

## **Abstract**

Throughout the years, humans have longed for the idea of media integration. That is, the idea of getting all of our media needs through one source. While initially we used to get our media through many different outlets, we began creating technologies that could begin to do more than just one function. We started understanding the idea of networks and the importance of communication between ourselves. With the influx of computers and other digital technology, that idea was becoming a reality faster than we could have imagined, brought about by man's own mind. As we continue into the present day, the idea of non-digital technologies is becoming more and more dated. While more tactile forms of technology still exist, take paper packaged mail for instance, the digital version has become more and more popular due to its ability for customization and manipulation that one simply cannot get with non-digital technology.

In today's digitally advanced world, where smart phones are the pinnacle of modern day technology, it is important to understand the impact that these new forms of technology have on our daily lives. Today, we have more computing power in the smart phones we own than the computer systems used to launch and land Neil Armstrong on the moon over 40 years ago. Understanding the concept of technological determinism is important in thinking about how we react with new technologies.

Technological determinism is the back and forth action that occurs between society and new technology. On one hand, we come up with ideas for new technologies based on what we need or would like to have in our life, be it access to information, or simply making our lives easier in different ways. On the other hand, our technology shapes us. Implementing new technology into our lives changes the way we live, we act, and the way we feel towards technology. And while some may argue that devices such as smart phones are somehow hurting the social world, they also cannot deny the influence and opportunities the modern day smart phone brings to the user.

This paper sets out to determine what differences and similarities, if any, are there between the user experiences of iOS based devices and those with Android based devices and determine how and why these differences and similarities are manifest.

## **Introduction**

Through these devices we have access to nearly all known knowledge in the world, as well as instant communication to every person who shares a similar device. Because of this, the operating system used to navigate and operate these handheld computers is extremely important in both user cognition and satisfaction with the user interface. Understanding the aspects of the operating system of a smart phone, much like a computer, is essential for the optimal operation. Checking email, browsing the web, even using the actual phone function are all aspects that should be taken into consideration when looking at the operating system of a smart phone.

With smart phones being a huge part of today's world, understanding how the user feels about their own personal experience with the phone is very important for both the user and actual operating system developers to understand, in order to get a better idea of what it is the user wants to see, have access to, and which functions they believe to be the most important. Our research group conducted an experiment over the course of a college semester in order to figure out exactly what is important in the eyes of the user when it comes to the user experience of a smart phone.

## **Statement of Research Problem**

For our research problem, our team was asked to compare and contrast the iOS and Android operating systems from a user's perspective. This meant rather than to judge the operating systems ourselves, we would need to conduct research in forms that would inform us of the actual users' experiences with both operating systems. Whether it be interviews, surveys or any other form of technology that would get data from the user, we had to make sure that the data was concise, nominal, and interesting, while also taking into considerations the personal, subjective thoughts, ideas and opinions we would get from the users that would ultimately shape our research into readable, actionable information. This information should be easy for others to understand and apply to the world in the way they see fit, from a college professor fully understanding the concepts and methods used to acquire this data, all the way to a potential software developer, who takes the ideas and opinions found in our research and applies them to the new wave of technological devices and services that are sure to come our way in the near future.

Understanding the ideas behind this research problem is also important to getting a full appreciation of the research problem itself. We can start by talking about why this research is done between two specific operating systems, iOS and Android. These two operating systems were chosen as our research problem for a few main reasons. First, at the current time (the tail end of the year 2012), both of these companies are the undisputed champions of designing and implementing fully functional, simple and helpful operating systems for multiple devices not only limited to smart phones, but reaches to other types of technology such as tablets, laptops, desktop computers, and many other devices. This made the question of seeing which operating system developers should be researched and thought about quite easy, as no other developer has come

close to ensuring the longevity of their brand, as well as the efficiency of their products, to the loyalty of their fan bases, as Apple and Android.

