p = .339, and neither training improved autistic youth for maintaining more eye contact during *The Story Reading Task*.

Moreover, dependent-*t* test analyses were completed on autistic youth *Story Reading: Following the Eye Gaze of Others Scores* (see Table 7). *LFI - SEPT* did not boost autistic youth in following the eye gaze of the principal investigator and/or the second autistic youth during *The Story Reading Task*, t (11) = 1.23, p = .231. The results indicated no significant gains in autistic youth gaze following abilities after completing Control Training, t (11) = -0.43, p = 0.674. Comparing yielded D scores from *LFI - SEPT* and Control Training, the active training condition was not found to be benefit over the control, t (11) = 1.20, p = .256.

Finally, dependent-*t* test analyses were completed on autistic youth *Story Reading:*

Sustaining Gaze Following Scores (see Table 7*). LFI - SEPT* did not lead to any improvements in autistic youth sustaining more gaze following with the principal investigator and/or the second autistic youth during *The Story Reading Task*, t (11) = 1.00, p = .339. Control Training results were also void of any statistical gains, t (11) = -1.00, p = 0.339. Comparing the *Story Reading: Sustaining Gaze Following Scores* at T1, T2, and T3 assessments, *LFI - SEPT* did not demonstrate any significant training effects over Control Training, t (11) = -1.39, p = .191.

Conversation Task. A series of dependent-t test analyses were completed on autistic youth *Conversation Task: Establishing Eye Contact Scores* (see Table 8). After *LFI - SEPT,* the number of instances when autistic youth with ASD engaged in establishing eye contact with the principal investigator during the *Conversation Task* was not found significantly increased, t (11) = 1.63, p = .013. Control Training produced similar non-findings, t (11) = -1.48, p = .166, with no improvements reported. *LFI - SEPT* was found no more beneficial than Control Training

Table 8

Means and Standard Deviations from the Conversation Task

	Active Training			Control		
Social Eye Processing Variables	Pre	Post	Difference	Pre	Post	Difference
Establishing Eye Contact Scores	7.9	8.5	0.6	8.8	8.2	-0.7
	(2.0)	*(1.7)*	*(1.2)*	*(0.4)*	*(1.7)*	*(1.6)*
Maintaining Eye Contact Scores	8.1	15.3	7.2*	11.8	11.1	-0.7
	(3.5)	*(8.7)*	*(7.3)*	*(10.9)*	*(10.8)*	*(5.5)*
Following the Eye Gaze of Others Scores	7.4	7.8	0.4	7.6	7.3	-0.3
	(1.7)	*(1.6)*	*(1.4)*	*(1.6)*	*(1.8)*	*(1.8)*
Sustaining Gaze Following Scores	8.3	10.4	2.2	9.8	7.1	-2.7
	(7.5)	*(5.9)*	*(6.3)*	*(8.1)*	*(5.9)*	*(4.7)*

* p = 0.006

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.*

in boosting *Conversation Task: Establishing Eye Contact Scores*, t (11) = 1.99, p = .072. Neither training was found to hold any significant effects.

Additional dependent-*t* test analyses were completed on autistic youth *Conversation Task: Maintaining Eye Contact Scores* (see Table 8). Autistic youth were found maintaining more eye contact with the principal investigator during the *Conversation Task*, t (11) = 3.39, p = .006, with large effect size, d = 0.98, after completing *LFI - SEPT.* No gains in maintaining eye contact could be established following Control Training, t (11) = -0.42, p = .682. Comparing the effects between the two trainings, *LFI - SEPT* was found superior to Control Training in demonstrating a successful training effect. Compared with Control Training, *LFI - SEPT* was found to significantly improve autistic youth in maintaining more eye contact with the principal investigator during the *Conversation Task*, t (11) = 3.23, p = .008, with large effect size, d = .93.

More dependent-*t* test analyses were completed on autistic youth *Conversation Task: Following the Eye Gaze of Others Scores* (see Table 8). *LFI - SEPT* was not found to improve autistic youth eye gaze following in administrations of the *Conversation Task*, t (11) = 1.05, p = .318. The Control Training results were also void of any significant findings, t (11) = -0.43, p = 0.674. No significant differences were identified analyzing *D* scores produced from *LFI - SEPT* and Control Training, t (11) = 1.20, p = .256. Neither training was found to enhance autistic youth ability in following eye gaze on the administered *Conversation Task.*

Finally, dependent-*t* test analyses were completed on autistic youth *Conversation Task: Sustaining Gaze Following Scores* (see Table 8). *LFI - SEPT* did not improve autistic youth to sustain more gaze following in the *Conversation Task*, t (11) = 1.19, p = .259. Similar non-significant findings were noted in the Control Training analysis, t (11) = -1.98, p = .073. Comparing the two trainings, *LFI - SEPT* did not yield any significant training effects over

Control Training, t (11) = 2.12, p = .057. Neither training was found to improve the gaze following ability of autistic youth as assessed utilizing the *Conversation Task.*

Face-to-Face Social Interaction Measures.

Facial Expressions Posing Task. A series of dependent-*t* test analyses were completed on autistic youth *Facial Expression Posing Composite Scores*, examining for the effects of *LFI - SEPT*, the effects of Control Training, and for comparing the effects between the two training conditions. The results (see Table 9) indicated that *LFI - SEPT* significantly improved autistic youth in their ability to pose facial expressions t (11) = -3.83, p = .003, with large effect size,

Table 9

Means and Standard Deviations from the Facial Expressions Posing Task

	Active Training			Control Training		
Facial Expression Posing Scores	Pre	Post	Difference	Pre	Post	Difference
Facial Expression Posing Composite Score	50.2 (12.3)	61.8 (13.0)	11.7* (10.6)	54.3 (13.6)	55.2 (11.3)	0.9 (12.8)
Happy	69.3 *(16.3)*	77.5 *(11.1)*	8.3 *(19.3)*	73.1 *(10.6)*	65.3 *(21.2)*	-7.8 *(22.7)*
Sad	46.2 *(16.6)*	61.4 *(19.6)*	15.3 *(14.4)*	50.9 *(22.4)*	54.6 *(26.9)*	3.7 *(29.0)*
Angry	54.4 *(27.2)*	58.8 *(31.4)*	4.3 *(22.7)*	49.7 *(26.7)*	63.2 *(17.0)*	13.5 *(21.6)*
Disgusted	35.9 *(26.6)*	71.0 *(25.8)*	35.1 *(28.7)*	51.3 *(26.8)*	52.5 *(24.3)*	1.2 *(32.9)*
Surprised	56.8 *(27.9)*	68.8 *(13.4)*	12.0 *(27.2)*	63.0 *(18.2)*	64.0 *(24.9)*	1.0 *28.0*
Afraid	38.4 *(20.1)*	43.7 *(28.9)*	5.3 *(31.7)*	37.7 *(28.3)*	40.1 *(20.6)*	2.4 *(22.3)*

* p = 0.003

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.* Scores appear as percentages.

d = 1.11 (see Table 9). The Control Training results were void of any facial expression posing gains, *t* (11) = 0.61, *p* = .553. Comparing effects between the two trainings, *LFI - SEPT* neared yet did not significantly outperform Control Training in terms of advancing autistic youth in their posing of facial expressions, *t* (11) = 2.06, *p* = .064. This highlights that the noted significant improvement in autistic youth posing better facial expressions after active training occurred due to perhaps time, practice, and or developmental effects; however, not due to an established *LFI - SEPT* effect.

The Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013). Dependent-*t* test analyses were completed on autistic youth *Composite Understanding of Faces Score*s, examining for the effects of *LFI - SEPT*, the effects of Control Training, and for comparing the effects between the two training conditions. The findings indicated that *LFI - SEPT* significantly boosted autistic youth social competency in understanding faces, *t* (9) = 4.64, *p* = .001, with large effect size, *d* = 1.47. There were no gains reported in the Control Training analysis, *t* (9) = .98, *p* = .353 (see Table 10). Analyzing the autistic youth *D* scores from the two trainings, *LFI - SEPT* exceeded Control Training in successfully demonstrating a significant training effect for raising autistic youth social competency in understanding faces, *t* (9) = 4.42, *p* = .002, with large effect size, *d* = 1.40. Additional post-hoc analysis was completed for determining if the improvement could be isolated to autistic youth performing better on specific test items from *The Multidimensional Social Competence Scale, Faces Screener Task* (Yager, & Iarocci, 2013). Nevertheless, only insignificant findings were identified in the item analysis.

The Friendship Survey Task (Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011). A series of dependent-*t* test analyses were completed on the autistic youth

Table 10

Means and Standard Deviations from The Multidimensional Social Competence Scale, Faces Screener Task

	Active Training			Control Training		
Task Items	Pre	Post	Difference	Pre	Post	Difference
Composite Understanding of Faces Score (Summed Total)	31.1	33.4	2.3*	33.8	32.8	-1.0
	(4.3)	*(4.5)*	*(1.6)*	*(4.1)*	*(5.7)*	*(3.2)*
1. His/her facial expressions are easy to read	3.9	3.8	-0.1	3.7	3.8	0.1
	(0.9)	*(1.0)*	*(0.8)*	*(0.9)*	*(1.0)*	*(1.2)*
2. His/her smiles seem forced or awkward	3.6	3.9	0.3	3.8	3.8	0.0
	(0.9)	*(1.0)*	*(1.0)*	*(0.9)*	*(0.8)*	*(1.0)*
3. Uses eye contact to get other people's attention	2.9	3.2	0.3	2.8	3.1	0.3
	(0.9)	*(0.8)*	*(0.6)*	*(0.8)*	*(1.2)*	*(1.1)*
4. Shows a range of facial expressions	3.9	3.9	0.0	4.1	3.8	-0.3
	(0.9)	*(1.1)*	*(0.9)*	*(0.9)*	*(1.0)*	*(0.8)*
5. Smiles appropriately in social situations	3.5	3.8	0.3	3.7	3.8	0.1
	(0.9)	*(0.6)*	*(0.6)*	*(0.7)*	*(1.0)*	*(1.0)*
6. Facial expressions seem flat	4.1	4.4	0.3	4.4	4.2	0.2
	(0.7)	*(0.5)*	*(0.5)*	*(0.5)*	*(0.7)*	*(0.8)*
7. Looks people in the eye when talking to them	2.9	3.0	0.1	2.8	2.9	0.1
	(1.1)	*(1.0)*	*(0.9)*	*(0.9)*	*(1.0)*	*(0.8)*
8. Is sensitive to the feelings and concerns of others	3.4	3.6	0.2	3.8	3.6	-0.2
	(1.1)	*(1.1)*	*(1.1)*	*(0.8)*	*(1.0)*	*(0.7)*
9. Expresses concern for those who are upset	3.8	3.7	-0.1	3.9	4.1	0.2
	(1.0)	*(1.1)*	*(1.3)*	*(0.8)*	*(0.7)*	*(0.7)*

* p = 0.001

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.* Scores appear as parent rating scores.

Composite Friendship Scores, examining the effects of *LFI - SEPT*, the effects of Control Training, and for comparing the effects between the two training conditions (see Table 11). *LFI - SEPT* was not found to significantly improve autistic youth in their classroom friendships, t (11) = 1.08, p = .304. All results were non-significant in the Control Training analysis, t (11) = -2.13, p = .057. Comparing the two trainings, no significant performance gains between *LFI - SEPT* and Control Training could be distinguished, t (11) = -1.64, p = .128. The results suggest

Table 11

Raw Scores and Standard Deviations from The Friendship Survey Task

	Active Training			Control Training		
Friendship Variables	Pre	Post	Difference	Pre	Post	Difference
Composite Friendship Scores	176	191	15	194	169	-25
(Summed Total)	*(7.0)*	*(9.6)*	*(5.3)*	*(8.6)*	*(7.6)*	*(4.1)*
Declared friendships	62	63	1	62	59	-3
	(2.5)	*(2.5)*	*(1.6)*	*(2.8)*	*(2.4)*	*(1.4)*
Named as a friend	58	59	1	62	56	-6
	(2.4)	*(2.4)*	*(0.8)*	*(2.4)*	*(2.6)*	*(0.9)*
Reciprocated friendships	35	36	1	37	30	-7
	(2.1)	*(2.5)*	*(1.6)*	*(2.4)*	*(2.0)*	*(1.2)*
Has a best friend	15	18	3	15	15	0
(each received score of 3)	*(1.5)*	*(1.6)*	*(2.4)*	*(1.5)*	*(1.5)*	*(1.8)*
Is a best friend	6	15	9	18	9	-9
(each received score of 3)	*(2.3)*	*(4.4)*	*(2.9)*	*(5.0)*	*(2.9)*	*(2.9)*

Note. N = 12. Standard deviations are presented in parentheses. Active Training refers to *Let's Face It! Scrapbook app: Social Eye Processing Training.*

that *LFI - SEPT* had no effects for enhancing classroom friendships.

Discussion

The current study explored to what extent the social eye processing abilities of autistic youth could be enhanced through *LFI - SEPT*. The study also assessed if any transfer of learning could be found with autistic youth improving in their daily face-to-face social interactions after completing *LFI - SEPT.* The innovative aspect of the *Let's Face It! Scrapbook* app is that the training content is user-generated, composed of images and video clips of autistic youth from within their immediate social circle. In this study, 12 autistic youth received 4.5 hours of *LFI - SEPT* over 3 weeks. The same 12 autistic youth completed 4.5 hours of Control Training over 3 additional weeks, using a pre-test/post-test control group switching replications design. As a

between-subjects design, the study compared the effects of the two trainings. As a within-subjects design, the autistic youth served as their own controls so that there were no significant differences between any of the training groups or comparisons made.

In *LFI - SEPT*, instruction was led by four research facilitators who were undergraduate psychology students. Each research facilitator was assigned to lead a small group of three autistic youth. In weekly small group learning sessions, the research facilitators implemented active training following the *LFI - SEPT Lesson Plans.* The research facilitators were tasked with introducing and modelling social eye processing abilities to autistic youth. The research facilitators then used the *Let's Face It! Scrapbook* app to photograph and video record the study youth demonstrating their own social eye processing abilities. For the remainder of the week, the autistic youth played the *Let's Face It! Scrapbook* app games in designated gameplay sessions. Autistic youth were paired and played the *Let's Face It! Scrapbook* app games together with a social gaming partner. All gameplay took place in the designated sessions, under the supervision of the principal investigator. The principal investigator actively coached autistic youth in linking their small-screen learning with big-world performance. The autistic youth had no further access to the *Let's Face It! Scrapbook* app games outside of the designated gameplay sessions.

