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Reading Emotions: Designing Digital Tools to Strengthen the "Social Brain" of Young Children with Autism

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<u>Abstract</u>

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Autism (ASD) is characterized by impaired development in social interaction and communication. This can affect the ability to develop relationships with peers and family. Being limited in this area leads those with Autism unable to translate their own emotions and the emotions of others. As technology develops, so do methods of teaching facial emotion recognition. Building these skills can increase the social communication abilities of those struggling with Autism. This paper will explore the effectiveness of various educational applications (apps).

Taking the lessons gained from previous iPhone application designs I will attempt to create a new application that incorporates the successes of my predecessors, as well as strengthening the areas needed to become a fully immersive learning experience for the user. This newly created application will then be presented to preschool aged children. The reactions of the students will be carefully noted as we continue to build teaching tools that are effective in theory and in practice.

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<u>Research: What Reaches Children with Autism</u>

When using neuroimaging to compare the brains of children who are Typically Developing (TD) and children with Autism (ASD), scientists have found that the undeveloped regions of the brain are the Superior Temporal Sulcus (STS) and the Middle Temporal Gyrus (MTG). These areas are built for processing visual and verbal stimuli. The STS and MTG regions have come to be known as the social brain. The social brain can be stimulated when children mimic facial expressions. Research has shown TD children as being able to mimic adults' facial expressions, whereas, children with Autism have the ability to mimic facial expressions when instructed but are not naturally inclined to do so. (Siegler and Mc Dougle, 2013).

Melissa Thye explores the importance of mimicry in her article; *The Impact of Atypical Sensory Processing on Social Impairments in Autism Spectrum Disorder*, "Alterations in the ability to integrate proprioceptive cues with visual inputs could greatly impact imitation, which is crucial for the development of many social functions. (Thye, M., 2017, p. 157)" Children with severe Autism may not have the ability to create imitations. By increasing opportunities for children with Autism to mimic facial movements we can strengthen the STS/MTS brain function, the social brain. Children with Autism can use these skills to process social cues, and identify their own emotions.

Thye states that in addition to mimicry, early intervention is key to improving the social communication skills of children with Autism. Thye's studies reported that infants with Autism "... attend to faces as frequently or even more frequently than typically developing children in the

first year of life (Elsabbagh et al., 2013b), decreasing this social attention thereafter and falling

behind typical development in the second year (Thye, M., 2017, p.153)" Using these fleeting

moments of focus can allow for children with Autism to have the building blocks of social

interaction. Thye goes on to say "It is possible that pre-existing visual processing deficits may

disrupt developing social skills by preventing the perception of visual cues that signal social

rewards, making the cause and effect of social interactions unpredictable. Over time, these

infants might begin to lose interest in these "unpredictable (p.153)" social interactions, and

instead seek out repetitive and predictable non-social stimulation (Thye, M.D., 2017, p.153)".

Building these skills at a young age gives children with Autism the core knowledge they need to

understand the meanings behind various facial expressions.

Without the first step of emotional understanding from facial cues, children with Autism

continue to find social situations unpredictable and, and therefore disconnect with the people

around them. Learning facial emotional recognition can help, not only the child, but also the

caregivers of that child. The Journal of Autism Spectrum Disorders explores the support of the

whole family in the article *Applying Technology to Visually Support Language and*

Communication in Individuals with Autism Spectrum Disorders "Improving any aspect of social

pragmatics can lead to significant, qualitative gains for both the individual and his or her family

(Shane, H., et al, 2015, p. 279)." Many families feel isolated and trapped by their child's

emotional outbursts and limits in transitions. Teaching children with Autism about their own

emotions, and how their actions can lead to emotional reactions in others can help reduce stress

put on families.

Increased exposure to various expressions can maximize emotional understanding; however, motivating children to focus on emotional meanings can be challenging. Many children with Autism simply do not connect with certain activities. Experts suggest following the interests of the child to engage and teach. By using a digital tool such as an app, you can reach the curiosities of the students. In *Autism Spectrum Disorder and ACC,* Pat Mirenda encourages educational screen-time saying, "The use of technology can increase the appeal and motivation of a task, as well as the time spent attending to a task (Mirenda, P., Iacono, T. 2009, p. 252)." Applications provide exposure to emotions in a predictable way. Additionally, apps provide clear directed goals for users to complete. Providing achievable goals gives the user more interest in completing the task. Antonia Hamilton explores this in her paper *Emulation and Mimicry for Social Interaction: A Theoretical Approach to Imitation in Autism* "Current evidence suggests that children with Autism are able to understand and emulate goal directed actions, but may have specific impairments in automatic mimicry of actions without goals (Hamilton, 2009, p.1)." When applications are formatted as games with rewarded outcomes, users are more likely to engage fully on the task. Well-designed apps can increase emotional understanding, allow the user to feel successful, and build the skills to anticipate outcomes in real life emotional encounters.

