

The Effect of Aesthetics on Perceived Usability in Mobile Applications

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### Abstract

In this study, the researcher examined the effect of aesthetics on perceived and actual usability in the context of mobile applications. Participants were asked to rate the usability of a mobile application before and after using one version of a mobile application that either had appealing aesthetics or unappealing aesthetics with constant actual usability. Afterwards, the participants were asked to rate the usability of the different version of the application as well. The sample size was 37 students (32 male, 5 female) from computer science classes (AP Computer Science A, AP Computer Science Principles, Intro to Computer Science), limited by the necessity of the participants needing to be surveyed one at a time. 16 students were randomly chosen to interact with the application with unappealing aesthetics while 21 students were chosen for the appealing one. The results of the survey showed that the aesthetics of a mobile application before actual interaction with it causes the first impression of the application and therefore forms expectations or standards which the usability of the application is expected to meet. In addition, it was found that aesthetics, when handled without overlap with usability, can only supplement perceived usability of an application but cannot take away.

## Introduction

### 1. Definitions

Aesthetics, or more specifically visual aesthetics in the context of information technology, have only recently been considered an integral aspect of Human Computer Interaction (HCI). According to Noam Tractinsky, an Associate Professor at the Department of Information Systems Engineering, Ben-Gurion University of the Negev, Israel who holds a Ph.D. in Information Systems from the University of Texas at Austin and who is one of the most cited authors in scholarly papers in the area of Human-Computer Interaction, design in HCI is often defined by the Vitruvian design principles *firmitas*, *utilitas*, and *venustas* (Soegaard, 2013).

Originally developed by Vitruvius for architecture, *firmitas* represents the strength and durability of a building. In computing and Information Technology (IT) disciplines, however, it represents the reliability and dependability of software, hardware, systems, and products and was adopted as a basis for good design with little disagreement. *Utilitas*, the usefulness and suitability of the buildings for its inhabitants, is synonymous with usability in HCI. Defined by the International Organization of Standardization (ISO) as the “effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments,” HCI was quickly adopted as an essential aspect of design in the computing industry as well (ISO 9241-11). The ISO is an independent, non-governmental international organization that sets world-class specifications for products, services, and systems by bringing experts from the respective fields together. Finally, *venustas*, a building’s beauty, represents the beauty and visual aesthetics of software or hardware design. However, unlike its counterparts, aesthetics was originally treated as an insignificant bonus at best and hurdle to good design at worst; the reasoning was that an emphasis on aesthetics inherently sacrificed usability (Soegaard, 2003); by

focusing on aesthetics, it would distract and draw away from usability. This viewpoint, however, has gradually been changing due to a series of studies proving otherwise.

## *2. Aesthetics vs. Usability*

In a study by Andreas Sonderegger and Juergen Sauer that tested the effect of visual aesthetics on perceived attractiveness and perceived usability (the person's view on how easy to use and learnable something is) as well as actual usability (actual user performance), participants were shown a mobile phone run as a simulation on a computer. Participants were asked about the perceived attractiveness and perceived usability of the simulated mobile phone before using it and also about the actual usability (task completion time, interaction efficiency, and errors), of the phone after completion of a task (sending a text message and suppressing a number). The results showed that both perceived usability and perceived attractiveness were much higher for the attractive device than the unattractive one while actual performance was also much better for the attractive device (faster time, higher efficiency, and less errors).

Andreas Sonderegger is a lecturer at the University of Fribourg, Switzerland who holds a Ph.D. in Psychology and who has written numerous peer reviewed papers in HCI and User Experience. An interesting aspect of the study was that both perceived usability and attractiveness increased after use for the attractive device while both variables decreased for the unattractive one (Sonderegger & Sauer, 2010). Although this study is not the most eminent study in all of HCI, it is the most recent and relevant. Other researchers in HCI also found similar results, although in the contexts of ATM machines and other products, and the positive correlation between aesthetics and at least perceived usability was quite strongly established. In other words, people tend to think that what is beautiful is usable.