Control Training was designed to mirror *LFI - SEPT*, except that there were no active social eye processing components. The research facilitators continued in leading weekly small group activity sessions. In Control Training, each research facilitator was responsible for leading a small group of three autistic youth. The research facilitators implemented 3 weeks of general education activities as outlined in the *Control Training Lesson Plans*. It was necessary to control for the high degree of ongoing face-to-face social interactions experienced by autistic youth in the active training condition. In addition, the Control Training involved autistic youth playing

from a suite of general education app games. Autistic youth played the general education app games together with a peer in all designated gameplay sessions. The sessions were supervised by the principal investigator, who provided additional coaching in linking small-screen learning with big-world autistic youth interests. The autistic youth were not permitted to access the general education app games outside of their designated gameplay sessions.

Finding Improvements in Social Eye Processing Abilities

It was hypothesized that after completing *LFI - SEPT,* autistic youth would improve in demonstrating social eye processing abilities. Comparing the effects of the two trainings, *LFI - SEPT* was found to be superior to Control Training. The results indicated that the autistic youth experienced significant improvements in social eye processing abilities after just 3 weeks of active training. No significant gains of any kind were reported from the Control Training data.

The findings indicated that *LFI - SEPT* significantly improved autistic youth in their ability to interpret facial expression through the eyes. More specifically, autistic youth demonstrated significant gains in their perceptual discrimination of emotional expressions as assessed using *The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017)*. On this task, autistic youth observed photographs of a single female actress posing happy, sad, angry, and disgusted facial expression across a scale of expressive intensity. For each expression, autistic youth were presented with two photographs and were instructed to select "which face shows more expression" (Motta-Mena & Scherf, 2017**).**

In the present study, autistic youth were assessed in their discrimination of facial expressions in both unfamiliar and familiar faces. In the unfamiliar version of the task, *The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017),* autistic youth demonstrated an overall improvement in their ability to detect emotional intensity in facial expressions. Further

analysis indicated that autistic youth had especially improved in their ability to detect a disgusted facial expression. No significant findings were noted in the Control Training data. It is possible that the training effect found was most pronounced for disgusted emotion because this expression relies primarily on perceptual information in the bottom-half of the face. Previous research has suggested that persons on the autism spectrum attend more to the mouth than the eyes (Tanaka & Sung, 2016). In the second version of the face task, *The Just Noticeable Differences Face Task - Mosaic Version,* autistic youth significantly improved in their ability to detect facial expressions in a familiar educator after completing *LFI - SEPT*. The autistic youth showed no such gains in the Control Training data analysis.

Together, these findings indicate that some limited transfer of learning had occurred in autistic youth after completing *LFI - SEPT.* During active training, autistic youth learned, demonstrated, and practiced their social eye processing abilities on the small screen using the *Let's Face It! Scrapbook* app. At post-testing, following active training, autistic youth were found better at interpreting unfamiliar facial expressions through the eyes on *The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017)*. Meanwhile, no such gains were seen in the Control Training analysis. Based on significant performance gains in *The Just Noticeable Differences Face Task - Mosaic Version,* autistic youth also improved in their ability to recognize the facial expressions of a familiar educator at Mosaic Learning Society of Victoria. In other words, *LFI - SEPT* demonstrated successful transfer of learning by enhancing social eye processing abilities and yielding meaningful gains within the daily educational setting at Mosaic Learning Society of Victoria.

Another main finding was that *LFI - SEPT* significantly improved autistic youth in their use of eye contact. Considering Senju and Johnson (2008)'s operationalization of eye contact,

autistic youth improved in their ability to lock attention with someone else's eyes in direct gaze. No such improvement in social eye processing ability was seen following the Control Training. In our everyday face-to-face encounters, eye contact is essential for initiating, maintaining, and regulating our social interactions with others. Previous research indicates that eye contact is severely compromised in autism (Tanaka & Sung, 2016). The results from this study provide proof of concept that despite the clinical deficits, eye contact abilities can be boosted in autistic youth through direct training.

Lacking established assessments in the extant literature, *The Story Time Reading and Conversation Task* was developed by the principal investigator as a naturalistic measure for assessing eye contact and gaze following in autistic youth. In this task, the principal investigator read a simple story out loud to a pair of study participants while their eye movements were videotaped and scored. A significant positive finding from the study was that during *The Story Reading Task*, autistic youth were found to establish more direct eye contact with the principal investigator after completing active training. No such gains in establishing eye contact were seen in the Control Training data.

In the ensuing *Conversation Task*, the principal investigator initiated and maintained eye contact with the autistic youth while asking simple questions from the story reading. The results indicated that after competing *LFI - SEPT,* autistic youth maintained their eye contact with the principal investigator for longer during conversation. No significant gains in maintaining eye contact were reported from the Control Training analysis. The results from *The Story Time Reading and Conversation Task* suggested that active training was effective in promoting autistic youth eye contact within a naturalistic learning assessment.

Following the eye gaze of others is necessary for regulating face-to-face social

interactions with others. The study aimed to improve this critical aspect of social eye processing ability in autistic youth. Research suggests that following the eye gaze of others is necessary for early learning, promoting theory of mind between social partners, and in driving joint attention bids (Mundy & Newell, 2007). Unfortunately, autistic youth in this study did not demonstrate significant improvements in their gaze following abilities on *The Story Time Reading and Conversation Task* after 3 weeks of *LFI - SEPT.* That is, autistic youth were not found to follow eye gaze more frequently during the actual story reading, nor during the ensuing conversation assessment. The study established that autistic youth did not spend more time following the eye gaze of others after completing *LFI - SEPT.*

For reaching improvements in following eye gaze on *The Story Time Reading and Conversation Task,* autistic youth would have needed to better observe the shared eye gaze held between the principal investigator and the second youth during completion of the task. In this observational viewing context, there were no direct cues for capturing the attention of autistic youth. Success in better following eye gaze in the task would require that autistic youth pay more attention, without receiving any prompting from the principal investigator or the second youth, on where and when to look. The evidence from the study suggests this was perhaps a transfer leap too far. Research suggests that delays in early language outcomes are commonly linked with poor joint attention found in ASD (Kasari et al., 2008). The non-significant findings from the study may also suggest that remediating gaze following in ASD remains a challenging prospect demanding further research efforts.

Interestingly, *LFI - SEPT* enabled autistic youth to make significantly more direct eye contact in *The Story Time Reading and Conversation Task* at post-test. After only 3 weeks of active training, the eye contact initiated by the principal investigator during *The Story Time*

Reading and Conversation Task was found serving as a more effective attentional cue. Autistic youth were found paying more attention to eye contact in *The Story Time Reading and Conversation Task* after completing *LFI - SEPT.* Autistic youth established more direct eye contact and maintained their eye contact for a longer period of time in *The Story Time Reading and Conversation Task* following active training. No gains in autistic youth eye contact could be identified from the Control Training analysis.

Trending Towards Transfer with Improvements in Daily Face-to-Face Social Interactions

It was hypothesized that after completing *LFI - SEPT,* autistic youth would experience transfer of learning by demonstrating improvements in their daily face-to-face social interactions. No such transfer of learning was expected to be seen in Control Training. The results from the study established that *LFI - SEPT* successfully transferred with evidence that autistic youth experienced gains across measures assessing daily face-to-face social interactions.

Comparing performance on The *Facial Expressions Posing Task,* the results indicated that *LFI - SEPT* outperformed the Control Training. The *Facial Expressions Posing Task* was developed by the principal investigator for evaluating autistic youth in their abilities to produce facial expressions. The autistic youth were instructed to pose their most happy, sad, angry, disgusted, afraid and surprised facial expressions at T1, T2, and T3 assessments. In week 1of active training, the primary theme for the small group learning sessions was *Eyeing My Feelings*. Following instructions from the *LFI - SEPT Lesson Plans*, research facilitators assisted autistic youth in posing their most, medium, and little: happy, sad, angry, surprised, disgusted, and afraid facial expressions. After receiving this training, autistic youth demonstrated significant gains in their ability to pose facial expressions, and their overall gain scores relative to Control Training

approached significant levels (p = .064). The autistic youth showed no improvements in posing facial expressions after Control Training.

In addition, the study results demonstrated that gains from *LFI - SEPT* successfully transferred beyond daily educational experiences at Mosaic Learning Society of Victoria. *The Multidimensional Social Competence Scale, Faces Screener Task (Yager, & Iarocci, 2013*) is a parent-completed measure that assesses an individual's social competency in understanding faces. The findings indicated that in the home environment, autistic youth had significantly improved in their social competency in understanding faces after completing *LFI - SEPT.* The parents of study youth reported no such gains from home in the Control Training analysis.

Finally, *The Friendship Survey Task (Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011*) was completed by autistic youth to quantify their classroom friendships. Classroom friendship networks were analyzed by exploring differences in friendship reciprocity following the active training. It was found that *LFI - SEPT* did not improve autistic youth in declaring more classroom friendships after completing active training. There were no significant increases in the number of friendship nominations received at completion of training. Autistic youth did not report gaining new best friends out of the training. The results indicated autistic youth did not report having more classroom friendships and there were no observed enhancements within existing friendships networks.

It may be speculated that longer periods of time between training and assessment is needed to capture reliable changes in classroom friendships. Due to the short-term nature of the current training study, where active training was completed in 4.5 hours over a span of just 3 weeks, there was likely insufficient time for broader gains in autistic youth friendship variables. In addition, the entire sample of autistic youth had been recruited from Mosaic Learning Society

of Victoria, At the beginning of active training, the autistic youth were already a very small and close-knit group of learners. Within this sample, there were likely limited and restricted opportunities for forming new friendships after only 3 weeks of active training. It is also possible that remaining deficits in social skills, perspective taking, and conversation skills further inhibited growth of friendships in the current study. More exploration can better refine the relationship between social eye processing abilities and the malleability of friendship variables in autistic youth.

While spending too much time in front of the computer is thought to have negative effects on the social development of typically developing children (Pea et al., 2012), there appears to be real world benefits in implementing screen-time learning for autistic youth. Autistic youth were highly engaged in the screen-based intervention, reflected in the study's strong training implementation data, and there were no cases of attrition. All autistic youth completed 4.5 hours of both *LFI - SEPT* and Control Training, with no youth withdrawing from training at any point. The efforts of the autistic youth, parents, and families must be truly recognized, commended, and celebrated!

Acknowledging the success experienced by youth, consider their achievements from their own words. At the beginning of *LFI - SEPT*, autistic youth were eager to start, albeit with some reservation. One youth remarked, "Why would I do that? My eyes don't talk!" Playing the *Let's Face It! Scrapbook* app games together with a peer, the autistic youth began making links between their small-screen learning and big-world performance. After playing the *Let's Face It! Scrapbook* app games, one youth proudly confirmed, "Yup! I need to look at eyes when someone is talking." The principal investigator reciprocated the improved social understanding with a confirming smile - established in eye contact - of course!

LFI - SEPT exemplifies how accessibility features now built into our common mobile devices stand to revolutionize the inclusive training field. The device's built-in-camera was utilized for capturing the everyday reality of autistic youth. The youth were continuously generating their own user content, extracted from their daily educational experiences at Mosaic Learning Society of Victoria. The iPad's touch screen was indispensable for providing intuitive and enjoyable gameplay. The in-game, text-to-speech function greatly expanded access to include both readers and non-readers. Ease of portability enabled the autistic youth to always enjoy having the training right by their side. Autistic youth reported very positive learning experiences from their *LFI – SEPT.*

Limitations of the Study

The main limitation of the study was its relatively small sample size of 12 autistic youth. In addition, the small sample was restricted within an educational setting where autistic youth congregated each day in learning. Adjusting for the small sample and educational context, a repeated measures design was implemented for comparing effects of *LFI - SEPT* and Control Training. Autistic youth completed both active training and control training, and autistic youth gain scores from *LFI - SEPT* and Control Training were then analyzed in a series of dependent t-tests. Future efforts with larger sample sizes and use of randomized group designs (Tabachnick & Fidell, 2007) are required for expanding the study findings.

Future Directions

Further research can explore methods for extending transfer of learning in computer-based training efforts such as this one. More research can chart key variables for improving gaze following abilities in ASD. It would also be valuable to reassess change in friendship variables after increasing the duration of *LFI - SEPT* by 1 or 2 months. Finally, it is recommended that

future study include follow up testing at 6 to 8 weeks post-training for determining if gains in autistic youth were stable and long lasting.

Conclusion

The *Let's Face It! Scrapbook* app is an exciting new tool for empowering different minds. After 3 weeks of *LFI - SEPT,* autistic youth displayed significant improvements in their social eye processing abilities. Autistic youth were found better interpreting facial expressions through the eyes on *The Just Noticeable Differences Face Task (Motta-Mena & Scherf, 2017).* Transfer of learning was demonstrated with the results confirming that autistic youth had also improved in interpreting the facial expressions of a familiar educator on *The Just Noticeable Differences Face Task - Mosaic Version*. Furthermore, analysis from *The Story Time Reading and Conversation Task* indicated that autistic youth established more direct eye contact and maintained their eye contact for longer after completing *LFI - SEPT*. More transfer of learning was highlighted with the finding that autistic youth had experienced significant gains across measures assessing daily face-to-face social interactions. The data revealed that following active training, autistic youth had improved in posing facial expressions on the *Facial Expressions Posing Task.* Finally, parents reported gains on *The Multidimensional Social Competence Scale, Faces Screener Task* (*Yager, & Iarocci, 2013),* indicating that the learning in *LFI - SEPT* had successfully transferred to the home environment. From the perspective of the study parents, autistic youth had made significant improvements in their social competency in understanding faces after only 4.5 hours of *LFI - SEPT.* No gains of any kind were reported in the Control Training analysis. Collectively, the efforts from this research strengthen the logic that mobile app training, by means of targeting social eye processing abilities, can indeed serve as an effective avenue for improving daily face-to-face social functioning in autistic youth.