Developers should take these factors into account when designing apps for children with Autism: early intervention, increased exposure, and frequent mimicry. These methods are proven to strengthen the social brain. Using these techniques, as well as focusing on the interests of the child can lead to great strides in emotional awareness. The article *Including Children with Autism in Inclusive Preschools* states: "When children with Autism learn how to initiate spontaneous

communications within natural social contexts and to respond appropriately to the

communications of others they can begin to control their environment appropriately and develop

positive relationships (Schwartz, 1998, p.21)." By scaffolding the learning of emotional

understanding we allow children with Autism to find predictability in social situations and create

positive peer relationships.

Review of Highly Rated Applications

Many students navigating Autism prefer computer screens to tactical tools; the advancement in technology has given students with special needs a wonderful portable tool to aid them in emotional and literal communication. Knowing that the greatest limitations for children with Autism is interacting socially and the inability to process facial emotional cues, developers have begun to build games, tools and apps to encourage these skills to grow. There are hundreds of digital games and apps to build this skill available, however, they are not all thoughtful with their design. We chose four apps to review and take a deeper look into the teaching methods they incorporate. To narrow the search of the many available on iTunes, we focused on finding top rated apps that are designed for early childhood and social emotional growth.

Successful apps incorporate current research of how best to communicate to students with Autism: increased exposure to facial expressions, encouraging mimicry, and early intervention. Additionally, apps that are highly rated incorporate animated characters. Most children with Autism find animated faces a clearer demonstration of emotion than photographs and in person interactions. Animated characters create a fun engaging game to motivate the user to continue their educational experience.

The apps we will focus on in this paper are *Touch and Learn Emotion* created by Grasshopper apps, *Learn with Rufus: Feelings and Emotions* created by Corona Lab, *Model Me Kids: Autism Emotions* created by Model Me Kids LLC*,* and *LearnEmotions* created by Que

Innovations Inc. These apps were chosen as the most currently effective at demonstrating emotions to children with Autism. We will be looking closely at the different representations of emotions provided by each app. These apps have been recommended by Autism Speaks, Parents.com and the Autism App (a list of apps designed for students with Autism). When reviewing these apps we focused on these six domains:

1. Does the app promote real world independence?

2. Is this app engaging (and/or) utilize a rewards system for the user?

3. Are diverse photos used for emotional exposure?

4. Is the app customizable to the user's interests?

5. Does the app incorporate up to date teaching methods for users with Autism?
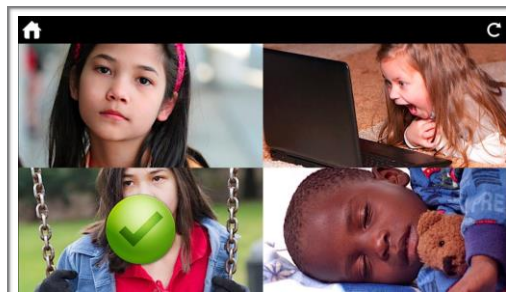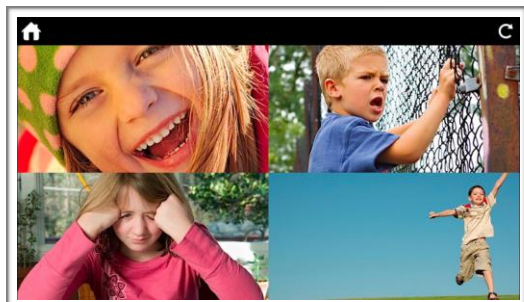
6. Is mimicry encouraged?

Using these questions as a guide we will explore the effectiveness of each app as well as the appropriateness of design for the Autistic population.

Touch and Learn Emotions
Available on iTunes for $1.99
3.5 out of 4 Stars
Recommended for iPad use but available for smart phone and tablets

(Images: Grasshopper Apps. *Touch and Learn Emotions)*

This app is one of the top recommendations by Autism Speaks. Using photographs of children and adults, users are asked to identify each photo's perceived emotion. Four faces appear on the screen as users listen to the prompt word; examples include, happy, sad, tired, yawning, angry, bored, and a multitude of others. Users are then asked to find the corresponding photograph of that emotion. When chosen correctly, a green check mark appears on the photograph and an encouraging word is given such as, "You're great" or "That's it!".

When chosen incorrectly, a gentle, yet negative sound effect is played. The user can continue to tap photos to find the correct corresponding photo. The images provided include many different ages and ethnicities to give users many examples of emotions. The system allows you to upload your own photos to the system. You can also edit existing photos that might appear nebulous to the user, if the photo is listed as tired but the user identifies it as sad you can recategorize it. You also are able to choose the frequency at which each emotion is repeated. This gives the user more exposure to emotions she/he might have trouble identifying.

While this app is highly customizable, easy to use, and provides exposure to many different people and emotions, it does not provide incentive for the user to continue. There are no rewards for hard work, and besides a few encouraging words, the user doesn't have greater challenges as they master the content. This app can be very effective if the caregiver is willing to upload pictures and preview the photos included in the app already. Some emotions are very similar and could lead to frustration for children.