Apple, formerly Apple Computer, Inc., is an American corporation headquartered in Cupertino, California that designs, develops, and sells consumer electronics, most notably the iPhone smart phone, on which the iOS operating system is based. The iOS operating system was originally called iPhone OS. This operating system is a variant of the same Darwin operating system core that is found in Mac OS X. Together with the PowerVR hardware, it is responsible for the user interfaces motion graphics, and because of its design, the operating system itself takes up less than half a gigabyte. The operating system is capable of supporting both bundled and future applications by Apple, as well as third party developers. However, software applications cannot be copied directly from Mac OS X, but must be written and compiled specifically for iOS. Apple provides free updates to the OS for the iPhone through its music interface iTunes, while more major updates have accompanied new models of smart phone throughout the years. The main difference between iOS and Android is that unlike Android, as well as other operating system such as Microsoft's Windows Phone, Apple does not license iOS for installation on non-Apple hardware,

Android, on the other hand, is a Linux-based operating system designed primarily for touch screen devices such as smart phones and tablet computers. Android was purchased by Google in 2005, and revealed in 2007, as an example of advancing open standards for mobile devices. The first Android powered phone was sold in October 2008. Android is an open source operating system which means that the software can be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. For applications, Android has a large community of developers dedicated to the task, writing applications that extend the functionality of smart phones and other devices. As of October 2012, there were approximately 700,000 apps available for Android, and the estimated number of applications downloaded from Google Play, Android's primary app store, was 25 billion (TomsGuide).

Because of the open source nature of Android operating systems, Android has become the world's most widely used smart phone platform and the software of choice for technology companies who require a low-cost, customizable lightweight system for high tech devices, without the need for developing one from scratch. As a result from this, while Android is primarily designed for use in smart phones, it has extended its reach to other types of technology, such as television, game consoles and others. Also, Android has encouraged a large community of developers and enthusiasts to use the open-source code it provides as a foundation for projects, which can add new features for advanced users, as well as bring Android to devices that were officially released running other operating systems.

After understanding the reason for these certain developers to be the basis of our research, we then began to look at the main focus of our research, the users. When discovering new information about a users preference of one operating system over another, it is important to understand a number of factors that go into the users preference. This can come down to multiple

factors, such as the user's prior experience with these operating systems, as well as their current daily experience.

### **Background/Related Work**

Group 19 had the awesome opportunity to work with a very diverse team. The 19<sup>th</sup> hole (team name) has members that live internationally, and all over the country. Due to the wide-ranging diversity of nationalities and personalities, we believe that this gave our group a great working environment, and a chance to hear opinions and ideas from all different backgrounds. Some group members had backgrounds in research, some in design, and some in presenting enabled our group to develop a solid core of functionality; this being said it also enabled us to delegate portions of the project to every group member's area of focus.

Tyler Barrett is a senior at Indiana University where he is majoring in Informatics, and earning a minor in Telecommunications: Application development. Reigning from central Indiana, Tyler has aspirations of attending graduate school here at Indiana University in the Human-Computer Interaction/design program. Tyler is currently focused on his Capstone project where he is developing an application. Unfortunately due to his desire to seek entrepreneurial funding to continue his development, information regarding the project must remain disclosed. Outside of his Capstone project, Tyler is frequently learning new techniques of design, and different programs that will enable him to continue working in the relative field. Another one of his current goals is to finish his online portfolio where he will be able to display all of his design work to future employers, and graduate school admission faculty.

Christopher Sprinkle is a senior at Indiana University; he is majoring in Informatics while focusing his area of study in Human-Computer Interaction/Design. Christopher truly has a passion for design and took the role of leader designer in his Capstone project. His group has undergone the difficult task of designing, and programming an ecosystem simulator application for the iOS system. Though the application is for recreational use, they believe they have a high probability of landing a top rank amongst the Capstone projects. Once the application is complete, Christopher plans on joining a technology design firm where he hopes to make a significant impact. His natural ability and eye for design will surely place him in a position to succeed and develop something for the entire world to enjoy.