References

Abrosoft. (2017). *Abrosoft FantaMorph*. https://www.fantamorph.com

Adams, R. B., & Kleck, R. E. (2005). The effects of direct and averted gaze on the perception of facially communicated emotion. *Emotion, 5,* 3-11.

Albee, Edward. (1966). *Who's afraid of Virginia Woolf?* Warner Home Video.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.

Apple Inc. (2016). App Store. https://www.apple.com/ca/app-store/

Argyle, M., & Cook, M. (1976). *Gaze and mutual gaze.* Cambridge University Press.

Baio, J. (2014). Prevalence of autism spectrum disorder among children aged 8 years- autism and developmental disabilities monitoring network, 11 sites, United States, 2010. *Surveillance Summaries- Centers for Disease Control and Prevention, 63,* 1-21.

Baldwin, D. A. (1991). Understanding the link between joint attention and language. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 131- 158). Lawrence Erlbaum.

Baron-Cohen, S. (2002). The extreme male brain theory of autism. *Trends in Cognitive Sciences, 6,* 248-254.

Baron-Cohen, S., Campbell, R., Karmiloff-Smith, A., Grant, J., & Walker, J. (1995). Are children with autism blind to the mentalistic significance of the eyes? *British Journal of Developmental Psychology, 13,* 379-398.

Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "reading the mind in the eyes" test revised version: A study with normal adults, and adults with asperger syndrome or high functioning autism. *Journal of Child Psychology and*

Psychiatry and Allied Disciplines, 42, 241-251.

Baron-Cohen, S., Wheelwright, S., & Jolliffe, T. (1997). Is there a "language of the eyes?" Evidence from normal adults, and adults with autism or Asperger syndrome. *Visual Cognition, 4,* 311-331.

Bauminger, N., & Kasari, C. (2000). Loneliness and friendship in high-functioning children with autism. *Child Development, 71,* 447-456.

Bavelas, J. B., Coates, L., & Johnson, T. (2000). Listeners as co-narrators. *Journal of Personality and Social Psychology, 79,* 941-952.

Bayliss, A. P, Paul, M. A., Cannon, P. R., & Tipper, S. P. (2006). Gaze cueing and affective judgments of objects: I like what you look at. *Psychonomic Bulletin and Review, 13,* 1061-1066.

Bayliss, A. P., & Tipper, S. P. (2006). Predictive gaze cues and personality judgments: Should eye trust you? *Psychological Science, 17,* 514-520.

Beaudry, O., Roy-Charland, A., Perron, M., Cormier, I., & Tapp, R., (2014). Featural processing in recognition of emotional facial expressions. *Cognition & Emotion, 28,* 416-432.

Becchio, C., Bertone, C., & Castiello, U. (2008). How the gaze of others influences object processing. *Trends in Cognitive Science, 12,* 254-258.

Bedford, R., Elsabbagh, M., Gliga, T., Pickles, A., Senju, A., Charman, T., & Johnson, M. H. (2012). Precursors to social and communication difficulties in infants at-risk for autism: Gaze following and attentional engagement. *Journal of Autism & Developmental Disorders, 42,* 2208-2218.

Bertenthal, B. I., & Boyer, T. W. (2015). The development of social attention in humans. In A. Puce & B. I. Bertenthal (Eds.), *The many faces of social attention: Behavioral and neural*

measures. (pp. 21-65). Springer International.

Biasini, F. J. (2011). Avatar assistant: Improving social skills in students with an ASD through a computer-based intervention. *Journal of Autism and Developmental Disorders, 41,* 1543-1555.

Birmingham, E., Smith Johnston, K. H., & Iarocci, G. (2017). Spontaneous Gaze Selection and Following During Naturalistic Social Interactions in School-Aged Children and Adolescents With Autism Spectrum Disorder. *Canadian Journal of Experimental Psychology,* Advance online publication. http://dx.doi.org/10.1037/cep0000131

Bolte, S., Feineis-Matthews, S., Leber, S., Dierks, T., Hubl, D., & Poustka, F. (2002). The development and evaluation of a computer-based program to test and to teach the recognition of facial affect. *International Journal of Circumpolar Health, 61 (Supple 2),* 61-68.

Bosseler, A., & Massaro, D. W. (2003). Development and evaluation of a computer-animated tutor for vocabulary and language learning in children with autism. *Journal of Autism and Developmental Disorders, 33,* 653-672.

Brighten Learning. (2021). *The social express.* https://brightenlearning.com/the-social-express-program/

Brooks, R., & Meltzoff, A. N. (2005). The development of gaze following and its relation to language. *Developmental Science, 8,* 535-543.

Brooks, R., & Meltzoff, A. N. (2008). Infant gaze following and pointing predict accelerated vocabulary growth through two years of age: A longitudinal, growth curve modeling study. *Journal of Child Language, 35,* 207-220.

Cairns, R., & Cairns, B. (1994). *Lifelines and risks: Pathways of youth in our time.* Cambridge

University Press.

Calder, A. J., Young, A. W., Keane, J., & Dean, M. (2000). Configural information in facial expression perception. *Journal of Experimental Psychology: Human Perception and Performance, 26,* 527-551.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development, 63,* 1-143.

Celani, G., Battacchi, M. W., & Arcidiacono, L. (1999). The understanding of emotional meaning of facial expressions in people with autism. *Journal of Autism and Developmental Disorders, 29,* 57-66.

Chamberlain, B., Kasari, C., & Rotheram-Fuller, E. (2007). Involvement or isolation? The social networks of children with autism in regular classrooms. *Journal of Autism and Developmental Disorders, 37,* 230-242.

Chawarska, K., Macari, S., & Shic, F. (2013). Decreased spontaneous attention to social scenes in 6-month-old infants later diagnosed with autism spectrum disorders. *Biological Psychiatry, 74,* 195-203.

Chawarska, K., & Shic, F. (2009). Looking but not seeing: Atypical visual scanning and recognition of faces in 2 and 4-year-old children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 39,* 1663-1672.

Constantino, J. N., & Gruber, C. P. (2002). *The Social Responsiveness Scale.* Los Angeles: Western Psychological Services.

Dadds, M. R., Allen, J. L., Oliver, B. R., Faulkner, N., Legge, K., Moul, C., Woolgar, M., & Scott, S. (2012). Love, eye contact and the developmental origins of empathy v.

psychopathy. *British Journal of Psychiatry, 200,* 191-196.

Dalmaso, M., Galfano, G., Tarqui, L., Forti, B., & Castelli, L. (2013). Is social attention impaired in schizophrenia? Gaze, but not pointing gestures, is associated with spatial attention deficits. *Neuropsychology, 27,* 608-613.

Dawson, G., Toth, K., Abbott, R., Osterling, J., Munson, J., Estes, A., & Liaw, J. (2004). Early social attention impairments in autism: Social orienting, joint attention, and attention to distress. *Developmental Psychology, 40,* 271-283.

Dawson, G., Webb, S. J., & McPartland, J. (2005). Understanding the nature of face processing impairment in autism: Insights from behavioral and electrophysiological studies. *Development Neuropsychology, 27,* 403-424.

Driver, J., Davis, G., Ricciardelli, P., Kidd, P., Maxwell, E., & Baron-Cohen, S. (1999). Gaze perception triggers reflexive visuospatial orienting. *Visual Cognition, 6,* 509-540.

Dua, V. (2003). *Standards and guidelines for the assessment and diagnosis of young children with autism spectrum disorder in British Columbia: An evidence-based report prepared for the British Columbia Ministry of Health Planning.* British Columbia Ministry of Health Planning.

Duchenne, G. B. (1990). *The mechanism of human facial expression or an electro-physiological analysis of the expression of the emotion.* Cambridge University Press.

Eagle, M., & Barnes, T. (2009). Experimental evaluation of an educational game for improved learning in introductory computing. In *Proceedings of the 40th Technical Symposium on Computer Science Education* (pp. 321-325). Special Interest Group on Computer Science Education.

Ekman, P. & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal*

of Personality and Social Psychology, 17, 124-129.

Ekman, P., Friesen, W. V. (1978). *Facial action coding system: Investigator's guide.* Consulting Psychologists Press.

Ekman, P., Sorenson, E. R., & Friesen, W. V. (1969). Pan-cultural elements in facial displays of emotion. *Science, 164,* 86-88.

Ellis, C. (2015). *Home.* Candlewick.

Ewert, A., & Sibthorp, J. (2009). Creating outcomes through experiential education: The challenge of confounding variables. *Journal of Experiential Education, 31,* 376-389.

Fager, J. (2011). Autism and the iPad [60 Minutes]. CBS.

Farmer, T. W., & Farmer, E. M. Z. (1996). Social relationships of students with exceptionalities in mainstream classrooms: Social networks and homophily. *Exceptional Children, 62,* 431-450.

Friesen, C. K., & Kingstone, A. (1998). The eyes have it! Reflexive orienting is triggered by nonpredictive gaze. *Psychonomic Bulletin & Review, 5,* 490-495.

Friesen, C. K., Ristic, J., & Kingstone, A. (2004). Attentional effects of counterpredictive gaze and arrow cues. *Journal of Experimental Psychology- Human Perception and Performance, 30,* 319-329.

Frischen, A., Bayliss, A. P., & Tipper, S. P. (2007). Gaze cueing of attention: Visual attention: Social cognition, and individual differences. *Psychological Bulletin, 133,* 694-724.

Frith, C. D. & Frith, U. (2006) The neural basis of mentalizing. *Neuron, 50,* 531-534.

George, N., & Conty, L., 2008. Facing the gaze of others. *Neurophysiologie Clinique, 38,* 197- 207.

Geschwind, N., & Galaburda, A. M. (1987). *Cerebral lateralization.* MIT Press.

Gilliam, J. E. (2006). *Gilliam autism rating scale: GARS 2.* Pro-ed.

Golan, O., Ashwin, E., Granader, Y., McClintock, S., Day, K., Leggett, V., & Baron-Cohen, S. (2010). Enhancing emotion recognition in children with autism spectrum conditions: An intervention using animated vehicles with real emotional faces. *Journal of Autism and Developmental Disorders, 40,* 269-279.

Golan, O., & Baron-Cohen, S. (2006). Systemizing empathy: Teaching adults with Asperger syndrome or high functioning autism to recognize complex emotions using interactive multimedia. *Development and Psychopathology, 18,* 591-617.

Goldstein, T. R., Miklowitz, D. J., & Mullen, K. L. (2006). Social skills knowledge and performance among adolescents with bipolar disorder. *Bipolar Disorder, 8,* 350-361.

Gravett, E. (2017). *Dogs.* Two Hoots.

Gravetter, F. J., & Wallnau, L. B. (2007). *Statistics for the behavioral sciences.* (7th ed.). Thomson Wadsworth.

Gresham, F. M., & Elliott, S. N. (1990). *Social Skills Rating System Manual.* American Guidance Service.

Gross, T. F. (2004). The perception of four basic emotions in human and nonhuman faces by children with autism and other developmental disabilities. *Journal of Abnormal Child Psychology, 32,* 469-480.

Gullane Entertainment. (1998). *Thomas and friends* (Season 5). Gullane Entertainment.

Guthrie, W., Swineford, L. B., Nottke, C., & Wetherby, A. M. (2013). Early diagnosis of autism spectrum disorder: Stability and change in clinical diagnosis and system presentation. *Journal of Child Psychology and Psychiatry, 54,* 582-590.

Happé, F. G. E. (1994). An advanced test of theory of mind-understanding of story characters

thoughts and feelings by able autistic, mentally-handicapped, and normal-children and adults. *Journal of Autism and Developmental Disorders, 24,* 129-154.

Heimann, M., Nelson, K., Tjus, T., & Gillberg, C. (1995). Increasing reading and communication skills in children with autism through an interactive multimedia computer program. *Journal of Autism and Developmental Disorders, 25,* 459-480.

Hobson, R. (1986). The autistic child's appraisal of expressions of emotion. *Child Psychology and Psychiatry and Allied Disciplines, 27,* 321-342.

Hood, B. M., Willen, J. D., & Driver, J. (1998). Adult's eyes trigger shifts of visual attention in human infants. *Psychological Science, 9,* 131-134.

Hopkins, I. M., Gower, M. W., Perez, T. A., Smith, D. S., Amthor, F. R., Wimsatt, F. C., & Biasini, F. J. (2011). Avatar assistant: Improving social skills in students with an ASD through a computer-based intervention. *Journal of Autism and Developmental Disorders, 41,* 1543-1555.

IBM. (2021). *IBM SPSS.* https://www.ibm.com/spss

Insch, P. M., Slessor, G., Warrington, J., & Phillips, L. H. (2017). Gaze detection and gaze cuing in Alzheimer's disease. *Brain and Cognition, 116,* 47-53.

Itier, R. J., & Batty, M. (2009). Neural bases of eye and gaze processing: The core of social cognition. *Neuroscience & Biobehavioral Reviews, 33,* 843-863.

Jemel, B., Mottron, L., & Dawson, M. (2006). Impaired face processing in autism: Fact or artifact? *Journal of Autism and Developmental Disorders, 36,* 91-106.

Jones, W., Carr, K., & Klin, A. (2008). Absence of preferential looking to the eyes of adults predicts level of social disability. *Archives of General Psychiatry, 65,* 946-954.

Jones, W., & Klin, A. (2013). Attention to eyes is present but in decline in 2-6-month-old infants

later diagnosed with autism. *Nature, 504,* 427-431

Kanner, L. (1943). Autistic disturbances of affective contact. *The Nervous Child, 2,* 217-250.

Kasari, C., Locke, J., Gulsrud, A., & Rotheram-Fuller, E. (2011). Social networks and at school: Comparing children with and without ASD. *Journal of Autism and Developmental Disorders, 41,* 533-544.

Kasari, C., Paparella, T., Freeman, S., & Jahromi, L.B. (2008). Language outcome in autism: Randomized comparison of joint attention and play interventions. *Journal of Consulting and Clinical Psychology, 76,* 125-137.

Kaufman, A. S., & Kaufman, N. L. (2004). *Kaufman brief intelligence test* (2nd ed.). Pearson.

Kendon, A. (1967). Some functions of gaze direction in social interaction. *Acta Psychologica*, *26,* 22-63.

Kim, Y. S., Fombonne, E., Koh, Y. J., Kim, S. J., Cheon, K. A., & Leventhal, B. L. (2014). A comparison of DSM-IV pervasive developmental disorder and DSM-5 autism spectrum disorder prevalence in an epidemiologic sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 53,* 500-508.