The cues are simple and verbal, with no reading skills required for the user. This allows for much independence. It is important for the user to feel successful at the process of using the app, as well as feeling successful with the lessons the app is providing. The process of communicating to the user that they have identified the incorrect emotions is clear, which is helpful for learning, however, the sound effect might create a negative reaction for users. It is gentle but feels jarring and not encouraging of a growth mindset.

The photos used are professional and only sometimes nebulous. Students will enjoy finding their own photos in the rotation but the layout of the screen is overwhelming and crowded. Overall this app feels more like a flash card experience than an interactive lesson. It does not incorporate any relatable animations, games, or rewards to encourage interest. A well-designed app should be revisited not because a student is required to, but because the student is excited to find the joy of learning.

To compare this app to the aforementioned questions I found that this app does promote real world independence by utilizing diverse photographs that depict a variety of emotions. The app is not engaging and no rewards system is utilized, leading to a lack of interest in returning to the program. This app is customizable to the learning needs of the student; however, it is not

customizable to the interests of the student. This app could use a few adjustments to make the

screen less overwhelming and more enticing to those who are easily overwhelmed by large

displays of emotions. This app is great for exposure, yet it lacks the game aspect that will keep

users returning on their own accord.

Learn with Rufus: Feelings and Emotions
$4.99 on iTunes
Not currently rated on iTunes
Recommended by Autism Speaks, Parenting.com, and Autism Apps
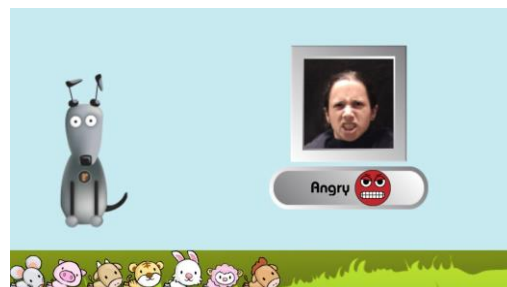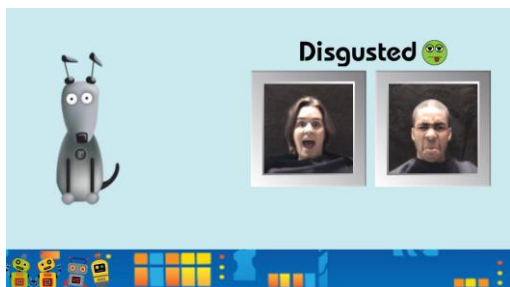
(Images: Corona Lab.(2013-2018). RufusRobot.com)

Learn with Rufus expertly employs a combination of flash card exposure with simple

rewards to create a game of emotional discernment. When you open the app you are asked to set

up the player's name, a seemingly simple step that adds a lot to the effectiveness of this app. By

setting up different players, the app is able to follow each user's progress. Caregivers and users

can now track areas of improvement or deficit. This step creates the atmosphere of a video game,

an important form of engagement for users, this no longer feels like a required lesson, but a game

you can track your scores in. Next users are asked to choose a reward icon for work completed.

Each correct answer earns you one new icon. There are several options that will entice users to

play again and again. The icons are simple and include animals, monsters, transportation

methods or robots. Each time a user answers a question correctly, the icon of the user's choice

appears at the bottom of the screen. This visual tracking of success enhances the desire to play

until the row is filled. The user now has a clear and customizable way to track their own growth.

As the game begins, the screen is shared by the image of Rufus the dog. Rufus is a grey dog that gently wags his tail as small framed pictures of an adult having an emotional reaction appears on the opposite side of the screen. The game proceeds with simple instructions "She feels sad. Touch Sad". The user is expected to tap the photo of the person feeling sad. When the photo is tapped a neutral sound is played. The emotions circulate with many examples of different emotions and a diverse group of people to demonstrate each feeling.

During the second stage of this game we see two different photos with contrasting emotions. The same language is used "She feels sad. Touch sad." The user is now expected to discern which picture is demonstrating the emotion stated. When chosen correctly the picture selected moves into the center of the screen as the incorrect emotion slowly fades away. When chosen incorrectly, the correct photo slowly moves to the foreground while the incorrect choice fades into the background. There are no negative sounds or images when the wrong image is chosen, However, the correct emotion is put in the forefront to continue positive reinforcement of that emotion.

After each round the app allows users a "break". During this break a screen appears where the user can draw in a variety of colors. The coloring is accompanied by light hearted music, and is always consistent, the same colors are present, and the same amount of time elapses for each break.

This app combines necessary learning with fun challenges. The challenges are offered with no judgement on results, focused instead on overall progress. It is also the most tailored to children with Autism, the layout is clear and playful, and the game is an experience that students will want to return to again and again. It incorporates real human faces, as well was playful

animations, and customizable rewards. However, the photos used in this app are not easy to see, do not look professional and the lighting adds shadows that could be confusing for users.

