How Does App Accessibility Impact The Usability For Non Disabled Users?

GRIFFIN OPP, Colorado State University, USA

Understanding how application accessibility impacts non-disabled users is vital for everyone to receive more usable and more efficient apps. In a user study with 10 participants, with two applications one accessible and one non-accessible, we discovered that accessible apps improve the usability for almost all users, as well as that most users prefer accessible applications when presented with a choice.

CCS Concepts: • **Human-centered computing** → **Accessibility design and evaluation methods**.

Additional Key Words and Phrases: accessibility, applications, user study

ACM Reference Format:

Griffin Opp. 2018. How Does App Accessibility Impact The Usability For Non Disabled Users?. *J. ACM* 37, 4, Article 111 (August 2018), 7 pages. https://doi.org/XXXXXXX.XXXXXXX

1 INTRODUCTION

Mobile applications are designed and meant to improve, enhance, and reduce frustrations for their users. However, for one large group of users in particular, some applications do the opposite. Users with disabilities make up 27% of adult Americans according to the Center for Disease Control and Prevention [6]. For a fourth of the population, if an application is not designed in an accessible manner, the application usability can range from unusable, partially usable, to fully usable depending on a user's disability and the nature of the app. These inconsistencies between applications can cause frustrations for users with disabilities, so, why not make all applications accessible? We wanted to better understand if making an app accessible changes the usability for a non-disabled user. This is important because if non-disabled users see little change or even see a positive impact from an app becoming accessible, there would only be positive benefits for the users of the application if the application became accessible.

2 RELATED WORKS

Multiple papers ask a similar question regarding web accessibility and accessibility in general with technology. For example, in "Effects of accessible website design on nondisabled users: age and device as moderating factors" Schmutz et al. [9] wanted to identify how high accessibility or low accessibility impacts a user's experience on a website and a laptop versus a tablet. What they discovered was that users had greater task completion when a website had high accessibility and when they were using a tablet. Another example of this is in "Accessible mathematics videos for non-disabled students in primary education" where Rodriguez-Ascaso et al. [8] wish to see different educational materials, one having no concern for individuals with disabilities, and the other one being specifically designed for students with visual impairments. What was discovered is that there are no significant differences in the scores when tested after the educational videos, however, students found the accessible video more attractive. Lastly, in "Investigating the Effects

Author's address: Griffin Opp, oppgp@colostate.edu, Colorado State University, 456 University Ave 444, Fort Collins, Colorado, USA, 80521.

Manuscript submitted to ACM

of Accessibility: A study on the influence of accessibility features for hearing-impaired players on the perceptions and immersion of non-disabled players" Zryd [11] asks the question if accessibility features impacted or changed how non-disabled players interacted with a game. What was found is that sometimes accessibility features can both negatively and positively impact non-disabled players depending on what is being used. For example, players preferred subtitles but did not enjoy closed captioning. Additionally, there's been research done on applications, more specifically IoT applications, regarding errors present in applications. In Tazi et al.[10] They pose the question what is the error rate of IoT companion apps and what is the most common accessibility error in these apps. They discovered that "nearly 87% of the apps exhibit errors involving a lack of names and descriptions of elements and/or images.". We can better understand the severity of applications not being ADA compliant, with such a high percentage of applications having errors that can drastically impact a user's enjoyment and experience with an app we need to better understand what can be done or why accessibility is not more common within applications. Alshayban et al. [2] additionally discovered issues with more than 1,000 popular apps that were studied, all with limited disabled user base to gadge and understand the issues they may face within that application. Meyer [7] suggests that it could be because of a lack of legal guidelines or a lack of transparency from government agencies which leaves businesses and the creators of these applications in the dark about what it means to be accessible. Additionally, Meyer provides evidence that the federal government has not sufficiently provided an incentive or a consequence for not having an accessible application which limits the desire for companies to spend the resources on creating an accessible application. Accessibility guidelines are something that is heavily researched, Ballantyne et al. [3] wanted to understand what an accessibility guideline for mobile applications is and wanted to provide a possible mobile-specific framework to ensure this transparency for app creators. However, these previous papers have not investigated what happens to a mobile application when it becomes accessible for non-disabled users.

3 METHODOLOGY

3.1 Participants

10 participants between the ages of 18 to 25, with a mix of genders, were selected for the study. All participants self-identified as individuals who did not use any assistive technology regarding computers or phones.