Kimble, C.E. & Olszewski, D. A. (1980) Gaze and emotional expression: The effects of message positivity-negativity and emotional intensity. *Journal of Research in Personality, 14,* 60-69.

Kleinke, C. L., Bustos, A. A., Meeker, F. B., & Staneski, R. A. (1973). Effects of self-attributed and other-attributed gaze on interpersonal evaluations between male and females. *Journal of Experimental Social Psychology, 9,* 154-163.

Kliemann, D., Dziobek, I., Hatri, A., Baudewig, J., & Heekeren, H. R. (2012). The role of the amygdala in atypical gaze on emotional faces in autism spectrum disorders. *Journal of*

Neuroscience, 32, 9469-9476.

Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002). Visual fixation patterns during viewing of naturalistic social situations as predictors of social competence in individuals with autism. *Archives of General Psychiatry, 59,* 809-816.

Klin, A., Lin, D. J., Gorrindo, P., Ramsay, G., & Jones, W. (2009). Two-year-olds with autism orient to non-social contingencies rather than biological motion. *Nature, 459,* 257-261.

Koegel, R. L., Koegel, L. K., & McNerney, E. K. (2001). Pivotal areas in intervention for autism. *Journal of Clinical Child & Adolescent Psychology, 30,* 19-32.

Kolassa, I. T., & Miltner, W. H. R. (2006). Psychophysiological correlates of face processing in social phobia. *Brain Research, 1118,* 130-141.

Korkman, M., Kirk, U., & Kemp, S. (2007). *NEPSY-II.* Pearson.

Kranz, L. (2013). *You be you.* Taylor Trade Publishing.

Kylliainen, A., & Hietanen, J. K. (2004). Attention orienting by another's gaze direction in children with autism. *Journal of Child Psychology and Psychiatry, 45,* 435-444.

Langdell, T. (1978). Recognition of faces: An approach to the study of autism. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 19,* 225-268.

Langer J. K., Lim M. H., Fernandez K. C., & Rodebaugh T. L. (2016). Social anxiety disorder is associated with reduced eye contact during conversation primed for conflict. *Cognitive Therapy and Research, 41,* 220-229.

Langton, R. R. H., & Bruce, V. (1999). Reflexive visual orienting in response to the social attention of others. *Visual Cognition, 6,* 541-567.

Langton, S. R. H., Watt, R. J., & Bruce, V. (2000). Do the eyes have it? Cues to the direction of social attention. *Trends in Cognitive Sciences, 4,* 50-59.

Le Couteur, A., Lord, C., & Rutter, M. (2003). *The autism diagnostic interview- revised (ADI-R).* Western Psychological Services.

Lord, C., Rutter, M., DiLavore, P., & Risi, S. (1999). *Autism diagnostic observation schedule (ADOS).* Western Psychological Services.

Lyall, K., Croen, L., Daniels, J., Fallin, M. D., Ladd-Acosta, C., Lee, B. K., Park, B. Y., Synder, N. W., Schendel, D., Volk, H., Windham, G. C., & Newschaffer, C. (2017). The changing epidemiology of autism spectrum disorders. *Annual Review of Public Health, 38,* 81-102.

Marini, A. & Genereux, R. (1995). The challenge of teaching for transfer. In A. McKeough, J. Lupart, & Marinin, A (Eds.), *Teaching for transfer: Fostering generalization in learning* (pp. 1-20). Lawrence Erlbaum Associates, Inc.

Massaro, D. W., & Bosseler, A. (2006). Read my lips: The importance of the face in a computer-animated tutor for vocabulary learning by children with autism. *Autism, 10,* 495-510.

MathWorks. (2016). *Matlab.* https://www.mathworks.com/products/matlab.html

Meltzoff, A. N., 2002. Imitation as a mechanism of social cognition: Origins of empathy, theory of mind, and the representation of action. In G. U. (Ed.), *Blackwell Handbook of Childhood Cognitive Development* (pp. 6-25). Blackwell Publishers.

Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science, 198,* 75-78.

Mitchell, P., Parsons, S., & Leonard, A. (2007). Using virtual environments for teaching social understanding to 6 adolescents with autistic spectrum disorders. *Journal of Autism and Developmental Disorders, 37,* 589-600.

Moore, M., & Calvert, S. (2000). Brief report: Vocabulary acquisition for children with autism:

Teacher or computer instruction. *Journal of Autism and Developmental Disorders, 30,* 359-362.

Motta-Mena, N. V., & Scherf, K. S. (2017). Pubertal development shapes perception of complex facial expressions. *Developmental Science, 20,* e12451.

Mundy, P. (1995). Joint attention and social-emotional approach behavior in children with autism. *Developmental Psychopathology, 7,* 63-82.

Mundy, P., & Newell, L. C. (2007). Attention, joint attention and social cognition. *Current Directions in Psychological Science, 16,* 269-274.

Neumann, D., Spezio, M. L., Piven, J., & Adolphs, R. (2006). Looking you in the mouth: Abnormal gaze in autism resulting from impaired top-down modulation of visual attention. *Social Cognitive and Affective Neuroscience, 1,* 194-202.

Norbury, C. F., Brock, J., Cragg, L., Einav, S., Griffiths, H., & Nation, K. (2009). Eye-movement patterns are associated with communicative competence in autistic spectrum disorders. *Journal of Child Psychology & Psychiatry & Allied Disciplines, 50,* 834-842.

Osterling, J., & Dawson, G., & Munson, J. A. (2002) Early recognition of 1-year-old infants with autism spectrum disorder versus mental retardation. *Development and Psychopathology, 14,* 239-251.

Over, H., & Carpenter, M. (2012). Putting the social into social learning: Explaining both selectivity and fidelity in children's copying behavior. *Journal of Comparative Psychology, 126,* 182-192.

Ozonoff, S., Young, G. S., Carter, A., Messinger, D., Yirmiya, N., Zwaigenbaum, L., Bryson, S., Carver, L. J., Constantino, J. N., Dobkins, K., Hutman, T., Iverson, J. M., Landa, R., Rogers, S. J., Sigman, M., & Stone, W. L. (2011). Recurrence risk for autism spectrum

disorders: A baby siblings research consortium study. *Pediatrics, 128,* e488-e495.

Palancia, A. & Itier, R. J. (2012). Attention capture by direct gaze is robust to context and task demands. *Journal of Nonverbal Behavior, 36,* 123-134.

Pea, R., Nass, C., Meheula, L., Rance, M., Kumar, A., Bamford, H., Nass, M., Simha, A., Stillerman, B., Yang, S., & Zhou, M. (2012). Media use, face-to-face communication, media multitasking, and social well-being among 8- to 12-year-old girls. *Developmental Psychology, 48,* 327-336.

Pelphrey, K. A., & Morris, J. P. (2006). Brain mechanisms for interpreting the actions of others from biological-motion cues. *Current Directions in Psychological Science, 15,* 136-140.

Pelphrey, K. A., Sasson, N. J., Reznick, J. S., Paul, G., Goldman, B. D., & Piven, J. (2002). Visual scanning of faces in autism. *Journal of Autism and Developmental Disorders, 32,* 249-261.

Posner, M. I., Cohen, Y., & Rafal, R. D. (1982). Neural systems control of spatial orienting. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 29,* 187-198.

Psychtoolbox-3. (2016). *Psychtoolbox-3 - Download, Installation, and Update.* http://psychtoolbox.org/download

Riby, D. M., Hancock, P. J. B., Jones, N., & Hanley, M. (2014). Spontaneous and cued gaze-following in autism and Williams syndrome. *Journal of Neurodevelopmental Disorders, 5,* 13.

Rice, L. M., Wall, C. A., Fogel, A., & Shic, F. (2015). Computer-assisted face processing instruction improves emotion recognition, mentalizing, and social skills in students with ASD. *Journal of Autism and Developmental Disorders, 45,* 2176-2186.

Robison, J. E. (2007). *Look me in the eye: My life with Asperger's.* Three Rivers Press.

Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning.* Association for Supervision and Curriculum Development.

Rutter, M., Le Couteur, A., & Lord, C. (2003). *Autism diagnostic interview revised.* Western Psychological Services.

Sadr, J., Jarudi, I., & Sinha, P. (2003). The role of eyebrows in face recognition. *Perception, 32,* 285-293.

Sasson, N. J. (2006). The development of face processing in autism. *Journal of Autism and Developmental Disorders, 36,* 381-394.

Schilalagebach, L. (2015). Eye to eye, face to face and brain to brain: Novel approaches to study the behavioral dynamics and neural mechanisms of social interactions. *Current Opinion in Behavioral Sciences, 3,* 130-135.

Schultz, R. T. (2005). Developmental deficits in social perception in autism: The role of the amygdala and fusiform face area. *International Journal of Developmental Neuroscience, 23,* 125-141.

Schyns, P. G., Bonnar, L., & Gosselin, F. (2002). Show me the features! Understanding recognition from the use of visual information. *Psychological Science, 13,* 402-409.

Senju, A., & Hasegawa, T. (2005). Direct gaze captures visuospatial attention. *Visual Cognition, 12,* 127-144.

Senju A, & Johnson M, H. (2008). The eye contact effect: Mechanisms and development. *Trends in Cognitive Sciences, 13,* 127-134.

Senju, A., Tojo, Y., Dairoku, H., & Hasegawa, T. (2004). Reflexive orienting in response to eye gaze and an arrow in children with and without autism. *Journal of Child Psychology and*

Psychiatry, 45, 445-458.

Shane, H. C., & Albert, P. D. (2008). Electronic screen media for persons with autism spectrum disorders: Results of a survey. *Journal of Autism and Developmental Disorders, 38,* 1499-1508.

Silver, M., & Oakes, P. (2001). Evaluation of a new computer intervention to teach people with autism or Asperger syndrome to recognize and predict emotions in others. *Autism, 5,* 299-316.

Singer, T. (2006). The neuronal basis and ontogeny of empathy and mind reading: Review of literature and implications for future research. *Neuroscience and Biobehavioral Reviews, 30,* 855-863.

Smith, M. L., Cottrell, G. W., Gosselin, F., & Schyns, P. G. (2005). Transmitting and decoding facial expressions. *Psychological Science, 16,* 184-189.

Savvas. (2014). *SuccessMaker Reading: Personalized learning to accelerate reading proficiency for Grades K-8.* https://www.savvas.com/index.cfm?locator=PS33U7

Sullivan, S., Ruffman, T., & Hutton, S. B. (2007). Age differences in emotion recognition skills and the visual scanning of emotion faces. *The Journals of Gerontology, 62,* 53-60.

Sung, A. N., Bai, A., Bowen, J. G., Xu, B., Bartlett, L., Sanchez, J. C., Chin, M. D., Poirier, L. J., Blinkhorn, M. R., Campbell, A. C., & Tanaka, J. W. (2015). From the small-screen to the big-world: Mobile apps for teaching real world facial recognition to children with autism. *Advanced Health Care Technologies, 1,* 37-45.

Swettenham, J., Condie, S., Campbell, R., Milne, E., & Coleman, M. (2003). Does the perception of moving eyes trigger reflexive visual orienting in autism*? Philosophical Transactions of the Royal Society of London Series B: Biological Sciences, 358,* 325-334.

Tabachnick, B. G., & Fidell, L. S. (2007). *Experimental designs using ANOVA.* Duxbury.

Tanaka, J. W. (2001). The entry point of face recognition: Evidence for face expertise. *Journal of Experimental Psychology: General, 130,* 534-543.

Tanaka, J. W., & Sung, A. N. (2016). The "eye avoidance" hypothesis of face processing in autism. *Journal of Autism and Developmental Disorders, 46,* 1538-1552.

Tanaka, J. W., Wolf, J. M., Klaiman, C., Koenig, K., Cockburn, J, Herlihy, L., Brown, C., Stahl, S., Kaiser, M. D., & Schultz, R. T. (2010). Using computerized games to teach face recognition skills to children with autism spectrum disorder: The Let's Face It! program. *Journal of Child Psychology and Psychiatry, 51,* 944-952.

Tanaka, J. W., Wolf, J. M., Klaiman, C., Koenig, K., Cockburn, J., Herlihy, L., Brown, C., Stahl, S. S., South, M., McPartland, J. C., Kaiser, M., & Schultz, R. T. (2012). The perception and identification of facial emotions in individuals with autism spectrum disorders using the Let's Face It! Emotion Skills Battery. *Journal of Child Psychology and Psychiatry, 53, 1259-67.*

Tenenbaum, E., Sobel, D. M., Sheinkopf, S. J., Malle, B. F., & Morgan, J. L. (2015). Attention to the mouth and gaze following in infancy predict language development. *Journal of Child Language, 42,* 1173-1190.

The University of Victoria, Centre for Autism Research, Technology, and Education (2016). *Let's Face It! Scrapbook* [Mobile app]. https://web.uvic.ca/~carte/lfiscrapbook.html

Thorup, E., Nystrom, P., Gredeback, G., Bolte, S., Falck-Ytter, T., & the EASE Team (2016). Altered Gaze Following During Live Interaction in Infants at Risk for Autism: An Eye Tracking Study. *Molecular Autism.* doi:10.1186/s13229-016-0069-9

Tipples, J. (2008). Orienting to counter predictive gaze and arrow cues. *Perception &*

Psychophysics, 70, 77-87.

Tomasello, M. (1995). Joint attention as social cognition. In C. Moore & P.J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 103-130). Lawrence Erlbaum Associates.

Trochim, W. M. K., & Donelly, J. P. (2007). *The research methods knowledge base* (3rd ed.). Thomson.

Tux Paint. (2010). *Tux Paint.* https://tuxpaint.org

Vertegaal, R., Slagter, R., van der Veer, G., & Nijholt, A. (2001). Eye gaze patterns in conversations: There is more to conversational agents than meets the eyes. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 308). ACM.

Vivanti G, & Hamilton A. (2014). Imitation in autism spectrum disorders. In: Volkmar, F. R., Paul, R., Rogers, S. J., & Pelphrey, K. A, (Eds.), *Handbook of Autism and Pervasive Developmental Disorders, Vol. 1* (pp. 278-301). John Wiley & Sons, Inc.