Overall, this app exceeds all our predetermined standards- it promotes real world independence by utilizing real images of diverse emotions and exposing the user to many different types of people. It uses a customizable rewards system to encourage users to return to the app with joy and ease, and by adding a break to the programming, each user feels refreshed and ready to absorb more information.
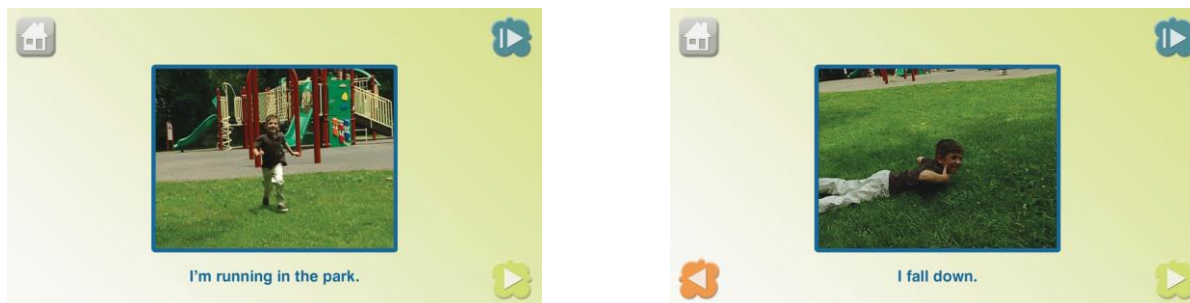
Model me Kids: Autism Emotions
$4.99 on iTunes
3.8 out of 4 stars
Recommended by Autism Apps
Smart Phone or iPad

(Image: Model Me Kids LLC. (2012). Autism Emotions)

The format of this app models Social Stories, however, this app is not customizable to your own experiences. When the app opens, the user is invited to choose between 4 different emotions (Happy, Sad, Proud, Calm). The user is expected to click thru the story to show the progression of an emotion. For example, the progression of sadness is pictured above. The child is running in the park and he falls down. The user is expected to label the emotion the child might be feeling. The story uses photographs of children interacting in typical day to day situations. The prompts are simple and users are not required to provide an answer. A rhetorical question is asked at the end of each story "do you know how I feel?" it is expected that the user will answer verbally. This app shows how a person came to feel the way they do, following clear simple sequences of events. This is an important skill that can aid users to understand not only how they feel, but how different actions can affect the emotions of the people around them.

This app is not customizable, it does not track progress, and it does not engage the users body other than observation. There is no use of game involved, and no animated characters. The

photos are diverse and clear emotionally. The program also offers users the choice of playing a

song that demonstrates the emotion being felt. The real world growth that can come from this

app are the actions that lead to a specific emotion. This app seems to be more for the user to

understand their own emotions, rather than the emotions of those around them. This skill is

arguably more valuable than the observation of others. If one can understand their own emotions,

they can grow into empathetic responses. This app is more like a soothing story to be used to

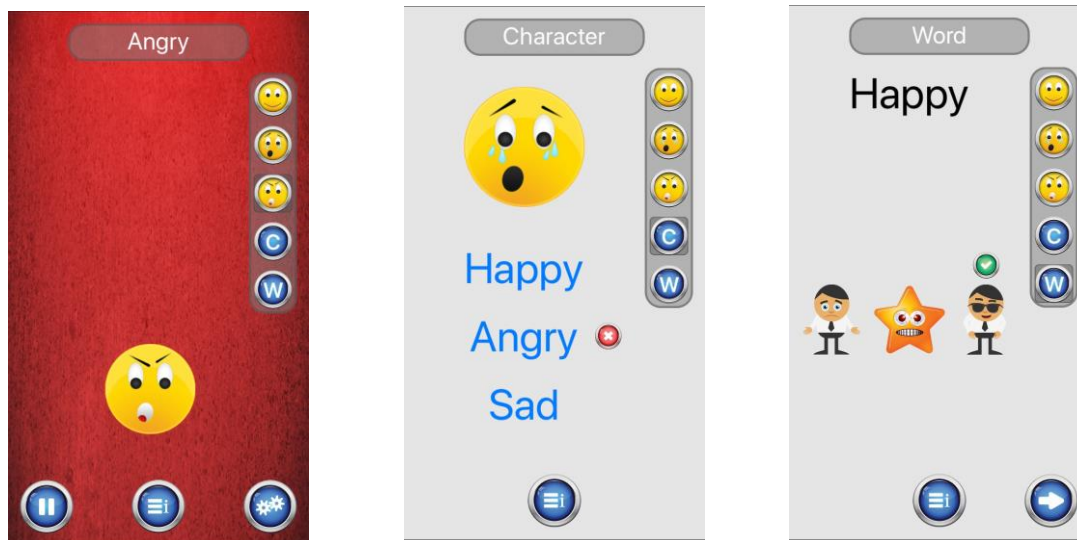create dialog rather than an interactive teaching tool.

Learn Emotions

Free

Not currently rated on iTunes

Recommended by parents.com

Smart phone and or iPad compatible

(Image: Que Innovations Inc. (2015) Learn Emotions. Androidappsapk.com)

Learn Emotions utilizes emojis and compelling music to teach users about emotions.