## *3. Physical Aesthetics vs. Usability of Software*

In a similar study by the same Sonderegger and Sauer where participants were asked to carry out tasks on an actual mobile device where only the outer casing, or the physical aspect of the phone, was changed in terms of aesthetics, participants unsurprisingly rated the aesthetically pleasing phone higher for perceived usability overall but surprisingly had higher times and lower efficiencies, namely lower performance, for the aesthetically pleasing phone rather than the displeasing phone (Sauer & Sonderegger, 2011). Sauer and Sonderegger provides a possible explanation to this discrepancy, which showed up in other studies as well, as possibly being the difference in environment or context. In a study where performance improved with pleasing aesthetics, the study was conducted at a high school. The environment being a work context instead of a leisure context, the participants might have placed higher emphasis on completing the task, which was aided by the pleasing aesthetics. When no stress was put on the participants to complete the task as fast as possible, as was in the case of this study, participants might have taken longer enjoying the aesthetics and wanting to use the aesthetically pleasing device longer, resulting in lower performance (Sonderegger & Sauer, 2010).

Although not mentioned by Sonderegger and Sauer, another possible reason for this specific discrepancy is that since the aesthetics of the casing around the interactive elements rather than the design of the interactive components themselves was changed, the displeasing aesthetics might have drawn attention away from the casing onto the actual software where the task is carried out; even if this was true, however, this does not necessarily mean that aesthetics distracted from usability since they are the aesthetics and usability of different parts of the mobile phone.

#### *4. Usability vs. Aesthetics*

Another study that found different results from the studies positively correlating aesthetics with usability was by Tuch et al. Alexandre Tuch holds a Ph.D. in Psychology from the University of Basel, Switzerland and is one of the most well-known researchers in HCI. In his study, aesthetics was manipulated to test its effects on perceived usability before and after use of a shopping website while usability was also manipulated to test its effects on perceived attractiveness before and after use; to have greater control over the usability of the website, keywords were used to search for websites rather than a search box. When manipulating aesthetics, to make sure usability remained constant and that therefore readability of the words remained constant as well, only the background color and texture was slightly changed to an unappealing color and texture. To change usability, nothing in terms of looks or aesthetics was changed; instead, only the keywords used to narrow down and find specified items was changed. For example, to find girl's sneakers, direct and related keywords "girl -> shoes -> sneakers -> girl's sneakers" was used for high usability while vague keywords "street wear -> must have -> shoes -> girl's sneakers" was used for low usability.

The study found that manipulating aesthetics did not affect perceived usability both before and after use, but interestingly found that low usability lowered perceived aesthetics after use while high usability did not change it. The study concludes that usability affected perceived aesthetics more than aesthetics affected perceived usability and that contrary to the idea that beautiful is usable, usable is actually beautiful. Although the result that difficulty of use frustrates the user and lowers the attractiveness of the website makes sense, the result that aesthetics does not affect perceived usability both before and after use is contradictory to other sources and could possibly be pinned to the relatively low manipulation of aesthetics.

##### *5. This Study*

As can be seen, there have been numerous studies researching the effects of aesthetics on perceived and actual usability, as well as the other way around. However, they have mostly been in the context of websites, computer software, and other machines, and in those concerning mobile phones, such as the two studies by Sonderegger and Sauer, they were either run on a computer as a simulation or on a phone where the physical aspect potentially overshadowed the software aspect. In other words, there have been few, if any, studies that actually tested aesthetics and usability directly on today's modern touchscreen phones where most of the visible and interactive elements are mostly the screen and the software itself. Much like Sonderegger and Sauer's first-mentioned study, this study will be testing the effect of visual aesthetics on perceived usability in the context of mobile applications in touchscreen phones before and after interaction with it while keeping actual usability constant; using a touchscreen phone will also most likely remove the possible discrepancy between manipulating the hardware's aesthetics and evaluating the usability of the software, seen in Sonderegger and Sauer's second-mentioned study, and evaluate if there is a difference in the relationship between aesthetics and usability in the relatively new realm of touchscreen mobile phones where interaction using physical buttons is no longer necessary. Following the trend of previous studies, the most likely result seems to be that the aesthetics of the mobile application will have a direct effect on the perceived usability of the application before interaction with the application; essentially, pleasing aesthetics will most likely result in higher perceived usability. After interaction, however, the difference between the perceived usability ratings for the two different aesthetics might diminish since the actual usability of both the appealing and unappealing aesthetics are actually the same; perceived usability of the aesthetically pleasing application might decrease while perceived usability of the aesthetically displeasing application might increase.

