Developing Applications to Compare Methods of Teaching Emotions

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1. Problem

Social cognition is a complex process where individuals acquire, understand, and use social knowledge to quickly and accurately respond to verbal and nonverbal social information. Studies have shown that social cognition is extremely important in human relationships, [9] ultimately leading to successful human communication. Psychologists and social psychologists believe social cognition to be a method in which "people make sense of other people and themselves." Lacking social cognition and having a deficit of social knowledge is one common trait in individuals with Asperger syndrome/High Functioning Autism (AS/HFA), which may be a reason why they are oftentimes behind their more social-thinking peers in terms of functioning in social situations.[9] Social skills are behavioral manifestation of social cognition. Having a social cognitive deficit means one has social difficulties in the initiation of communication, listening to and processing of subtle sensitive cues, abstract and inferential thinking, understanding the perceptions of others, gestalt processing, and/or humor. [14] Individuals with AS/HFA, or anyone with a social cognitive deficit, are thus limited in the jobs, environments, activities, and opportunities available to them because many social situations with other people would make them uncomfortable: they would not understand some of what was happening around them, and others would not understand what they were doing or why they were reacting in the way they were.

Linguists believe that each distinct language has two sublanguages. Expressive language encodes messages by translating them into words or other symbols. Receptive language decodes messages so that their meanings are accurately understood with their intended meanings. [8] This means that speaking and writing words is expressive and understanding those words is receptive. Communicating how one feels internally through emotions is expressive nonverbal language. Albert Mehrabian studied face-to-face interactions of a wide range of people and found that fifty-five percent of a message's emotional meaning is conveyed through "...facial, postural, and gestural means", and the other thirty-eight percent of a message's emotional meaning is communicated by the mood of a voice. Words contribute to a mere seven percent of a message's emotional meaning. [8] These studies show the importance and value of nonverbal communication and social cognition in understanding how someone is feeling and what they are thinking: correctly identifying and reacting to facial, postural, and gestural means can make one more welcomed, respected, and wanted by those around them. Conversely, if one incorrectly sees and reacts to facial, postural, and gestural means, they could become social outcasts because "serious misunderstandings can occur if [someone fails] to interpret nonverbal messages correctly, or if [they] send nonverbal messages that do not accurately reflect [their] emotions." [8] Furthermore, recent surveys show that the average person spends less than forty minutes per day communicating verbally with others. (This does not mean they are not communicating at all: they are merely communicating non-verbally as well.)

Related to social cognition is the concept of “Social Thinking" which emphasizes teaching and studying the reasoning behind socialization "...without implicitly targeting discrete social skills.” [9] Our project will focus on both social cognition as well as Social Thinking in order to teach emotions to users of our applications.

2. Related Work

Fortunately, however, studies have also shown that social skills can be taught. [9] Already, people have been trying to teach social skills in schools. Below is an image of a poster in a classroom from Stanbridge Academy, a kindergarten-high-school for students with mild to moderate learning differences and social communication disorders in San Mateo, California. [11]

The poster shows an image of a smiling person and students must select the emotion from a series of options that best fits that of the smiling person. This poster is one way to teach social knowledge. “...children with ASD need a structured educational approach with explicit teaching.” [6] As some of the students who attend Stanbridge have ASD, this poster is one example of a structured, clear, and simple educational approach with explicit teaching. Different levels or questions can be added or removed based on the student or their previous answers.

Figure 0.1: "Poster from Stanbridge Academy"

2.1 Related Technical Solutions

Much work has been done in the field of iOS development to address the teaching of social skills. Some similar applications include *BodyLanguage*, which is meant to guide users on how to gesticulate, greet people, and remain calm while considering what their body language conveys. [2] iOS applications that tackle the teaching of emotions include *Micro-Expression Trainer*, which shows users what an emotion looks like and explains facial features that match said expression. It focuses on anger, contempt, disgust, fear, happiness, sadness, and surprise, which it believes to be the seven universal emotions.*Micro-Expression Trainer* costs $3.99 and lacks sound or audio.

Another iOS application that teaches emotions is *AutismXpress*. It has twelve faces with basic feelings, and the user chooses one to see a fun animation and hear some sound effect that goes along with the feeling.