Focusing only on happy, sad, and angry this app is simple to use, and bluntly clear. The first level

of the game allows the user to choose an emotion. The screen is then transformed by color and

soundscape; yellow for happy with an upbeat song, blue for sad with a slow lonely tune, and an

ominous soundtrack and red background for angry. This app is activated in a few different ways

by the user. First, if the screen is tapped an emotional sound is played- a hiss for angry, tears and

wails for sad, and giggles for happy. The app is also affected when the device is shaken, making

it very interactive, yet overwhelming. If the user shakes the angry face it roars and begins

moving erratically around the screen. When the sad face is shaken it cries harder, and when

happy is shaken it squeals in delight. Lastly if you swipe your finger over the faces you get a third reaction; angry hisses, sad groans, and happy laughs.

This app is not customizable, yet it is highly interactive. It appears as a game, yet no scores are kept, and therefore, no progress is noted. Although the signals of emotional distress are clearly enacted, it feels intense. For children with Autism these emotions can be so overwhelming that it is paralyzing. This app might be triggering rather than illuminating.

The next levels of this app crosschecks users' understanding of cartoon emotions and textual cues. The word happy, sad, or angry appears at the top of the screen and the user is expected to tap the cartoon face that corresponds with that cue. If chosen correctly a green check appears along with a crowd cheering, if incorrect a red X appears and a collective "awww" is played. Not only is the user expected to read the messages given, he or she is also expected to not become emotionally affected by the extreme response of a crowd reaction to the answer. The app then places a cartoon face that is either happy, sad or angry at the top of the screen and the three emotion words listed under it. The user is expected to identify the correct word.

This app is not customizable, it does not promote peaceful learning, and seems to bombard the users' senses. It is not accessible to all learners, and written words are not read aloud for users to hear. The cartoon faces are dynamic and clear, yet not diverse, and not applicable in real life situations. There is no way to track progress or user growth. This app may teach emotions; however, for a demographic that is sound and sensory avoidant, this app is overpowering visually, audibly, and reactionary to user responses.

General Findings

After researching these apps, I have found they most commonly neglect an opportunity to demonstrate the user's facial expressions. It is shown that if a child can exercise their facial features the movements will link to the social brain, therefore, strengthening the brain as and improving the muscular structure of the face. While flash card exercises, which many of these apps are, aid in the exposure of emotions it is the practicing of emotional expressions that can create a deeper understanding of nonverbal communication. These skills link directly to real world interactions.

Almost as necessary as verbal language, is the ability to communicate emotions with your expressions and body language. When considering these highly recommended applications, the question becomes if these programs truly aid their users in their social emotional lives. How can a new design increase the emotional range of its users? Giving students additional tools to comprehend nonverbal communication makes unpredictable and overwhelming social situations more manageable. These apps can allow users to gain the observational skills needed to address potentially dangerous real life situations, creating the potential to avoid or diffuse negative interactions in the future. Gaining fluency in nonverbal communication allows for students to become more independent. Students with nonverbal fluency can master day to day tasks that require interpersonal skills, and feel prepared to interact within complex social situations. Building upon the basic structure of the previous apps I designed my own app intended to encourage emotional literacy and mimicry.

Evidence Based Design
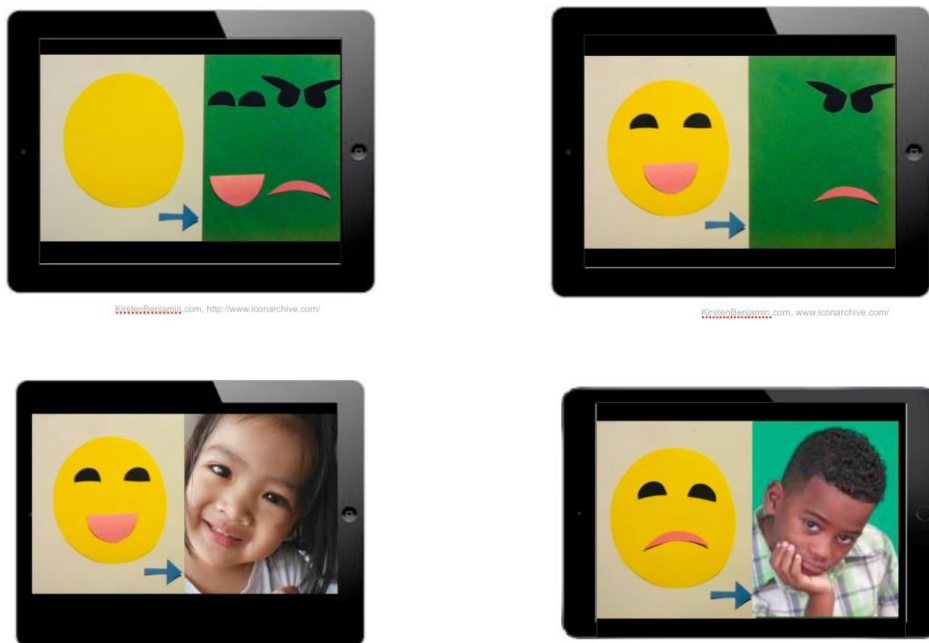
(Image: (KirstenBenjamin.com & www.iconarchive.com & shutterstock.com)

This app is designed to help the user gain greater emotional fluency. By learning the physical language of facial expressions children of all variations can create stronger bonds with their friends and family, feel less isolated, and have the tools needed to express themselves when they are under duress. Including mimicry was a key strategy in the design this app. Finding a way to kindle the desire for students to mimic emotions was the challenge. Using a live stream of the user's image could perhaps encourage a deeper relationship with facial emotions. Emojis emerged as the clear answer to teaching different emotions in conjunction with the mirrored image.