## Method

In this study a group of students from Jenks High School was surveyed before and after interacting with a mobile application (on the Android operating system). The students were informed that all results would remain anonymous and confidential.

### *1. Participants*

The participants of this study consisted of 37 students (32 male, 5 female). All of them were students in a computer science class (AP Computer Science A, AP Computer Science Principles, Intro to Computer Science) taught by Mr. Riggs. Because only computer science classes were interviewed where most of the students are male, most of the participants turned out to be male as well. 16 students were randomly chosen to interact with the application with unappealing aesthetics while 21 students were chosen for the appealing one.

### *2. Mobile Application*

The mobile application used was a simple note-taking application with a main first screen containing a preview of previously-taken notes, a second screen containing the full text and additional information of one note, and a third screen containing an editable title and content. In the main screen, a circular button in the lower right corner allows the addition of more notes by redirecting to an empty third screen. In the second screen containing the title in the top and the text of the note in the middle, the circular button in the lower right corner redirects to the third screen as well but filled with the text of notes, all of which are editable when clicked. To save a note, the button on the upper right corner has to be pressed. Identical sample notes were taken in both versions of the application. The three screens for the aesthetically pleasing and displeasing applications are shown side by side in Image 1.1 and Image 1.2, respectively.



Image 1.1

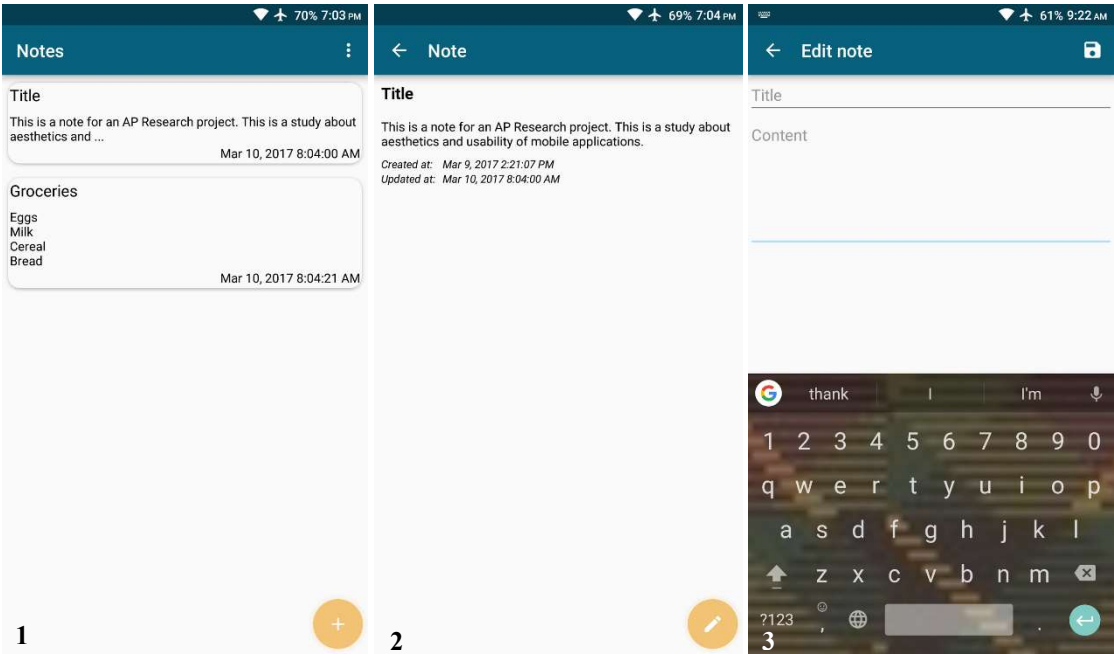