3.2 Apparatus

The study was performed on a Samsung Galaxy s22 plus, The software used was two applications that were created explicitly for this study. The software was created using Android studio template apps and then was customized to fit the parameters of the study. One application had no effort put into creating an accessible app; the other application was scanned using Google's "Accessibility Scanner" tool for Android with corrections taking place to ensure an accessible app. The decision to use this accessibility scanner was based upon its usage and verification within other research [1]. The difference between the two applications can be seen in figure 1 which shows the errors provided by the accessibility scanner, and figure 2 which displays the minor changes to remove errors.

3.3 Procedure

Participants volunteered without pay, and were instructed that they would be provided two different applications, they were going to be asked three questions regarding information within each application and the length of time it takes them to find this information will be timed. They were also informed that after they completed both applications, they

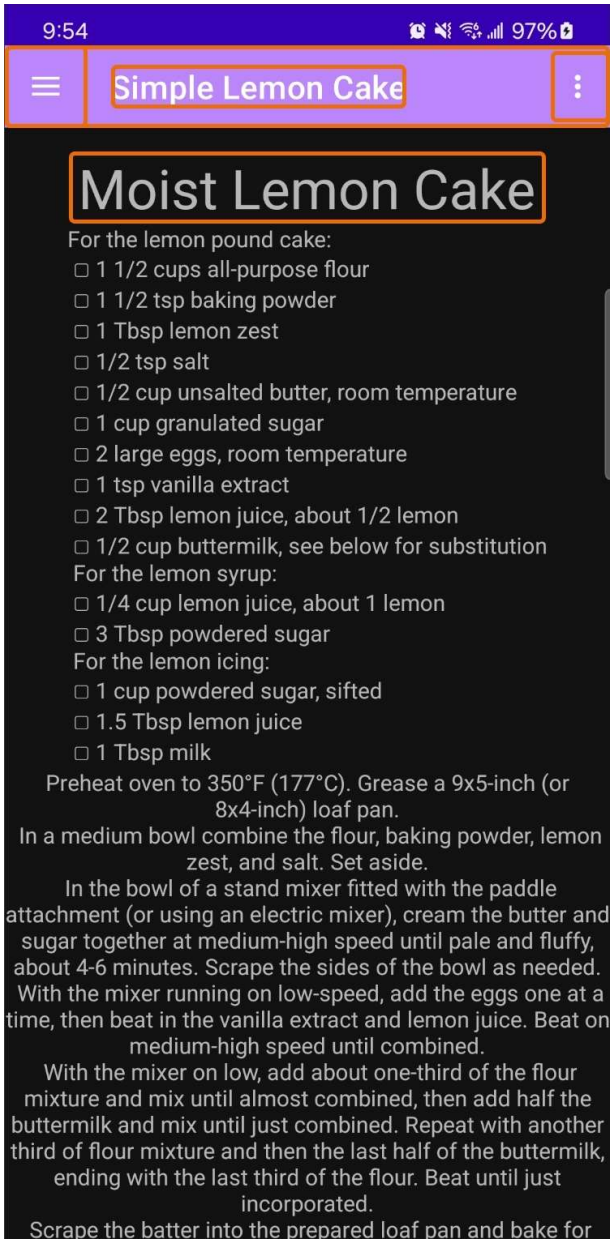

Fig. 1. The Non-Accessible Application with errors represented by orange boxes.

were going to be asked questions regarding their experience with the applications. There was no demonstration or practice given to the participants. The three questions of the participants were kept the same for the same app type. For the non-accessible app, the three questions were “What is the website the moist lemon cake is from?”, “ What oven setting do you use for the last minute easy chicken?”, and “What recipe name is the one pot meal?”. For the accessible