Yuanixiang Shi (aka Kevin) is also a senior student here at Indiana University, where he is majoring in Informatics. Kevin has also earned a minor in business, while gearing up towards his goal of working in the international business trade. A lot of Kevin's free time is dedicated towards the development of his Capstone. He is constructing a combination of a fully interactive website with an application for mobile devices, but for confidentiality reason we unfortunately cannot release details on the scope of his work. Kevin's ambitions for his postgraduate career are to work in both the United States and in his home country of China. Though he is undecided if he wants to work for corporations in the financial industry or the technology industry, he is looking forward to applying what he has learned here at the School of Informatics towards the real world.

Murat Kacan is a senior in the school of Informatics and computing at Indiana University. A seasoned “collegiate veteran”, Murat is making his second go around as he previously attended Portland State University. Murat has a diverse and varied carrier background including working as a Sport Specific trainer, being an owner operator for the largest sports specific training program in Southern Indiana before moving to Portland. While at Portland Murat interned at Intel on the college development team and started working part time as a chef. Upon moving back to Bloomington, Murat worked as a saucier at Farm Restaurant before embracing life as a freelance application and web developer. Along the way, Murat has worked with successful IU startups TextYard.com and GrubClub Campus, as a financial analyst for IOS Inc., along with competing in several case competitions through the School of Informatics and the Kelley School of Business. He is firm in his resolve that he wants to work as a user interface designer in the future and is contemplating applying to the HCI/D graduate program at Indiana University. In his free time, Murat is an avid sportsman both outdoors and indoors and finds incomprehensible ways to spend hours on social sites such as Reddit.

### **Research Methodology**

When given this topic, group 19 had debated on what exact method we would use to gather our research data. Our main goal was to test our user’s perspectives on what mobile operating system they were using. We had to make sure that this test included everything such as brand preference and bias testing to ensure our data was being formed via reasonable thought, not in the context of a brand dispute. This was very important to keep an eye out for because we wanted to make sure our data was quantifiable and accurate.

Initially we created a survey monkey that had roughly twelve questions, in which we sent out to over a hundred people seeking their response. Once we collected the majority of the surveys we started the process of compiling our data and analyzing for trends. Unfortunately the trends we were seeing through the surveys were not definitive enough to make a clear statement on our research problem. Thankfully we had the opportunity to speak with Professor Jeff Bardzell and ask for input on how he would go about researching our topic. Immediately he suggested conducting interviews and determining what the overarching “story” was. We noticed that by doing this we would be able to not just collect quantifiable data, we would have a variety of data that can be classified as qualitative and quantitative data. This would enable our group to not only test for the user’s perspective, but also gain knowledge of where their bias stands towards each operating system; thus allowing trends to form naturally, and be eliminated if data was skewed.

There were specific topics that we wanted to cover during our research; most often the questions that were asked detailed the user’s experience with individual applications and types of applications. Topics that were touched on were: E-mail, browsers, App Stores, GPS, voice assistance, news, photos, weather, and music. We were also able to gather demographic information such as age, type of phone/operating system, and years of experience with said operation system. This allowed group 19 to easily form trends amongst the data they had collected.

There were a couple different mediums that were used when conducting interviews. Some members of the group conducted their portion of the interviews through phone, or Skype, whereas other members used the in-person interview format so that every interview could be taped and used at a later time to ensure the quality of the data, and to check for discrepancies. From there each group member was responsible for separating their data into qualitative, and quantitative data so we could ease the process of compiling and analyzing. A total of fifty interviews were ultimately done, with the demographic being split exactly down the middle for iOS/Android users. Because of the groups due diligence we were able to discover quantifiable trends and significant differences for certain operating system interactions. Our findings were very conclusive, and even shocking due to the disparity of some of the differences between the two systems. The methodology approach that group 19 took was very efficient, which granted us more time to work on other parts of the project such as the final presentation and final poster.

### **Analysis (Methodology and Process)**

When it came down to decide how we wanted to analyze the data we examined several different sources on how to go about analyzing qualitative data. Murat's experience as a financial analyst and all of our backgrounds in statistics made for easy work of the quantitative data but we were unsure on how to interpret qualitative data in a manner that would allow us to draw conclusions. Intuitively we know that our qualitative information was valuable, but we needed to express exactly what that value was to our research.