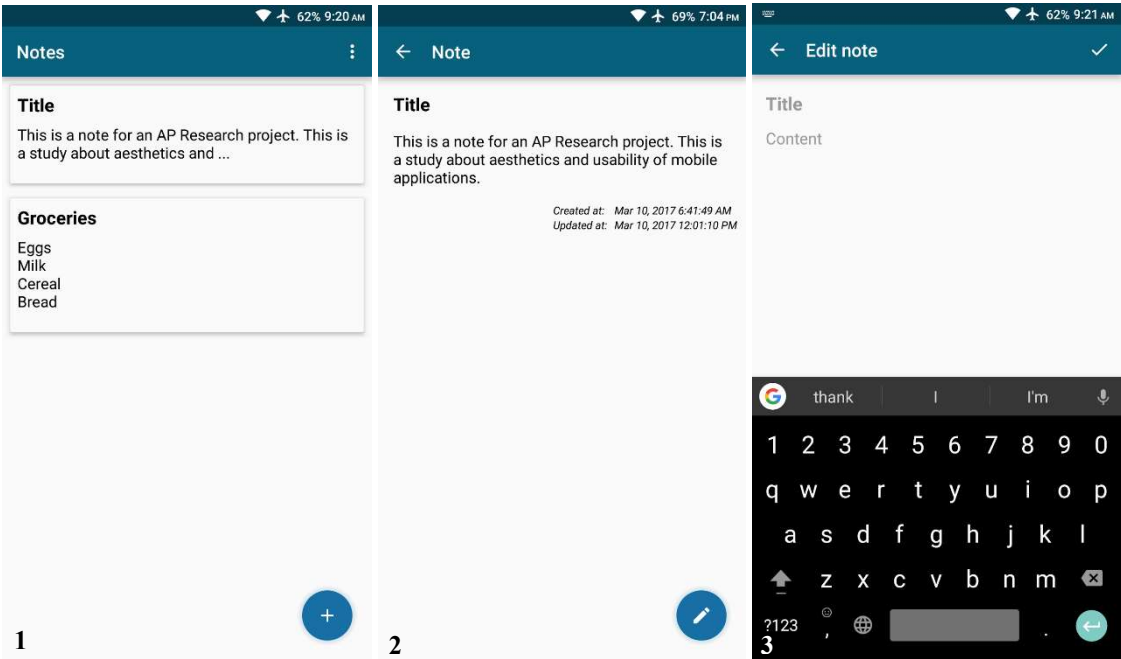


Image 1.2



As can be seen, the aesthetic differences are pretty minor, with most of the changes have been made in layout and symmetry as well as margins and paddings (generally speaking, spacing) of elements on the screen. The text sizes and the shapes of the cards containing the notes on the main screen was also manipulated. The color of the circular buttons were also changed in the aesthetically displeasing application to a brown color that doesn't match the blue theme. Different themes were also used for the keyboard (Gboard by Google), with the aesthetically unappealing application having a low-resolution, vague fabric pattern as the background while the aesthetically pleasing application having a simple black color. The reason aesthetics was not manipulated too much was because major elements of aesthetics can overlap with usability (e.g. an aesthetically displeasing color combination between the background color and the font might lower the readability and therefore the usability of the application).

The applications were created using Android Studio, Google's official IDE (Integrated Development Environment) for Android. The core functionality of the applications were based on the open-source software Material Notes by Daniel Pedraza-Arcega found in Github and used under the Apache License, Version 2.0. Most of the alterations were made on the files containing the layout and User Interface information, called XML (Extensible Markup Language) files. Both of the applications were run on the OnePlus X (made by the smartphone company OnePlus) without any changes in the hardware of the phone. Since the aesthetics of the physical aspect of the phone was constant and the design of the OnePlus X is not very conspicuous, the only notable aesthetics was of the software itself.