Von Grunau M, & Anston C. (1995). The detection of gaze direction: A stare-in-the-crowd effect. *Perception, 24,* 1297-1313.

Weigelt, S., Koldewyn, K., & Kanwisher, N. (2012). Face identity recognition in autism spectrum disorders: A review of behavioral studies. *Neuroscience and Biobehavioral Reviews, 36,* 1060-84.

Whalen, P. J., Kagan, J., Cook, R. G., Davis, F. C., Kim, H., Polis, S., McLaren, D. G., Somerville, L. H., McLean, A. A., Maxwell, J. S., & Johnstone, T. (2004). Human amygdala responsivity to masked fearful eye whites. *Science, 306,* 2061.

Wheeler, R. W., Baron, J. C., Michell, S., & Ginsburg, H. J. (1979). Eye contact and the

perception of intelligence. *Bulletin of the Psychonomic Society, 13,* 101-102.

Williams, B. T., Gray, K. M., & Tonge, B. J. (2012). Teaching emotion recognition skills to young children with autism: A randomized controlled trial of an emotion training programme. *Journal of Child Psychology and Psychiatry, 53,* 1268-1276.

Wolf, J. M., Tanaka, J. W., Klaiman, C., Cockburn, J., Herlihy, L., Brown, C., South, M., McPartland, J., Kaiser, M. D., Phillips, R., & Schultz, R. T. (2008). Specific impairment of face-processing abilities in children with autism spectrum disorder using the Let's Face It! skills battery. *Autism Research, 1,* 329-340.

Xu, B., & Tanaka, J. W. (2015). The cued recognition task: Dissociating the abrupt onset effect from the social and arrow cueing effect. *Attention, Perception, & Psychophysics, 77,* 97-110.

Yager, J., & Iarocci, G. (2013). The development of the multidimensional social competence scale: A standardized measure of social competence in autism spectrum disorders. *Autism Research, 6,* 631-641.

Young, G. S., Merin, N., Rogers, S. J., & Ozonoff, S. (2009). Gaze behaviour and affect at 6 months: Predicting clinical outcomes and language development in typically developing infants and infants at risk for autism. *Developmental Science, 12, 7*98-814.

Zwaigenbaum, L., Bryson, S., & Garon, N. (2013). Early identification of autism spectrum disorders. *Behavioural Brain Research, 251,* 133-146.

Appendix A

Parent Demographic Form

Centre for Autism Research,
Technology, and Education
University of Victoria
3800 Finnerty Road
Victoria, BC V8N 1M5

Department of Educational
Psychology and Leadership
Studies
PO Box 1310 STN CSC
Victoria BC V8W 3N4

To: Parent/Guardian at Mosaic Learning Society of Victoria
Re: **Social training**

Your child has been included in our study. We kindly request that one parent/care giver/guardian assist us in filling out this demographic form. Its purpose is to help us report to others the overall demographic nature of our study sample. It will help others to judge whether our sample is representative of the overall population. We assure you that your demographic information will remain completely confidential.

Date form was completed: _____

Parent/Guardian Information

Parent/Guardian Name:	Street Address:
Child's Name:	City and Province:
Relations to Child (e.g., mother/father)	Postal Code:
Phone Number (s):	Email:

Are you male or female? (Please Mark with X)

MALE _____ FEMALE _____

What language/languages are spoken in your home? (Please include all)

_____

_____

What is your child's race/ethnicity? (Please Write)

_____

What is your child's date of birth?

Year: _____ Month: _____ Day: _____

When was your child diagnosed with autism?

Year: _____ Month: _____ Day: _____

Who diagnosed your child?

_____

Where? (Hospital, Clinic, doctor's office)

_____

Appendix B

Let's Face It! Scrapbook app: Social Eye Processing Training Lesson Plans

LET'S FACE IT! SCRAPBOOK APP: SOCIAL EYE PROCESSING TRAINING

-WEEK 1-

EYEING OUR FEELINGS:

(INTERPRETING FACIAL EXPRESSIONS THROUGH THE EYES)

MATERIALS:

-Photobooth (white board)
-iPad
-High Score Board

INTRODUCE THE LESSON:

Hi and thanks for helping me. Over the next 3 weeks you are going to transform into FACE ACTORS. I'll be your producer and each week when we meet, we will be taking face photos and videos. You'll have to listen to me because this will be like a professional production. You'll have to do your best posing facial expressions. I'll tell you where to stand and where to look. But just like the movies, it will be really fun. Oh, and when I'm not here, you'll be using your own photos and videos in your own videogames using the Let's Face It! Scrapbook app. Your acting skills will be transported into your very own videogame. Okay, so let's start!

This week's theme is all about EYEING OUR FEELINGS! We're going to take photos of our feelings and you will play the Let's Face It! Scrapbook app games to better understand each other's feelings. This will help you here at Mosaic because you spend a lot of time together and learn stuff together. By better understanding feelings you'll be better friends.

CREATE "EYEING OUR FEELINGS" ALBUM:

- ❒ PRESS ADD ALBUM BUTTON
- ❒ LABEL ALBUM "EYEING OUR FEELINGS"

ROUND 1: WORK WITH PARTICIPANTS TO CAPTURE THEIR MOST HAPPY, SAD, ANGRY, DISGUSTED, SURPRISED, AND AFRAID FACES.

Today we will be making our most happy, most sad, most angry, most disgusted, most surprised, and most afraid faces. Think about how each facial expression feels, especially in your eyes because feeling come from our eyes. But, you must use your eyes, mouth, and face muscles all together when making facial expressions. It helps a lot to breath in or out as you are making happy, sad, angry, and disgusted faces. For each of these, your mouth is going to be open, your eyes are going to be wide open, and you will really feel the muscles in your face. This isn't easy but it's just like the movies.

We need to practice just like real actors do. Okay, so let's try these now as a group. Watch each other to see what they look like too. And I'm the producer so I will give you lots of feedback on how your feelings look.

First, let's all do our most happy face. Everyone let's see most happy. This one is all about making your mouth move up high and breathing out. Think of what you like the most and having fun.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MOST HAPPY FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MOST HAPPY"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our most sad face. Everyone let's see most sad. This one is all about making your lips fat and breathing out. For me, I'm sad when I watch a sad movie like The Land Before Time.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MOST SAD FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MOST SAD"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our most angry face. Everyone let's see most angry. This one is all squinting your eyes, spreading your teeth, and breathing out. Think of what happens when the computer breaks down.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MOST ANGRY FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MOST ANGRY"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our most disgusted face. Everyone let's see most disgusted. Breathe out really hard, spread your teeth, stick out your tongue, and even close your eyes. Think of the grossest smell.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MOST DISGUSTED FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MOST DISGUSTED"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our most afraid face. Everyone let's see most afraid. This one you need to breathe in really hard and open your eyes as wide as you can, almost like you can feel them in the back of your head. Think of Jurassic Park and having the scariest dinosaurs chasing you.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MOST AFRAID FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MOST AFRAID"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our most surprised face. Everyone let's see most surprised. This one you need to breathe in really hard again and open your eyes as wide as you can and open your mouth too. Think of winning a prize! Hurray!

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MOST SURPRISED FACE.**
  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MOST SURPRISED"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

ROUND 2: WORK WITH PARTICIPANTS TO CAPTURE AND LABEL THEIR MEDIUM HAPPY, SAD, ANGRY, DISGUSTED, SURPRISED, AND AFRAID FACES.

Okay, great, everyone's gotten the hang of it. But let's think, do you always walk around with your happiest happy face? Not really? Sometimes you're happy just riding the bus instead of walking. Or maybe you are watching TV. So now, let's talk about our medium happy, medium sad, medium angry, medium disgusted, medium surprised, and medium fearful faces. Again, think about how each facial expression feels. It's similar like last time, but you keep your mouth closed this time. You must use your eyes, mouth, and face muscles all together. For each of these, your mouth is going to be closed. But you're still going to really feel the expression.

USE SAME INSTRUCTIONS AS PREVIOUS BUT HAVE PARTICIPANTS DO WITH CLOSED MOUTH.

Let's try these now as a group. Watch each other to see what they look like too. First, let's all do our medium happy face. Everyone let's see medium happy. This one is all about making your mouth move up high and breathing out, but keeping your mouth closed.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MEDIUM HAPPY FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MEDIUM HAPPY"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our medium sad face. Everyone let's see medium sad. This one is all about making your lips fat and breathing out with mouth closed. For me, I'm sad when I watch a sad movie like The Land Before Time.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MEDIUM SAD FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MEDIUM SAD"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our medium angry face. Everyone let's see medium angry. This one is all squinting your eyes, with mouth closed, and breathing out. Think of what happens when the computer breaks down.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MEDIUM ANGRY FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MEDIUM ANGRY"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our medium disgusted face. Everyone let's see medium disgusted. Breathe out really hard and spread your teeth but keep your mouth closed. Think of the grossest smell.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MEDIUM DISGUSTED FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MEDIUM DISGUSTED"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our medium afraid face. Everyone let's see medium afraid. This one you need to breathe in really hard and open your eyes as wide as you can, but keep your mouth closed this time.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MEDIUM AFRAID FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MEDIUM AFRAID"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our medium surprised face. Everyone let's see medium surprised. This one you need to breathe in really hard again and open your eyes as wide as you can but close your mouth.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR MOST SURPRISED FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "MEDIUM SURPRISED"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

ROUND 3: WORK WITH PARTICIPANTS TO CAPTURE THEIR LITTLE HAPPY, SAD, ANGRY, DISGUSTED, SURPRISED, AND AFRAID FACES.

Okay, and how about our little happy, little sad, little angry, little disgusted, little surprised, and little afraid faces?

***Let's practice these together again and we can see how everyone is a bit different. See how they are not exactly the same. These are not like our MOST expressions when we have our mouths open and our eyes are wide. They are not like our MEDIUM expressions when we had our mouths closed. They are less than that this time. You're still going to be happy,* sad, angry, disgusted, surprised, and afraid, but just show them with less feeling.**

Okay, let's all do our little happy face. Everyone let's see little happy.

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR LITTLE HAPPY FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "LITTLE HAPPY"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our little sad face. Everyone let's see little sad.

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR LITTLE SAD FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "LITTLE SAD"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our little angry face. Everyone let's see little angry.

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR LITTLE ANGRY FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

***** LABEL EXPRESSIONS AS "LITTLE ANGRY"**

*****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our little disgusted face. Everyone let's see little disgusted.

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR LITTLE DISGUSTED FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "LITTLE DISGUSTED"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Next, let's all do our little afraid face. Everyone let's see little afraid.

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT POSING THEIR LITTLE AFRAID FACE.**

  *****CAPTURE PHOTOGRAPHS ONLY**

  ***** LABEL EXPRESSIONS AS "LITTLE AFRAID"**

  *****YOU MUST SEE THE PARTICIPANT'S WHOLE FACE.**

Great job everyone. Let's see how we look in the Let's Face It! Scrapbook app.

PREVIEW THE *LET'S FACE IT! SCRAPBOOK APP* GAMES WITH PARTICIPANTS:

- ❒ PLAY ALL FOUR GAMES WITH NEWLY CREATED ALBUM AS A GROUP

PREVIEW FLASH CARD MODE:

- ❒ CLICK ON THE LIGHTNING BUTTON IN TOP LEFT CORNER TO ENTER FLASH CARD MODE

Hey, wasn't that fun? Well before the end of the day, let's just go over things for playing the Let's Face It! Scrapbook app games this week.

GAMEPLAY DISCUSSION:

- ❒ INTRODUCE HIGH SCORE BOARD.

- ❒ TELL PARTICIPANTS THEY WILL BE PLAYING THIS THROUGHOUT THE WEEK FOR 15 MINUTES A DAY ON AT LEAST 3 DAYS WITH ANDY. AS A REWARD, FOR EACH DAY THAT THEY PLAY 15 MINUTES WITH ANDY, CHILDREN WILL BE GIVEN 5 BONUS MINUTES TO TAKE EXTRA FACE PHOTOS AND VIDEOS OF THE GIVEN THEME FOR THE WEEK.

- ❒ ENCOURAGE PARTICIPANTS TO PLAY EACH OF THE FOUR GAMES.

LET'S FACE IT! SCRAPBOOK APP: SOCIAL EYE PROCESSING TRAINING

-WEEK 2-

LOOKING AT MY EYES:

(ESTABLISHING AND MAINTAINING EYE CONTACT)

MATERIALS:

-Photobooth (white board)
-iPad
-High Score Board

REVIEW FROM LAST WEEK:

- ❒ CHECK IN WITH PARTICIPANTS
    - HOW WERE THE GAMES?
    - WHAT DID YOU LIKE THE MOST?
    - WHAT WERE YOUR GAME SCORES?
        - REVIEW GAME SCORES AND RECORD ON THE HIGH SCORE BOARD FOR THAT WEEK. COMPLIMENT EACH PARTICIPANT ON THEIR BEST HIGH SCORES.

INTRODUCE THE LESSON:

Everyone did a great job last week! Remember how we took photos of our most feelings, medium feelings and just a little bit feelings? It's important to know these feelings about our friends so we can be better friends. When we see happy people, we can feel happy too. If someone is sad, we can help them.

Okay, so this week is about LOOKING AT MY EYES! Eyes are really important because we use them all the time. Remember last week how our eyes changed with our feelings? Our eyes also move to look at people. And when our friends look at us, we need to look back at them too. But I know that sometimes we may not want to make eye contact, because we are shy, or we just don't like it. But we need to make eye contact with our friends and teachers and

families so this week we'll be doing a lot of eye practice. We'll be taking face photos and videos and then you will practice looking at eyes using the Let's Face It! Scrapbook app games. We'll practice, practice, practice so you'll know to always look me in the eyes!

So, put on your face acting hats because here we go. We're going start now. One person is going to look into the iPad camera and everyone else gets to look somewhere else. We're doing this so that later in the Let's Face It! Scrapbook app games, your job will be to look in the eyes when you see your friends looking at you, look in the eyes when you see your friends talking to you, and look in the eyes when your friends show feelings. This is because when someone watches you, your job is to look them in the eyes. Okay, so let's just practice for a bit now here. Look at one another in the eyes.

Great, so now we'll put our eyes into the Let's Face It! Scrapbook app!