TouchLearn is one iOS and iPad app that displays four faces with different emotions, and the user must select the face that matches the one given emo-

Figure 0.2: "Screen from Micro-Expression Trainer"

tion.[12] Questions and levels can be added to further and hone the learning and teaching of emotions and social skills to different types of people. One iOS and iPad application available to the public is Avokiddo Emotions which is more interactive and geared towards younger children. It involves dressing up animals and seeing their reactions to different actions like being poked, hearing an alarm, dancing, and more. [1] Another iOS and iPad application available to the public is Emotionary+ which guides users past five core emotions, helping them learn more specific ones based on one of those five primary ones. [4] Speech Language Pathologist Lois Jean Brady advocates for “iTherapy”, or the usage of Apple products like the iPhone, iPad, or iPod Touch and iOS applications to help students, both ones with and without Autism, to achieve their personal educational goals. [2] She points out that Apple products support applications involving voice output, text-to-speech, sign language, sentence generation, and other forms of communication to help gamify and reinforce repetition and usage, making learning fun for students and people of all ages.

Figure 0.3: "Screen from AutismXpress"

3. Our Solution

Our project differs from other applications currently available to the public in the form of graphic used, the levels, and types of questions asked. It also is primarily on the web platform, but has a small iOS component. Our applications also differ from others already out on the App Store in that they use different technologies, which we will go into more detail about down below.

Our hope for our applications is that they tackle this problem of individuals lacking social knowledge by digitizing and gamifying the teaching of social skills through application development, which we will go into greater detail when discussing the technical methodology used. This should address the problem because “...children with ASD need a structured educational approach with explicit teaching.”

3.1. Our Applications

Our project is the development of a series of web applications to make the teaching of emotions more accessible to everyone–regardless of whether or not they have Autism or ASD, or have a social cognition deficit– so that anyone (and everyone) can learn the skills to be comfortable in any and every social environment.

3.2. Web versus Mobile Platforms

Most of the applications are made for the web platform because that is most accessible: most people are able to somehow get to a public library that provides free access to computers. Whereas the mobile platform, though it allows users to use applications wherever they are with Wi-Fi or data, is limited to those users who own smart phones or tablets. Since social skills and cognition can be taught, applications teaching social skills should and could make it easy and accessible for anyone, regardless of background or prior social knowledge, to learn and develop social skills. The purpose of the series of web applications is to compare which one is better at teaching emotions. The web applications should also sync with a mobile application to give users the option to continue learning while on-the-go. So far, there are three web applications with the same questions and possible answer choices, but the applications differ by the type of graphic displayed for each question. One has static images of faces displaying different emotions, one has short gifs that lack sound of faces displaying different emotions, and one has a short video with sound of images of faces displaying different emotions. This is the only difference between each web application: the questions, question order, possible answers, and possible answer orders remain the same to best compare which media type the user scores better on. Their score will be based on the number of questions they get right.

3.3. Distinctions in our Applications

That distinction in media type is important because most applications available to the public that teach emotions or similar social skills only use static images. We hope to test whether or not a user gets more questions right on a certain media type. Each application also has multiple levels or styles to teach different social skills: one asks the user to identify the emotion shown, one asks the user what the person could be thinking, and one asks the user what they themselves could say to the person shown. Each question aims to teach a particular emotion.

3.4. Emotions in our Applications

The emotions we chose to teach and focus on are based on Plutchik's Model. [10] Robert Plutchik created a theory of emotion that categorizes emotions into primary emotions as well as the responses to them. He also claimed that the primary emotions developed over time and that responses to each such emotion are likelier to deliver a higher possibility of survival. Plutchik believed the eight basic emotions were comprised of anger, disgust, fear, sadness, anticipation, joy, surprise, and trust [10] He claimed that together, they made up the Wheel of Emotion which is a way to categorize emotions as primary emotions and how people respond to them.

We decided to focus on anger, disgust, fear, sadness, joy, and surprise because we believed they were most important to learn and distinguish, and also that there is slight overlap and similarities between many of the eight primary emotions. Some complaints about Plutchik's model are that it is too simplified, not reflecting larger emotional nuances. Regardless, it is generally believed that his Wheel of Emotion is a good starting point when deciding what emotions to target when designing an application or other product.