### *3. Procedure*

Students were randomly chosen by assigning a number to each student and using a random number generator from random.org to choose a number. Students were randomly

assigned to interact with the application with good aesthetics or bad aesthetics using a random number generator as well, with students rolling between 1 and 5 being assigned the application with good aesthetics and those rolling between 6 and 10 being assigned the one with bad aesthetics. Students were surveyed one at a time so that all participants would use the same mobile device and therefore eliminate any other potential variables, such as the physical aesthetics of the mobile device itself. This study was the direct opposite of the previously mentioned study by Sonderegger and Sauer where only the aesthetics of the physical device was changed.

Each participants were asked to answer some preliminary questions before interacting with the application, including how important they considered aesthetics to be on a five-point Likert Scale of “Not Important” to “Very Important.” The same question was asked concerning usability. Afterwards, participants were asked which of the two, aesthetics or usability, was more important to them. Next, participants were asked to only look at the application set for them and answer, on a seven-point Likert scale, how attractive the design of the application was (from “Extremely Unappealing” to “Extremely Appealing”) and how usable the application seemed (from “Not Usable” to “Very Usable”); although the other two screens were not available to the participants for their initial impression of the application’s usability, since the main screen had the largest difference in aesthetics it can be seen as negligible. After this, participants were asked to actually interact with the application by adding a note and filling out whatever they wanted on the Title and the Content, saving it (by pressing the save button on the top right corner), editing that note (by pressing on the note card on the main screen and then on the bottom left circular button), and then deleting it (by long-pressing the note and pressing the delete button on the top right corner). After the interaction, the same questions about the aesthetics and usability of the

application on the seven-point Likert scale was asked to see if they had changed due to interacting with the application.

Finally, the participants were asked to change the application to that of its alternate version, carry out the same list of instructions, and answer the same seven-point Likert scale. This was done because the objective difference in aesthetics was somewhat minor and therefore relative difference was necessary to gauge the difference in their effects on perceived usability. In addition, since each participant's idea of aesthetics might be different from each other's, the difference of the ratings on the different applications holds more meaning than the ratings by themselves.

## **Data**

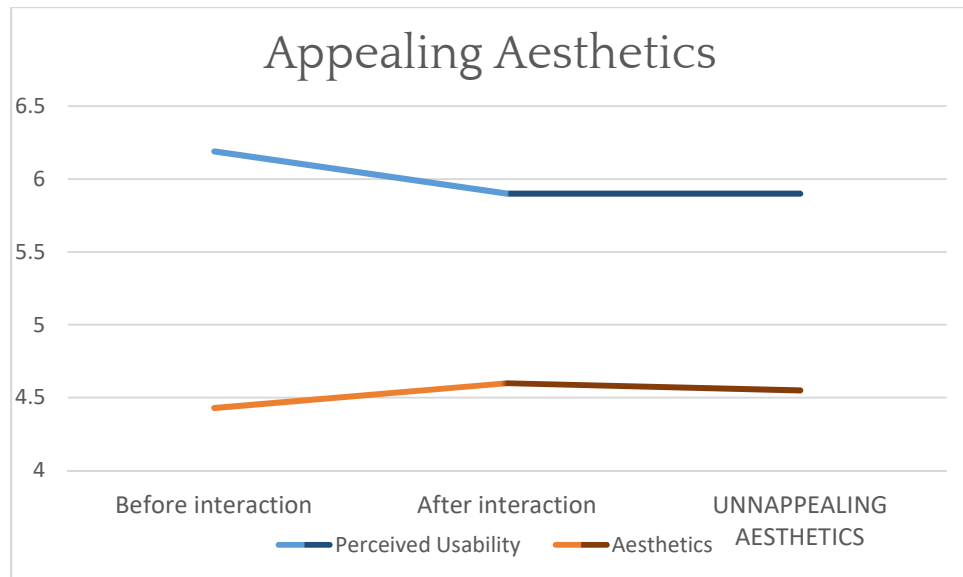
For the group of participants that interacted with the aesthetically appealing application, from a scale of 1 to 5 the average rating for the importance of aesthetics was 3.62 while the average for usability was 4.43. Comparatively, the average rating for the importance of aesthetics and the importance of usability for the group interacting with the aesthetically unappealing application was 3.56 and 4.69, respectively. Not surprisingly, 95% of participants interacting with the aesthetically appealing application chose usability as more important than aesthetics while 100% of those interacting with the aesthetically unappealing one chose the same.