When probing the graduate community for how they would go about conducting analysis of qualitative data we were eventually directed to a PDF lecture by professor Johnson at the University of South Alabama that clearly displayed several techniques we could use when analyzing our qualitative data. The first approach that we saw that we immediately felt comfortable with was the process of enumeration, or as the guide stated, "the process of quantify data, an yes, it is often done in 'qualitative' research." One of the enumeration techniques we used was the process where we analyzed and noted the frequency how many times a specific topic got a "positive mention" and how many times it got a "negative mention" along with the correlating demographics. At first our sorting of positive and negative mentions was, while entirely reasonable, purely subjective in its nature. We understood that we had to some how further sort the mentions into more specific categories. Because of this, we combine the enumeration technique with another technique we learned from the guide that was that of creating a hierarchical category system.

Creating a hierarchical category system can be done by organizing data into different levels or hierarchies based on their similarities. This is done to help distinguish qualitative data from one another when simple distinctions don't provide enough useful information. As an example, when a subject described a particular activity or function as being "easy to use" we would not only enumerate the data by making a tally in the positive mentions but also

categorizing the comment in the hierarchy of “comments regarding ease of use” and then another tally in the positive level of the ease of use section. (Johnson, 2010)

At the time we didn't know it, but we were developing categories on our own based on the different responses we were getting. Later, we discovered that this is an actual and acceptable technique for creating category systems, and learned that it is called inductive coding, or “codes that are developed by the researcher by directly examining the data.” (Johnson, 2010). From there we came to a total of five inductive categories: ease of use, comparative, operating system specific, third party specific, cross platform integration. Surprisingly, we were able to categorize the majority of our qualitative data in these specific inductive hierarchies and then further sub divide those categories into levels with positive, neutral, or negative mentions.

One issue that we did run into was the overlap that existed between certain categories. The guide we read informed us that, “Qualitative researchers have a broad view of what constitutes a relationship” (Johnson, 2010). It referenced a relationship structure first developed by J.P. Spradley in 1979 called, “Spradley's Universal Semantic Relationships.” It turns out Chris had actually had some experiences working with the table and he was able to help guide us in determining what, if any, relationships existed within our inductive categories. By applying the Spradley method we were able to determine that our “ease of use” category was related to all the other categories via a spatial relationship. A spatial relationship in mathematical terms can be expressed as, “X is a place in Y; X is a part of Y” (Spradley, 1979). In layman's terms, our “ease of use” is a category that exists within all the other inductive categories and therefore is as much a part of the positive and negative of those categories as it is its own. This was a bit confusing for us at first until we realized that it was Spradley's relationships that would enable us to draw conclusions and develop hypothesis on *why* a user or group of users felt a certain way about a particular function or question we asked.

Our analysis of the quantitative data was relatively straightforward. We decided against using T and Z tests to predict the probability that our data was translatable to the general population as a whole for two specific reasons: 1) such empirical data already exists in spades with testing conducted under much more stricter guidelines using a much broader audience; the exercise of trying to repeat this ourselves seemed both unnecessary and relatively futile and 2) the goal of our research wasn't to necessarily determine what the average person felt about a certain experience within the operating system but instead determine what was causing them to think that way and how that thought became manifest. As such, we determined our quantitative data could be properly handled using basic statistical analysis, including means and averages, if it's primary function was solely to support the conclusions we drew from analyzing our qualitative data using enumeration techniques within the context of our inductive categories.

## Results / Conclusions

Certain results popped out at us immediately. Even before analyzing the data, the group noted several glaring results that were clearly indicative of significant user dissatisfaction with a particular function in the context of their personal experience. Of the 19 Android users that were surveyed, not a single one reported that they kept music locally on their phone that was synced with their music on another platform. While our initial forays into established research suggested that the number of Android users syncing music was significantly lower than iOS, we were shocked that not a single person responded in the affirmative. We immediately recognized that this was partially a result of sample size, Chris himself is an Android user who stores music locally on his phone, something that our professor, Gregory Fox, also claimed that he frequently did. We realized though, especially examining the qualitative data, that the quantitative data supported our results in that users we interviewed had significant dissatisfaction in the form of negative mentions populating the “ease of use” and “operating system specific” inductive categories within the music section of the interview.

