Beyond Childhood: Mobilizing Applications for Adults with Autism

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Abstract
This research seeks to identify existing assistive mobile applications targeted at individuals with autism over the age of 18 ("adults with autism") who have trouble communicating or lack the ability to live independently. This research seeks to answer the question, "what are the existing gaps in mobile assistive technology for adults with autism?" Through performing a qualitative analysis, we examined existing gaps in mobile assistive technology for adults with autism. Our research analyzed 39 mobile applications by identifying prominent features/characteristics. Our initial findings showed that there needs to be an emphasis on communication and functional life skills when creating mobile applications geared towards adults with autism.
Keywords: autism; mobile applications; assistive technology; adults with autism
doi: 10.9776/16579

Acknowledgements: The authors would like to acknowledge the iSchool Inclusion Institute (i3), Michael Depew, Courtney Loder, and our advisor Josh Cartagena for guiding our project and providing feedback throughout the year.
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1 Introduction

The diagnosis of autism in individuals have become highly prevalent in the United States, with 1 in 68 individuals being diagnosed. The disorder affects not only the individual, but families as well (Center for Disease Control, 2015). According to Autism Speaks, a nonprofit organization focused on autism awareness, autism costs families roughly $60,000 per year due to therapies and special care. Autism is the most severe disorder on the Autism Spectrum, which is a range of complex, neurological disorders that affect communication, motor, and social skills (National Institute of Neurological Disorders and Stroke, 2015). Some individuals with autism are nonverbal and unable to live independently while others possess "above average" abilities in visual arts, music, or academic areas. This variance in physical and cognitive ability stems from the observation that adults with autism tend to think in a more visual manner while others are more auditory or are able to grasp concepts and process information faster than others.

Communicating with caregivers, parents, and friends remains a major difficulty for many individuals with autism. According to the National Institute on Deafness and Other Communication Disorders (NIDCD, 2012), "Children with Autism Spectrum Disorder (ASD) are often self-absorbed and seem to exit in a private world where they are unable to successfully communicate and interact with others." Adults with autism may misunderstand verbal cues, facial features depicting changes in mood, or experience an inability to convey emotions clearly. Communication problems between patients and caregivers or physicians can lead to less effective treatment and delayed progress towards social development and independent living.

To combat such communication problems, smartphones and mobile applications have emerged as potential aids for adults with autism and other communication-related disorders. Boulos, Wheeler, Tavares and Jones (2011) emphasize the widespread use and benefits of application development and smartphone use in hospitals and the healthcare industry. While the current literature focuses heavily on children and youth with autism, this study focuses on individuals over the age of 18 with autism ("adults with autism"). Specifically, we investigate the emergence of mobile applications use to assist adults with autism to improve communication and independent living skills.

2 Methodology

Our research consisted of a qualitative analysis by utilizing a case study approach to identify existing assistive mobile applications for adults with autism. We identified and studied thirty-nine assistive mobile applications. Our method of observation was modeled on research by Ennis-Cole, Wada, and Chen, "An App Recommendation System for Children with Autism Spectrum Disorder" (2015) and Yee's 2012 word title, "Mobile Technology for Children with Autism Spectrum Disorder: Major Trends and Issues." The study investigated pathways in which assistive mobile applications can be chosen based upon various desired characteristics. We followed similar protocols and concepts from these studies and examined the types of features that were most common across different applications targeted towards adults with autism.

The 39 mobile applications selected for evaluation were found through keyword searches on Google using purposive and convenience sampling. Keywords used for searching included: autism, mobile applications, adults with autism, and assistive technology. We evaluated the applications along four criteria identified in the literature: operating system (Apple's iOS or Google's Android), price, purpose, and features. Operating systems were limited to Android or Apple, due to respective market size and customer demand. The 'price' criterion was segmented into five price ranges: free, $0.99-$19.99, $20-$49.99, $50-$99.99, or over $100. The purpose of applications was categorized along common features listed on the Autism Speaks website, including: communication, social skills, academic, functional life skills, or multiple purposes. Lastly, each application's features were evaluated in comparison to a set of common features that Leo, et. al. (2011), Yee (2012), and Cole, et. al. (2015) identified as highly valued by individuals with autism.