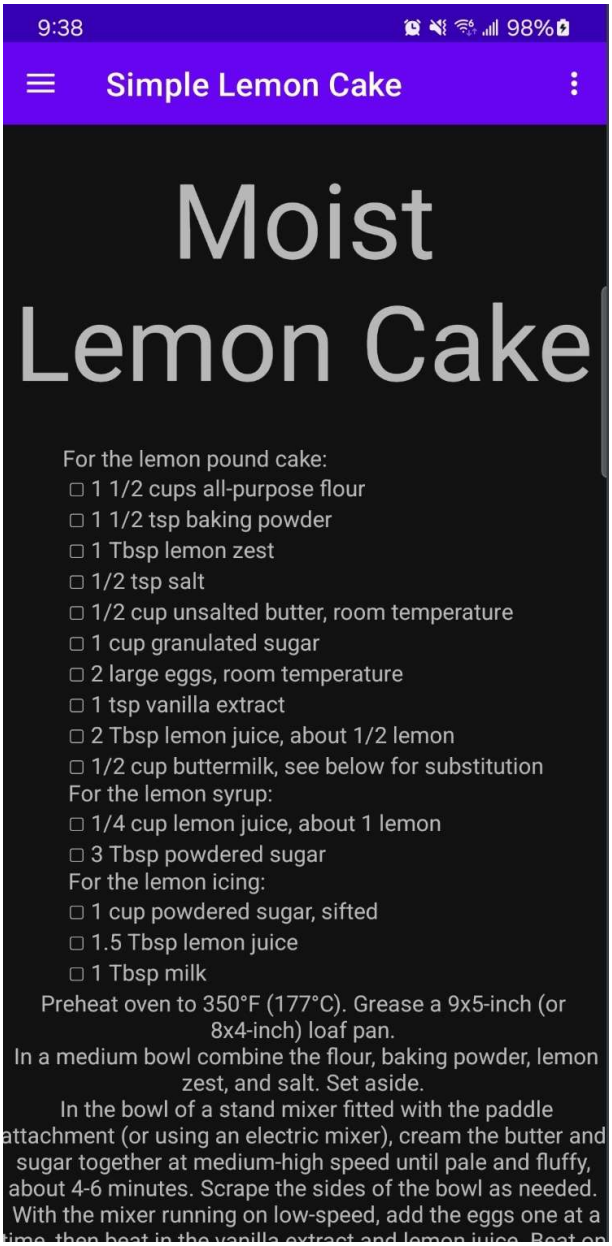

Fig. 2. The Accessible Application after error remediation.

app, the three questions were “What oven setting do you use for the moist lemon cake?”, “ What is optional for the last minute easy chicken?”, and “How long do you cook the pasta for the one pot meal?”. Timing began when they were instructed to start and stopped when they repeated the last question successfully. an error is the incorrect information for the answer. There were no errors recorded for this study however. Total time for testing with each participant was

under 5 minutes. Once participants were finished with the applications the three questions they were asked are “Which application did you prefer?”, “On a scale of 1 to 10 how usable was the first app? 10 being the most usable.”, and “On a scale of 1 to 10 how usable was the second app? 10 being the most usable.”. Users’ responses were then recorded for each of these questions. The first application presented to a participant switched each participant to reduce bias, we found no significant difference between each app being presented first

3.4 Design

The experiment was a 2 x 3 within-subjects design. The independent variables were the two different types of applications that the users were presented with. The dependent variables were the time it took for users to complete each application in seconds, their preference of application, and the usability of each application. There was no counterbalancing or participants removed from the study. There were a total of 20 trials with each trial requiring three questions to be answered by the participant.

4 RESULTS

During the study, there were no issues with data collection or participants that were eliminated before analysis. All participants have been included in the analysis. During analysis, we discovered that the mean task completion time for the accessible apps was 37 seconds, whereas the mean task completion time for the non-accessible app was 135% slower at 50 seconds. However, when using an ANOVA table, this was statistically insignificant given the p value was >0.05 as seen in table 1. Additionally, we found that on average participants gave the accessible app a 8.6 usability rating whereas participants gave the non-accessible app a 7.45 usability rating, a 15% decrease in usability. This was statistically significant when using an ANOVA table, as the p value was <0.05 as in table 2. Lastly, we found that seven participants preferred the accessible app, two had no preference, and only one participant preferred the non-accessible app.

Table 1. An ANOVA table for the time between apps

Effect	df	SS	MS	F	P
Participant	9	2129	236.556		
Accessible App	1	845	845	3.311	0.1022
AAxPar	9	2297	255.222		

Table 2. An ANOVA table for the usability between apps

Effect	df	SS	MS	F	P
Participant	9	40.113	4.457		
Accessible App	1	6.612	6.612	7.922	0.0202
AAxPar	9	7.513	0.835		

5 DISCUSSIONS

In the process of conducting this study, participants often gave reasoning as to why they chose one application over the other. One main aspect that led people to enjoy the accessible app more is they believe the layout was more efficient and

easier to follow, however layout was unaffected in the process of correcting to make the applications accessible. Other changes to make the application more accessible gave users a perceived difference in the applications, a difference they enjoyed. The questions asked on both applications find information in similar locations, the difference in questions could potentially be the cause for time differences. Both applications required the same inputs to fulfill the tasks, and no participant voice concern or fatigue during the study. Even though there was a 130% difference in time to complete tasks between applications, it is not statistically significant given the variability in the different observations. However, there is a statistically significant difference between the usability of the applications, meaning users saw a positive benefit in the usability of the accessible app.