Given extra time, we, or other developers, could add on to these applications to further the teaching of emotions and social skills. Other possible levels could be added on to include questions about recognizing and identifying language like sarcasm, idioms, metaphors, humor, or irony. Similarly, another method might be to develop some mobile application to mobilize the game that syncs with the web version, thus letting users learn on-the-go. We are not adding these features yet, but they reflect the ways for the project to be continued, improved, and added on to.

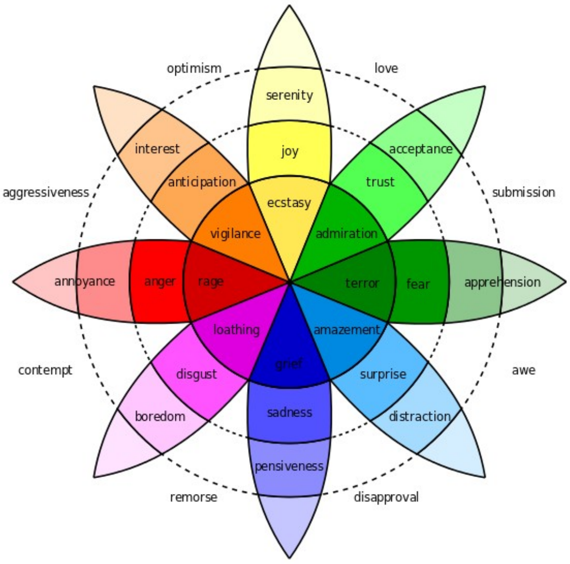
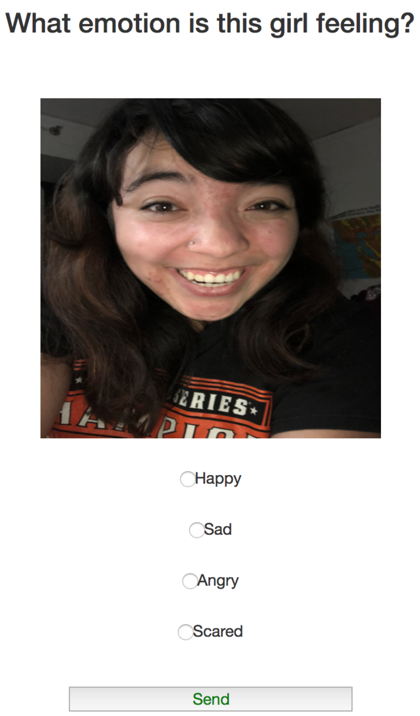


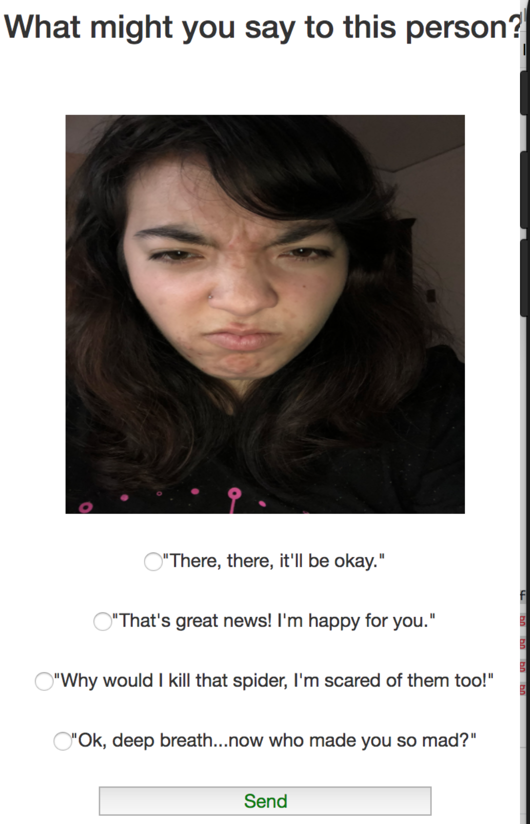
Figure 0.4: "Plutchik's Wheel of Emotions with the eight primary emotions and the emotions the primary ones combine together to form