When evaluating specific applications for purpose, the product descriptions and list of 'skills gained' included on the application websites were analyzed for content. Application descriptions and websites included various claims, including: teaching adults with autism how to read, write, or talk; improving interactions with people; understanding emotions; improving conversational speech, phrases, and sentences; and helping adults adapt to life situations through simulations.

3 Findings

Of the thirty-nine applications evaluated for operating systems, 25 of the applications (64.10%) were available exclusively on Apple. Eight applications (20.51%) were available on Apple and Android. 25 of the applications were either free (30.8%) or in the $0.99-$19.99 range (35.9%). The average price of an application in the $0.99-$19.99 range was $8.00. In the $20-49.99 range, the average price of an application was $30. When the applications were categorized by purpose, 14 of the applications (35.9%) focused on Communication and 14 applications (35.9%) focused on developing Functional Life Skills. The other categories were social skills and academics which had 5 and 7 applications, respectively. There were only 3 applications that served more than one purpose. When categorizing the applications based on common features, the three most common features were picture exchange communication, customization, and a function for task completion. Picture exchange communication, customization, and a function for task completion were available in 27 (69.23%), 26 (66.67%), and 25 (64.1%) of applications, respectively. Out of 39 applications, 3 applications had only 2 out of the 3 most common features and 6 applications included all 3 of these features. Other features that were popular were multimedia and login functions which allowed users to input recordings, photos, and videos and enabled other users to log in and create multiple accounts.

4 Discussion

Our findings indicate initial trends within developed mobile applications among adults with autism. In terms of the operating system, Apple is the more popular platform of choice for development. Apple has created several applications that are accessible through their iPhones or iPads and these products come standard with innovative accessibility features making it easy to use and understand for adults with autism (Apple, 2015). The average application price was in the $0.99-$19.99 range, at approximately $8. This is considered to be expensive, given the fact that most applications in the market are free.

Due to high therapy costs for adults with autism, applications are able to act as a substitute or supportive aid at a lower price. Regarding application purpose, communication and functional life skills were most common. Communication is an important aspect when developing applications, as miscommunication issues that are present in many adults with autism are due to significant language delays (Autism Speaks, 2013). Adults with autism who experience language delays are unable to communicate their needs to a caregiver or special needs physician, which further causes frustration and confusion when trying to care for them. Lastly, the popularity of features such as picture exchange communication, customization, and a function for task completion are consistent with the classification by purpose. Picture exchange communication aligns with the need to improve communication skills for adults with Autism. Similarly, a function for task completion supports functional life skills and overall independence.

5 Conclusion

This study investigated assistive mobile applications that are designed for adults with autism. 39 mobile applications were analyzed by operating system, price, purpose, and common features. Current literature discusses how assistive mobile applications for adults with autism lacks strong scientific support and that there is a lack of existing research about adults with Autism and assistive technologies (Yee, 2012). Based on our findings, applications available to adults with autism most commonly operate on Apple's iOS platform, are priced under $19.99, focus on strengthening communication and functional life skills, and include features such as picture exchange communication, customizability, and a function for task completion. These initial findings suggest a starting point for designing applications to assist adults with autism. However, additional research is necessary to take into account the cost of creating applications, customer demand, and usability. Future research could include interviews and user studies with application users to gain more in-depth understanding of application functionality in regards to effects on communication and independent living.

5.1 Tables

Abilipad	Grace App	Quickcues
Aut2Speak	I Can Have Conversations With You!	Social Skills
AutisMate	I Get...Cooking	SPEAKall!
AutismTrack	ICE4Autism	Speech Assistant
Autism Aid Education Timer	iLearnNEarn	StepByStep
Azahar	iPrompts	Stories2Learn
Birdhouse	iTrack Client	StoryMaker for Social Stories
ChooseIt! Education	iTrackMood	The iAssist Communicator
Chore Pad	Language TherAppy	The Zones of Regulation
Emotions Reader	LetMeTalk	This for That
Everyday Skills	Living safely	Visual Schedules
Everyday Social Skills	Model Me Going Places	Words in Pictures
First Then Visual Schedule	Pictogram Agenda	
	Proloquo2Go	

Table 1. List of Mobile Applications for Adults with Autism

This table lists out the 39 mobile applications evaluated for this research study based on the targeted age group and the targeted disorder of individuals with autism.