Our app begins with a blank yellow circle on the left side of the screen. On the opposite side are two sets of emoji eyes, and two choices of emoji mouths. Each facial feature resembles a different emotion. The user is asked to build their own emoji by tapping the desired eyes and mouth. The options are kept simple and clear to keep the screen clutter free and the steps easy to follow. There are verbal, not written, instructions. When the facial features are tapped they appear on the yellow circle (no drag and drop, just a simple tap) in the appropriate place. When the user has completed the emoji they are instructed to touch the blue arrow.

The options for facial features now disappear and in their place is a split screen in which one side transforms into a live video stream of the user's face. The user is then asked to mimic the emotion they have created. The user is not required to get the emotion "correct". The aim is to exercise the facial muscles. If the student can participate in this exercise for 30 seconds they earn the right to download the emoji onto their device for further use. A self-created emblem of emotion further empowers the user to practice expressing themselves. Taking this self created image into day-to-day life can allow the user to demonstrate emotions when body language isn't getting the point across. In addition to earning the emoji, a record is kept of how long each user engages in active facial movements. The longer the user exercises their facial muscles the more stars they are awarded. On the bottom of the screen, a star appears for the completion of every five second-interval the user actively engages in the task. When the user completes the task, a shooting star with bright joyful music flies across the screen. The app records the progress of the user, tracking how long the user engages with their own facial features, measuring progress with a simple line graph, and noting the emotions with which the student does not engage.

As the user gains skills needed to express emotion in social situations the tasks become harder. In level two students are expected to name emotions and identify moments that would lead to that type of emotion. The angry face built by the user will be animated into a scene where a child is being sent to bed before they are ready. A voice will narrate what is happening and the user's name will be put into the game "James is angry, he doesn't want to go to bed." The same animation will be shown again this time without the narration. At the end of the animation the user is asked to match the angry emotion with the matching emotion on the side of the screen, thus asking the user to notice the similarities of features, gaining practice in detailed observation. This round will continue with different scenarios of happy, sad, angry, and tired. Scaffolding the learning in this way breaks down emotions and gives every user the chance to learn and grow.

Today's demographic of young children are inundated with media. Linking this teaching tool with the popular digital language of emojis makes this an enticing game rather than a mandated chore. Not only are emojis a universal communication of emotion (with clear visuals), they are also recognized by a large spectrum of age groups. The delight they engender in children, no matter their grade, increases the desirability of our program. The familiarity that emojis have gained take the stigma out of this educational app. Creating a space where learning is a game and not prescribed will also allow students to have more freedom to try experiences they may typically resist.

Theory and Practice

Many apps that proclaim to be helpful for the Autistic community are developed without proper research into and thought for how information is being presented. While I knew combining elements of successful apps could create an appropriately designed teaching tool, I did not want to fall into the trap of building something without expert feedback. To understand if my app was real world applicable I asked for the opinion of several special education teachers. Here are some of the comments and suggestions I received:

"I like how the child's face is next to the emoji so they can make the connection. Is it easy to customize it?" (Special Education Teacher)

"I think there should be a little more of a distinct difference between the shape of the mouths. They look very similar and maybe should be a little more exaggerated. Overall…. cute idea." (Speech Therapist)

"I like the idea that the child could connect their face to the correct emotion. I think it would work for children with an emotional IQ under 3rd grade."
(Special Education Teacher)

"This is awesome! This would be great during social skills activities. Thank you for sharing!" (Learning Support Teacher)

"Maybe add an achievement chart? Children are very goal oriented."
(Special Education Teacher)

"Perhaps add an element of verbalization? 'When I fall off my bike I feel…"
(Special Education Teacher)

With positive feedback from experienced educators I decided to pursue building my design. To begin the process I met with two experts in assistive technology for children with

developmental variations. They had opposite reactions to this concept. One expert complimented the teaching methods, impressed by the connections made between the emotions and the self, and the use of emojis as communicative methods for future emotional interactions. The second, pointed out that I had oversimplified some very complex research, and that maybe the market is already saturated with apps that are not useful for this demographic. I found reasons to agree with both experts. Mimicry and facial recognition are concepts I am just beginning to understand, and this app is in the infancy of its design. With these notes I delved deeper into research and began the long process of building an app.