To test the results, we will look human subjects to volunteer to use the applications after submitting an IRB form. These subjects will sign a waiver and can be anyone. It would be preferred to test on subjects who have been diagnosed as being on the Autism spectrum, but that requires more paperwork and more time searching for subjects. These subjects will go through each question of the applications and we will see which media questions the user performs better on. We predict that most users will perform better on questions with a video graphic as opposed to one with a static image or a simple, no-sound gif, but are unsure that this prediction is true: that is why we will compare each application that has a different, distinct media type. The UI design of these applications is very simple, as demonstrated by images in table 0.2.

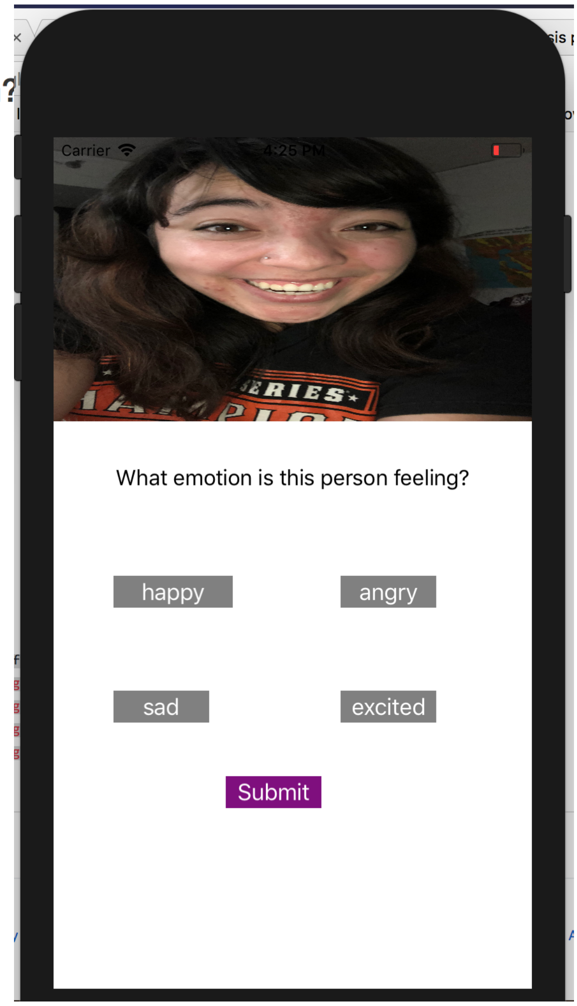


(a) "guess emotion from image" of web application

(b) "what might they say based on their emotion" of web application



(a) "what might you say based on their emotion" of static image application



(b) "guess their emotion" of iOS application

Table 0.2: E
xample Questions from Static Image Apps

4. Application Development

First, we drew out with pen and paper the design and flow of our application pages. We knew we wanted to develop for the web to make our applications accessible to more people, so we knew what languages to start with: HTML, CSS, JavaS We drew out what the homepage would look like, what buttons would go where, and where each button would lead to. Figure 0.5 shows our first sketch of the flow of what was the whole project at the time.