CREATE "LOOKING AT MY EYES" ALBUM:

- ❒ PRESS ADD ALBUM BUTTON
- ❒ LABEL ALBUM "LOOKING AT MY EYES"

ROUND 1: LOOKING AT MY EYES VS. NOT LOOKING.

WORK TO CAPTURE ONE PARTICIPANT LOOKING INTO THE IPAD CAMERA WITH TWO PARTICIPANTS LOOKING AWAY.

***** USE PHOTO AND VIDEO CAPTURE MODES! IN PHOTO MODE TAKE DIRECT EYE CONTACT**

***** LABEL EACH PHOTO OR VIDEO, "(*PARTICIPANT'S NAME) LOOKS",* (e.g., "*ANDY LOOKS")***

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE A PICTURE OF EACH PARTICIPANT LOOKING INTO THE IPAD WITH OTHER TWO PARTICIPANTS LOOKING AWAY**
- ❒ **TAKE A VIDEO OF EACH PARTICIPANT LOOKING AWAY AND THEN LOOKING INTO THE IPAD WITH THE OTHER TWO PARTICIPANTS LOOKING AWAY**

Nice work everyone! Okay, so now we are going to add in feelings. When people are watching us, they also have facial expressions so we're going to add in our feelings now too. It's important that if you see a friend with lots of feelings in their face that you look at them right away. This way you can figure out if they need help, or if they are happy. By looking at feelings we become better friends! So, let's practice. If suddenly I tell you I had the best weekend ever and I pose my best happy face, then you should look me in the eye. Okay, and

how about if I tell you I was so surprised, because I got a new computer game! You should always look me in the eye.

So now let's put our looking with feelings into the Let's Face It! Scrapbook app!

ROUND 2: LOOKING AT MY EYES WITH EXPRESSIONS VS. NOT LOOKING WITHOUT MAKING EXPRESSIONS.

WORK WITH PARTICIPANTS TO CAPTURE ONE PARTICIPANT LOOKING INTO THE IPAD MAKING A HAPPY, SAD, ANGRY, SURPRISED, DISGUSTED, AND AFRAID FACE, WITH TWO OTHER PARTICIPANTS LOOKING AWAY OR LOOKING AT EACH OTHER WITHOUT MAKING ANY FACIAL EXPRESSIONS. ENCOURAGE PARTICIPANTS TO BE CREATIVE AND COMMUNICATIVE IN HOW THEY POSE.

***** USE PHOTO MODE ONLY!**

***** LABEL EACH PHOTO, "*HAPPY/SAD/ANGRY/DISGUSTED/SURPRISED/AFRAID (CHILD'S NAME)*" (e.g., "*HAPPY ANDY")***

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE SIX PICTURES OF EACH PARTICIPANT LOOKING INTO THE IPAD MAKING A HAPPY, SAD, ANGRY, SURPRISED, DISGUSTED, AND AFRAID FACE, WITH THE TWO OTHER PARTICIPANTS LOOKING AWAY WITHOUT ANY FACIAL EXPRESSIONS.**

  IF YOU HAVE EXTRA TIME, TRY RETAKING USING VIDEO MODE.

You are all great actors! Okay, so now we are going to add in talking. When people are talking to us, or reading to us, or coaching us, we need to watch their eyes. Whenever we can hear people, we need to look them in the eye. By looking at people talking we become better friends. Okay, let's practice. One by one you get to share something. We are all going to listen and look the person in the eyes who is talking. By looking at our friends while talking, we become better friends

Now let's put our looking from talking into the Let's Face It! Scrapbook app!

ROUND 3: LOOKING AT ME TALKING VS. NOT TALKING, NOT LOOKING, AND NOT MAKING FACIAL EXPRESSIONS.

WORK WITH PARTICIPANTS TO CAPTURE ONE PARTICIPANT LOOKING INTO THE IPAD CAMERA WHILE SAYING, "LOOK AT ME," WITH TWO PARTICIPANTS NOT TALKING, NOT LOOKING, AND NOT MAKING ANY

FACIAL EXPRESSIONS. THESE PARTICIPANTS CAN LOOK AWAY IN ANY DIRECTION OR LOOK AT EACH OTHER.

***** USE VIDEOCAPTURE MODE ONLY.**

***** LABEL EACH VIDEO, "*(PARTICIPANT'S NAME) TALKING" (e.g., "ANDY TALKING")***

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE THREE VIDEOS OF EACH PARTICIPANT LOOKING INTO THE IPAD, SAYING "LOOK AT ME," WITH TWO PARTICIPANTS NOT TALKING, NOT LOOKING, AND NOT MAKING ANY FACIAL EXPRESSIONS. THESE PARTICIPANTS CAN LOOK AWAY IN ANY DIRECTION OR LOOK AT EACH OTHER.**

  IF YOU HAVE EXTRA TIME THEN CAN ROTATE PARTICIPANT POSITIONS AND RETAKE USING VIDEO MODE.

  Great job everyone. Let's see how we look in the Let's Face It! Scrapbook app.

PREVIEW THE *LET'S FACE IT! SCRAPBOOK* APP GAMES WITH PARTICIPANTS :

- ❒ PLAY ALL FOUR GAMES WITH NEWLY CREATED ALBUM AS A GROUP

PREVIEW FLASH CARD MODE:

- ❒ CLICK ON THE LIGHTNING BUTTON IN TOP LEFT CORNER TO ENTER FLASH CARD MODE

GAMEPLAY DISCUSSION:

- ❒ REMIND OF HIGH SCORE BOARD.
- ❒ TELL PARTICIPANTS THEY WILL BE PLAYING THIS THROUGHOUT THE WEEK FOR 15 MINUTES A DAY ON AT LEAST 3 DAYS WITH ANDY. AS A REWARD, FOR EACH DAY THAT THEY PLAY 15 MINUTES WITH ANDY, PARTICIPANTS WILL BE GIVEN 5 BONUS MINUTES TO TAKE EXTRA FACE PHOTOS AND VIDEOS OF THE GIVEN THEME FOR THE WEEK.
- ❒ ENCOURAGE PARTICIPANTS TO PLAY EACH OF THE FOUR GAMES.

LET'S FACE IT! SCRAPBOOK APP: SOCIAL EYE PROCESSING TRAINING

-WEEK 3-

FOLLOWING THE EYES:

(FOLLOWING THE EYE GAZE OF OTHERS)

MATERIALS:

Photobooth (white board)
iPad
High Score Board
Tip Cards For The Week

REVIEW FROM LAST WEEK:

- ❒ CHECK IN WITH PARTICIPANTS
    - HOW WERE THE GAMES?
    - WHAT DID YOU LIKE THE MOST?
    - WHAT WERE YOUR GAME SCORES?
    - REVIEW PARTICIPANT GAME SCORES AND RECORD ON THE HIGH SCORE BOARD FOR THAT WEEK. COMPLIMENT EACH PARTICIPANT ON THEIR BEST HIGH SCORES. LET THEM KNOW THAT THIS IS THE LAST WEEK PLAYING FROM *LET'S FACE IT! SCRAPBOOK* APP.

INTRODUCE THE LESSON:

This is our last week of Let's Face It! Scrapbook app. Remember that we have played the Let's Face It! Scrapbook games using our most, medium, and just a little bit feelings? Last week we were playing the "Looking at my Eyes" games. It's important to remember to look at the eyes of our friends, teachers, and families. We need to look people in the eyes when they are watching us, when they are showing their feelings, and when they are talking. I do lots of talking each week and you should always be looking me in the eye when I speak.
So now let's put on our face acting hats for one final time. This week we'll be taking face photos and videos again. During the week you'll be playing the Let's Face It! Scrapbook app

games again and for this week the games will be called FOLLOWING THE EYES! Now, it's important to know that we need to follow eyes because they tell us where we need to look. We'll practice, practice, practice so you'll know when to follow people's eyes! Let's get our\ eyes into the Let's Face It! Scrapbook app!

CREATE "FOLLOWING THE EYES" ALBUM

- ❒ PRESS ADD ALBUM BUTTON
- ❒ LABEL ALBUM "THE EYES TELL ME TO WATCH"

ROUND 1: FOLLOWING THE EYE GAZE BETWEEN TWO PEOPLE.

WORK WITH PARTICIPANTS TO CAPTURE TWO PARTICIPANTS SHARING EYE GAZE, WITH ONE PARTICIPANT LOOKING AWAY. THE LOOKING AWAY PARTICIPANT CANNOT LOOK INTO THE CAMERA AND CANNOT SHARE EYE GAZE WITH TWO OTHER PARTICIPANTS.

***** USE PHOTO AND VIDEO CAPTURE MODES.**

***** LABEL EACH VIDEO, "*WATCHING EACH OTHER"***

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

So, that's one way we follow eyes. But there are more too. We also need follow eyes when they move around because they will tell us where to watch. It's a bit different from last week when we looked at people in the eyes as they looked at us. Sometimes your friends look just for a moment, but we always have to follow their eyes. Follow my eyes as I watch up, down, left, and right. It's important to follow where I am watching, because when my eyes move, they give you clues where to look next. Let's practice. Where am I watching? Just follow my eyes! (After demonstrating, give each child a chance to watch up, down, left, and right with rest of children following the eye gaze).

Nice, let's put our following of eyes into our Let's Face It! Scrapbook app.

ROUND 2: FOLLOWING EYE GAZE.

WORK WITH PARTICIPANTS TO CAPTURE ONE PARTICIPANT WATCHING UP, DOWN, LEFT, AND RIGHT, WITH OTHER PARTICIPANTS LOOKING AWAY, NOT WATCHING EACH OTHER WITH SHARED EYE CONTACT, AND NOT LOOKING INTO THE IPAD CAMERA.

***** USE VIDEOCAPTURE MODE ONLY. NO PHOTOGRAPHS!**

***** LABEL EACH VIDEO, "(*NAME OF PARTICIPANT) WATCHES"***
(e.g., "ANDY WATCHES")

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

- ❒ **TAKE FOUR VIDEOS OF EACH PARTICIPANT WATCHING UP, DOWN, LEFT, AND RIGHT. OTHER PARTICIPANTS MUST LOOK AWAY, NOT WATCH EACH OTHER WITH SHARED EYE GAZE, AND MUST NOT LOOK INTO THE IPAD CAMERA.**

High fives for all! Okay, we're going to keep being face actors today to show another way we need to follow eyes. If we're all sitting here and you see your friends watching me, it means you need to watch me too. Following our friend's eyes will tell us who and where to watch. Okay, let's practice as a group.

Right, okay, now let's put our eyes into the Let's Face It! Scrapbook app.

ROUND 3: FOLLOWING EYES GAZE TOWARDS ANOTHER PARTICIPANT.

WORK WITH PARTICIPANTS TO CAPTURE ONE PARTICIPANT BEING WATCHED BY TWO OTHER PARTICIPANTS. THE PARTICIPANT BEING WATCHED BY THE TWO OTHER PARTICIPANTS MUST BE LOOKING DIRECTLY INTO THE IPAD CAMERA.

***** USE PHOTO AND VIDEO CAPTURE MODES.**

***** LABEL EACH PHOTO AND VIDEO, "*WATCHING (NAME OF* PARTICIPANT*)" (e.g., "WATCHING ANDY")***

REVIEW POSING. COACH AND CRITIQUE WHEN NECESSARY.

Great job everyone. Let's see how we look in the Let's Face It! Scrapbook app.

PLAY GAMES:

- ❒ PLAY ALL FOUR GAMES WITH NEWLY CREATED ALBUM AS A GROUP

GAMEPLAY DISCUSSION:

- ❒ REMIND OF HIGH SCORE BOARD.

- ❒ TELL PARTICIPANTS THEY WILL BE PLAYING THE *LET'S FACE IT! SCRAPBOOK* APP GAMES THIS WEEK FOR 15 MINUTES A DAY ON AT LEAST 3 DAYS WITH ANDY. AS A REWARD, FOR EACH DAY THAT THEY PLAY 15 MINUTES WITH ANDY, PARTICIPANTS WILL BE GIVEN 5 BONUS MINUTES TO TAKE EXTRA FACE PHOTOS AND VIDEOS OF THE GIVEN THEME FOR THE WEEK.

- ❒ ENCOURAGE CHILDREN TO PLAY EACH OF THE FOUR GAMES.

Appendix C

Control Training Lesson Plans

CONTROL TRAINING

-WEEK 1-

MAP OF CANADA ACTIVITY

MATERIALS:

-ATLAS WITH MAP OF CANADA
- BLANK MAPS OF CANADA (included in this lesson plan)
-CRAYONS
-PENS

INTRODUCE THE LESSON:

Today we have a fun and exciting mapping activity. You will all be making your own cool map of Canada. But remember, we'll all still have to work together in sharing crayons and pens. Help each other out with your maps and have fun!

MAP OF CANADA ACTIVITY: WORK WITH PARTICIPANTS TO COMPLETE THE FOLLOWING MAPPING ACTIVITY.

- ❒ COLOR PROVINCES
- ❒ LABEL CITIES
- ❒ LABEL OCEANS
- ❒ DRAW IN MOUNTAINS, LAKES,
- ❒ DRAW IN INDUSTRIES: (e.g., BRITISH COLUMBIA SALMON, ALBERTA OIL, SASKATCHEWAN WHEAT, MANITOBA POLAR BEARS, ONTARIO MEDIA, QUEBEC SYRUP, NEW BRUNSWICK TREES, NOVA SCOTIA BLUEBERRIES, PRINCE EDWARD ISLAND POTATOES, NEWFOUNDLAND AND LABRADOR COD, YUKON GOLD, NORTHWEST TERRITORIES ICE, NUNAVUT SEAL)

Map of CANADA

GAMEPLAY DISCUSSION:

- ❒ REMIND OF HIGH SCORE BOARD.
- ❒ TELL PARTICIPANTS THEY WILL BE PLAYING EDUCATIONAL APP GAMES THROUGHOUT THE WEEK FOR 15 MINUTES A DAY ON AT LEAST 3 DAYS WITH ANDY. AS A REWARD, FOR EACH DAY THAT THEY PLAY 15 MINUTES WITH ANDY, THEY GET TO UNLOCK ONE APP TO DOWNLOAD

- ❒ PARTICIPANTS WILL PLAY FROM THE FOLLOWING VETTED APPS:
    - Jigsaw Bug, Fun Maths, HangmanFree, Spell Mania, Chess, KidsDoodle, Animation Desk, Chicktionary, Mathblasters, Reading Eggs, Word Crush, and Sudoku.