5.2 Figures

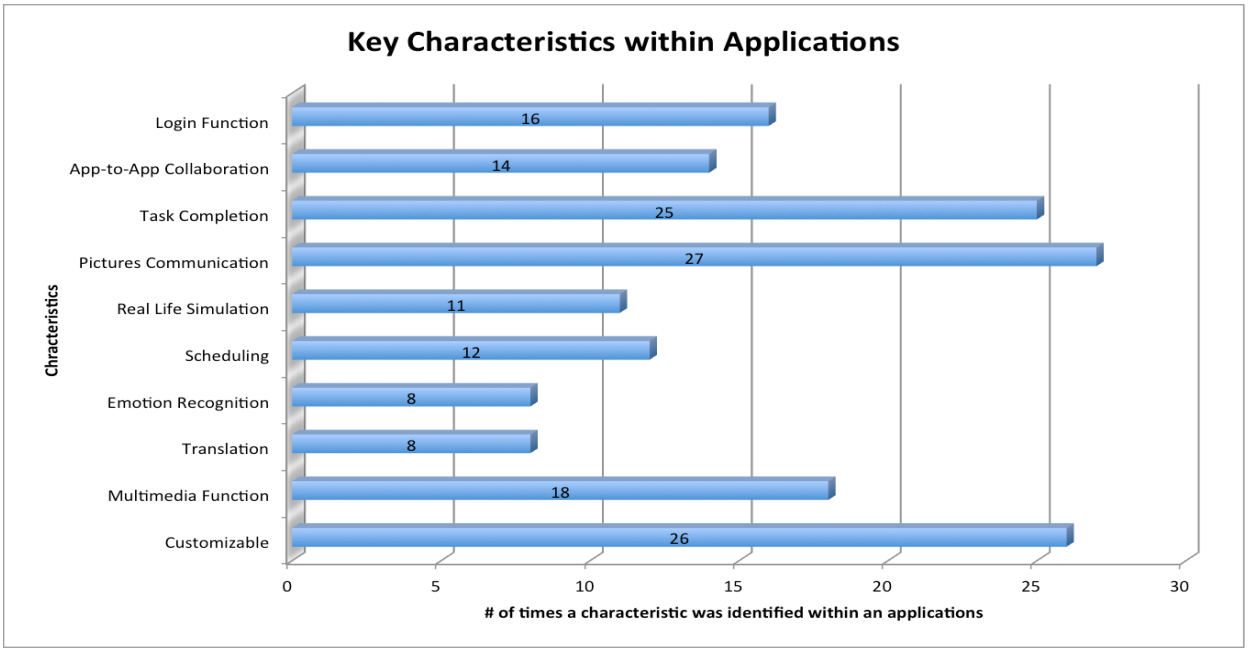

Figure 1. Key Features
The figure above indicates the frequency of key features found throughout the 39 mobile applications

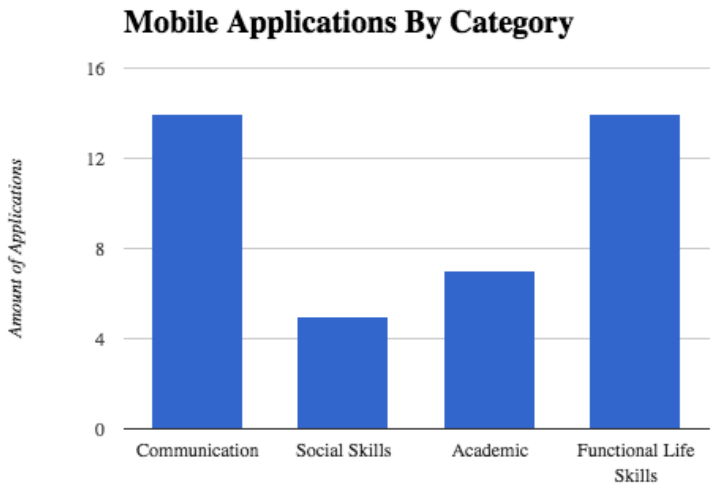

Figure 2. Mobile applications based on purpose
This figure broke down all 39 applications organized into categories based on purpose.

6 References

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