For the application with the appealing aesthetics, from a scale of 1 to 7 the average rating for its aesthetics was 4.43 while its usability rating was 6.19 before the participants interacted with the application. After interaction, the average aesthetics rating was 4.6 while the average rating for usability slightly was 5.9. The average rating for aesthetics and usability after

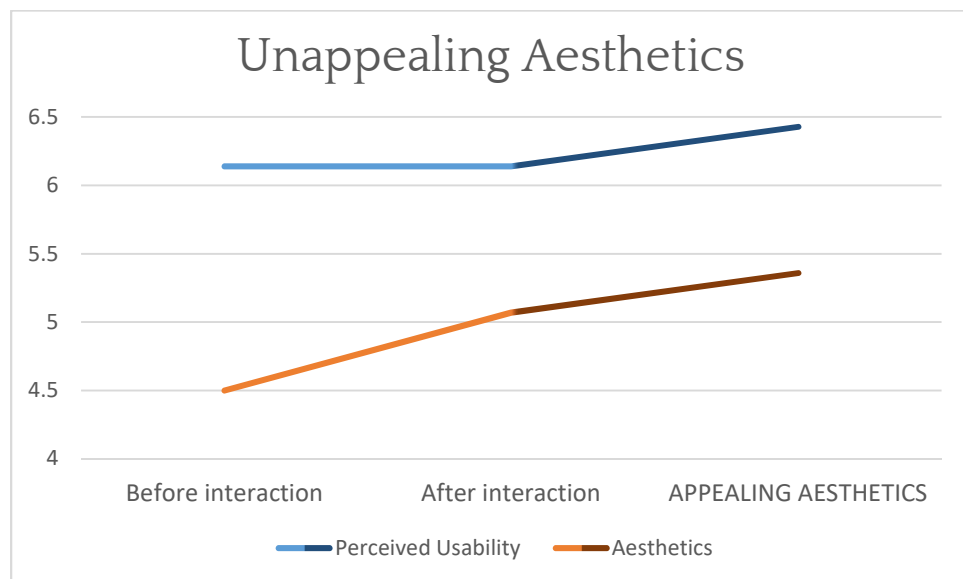
interaction with the aesthetically unappealing application shortly after was 4.55 and 5.9, respectively. This change is seen in Graph 1.1.

For the application with the unappealing aesthetics, from the same scale of 1 to 7 the average rating for its aesthetics was 4.5 while its usability rating was 6.14 before the participants interacted with the application. After interaction, the average aesthetics rating was 5.07 while the average rating for usability was 6.14. The average rating for aesthetics and usability after interaction with the aesthetically unappealing application shortly after was 5.36 and 6.43, respectively. This change is seen in Graph 1.2.

**Graph 1.1**



**Graph 1.2**



## Analysis

For the aesthetically pleasing application, the aesthetic rating slightly increased (from 4.43 to 4.6) while the usability rating slightly decreased (6.19 to 5.9) after participants interacted with it. Although the increase in aesthetic rating was expected, the decrease in the usability rating was somewhat surprising. A possible explanation for this might be that the high level of aesthetics might have caused a high expectation for the usability of the application as well which were betrayed by the static usability; since initial impressions such as perceived usability of the application before actual interaction with it is formed solely on how it looks, the idea that aesthetics can form a standard for the usability sounds plausible. After interacting with the aesthetically unappealing application right after, the unappealing application had a slightly lower aesthetic rating (4.6 to 4.55) but had the identical usability rating (5.9), meaning that when the aesthetic level decreased, the aesthetic level decreased as well but perceived usability of the application did not decrease.