CONTROL TRAINING

-WEEK 2-

ORIGAMI ACTIVITY

MATERIALS:

-ORIGAMI INSTRUCTIONS (included in this lesson plan)
-ORIGAMI PAPER
-CRAYONS
-PENS
-BUCKET FULL OF WATER

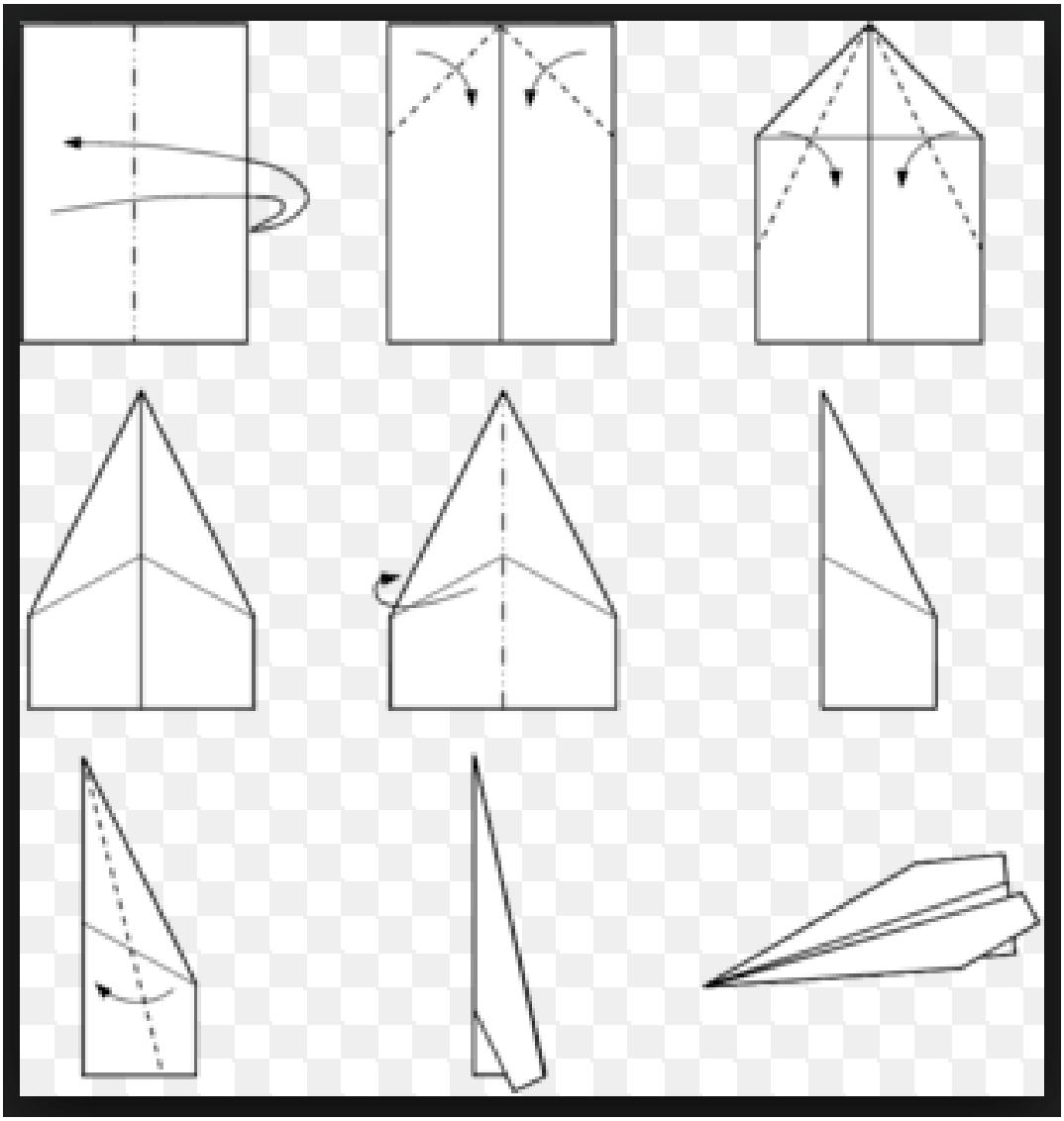
INTRODUCE THE LESSON:

Today in our small group, we will be making origami! That means we'll be folding this paper into airplanes, boats, and cranes. Just like last week, we will all be working together. After making your origami, you can also color and decorate. At the end we will fly our planes and see if our boats and cranes can float in this bucket of water. Let's get started!

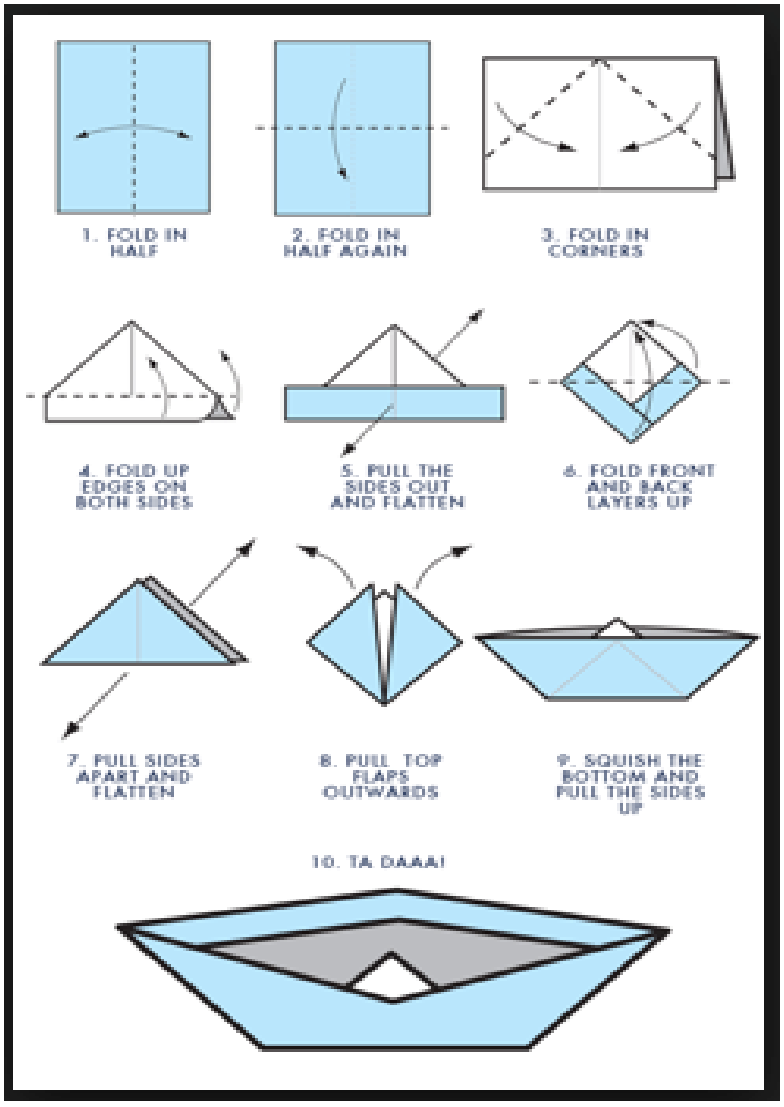
ORIGAMI ACTIVITY: LEAD PARTICIPANTS IN MAKING THEIR OWN AIRPLANE, BOAT, AND CRANE

- ❒ PASS OUT ORIGAMI PAPER, CRAYONS, AND PENS
- ❒ WORK WITH PARTICIPANTS TO FOLLOW THE ORIGAMI INSTRUCTIONS BELOW

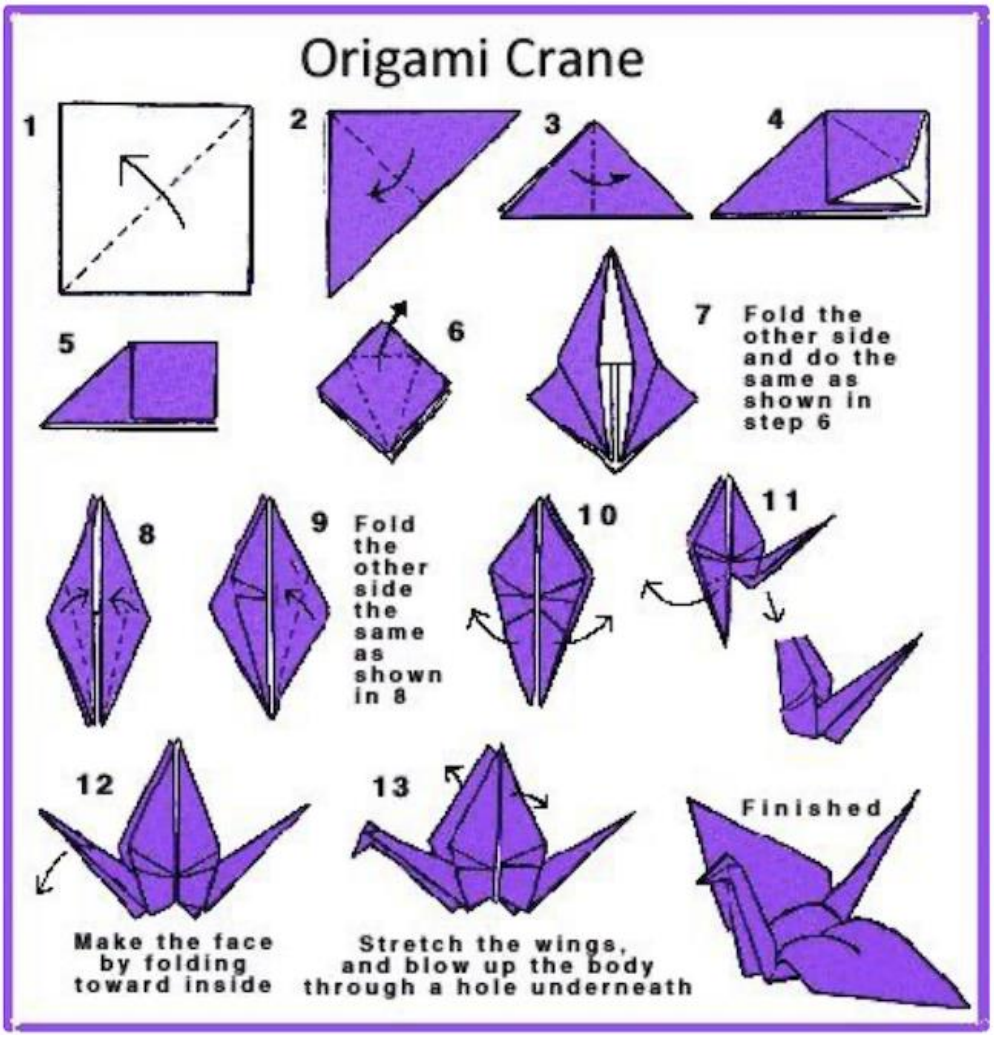
ORIGAMI AIRPLANE INSTRUCTIONS:



ORIGAMI BOAT INSTRUCTIONS:



ORIGAMI CRANE INSTRUCTIONS:



- ❒ PARTICIPANTS CAN COLOR AND DECORATE AFTER COMPLETING AIRPLANE, BOAT, AND CRANE,

- ❒ ASK PARTICIPANTS FOR THEIR PERMISSION BEFORE PLACING THEIR BOATS AND CRANES IN THE BUCKET OF WATER TO SEE IF THEY FLOAT!

GAMEPLAY DISCUSSION:

- ❒ REMIND OF HIGH SCORE BOARD.

- ❒ TELL PARTICIPANTS THEY WILL BE PLAYING EDUCATIONAL APP GAMES THROUGHOUT THE WEEK FOR 15 MINUTES A DAY ON AT LEAST 3 DAYS WITH ANDY. AS A REWARD, FOR EACH DAY THAT THEY PLAY 15 MINUTES WITH ANDY, PARTICIPANTS GET TO UNLOCK ONE APP TO DOWNLOAD

- ❒ PARTICIPANTS WILL PLAY FROM THE FOLLOWING VETTED APPS:

    - Jigsaw Bug, Fun Maths, HangmanFree, Spell Mania, Chess, KidsDoodle, Animation Desk, Chicktionary, Mathblasters, Reading Eggs, Word Crush, and Sudoku.

CONTROL TRAINING

-WEEK 3-

COMMUNITY DISASTER PLANNING ACTIVITY

MATERIALS:

-WHITE BOARD
-PAPER FOR DRAWINGS
-CRAYONS
-PENS
-TAPE

INTRODUCE THE LESSON:

In week 1, we all worked together to draw our maps of Canada. Last week we all made origami together. Today we will be working together in our small group to simulate disaster planning. We will start first by naming our community and then we will write the name of our community on the white board here. We will also brainstorm to make a list of community buildings.

Then we will discuss possible disasters and draw them on pieces of paper

Finally, we will draft survival plans. We will write separate survival plans for each of our community buildings.

This will help the community to prepare for a disaster!

COMMUNITY DISASTER PLANNING ACTIVITY:

- ❒ **NAME THE HYPOTHETICAL COMMUNITY AND THEN TITLE THE WHITEBOARD: "(HYPOTHETICAL COMMUNITY NAME)" DISASTER PLAN**

- ❒ **PASS OUT PAPER TO EACH PARTICIPANT BEFORE ASSIGNING PARTICIPANTS IN THE GROUP TO DRAW OUT AND COLOR THE FOLLOWING COMMUNITY BUILDINGS:**

    - o **CITY HALL**
    - o **POLICE STATION**

- **LIBRARY**
- **FIRE HALL**
- **SCHOOL**
- **SPCA**
- **ANY TEAM LEADER/CHILD SELECTED BUILDINGS/PLACES**

***EACH BUILDING WILL BE DEPICTED ON A SINGLE SHEET OF PAPER. TAPE ALL BUILDING PAGES TO WHITE BOARD**

- ❒ **BRAINSTORM WITH THE GROUP TO WRITE DOWN NAMES OF DIFFERENT DISASTER SCENARIOS (FOR EXAMPLE: Tornado, Tsunami, Hurricane, Snowstorm, etc.)**

- ❒ **ASSIGN PARTICIPANTS TO LABEL, DRAW, AND COLOR EACH DISASTER SCENARI0**

  ***EACH DISASTER WILL BE DEPICTED ON A SINGLE SHEET OF PAPER. TAPE ALL DISASTER PAGES TO WHITE BOARD**

- ❒ **DISCUSS AND WRITE DOWN SURVIVAL PLANS FOR EACH BUILDING IN THE CASE OF A DISASTER**

  ***EACH DISASTER SURVIVAL PLAN WILL BE DEPICTED ON A SINGLE SHEET OF PAPER. TAPE ALL SURVIVAL PLAN PAGES TO THE WHITE BOARD.**

- ❒ **REVIEW AND FURTHER DISCUSS THE COMPLETED COMMUNITY DISASTER PLANNING ACTIVITY**

GAMEPLAY DISCUSSION:

- ❒ REMIND OF HIGH SCORE BOARD.