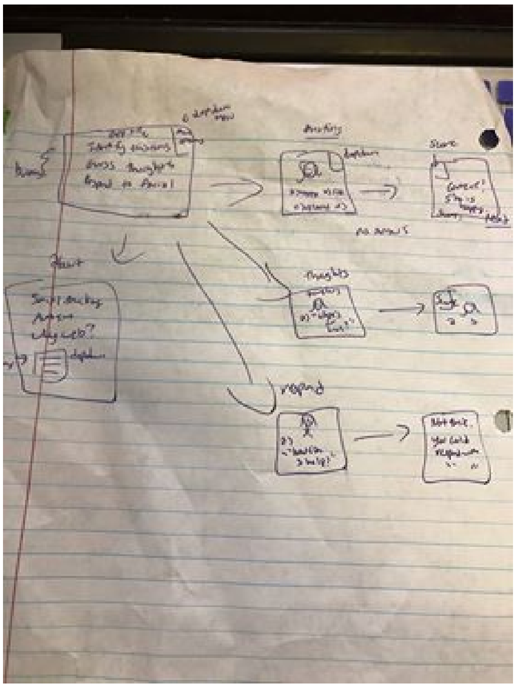


Figure 0.5: Our initial drawing of the flow of one application, October 2017

From there, we started out developing static web pages in HTML, CSS, JavaScript, and jQuery (which we will look at more in the next section) that we ran locally on our machines. Static web pages almost solely use client-side languages and are more simple. This was alright for testing each application, but it was difficult to save answers from the web pages. In November 2017, we found a script that could save responses to a Google Form. This was handy because it worked with static web pages, but for some unknown reason or reasons, not every answer was saved. It was not always accurate.

4.1 Dynamic Web Pages and Servers

In order to better save answers, we decided to make our web pages dynamic rather than static. Dynamic web pages have code written in a server-side language, and we needed a server to save our answers to. Most of our time has since been spent working on the back-end code to power the applications so the web pages do not look as pretty or complex as they could, and we will work on that in the near future.

In order to make the web pages dynamic, we converted our web applications to Django. Django is a free and open-source Python web framework that handles dynamic web actions related to servers such as user authentication and forms. [13] This helps get the web application hosted on Digital Ocean, a cloud computing platform which makes the application accessible by anyone in the world. More specifically, this project is deployed to the world wide web on Digital Ocean droplets, which are cloud servers for personal use. [3] Anyone can view and partake in this project by visiting http://104.131.74.54/ in their browser. Google Chrome will tell you "Deceptive site ahead. Attackers on 104.131.74.54 may trick you into doing something dangerous like installing software or revealing your personal information (for example, passwords, phone numbers, or credit cards)." Get past it by clicking *details* followed by *visit this unsafe site*

4.3. Methodology

For this project, the web pages are designed with HTML and CSS. The answer options are represented by radio buttons, and the answer responses are saved with the JavaScript language and jQuery library. According to the jQuery website, it "...is a fast, small, and feature-rich JavaScript library...[making] things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers." [7] In other words, jQuery makes it easy to access the HTML webpage in JavaScript when communicating between both the client and server sides. We also use jQuery to check that each question has an answer: otherwise, a screen pop ups telling the user the first question that they did not answer. The answers from the radio buttons are then saved to a Google Firebase database. Google Firebase offers numerous developer products across multiple platforms, but the one our project uses is the real-time database. This "cloud-hosted NoSQL database... lets you store and sync data between your users in realtime", providing real-time syncing for the radio button answers once they are converted to JSON data.[5] We decided to use Firebase over other database services because of its extensive documentation, ease of use for cross-platform applications (time-permitting, the web applications will sync with iOS applications), and ease of use for smaller applications and prototypes. Figure 0.6 displays how Firebase saves the answers for each separate level for each separate application in the console (accessible on the web.)

Initially, each question was on one web page. We could save the answer from each question to a Google Form, but when we migrated over to using Firebase, realized that each separate web page would be one separate call to Firebase. That over-complicated matters, so we decided to make it so each level was on one web page and the user would just scroll down. Now, at the moment, when a user finishes a level, the *submit* button checks that each question is answered, and then publishes the answers (which have been converted to JSON form to be read by Firebase) to Firebase and goes to the next level. After three levels, the user is directed to the next web application (first they have static images, then silent gifs, and lastly videos with sound.)

We had never used Django before so a lot of time was spent learning it and working to get our applications on it. A surprising and interesting fact about Django is that it can sometimes distort images and graphics. When we tried to convert our first static web pages to Django, the images rotated ninety degrees. In order to rotate them back, we implemented Cloudinary, which provides APIs for image and video manipulation, cloud storage, and file upload in the cloud across platforms. Because of Cloudinary, not only is every picture oriented correctly, but the gifs and videos appear directly in the web page. Without Cloudinary, no gifs or videos showed up in our Django application. (Figure 0.7 shows the Cloudinary console.)