Consequently, the prevalence of users adopting streaming music services in our Android group was at a nearly two to one ratio over that of their iOS counterparts (82% to 44%). For the sake of specificity, iOS’s new implementation of cloud streaming iTunes was not categorized as streaming and was only found in two respondents. This was determined because it was still essentially a sync between a locally own user source and not a stream of music being stored on a third party server ala Spotify or Pandora. Android users spoke well of their ability to stream with positive mentions outweighing negative mentions 13 to 1 compared to only a 4 to 1 ratio from the iOS crowd. As a group, we were unable to definitively determine if this was because Android provided a better platform for third party applications to stream or if their users were simply so relieved to have a feasible source of music that confirmation bias was seeping into the users subconscious. We hypothesize that this was in fact the case as iOS users had significantly more negative mentions regarding the frequenting “dropping” that occurs when streaming music wirelessly over a network, something that was just as prevalent on Android phones but not nearly referenced as much in the qualitative data.

Another result with significant implications was the data we analyzed regarding mail applications on the respective operating systems. iOS users were more likely to use the default mail app, doing so at a rate of 86%, whereas a majority of Android users opted instead to use the Google Gmail app instead of the default mail app included in Android. When we examined the qualitative data regarding the two, we developed a hypothesis based on two premises: many users choose Android devices in the first place because they liked Google products and services (68%) and because each individual phone company (Samsung, HTC, etc...) developed and operated their own modified variation of Android, causing fragmentation of the default application systems. The hypothesis that we have developed and have included as part of our conclusions, is that iOS and by extension Apple, possess a unique ability to integrate other services into their default ecosystem because they operate within a closed development environment and essentially force developers to create applications specifically for their system. Whereas the Android platform is open source and provide flexibility for developers and users alike, fragmentation of the operating



system has led to a wholesale rejection of many default applications by Android users in favor of a conglomerate of third party applications which meet their individual needs using a de facto Bricolage system.

Further quantitative analysis of our data supports this conclusion. Android users were less likely to use the default music application and mail application as stated above and were less likely to use the default browser (55%) to that of iOS users (85%). Even the process of purchasing apps showed significant satisfaction with Android users (68% dissatisfaction) compared to 88% satisfaction with iOS users, resulting in three times more iOS users responding that they pay for apps at least once a month. The average ratio of positive to negative mentions of the five default applications we included as part of our interview for iOS users was 7 to 1, whereas the ratio of *negative* to positive ratio for Android users in the same context was an astounding 9 to 1. Simplified further, Android users in our study were as likely to be displeased with default Android applications as iOS user's were likely to be pleased.

We recognize several issues that can be taken with our study especially considering its relatively small sample size. We must also recognize that our specific demographic was relatively young (approximately 27) and properly experienced on their current device (14 months on average). Additionally, we concluded that we were not able to properly determine of much of the respondents brand based biases, but we did note that Android users were 3 times more likely to have owned an iOS device in the past or concurrently than vice versa.

Our final conclusion then, must be taken with a grain of salt, but is nonetheless intuitively satisfying. Apple has a significant advantage in cross platform vertical integration and is able to integrate other services into their ecosystem without sacrificing quality by utilizing a closed development environment. This resulted in significantly higher positive mentions in ease of use and operating system inductive categories and the quantitative data supported this conclusion. Android users, while less likely to use and be satisfied with the default applications, are more adept at finding third party solutions to satisfy their need without having to pay for the inconvenience, often deriving satisfaction in the user in the process. Because of it's relationship with Google, however, the Android operating system provided greater satisfaction among prevalent Google related applications on both platforms, with Gmail and Google Maps receiving significantly higher positive mentions than Apple related applications such as Apple Maps and .Me services.

### Citations

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Jeffery Bardzell and Gregory Fox for in-class insight.