After four months of work and research I was able to find the right person to help me with the technical aspects of this project. This assistance was necessary as the app industry has its own language, I found that the use of a translator expedited the process significantly. There are still edits to be made. At this time the video function only works on a laptop and not all laptops have the necessary touch screen which is important for added usability. Some of the artistic choices still need to be edited, colors can be made brighter and animations made clearer. Lastly, this version has no verbal directions or sound effects. These elements will be added after the initial testing has occurred. With these limits in mind, I was ready to take my design into classrooms to witness firsthand how students interface with it.

I was most nervous to see how children interacted with this tool as their reviews are the most important to me. The teaching methods are only effective insofar as they speak to the user's enjoyment and curiosity. I observed twelve pre schoolers interface with the app. Each student was between the ages of two and three and a half years old. We worked in their classroom, the setting and participants were familiar. Each student created their own facial expression and was

then asked to mimic the emotion while watching live video feed of their face on an iPad screen. The verbal cues were delivered by me. I took careful note of the student's reactions, and where adjustments were needed.

In general there were three types of interaction with this design. 1) the children who were able to identify and mimic the emotions they chose, 2) the children who were able to identify the emotions they chose and then became silly (making faces at the camera) when their reflection was on screen, and 3) the children who created a dynamic face and then had no expression at all when their reflection was shown. The older children in this group were able to identify and mimic emotions with ease. The younger children seemed to be intimidated by their own reflection. For example instead of watching their face on camera they chose to look at me directly. When they disconnected with their own reflection they were able to process the instructions I was giving them and create expressions of their own. When I asked one of the older children how he felt about the game he said "oh yeah I liked the <he then made an angry face>!" He was able to create, mimic, and remember the experience in a positive way. That is the goal of this tool. It is worth considering, however, that this child enjoys dramatic play, and is often enacting different emotions. He already possesses the skills this tool aims to improve.

There was some consistency in how each child interacted with the design. A majority of the children chose the most dynamic emotions for their face. The angry eyes made multiple appearances on the emoji, although only a few of the students were able to imitate the expression themselves. This makes sense to me, as the big emotions can be overwhelming for children. One way to gain understanding of these emotions is to be in charge of creating them. The younger

children may still feel trepidation's when expressing these feelings. I see the choosing of the most dynamic expressions (angry eyes) as the first step toward deeper emotional understanding.

The children who simply made silly faces were participating in facial emotional expression, although not participating in mimicry. I see this as an excellent way to exercise the facial muscles and to gain greater fluency in emotional expression. More importantly, I want the act of using the app to be fun, so children will return to it in the future. It is my hope that as the students return to the app more frequently, they will begin to mimic the emotions they create.

My hardest critics were these children. I asked a one of them if they enjoyed the game "No." she replied (her nonverbals would tell you otherwise). The app needs work, it needs sound effects, I could add music, and maybe some encouraging statements. The addition of goals is necessary before my next interaction with children. Most of all, narration of what each item is as the children places it on their emoji, "you chose angry eyes" would really help. This will aid in the verbal and physical connection of emotion as well as clarifying what the child is to be doing when their face is on the screen. My favorite moments teaching are when my students take my carefully designed lesson plans and teach me what I've missed, I feel similarly here. Without their input this app would not become full immersive and useful.

Using the feedback from these students, special educators, and assistive technology experts, I will continue to edit this design with the Autistic communities needs in mind. After perfecting the interface for users, more rigorous testing can occur. At that point the evaluation of the Autistic community will be sought out. This is an essential step in the growth of this app, my design is based off of current research and the suggestions of experts, without the input of the Autistic demographic this app is not valid for educational purposes.

In Conclusion

Assistive technology, personal communication devices, and educational apps have changed how the Autistic community communicates with the neurotypical community. New technology now strives to offer those with Autism the tools to communicate verbally and also nonverbally. This technology can provide clarity and practice for real world interaction.

The research presented in this paper demonstrates the benefits of mimicry when gaining facial emotional fluency. The process of reviewing highly rated social emotional education apps has shown the app industry has yet to incorporate mimicry into their catalog of teaching methods. This oversight in development indicates a lack of understanding when considering the Autistic population. By creating an app that fills this educational gap we were able to recognize the importance of evidence based design, as well as the endless possibilities of creative teaching provided by this new technology. Pairing the demand for strengthening the social brain with the desire to interact with playful emoji's allows the Autistic and nuerotypical populations an opportunity to enjoy exploring emotional expression.

As developers continue to build more products based in mimicry, it is suggested they stay connected to current research and to the opinions of the Autistic community. Working together in this way will allow for more innovative techniques to flourish, and for a deeper understanding of emotional expression. By valuing evidence based design and the needs of the targeted demographic more useful and thoughtful tools can be produced for those who need them most.

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Appendix A

Bank Street Graduate School of Education

Bank Street College of Education
Institutional Research and Review Board
Application Form
STUDY FULL BOARD REVIEW CHECKLIST

Directions: The purpose of this checklist is to provide documentation of determining whether a project meets the criteria for approval at a convened full board meeting.