The web applications are done and ready to be tested by users. We plan on making the web pages look fancier and more aesthetic, and are currently drawing out more prototypes as their design at the moment is extremely basic because we were focusing on the backend code that powers the applications rather than the frontend design. The only backend changes we may make are to implement a login system so Firebase does not use randomly-generated strings for each user, or to pull the answers from Firebase and display the results on a web page to let users know how they performed.

The iOS application is incomplete at the moment. It has the first level (recognizing emotions), but does not save to Firebase yet or have any other levels or any other media types besides static images. Additionally, we successfully implemented a video chat feature, but are unable to successfully merge it with the Django application so far.

In summary, the languages we are using and have implemented so far are Python, JavaScript, HTMl and CSS, and Swift. The external libraries, APIs, and services we are using include Firebase database, Digital Ocean for servers, Cloudinary APIs, and the Django web framework.

Figure 0.6: Answers for each web app saved to Firebase

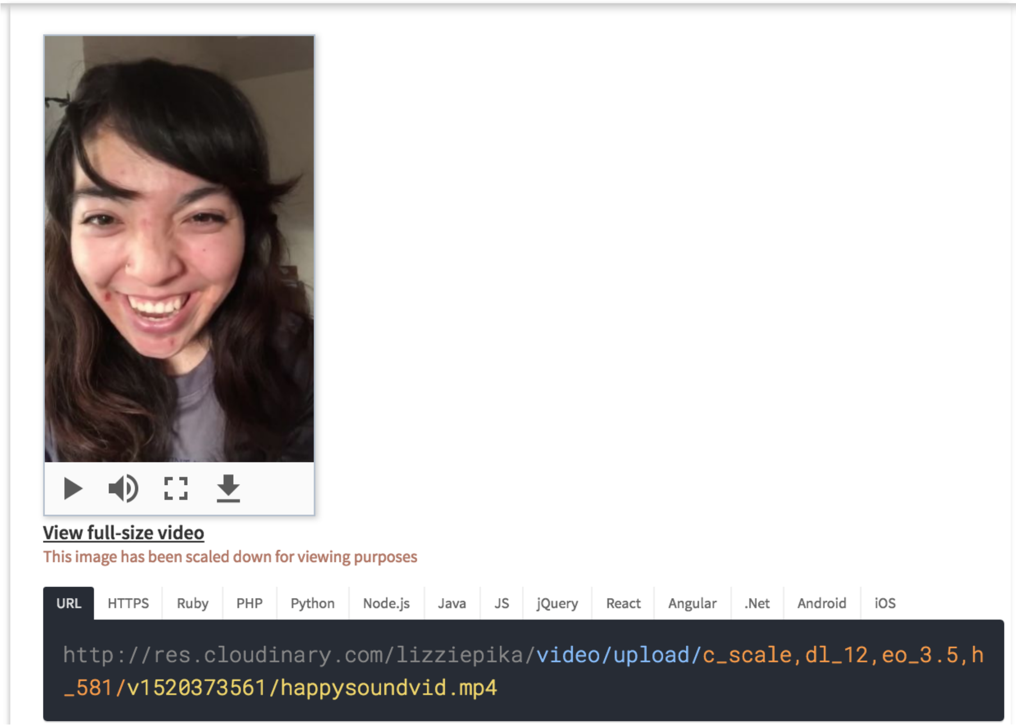


Figure 0.7: Screen grab of the video URL generated in the Cloudinary console

5. Goals

After usage of these applications, we hope to see improvement in interpersonal relationships, play and leisure interactions, and social skills. Skills to be targeted include awareness of feelings, recognition of non-verbal communication, starting a conversation, and making small talk. Outcomes will be based not just on how users score on the questions, but also through questionnaires. This is similar to how studies with ASD/HFA children measured progress and results. They targeted the same skills and more, such as politeness, introducing oneself to others, maintaining a conversation, ending a conversation, making small talk, negotiating with others, responding to teasing and bullying, hygiene, dining etiquette, and dating etiquette. [9]

6. Appendix

This web project's droplet can have backup versions in case one the droplet (server) goes down, is configured with 1 GB memory. You, or anyone with access to the internet, can visit the project at the following public network or IP address: 104.131.74.54.We edit the project by SSH-ing on our local machine to our Digital Ocean droplet.

7. Acknowledgements

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