For the participants testing the aesthetically unappealing application, the aesthetic rating increased quite a bit after interaction with the application (from 4.5 to 5.07) while the usability rating stayed the same (6.14). The increase in aesthetic rating could be attributed to the fact that the main screen arguably looks worse than the next two screens that are not visible until during the interaction, causing the two screens to improve the participants' view of the aesthetics of the application. Another idea that the usability might have been better than the participants expected based on their initial impression caused by the aesthetics causing a higher rating in aesthetics (based on Tuch's assertion that usable makes beautiful) seems plausible but unfortunately does not stand, seeing how the usability rating stayed the same rather than increasing. Both the aesthetic and usability ratings for the aesthetically appealing application used right afterwards,

however, was vastly higher (5.07 to 5.36 in aesthetics and 6.14 to 6.43 in perceived usability), meaning that when the aesthetic level increased, the perceived usability level increased as well.

After interaction with both aesthetic versions of the application, an increase in aesthetics had a directly positive effect on perceived usability while a decrease in aesthetics seemed to have no effect on it. This could mean that aesthetics can usually only serve as an addition or supplement to perceived usability but cannot take away from it; an exception of this would be, as previously mentioned, when the aesthetics is so bad that the aspect of aesthetics overlapping with usability, such as readability of text, is also manipulated.

## **Discussion**

According to the results of the study, the idea that the visual aesthetics of a mobile application can directly affect the way people perceive its usability, or ease of use and learnability, both before and after interacting with it is supported. The specifics of how aesthetics affects perceived usability, however, is not too clear. Since the perception of usability and functionality of an application is first formed by how it looks before actually interacting with it, the aesthetics of the application might set a standard for usability as well, with aesthetically pleasing applications being expected to work well and aesthetically displeasing applications being expected not to; basically, it is not the idea that beautiful is useful, but rather that people expect the beautiful to be useful as well. This is supported by the interaction with the aesthetically pleasing application but is neither supported nor debunked by the interaction with the aesthetically displeasing application, which warrants further study. This is only halfway consistent with the initial hypothesis that perceived aesthetics of the aesthetically pleasing



application would decrease while perceived aesthetics of the aesthetically displeasing application would increase.

However, the fact that the usability rating decreased after interaction with the aesthetically pleasing application does not mean that aesthetics took away from the perceived usability of the application; after all, in the case of the aesthetically displeasing application, when participants interacted with the aesthetically pleasing application after they interacted with the displeasing one, both the aesthetic rating and usability rating increased. Since good aesthetics lowered the perceived usability of an application when compared to itself but increased the perceived usability when compared to another application, this further supports the idea that aesthetics can affect the expectations towards usability.

Another possible conclusion that can be drawn from the results is that visual aesthetics (that does not overlap with usability) can only serve as a supplement but not a detriment to functionality and usability. Shown in both cases where participants rated the different version of the application after interacting with their own, when the aesthetics of the application increased perceived usability increased but when the aesthetics decreased the perceived usability of the application stayed the same; since actual usability between the two applications are actually identical (with nothing in terms of functionality or core components having been changed), it makes sense that actual usability is the basis for perceived usability and therefore perceived usability cannot go below actual usability. In other words, aesthetics can only build on top of actual usability to add up to perceived usability.

Although these two conclusions are supported by the results, the numerous limitations of the study should be taken into consideration. Because there was only one mobile device of its model present, students had to be surveyed one at a time which was extremely time consuming.

In addition to this limitation of time, the survey sample was very limited, with the available resources of the researcher allowing only computer science students to be surveyed. Since most of the computer science students were male, this possibly skewed the results. Since females might have a different sense of aesthetics than males, further research should be carried out on a more general sample group with a larger sample size to get more accurate results; in addition, since females might care more about aesthetics than males, gender as a variable in and of itself might be interesting to look at as well. For further research, introducing the variable of actual usability as well (where the actual usability is changed while aesthetics is held constant) might get more interesting results concerning the connection between aesthetics and usability.

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