- ❒ TELL PARTICIPANTS THEY WILL BE PLAYING EDUCATIONAL APP GAMES THROUGHOUT THE WEEK FOR 15 MINUTES A DAY ON AT LEAST 3 DAYS WITH ANDY. AS A REWARD, FOR EACH DAY THAT THEY PLAY 15 MINUTES WITH ANDY, PARTICIPANTS GET TO UNLOCK ONE APP TO DOWNLOAD

- ❒ PARTICIPANTS WILL PLAY FROM THE FOLLOWING VETTED APPS:

  - Jigsaw Bug, Fun Maths, HangmanFree, Spell Mania, Chess, KidsDoodle, Animation Desk, Chicktionary, Mathblasters, Reading Eggs, Word Crush, and Sudoku.

Appendix D

Administration of the Story Reading and Conversation Task

General Description

The task is videotaped using a camera (with tripod) for recording eye contact behaviors.

- *Examiner reads with two participants and then asks questions about the reading*
- *Seating arrangement is in a triangle formation*
- *The examiner provides a series of prompts eliciting eye contact with participants*
- *Each participant receives six prompts for eye contact during the story reading*
- *Each participant receives nine prompts for eye contact in the conversation*

The examiner reads a short story. While reading, the examiner takes pauses for making direct eye contact with each participant. These are direct prompts for eye contact that participants may or not reciprocate. Each participant receives six such prompts during the story reading.

After the story reading, the examiner then poses three general questions. The examiner prompts each participant to respond individually to all questions (e.g., Simen, do you like dogs?). Each question provides the examiner with an opportunity to pause for making direct eye contact with participants. While the participant is answering, the examiner will confirm their answer and ask a second question (e.g., oh, I see, do you have a dog?) and this provides an additional prompt for eye contact. Based on each participant's response the examiner will then ask a final individualized question (e.g., what kind of dog do you have?). Each conversation question elicits three prompts for eye contact. By asking 3 separate conversation questions, each participant receives a total of nine prompts for eye contact while answering questions about the reading.

T1 Script Using Emily Gravett's *"Dogs"*

Examiner reads the story, keeping eyes on the pages.

Today we'll be reading a story called "Dogs" by Emily Gravett.

I love dogs.
(Examiner initiates eye contact with Participant One, for Prompt 1)

I love big dogs and small dogs.
(Examiner initiates eye contact with Participant Two, for Prompt 1)

I love tough dogs and soft dogs.
(Examiner initiates eye contact with Participant One, for Prompt 2)

I love dogs that bark and dogs that don't.
(Examiner initiates eye contact with Participant Two, for Prompt 2)

I love dogs that play and dogs that won't.
(Examiner initiates eye contact with Participant One, for Prompt 3)

I love hairy dogs and bald dogs.
(Examiner initiates eye contact with Participant Two, for Prompt 3)

Stripy dogs and spotty dogs.
(Examiner initiates eye contact with Participant One, for Prompt 4)

I love slow dogs and fast dogs.
(Examiner initiates eye contact with Participant Two, for Prompt 4)

Shabby and chic dogs.
(Examiner initiates eye contact with Participant One, for Prompt 5)

I love dogs that are good and dogs that are bad.
(Examiner initiates eye contact with Participant Two, for Prompt 5)

But the dog I love best? Let's see…
(Examiner initiates eye contact with Participant One, for Prompt 6)

is any dog that won't chase me.
(Examiner initiates eye contact with Participant Two, for Prompt 6)

Conversation Task Starter Questions:

1.) *Do you like dogs?*
2.) *Do you like cats?*
3.) *Do you like birds?*

T2 Script Using Linda Kratz's *"You Be You"*

Examiner reads the story, keeping eyes on the pages.

Today we'll be reading the story "You Be You" by Linda Kratz.

Some fish swim left. Some fish swim right.
(Examiner initiates eye contact with Participant One, for Prompt 1)

Some fish swim in a circle. Some fish swim in a line
(Examiner initiates eye contact with Participant Two, for Prompt 1)

Some fish swim up. Some fish swim down.
(Examiner initiates eye contact with Participant One, for Prompt 2)

Some fish swim quiet. Some fish swim loud.

(Examiner initiates eye contact with Participant Two, for Prompt 2)

Some fish are colorful. Some fish are plain.
(Examiner initiates eye contact with Participant One, for Prompt 3)

Some fish look different. Some fish look the same.
(Examiner initiates eye contact with Participant Two, for Prompt 3)

Some fish are big. Some fish are tiny.
(Examiner initiates eye contact with Participant One, for Prompt 4)

Some fish are smooth. Some fish are spiny.
(Examiner initiates eye contact with Participant Two, for Prompt 4)

Some fish swim high. Some fish swim low.
(Examiner initiates eye contact with Participant One, for Prompt 5)

Some fish swim together. Some fish swim alone.
(Examiner initiates eye contact with Participant Two, for Prompt 5)

Some fish are red.
(Examiner initiates eye contact with Participant One, for Prompt 6)

Some fish are blue.
(Examiner initiates eye contact with Participant Two, for Prompt 6)

Conversation Task Starter Questions:

1.) *Do you like fish?*
2.) *Do you like sharks?*
3.) *Do you like whales?*

T3 Script Using Carson Ellis' *"Home"*

Examiner reads the story, keeping eyes on the pages.

Today we'll be reading "Home," by Carson Ellis.

Home is a house in the country. Or home is an apartment.
(Examiner initiates eye contact with Participant One, for Prompt 1)

Some homes are boats. Some homes are wigwams.
(Examiner initiates eye contact with Participant Two, for Prompt 1)

French people live in French homes. Atlantians make their homes underwater.
(Examiner initiates eye contact with Participant One, for Prompt 2)

And some folks live on the road. Clean homes. Messy homes.
(Examiner initiates eye contact with Participant Two, for Prompt 2)

Tall homes. Short homes. Sea homes. Bee homes.
(Examiner initiates eye contact with Participant One, for Prompt 3)

Hollow tree homes. But whose home is this? And what about this?

(Examiner initiates eye contact with Participant Two, for Prompt 3)

Who in the world lives here? And why?

(Examiner initiates eye contact with Participant One, for Prompt 4)

This is the home of a Slovakian duchess. This is the home of a Kenyan blacksmith.

(Examiner initiates eye contact with Participant Two, for Prompt 4)

This is the home of a Japanese businessman. This is the home of a Norse god.

(Examiner initiates eye contact with Participant One, for Prompt 5)

A raccoon lives here. An artist lives here.

(Examiner initiates eye contact with Participant Two, for Prompt 5)

This is my home, and this is me.
(Examiner initiates eye contact with Participant One, for Prompt 6)

Where is your home? Where are you?
(Examiner initiates eye contact with Participant Two, for Prompt 6)

Conversation Task Starter Questions:

1.) *Do you like big houses?*
2.) *Do you like a boat house?*
3.) *Do you like your house?*

Appendix E

Eye Behavior Coding Scheme from the Story Reading and Conversation Task

Orienting to Eyes Coding:

Behavior: Orients to eye contact:

1.) Participant orients eyes to the examiner's face, while the examiner is making direct eye contact with the participant (Y = 1/N = 0) (if yes, please mark time of occurance)
(if yes, participant receives score of 1)
(if no, participant receives score of 0)

1.s.) Was it sustained? Did the participant orient eyes to the examiner's face for 2 seconds or more?
(each 2 second increment receives score of 1) (e.g., 3 seconds = 1; 4 seconds = 2)
(if no, then sustained score is 0)

Behavior: Orients to eye gaze:

3.) Participant orients eyes to the examiner's face, while the examiner is looking at the other participant (Y = 1/N = 0), or the participant orients to the other participant's face, when the other participant is looking at the examiner (Y = 1/N = 0) (if yes, please mark time of occurance) (NOTE: THE EXAMINER AND THE OTHER PARTICIPANT DO NOT HAVE TO BOTH BE LOOKING AT EACH OTHER AT THE SAME TIME)
(if yes, participant receives score of 1)
(if no, participant receives score of 0)

3.s.) Was it sustained? Did the participant orient eyes to the examiner's face, or the other participant's face (including any looking back and forth) for 2 seconds or more?
(each 2 second increment receives score of 1) (e.g., 5 seconds = 2; 6 seconds = 3)
(if no, then the sustained score is 0)

Notes:

Story Reading Task: The examiner reads the story and pauses 6 times to make direct eye contact with the participant.

# of times when the examiner pauses for making direct eye contact with the participant during the "Story Reading Task" (with time of occurance)	example	example	example	1	2	3	4	5	6	Total:
1.) Story Reading Task, Participant Orients to Eye Contact from the Examiner (YES = 1, No = 0)	1 (3:02)	1 (3:32)	0							
1.S.) Story Reading Task, Participant Sustains Eye Contact with the Examiner (each 2 second increment receives score of 1).	0	2 (3:32-3:36)	0							
* Please record the time of any participant orienting to, or sustaining eye contact *										

# of times when the examiner pauses for making direct eye contact with the other participant during the "Story Reading Task" (with time of occurance)	example	example	example	1	2	3	4	5	6	Total
3.) Story Reading Task, Participant Orients to Eye Gaze Between the Examiner and the Other Participant (Yes = 1, No = 0)	0	1 (4:32)	0							
3.S.) Story Reading Task, Participant Sustains Orienting to Eye Gaze Between the Examiner and the Other Participant (each 2 second increment receives score of 1).	0	1 (4:32-4:34)	0							
* Please record the time of any participant orienting to, or sustaining gaze following *										

Conversation Task: Three times (e.g., about dogs, cats, and birds) the examiner asks the participant a question, then provides a statement, and asks a final question. The examiner pauses 9 times to make direct eye contact with the participant.

				Dogs			Cats			Birds			
# of times the examiner pauses for making direct eye contact with the participant during the "Conversation Task" (with time of occurance)	example	example	example	1	2	3	1	2	3	1	2	3	Total:
1.) Conversation Task, Participant Orients to Eye Contact from the Examiner (YES = 1, No = 0)	1 (6:30)	1(6:45)	0										
1.S.) Conversation Task, Participant Sustains Eye Contact with the Examiner (each 2 second increment receives score of 1).	0	3 (6:45-6:51)	0										
* Please record the time of any participant orienting to, or sustaining eye contact *													

# times the examiner questions/answers making direct eye contact with the other participant during the "Conversation Task" (with time of occurance)	example	example	example	1	2	3	1	2	3	1	2	3	Total
3.) Conversation Task, Participant Orients to Eye Gaze Between the Examiner and the Other Participant (Yes= 1, No = 0)	0	1 (7:45)	1 (7:53)										
3.S.) Conversation Task, Participant Sustains Orienting to Eye Gaze Between the Examiner and the Other Participant (each 2 second increment receives score of 1).	0	1 (7:45-7:47)	2 (7:53-7:57)										
* Please record the time of any participant orienting to, or sustaining gaze following *													

Appendix F

The Multidimensional Social Competence Scale, Faces Screener Task

(Yager, & Iarocci, 2013)

MSCS- Parent Report Jodi Yager, PhD and Grace Iarocci, PhD Pg. 1 of 4

Child's/ Adolescent's Name (First, Middle, Last): _____

Child's Birth Date (Month, Day, Year): _____ Sex: __ Male __ Female __ Other

List any developmental disorders/ learning disabilities that you are aware of:

_____

Your Name (First, Middle, Last): _____

Relationship to Child/ Adolescent: □ Mother □ Father □ Other_____

Today's Date (Month, Day, Year): _____

Instructions: For each item, circle the number that best describes your child's/ adolescent's behaviour over the **past six months**.

1 = Not True or Almost Never True
2 = Rarely True
3 = Sometimes True
4 = Often True
5 = Very True or Almost Always True

Many of the items may seem similar to one another, but your response on each one is very important. If you are unsure of an item, please put your best estimate.

1 = NOT TRUE OR ALMOST NEVER TRUE	2 = RARELY TRUE	3 = SOMETIMES TRUE	4 = OFTEN TRUE	5 = VERY TRUE OR ALMOST ALWAYS TRUE

1.) His/her facial expressions are easy to read	1	2	3	4	5
2.) His/her smiles seem forced or awkward	1	2	3	4	5
3.) Uses eye contact to get other people's attention (to start a conversation, ask a question)	1	2	3	4	5
4.) Shows a range of facial expressions (happy, angry, sad, disgusted, fear, surprised)	1	2	3	4	5
5.) Smiles appropriately in social situations	1	2	3	4	5
6.) Facial expressions seem flat (like a blank slate or seem overly serious)	1	2	3	4	5
7.) Looks people in the eye when talking to them	1	2	3	4	5
8.) Is sensitive to the feelings and concerns of others	1	2	3	4	5
9.)Expresses concern for others when they are upset or distressed	1	2	3	4	5

Appendix G

The Friendship Survey Task

(Cairns & Cairns, 1994; Farmer & Farmer, 1996; Kasari et al., 2011)

NAME_____

Instructions: Please write down the names of your friends at Mosaic.

Write down their first name and last name.

For your best friend at Mosaic, draw a star next to his or her name.

You can only have one star on your page, so make sure it appears next

to your best friend at Mosaic.

My friends at Mosaic are…

Instructions: Please write down the names of any other friends you have.

Please write their first name only.

My other friends are…

THANKS FOR HELPING US WITH YOUR FRIENDS!