6 CONCLUSION AND FUTURE WORK

Throughout the study, we have seen how a group of 10 participants interacted with two different applications, one that was successful, one that was not. From this, we discovered that while the time it takes to perform actions on both apps are not statistically significant in between the apps, the usability score from the participants was statistically significant between the two applications. We also learned that 90% of the participants had no preference or preferred the accessible app, which displays how important it is for applications to be accessible. This contribution aids in the discussion of requiring apps to be accessible because it enables all individuals to have improved the usability in applications. Future work could potentially be learning if developers understand the impact of accessible applications to not only users with disabilities but users without disabilities. Guiding and helping developers understand accessibility in web applications have been performed in a few different ways in [4, 5]. However, similar studies and guidance has not been performed for Android developers which we believe to be the next step in better understanding app accessibility.

ACKNOWLEDGMENTS

Thank you to Android Studio for the templates used to create the two applications.

REFERENCES

[1] Patricia Acosta-Vargas, Luis Salvador-Ullauri, Janio Jadán-Guerrero, César Guevara, Sandra Sanchez-Gordon, Tania Calle-Jimenez, Patricio Lara-Alvarez, Ana Medina, and Isabel L. Nunes. 2020. Accessibility Assessment in Mobile Applications for Android. In *Advances in Human Factors and Systems Interaction*, Isabel L. Nunes (Ed.). Springer International Publishing, Cham, 279–288.

[2] Abdulaziz Alshayban, Iftekhar Ahmed, and Sam Malek. 2020. Accessibility issues in Android apps: state of affairs, sentiments, and ways forward. In *Proceedings of the ACM/IEEE 42nd International Conference on Software Engineering* (Seoul, South Korea) *(ICSE '20)*. Association for Computing Machinery, New York, NY, USA, 1323–1334. https://doi.org/10.1145/3377811.3380392

[3] Mars Ballantyne, Archit Jha, Anna Jacobsen, J. Scott Hawker, and Yasmine N. El-Glaly. 2018. Study of Accessibility Guidelines of Mobile Applications. In *Proceedings of the 17th International Conference on Mobile and Ubiquitous Multimedia* (Cairo, Egypt) *(MUM '18)*. Association for Computing Machinery, New York, NY, USA, 305–315. https://doi.org/10.1145/3282894.3282921

[4] Jeffrey P. Bigham, Jeremy T. Brudvik, and Bernie Zhang. 2010. Accessibility by demonstration: enabling end users to guide developers to web accessibility solutions. In *Proceedings of the 12th International ACM SIGACCESS Conference on Computers and Accessibility* (Orlando, Florida, USA) *(ASSETS '10)*. Association for Computing Machinery, New York, NY, USA, 35–42. https://doi.org/10.1145/1878803.1878812

[5] Jeff Carter and Mike Markel. 2015. *Web Accessibility for People with Disabilities: An Introduction for Web Developers.* John Wiley Sons, Ltd, 484–492. https://doi.org/10.1002/9781119134633.ch76 arXiv:https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781119134633.ch76

[6] Centers for Disease Control and Prevention. 2023. *Disability Impacts All of Us.* https://www.cdc.gov/ncbddd/disabilityandhealth/infographic-disability-impacts-all.html.

[7] Josephine Meyer. 2020. Accessible Websites and Mobile Applications Under the ADA: The Lack of Legal Guidelines and What This Means for Businesses and Their Customers. (2020).

[8] Muñoz-Carenas J Finat C Rodriguez-Ascaso A, Letón E. 2018. *Accessible mathematics videos for non-disabled students in primary education.* https://doi.org/10.1371/journal.pone.0208117.

[9] Andreas Sonderegger Juergen Sauer Sven Schmutz. 2016. *Effects of accessible website design on nondisabled users: age and device as moderating factors.* https://www.tandfonline.com/doi/full/10.1080/00140139.2017.1405080.

[10] Faiza Tazi, Suleiman Saka, Griffin Opp, Shradha Neupane, Sanchari Das, Lorenzo De Carli, and Indrakshi Ray. 2023. Accessibility Evaluation of IoT Android Mobile Companion Apps. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems* (, Hamburg, Germany,) *(CHI EA '23)*. Association for Computing Machinery, New York, NY, USA, Article 19, 7 pages. https://doi.org/10.1145/3544549.3585652

[11] Viktor Zryd. 2017. *Investigating the Effects of Accessibility: A Study on the Influence of Accessibility Features for Hearing-Impaired Players on the Perceptions and Immersion of Non-Disabled Players.*