I. GENERAL

Project Title: Designing Digital Tools to Strengthen the "Social Brain" of Young Children with Autism	
Principal Investigator: Kirsten Benjamin	
Reviewer: Sean O'Shea	For Meeting Date: March 15, 2019

II. REVIEW CRITERIA:

1.	All appropriate documents are included for review.	X YES	☐ NO	☐ NA
2.	Risks to participants are minimized by using procedures which are consistent with sound research design and do not unnecessarily expose	X YES	D No	D NA
3.	Risks to participants are minimized whenever appropriate, by using procedures already being performed on the participants for educational, diagnostic, or treatment purposes.	X YES	D No	D NA
4.	Risks to participants are reasonable in relation to anticipated benefits, if any, to participants, and the importance of the knowledge that may	X YES	D No	D NA
5.	Selection of participants is equitable taking into account the purposes of the research, the setting in which the research will be conducted, the special problems of research involving vulnerable populations, the	X YES	D No	D NA
6.	Informed consent will be sought and appropriately documented from each prospective subject or the subject's legally authorized representative. If a waiver to obtain, document or alter the requirements of inf	X YES	D No	D NA

		YES	NO	NA
7.	When appropriate, the research plan makes adequate provision for monitoring	X YES	☐No	☐ NA
8.	When appropriate, there are adequate provisions to protect the privacy of	X YES	☐No	☐ NA
9.	Are adequate safeguards still in place for participants who are likely to be	☐ YES	☐No	X NA
10.	Are there significant new findings concerning this research that might affect the willingness of participants to continue to take part in the research. If there are significant new findings, are they adequately	☐ YES	☐No	X NA
11.	Do any reports of non-compliance or participant complaints represent unanticipated events or problems involving risks to participants or others or serious or continuing non-compliance?	☐ YES	☐No	X NA

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		YES	NO	NA
1.	Research previously reviewed and approved by the full board may be approved for future continuing reviews under expedited category 9 of the 2010 Guidance on Continuing Review if conditions a, b, and c are met: (a) The research is not conducted under an investigational new drug application (IND) or investigational device exemption (IDE); and (b) No additional risks have been identified since IRB review at a convened meeting; and (c) The IRB has determined and documented at a convened meeting that the research involves no greater than minimal risk. Based on (a) and (b), would you recommend future continuing reviews for this study under category 9? If so, the committee will be r r.om· r. rto vote on this for (c).	☐ YES	☐ NO	X NA
2.	Information from a public data base where aggregated data cannot be associated with any particular individual or group of individuals	☐ YES	☐ NO	X NA
3.	Observations of behavior within a public gathering that cannot be associated with any particular individual or group of individuals	☐ YES	☐ NO	X NA
4.	Information that is already in the public domain (e.g., autobiographies, diaries, other published materials)	☐ YES	☐ NO	X NA

IV. DETERMINATION	
☐X	Recommend approval with no changes or stipulations
☐	Recommend disapprove
D	Recommend approval with changes or stipulations (use comment box below)
	COMMENTS:

Appendix B

Informed Consent for Child Participants in a Study

Dear Parents of the Upstairs Twos:

For my culminating project at Bank Street I have designed and built an Application (App) for small children. The last and most important opinion of my work, is that of your children. I am writing to request permission to present this App to our classroom. I would like to include the children's reactions to the App in my research paper. Below you will find visual images of how the App works, and be assured that the process to complete the activity for each child would be between one and five minutes.

The study is entitled: Identifying and Mimicking Emotional Expression

The purpose of this study is to encourage young children to create, and then mimic, emotional expressions.

Step one:

The user is asked to choose facial features to create a face.
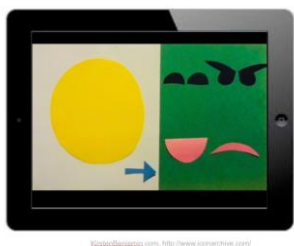
Step two:

The user employs the facial features to construct their own emotional expression, and then clicks the blue arrow.

Step three:

The screen is split, a live camera is activated, and the user is asked to mimic the expression they created.

I will collect data for this study by taking written notes on the reactions of your children. No names or identifying features will be shared. I will use vague language, such as "The children seemed to enjoy the visuals" or "The process was not engaging for the children". The paper will be shared with a faculty member from a graduate course at Bank Street College.

You have a right to review the research paper.

If you agree to participate in the study, all identifying information will be masked and/or pseudonyms will be used to ensure anonymity.

Participation in this study is voluntary. Should you agree to be involved in the study, you will have the right to withdraw at any time, and all data pertaining to you will be destroyed upon withdrawal from the study. There are no known risks to participating in this study.

If you would like to participate in this study, please sign the consent form below. If you have any questions about the study, I would be happy to answer them for you. I can be reached at: email address: KBenjamin@gracechurchschool.org

Thank you so much for your consideration. I greatly appreciate it.

Sincerely,

Consent

I have read the description of the study entitled: Identifying and Mimicking Emotional

Expression that is being conducted by Kirsten Benjamin.

___ I agree to participate in the study.

___ I do not agree to participate in this study.

Name: _____

Date: _____

Signature: _____