HCI Design and Age Groups

Monnisa Nash
ENG 225, Section 003

Abstract:

This research paper discusses the correlation between Human Computer Interaction (HCI) and the value of aesthetic attractiveness as opposed to usability with different age groups. Younger age groups are often more intuitive and proficient in using technology than older age groups. Additionally, other studies have shown that aesthetic attractiveness often yields positive effects on the perceived usability of a product. This study examined whether younger age groups (adults between the ages of 18-39) would be more inclined than older age groups (adults aged 40 and older) to use a product for its aesthetics rather than its usability, given their proficiency.

A program containing two visual and interactive calculators was created. The first calculator was an "attractive" calculator that had less usability. The "attractive" calculator was designed to have a more pleasing color scheme and smaller misplaced buttons. The second calculator an "unattractive" calculator that had more usability. The "unattractive" calculator used a less complimentary color scheme, but had large buttons that were reasonably placed like most calculators. A second set of calculators was also created using the same designs of the calculators, but with different colors palettes to further emphasize the aesthetic discrepancy. Two surveys were conducted for each set of calculators. The surveys had the participants assess their initial impressions of the calculators before testing each calculator by timing participants while they solved a list of equations. The survey then required the participants to reassess their ratings of each calculator's aesthetic attractiveness and usability. The surveys were conducted with each set of calculators on different occasions and with participants with similar educational and career backgrounds. The results of the surveys found that both age groups preferred to use the "unattractive" calculator as it had higher usability. Younger age groups were not more inclined to use the more aesthetically pleasing calculator despite their proficiency, refuting the hypothesis.

Introduction:

Usability is one of the most important factors to consider when designing an interface or product. When products are seen as equal the one with higher usability is often the more popular choice. Additionally, an attractive aesthetic often yields higher usability ratings which has been dubbed the "aesthetic-usability effect". Aesthetics add levels of desirability to products. Their characteristics can reflect on the user. Since teenagers are usually highly proficient at using and adapting to new technologies, teenagers may still find appeal in aesthetically pleasing products that are less usable. As such, I hypothesize that teenagers may place more value on the attractiveness of a product rather than its usability.

Literature Review:

The correlation between usability and aesthetics has been observed and measured through various different methodologies. Despite these factors contributing significant influence to the value of products, not many studies have examined how this duality affects users' perspective and experience. These views and experiences also differ by user age range and previous knowledge concerning human computer interface. Since a product's aesthetics are often one of the leading factors for its first impression, they play a prominent role in influencing consumers' immediate perception of its usability.

Beauty and aesthetic appeal are subjective opinions. However, there are conventional standards that most people use to define the attractiveness of an item. These standards can be used to influence other aspects of a product. According to Sonderegger (2014), "Although there are different aspects that influence our perception of beauty (colour, simplicity, creativity, etc.), it is the overall evaluation of the attractiveness of the object which influences the evaluation of concepts such as usability or trustworthiness" (p. 1187). After the standards of attractiveness have been assessed, they can be used to manipulate initial user opinions on important traits for a product such as usability and trustworthiness. These standards change over time, adjusting to the differences in culture and trends, however people's enticement to alluring items remains unchanged.

Even before users initiate tasks on a product, they form views on its usability. These views are greatly shaped by the product's aesthetic appeal. Additionally, the first impression is usually sustained throughout use of the product while users grow accustomed to its process (Saur, 2011, p. 794). This suggests that aesthetics play an immediate role in the usability of a product. It is possible that a product may be well-received before it has proven whether it is truly efficient or not. Additionally, the more appealing a product is, the more persuasive influence it may have over users. A study (2014) by Khan compared the effectiveness of an attractive animated character over an unattractive character persuading users to change their ranking of important objects. The study stated, "Although the unattractive agent was also effective in influencing the user to change ranking choices, the effect was small compared to the influence of the attractive agent" (p. 147). Appealing products maintain influence of users throughout the duration of the product's use. As the product's aesthetic appeal increasing, so does the influence it has over users.

Although aesthetically pleasing products are usually rated higher in usability, they often have longer task performing times. However, as Saur (2011) stated, this can most likely be attributed to the 'prolongation

of joyful experience' phenomenon (p. 793). As such, while an attractive product's usability may have high ratings by users, it may score lower in efficiency due to this increase in task completion time. The user's views change over time as an interface is used. An aesthetically appealing product may decrease slightly in ratings after users are able to assess its capabilities. However, if an unappealing product surpasses users' expectations its ratings may increase. In a study comparing the aesthetics in websites Sonderegger (2014) states, "The findings also revealed that the website with low aesthetic appeal was given higher ratings after task completion than prior to it, whereas the scores for the two appealing websites showed a modest decrease" (p. 1186) So, although appealing aesthetics may positively affect users' initial view of a product's usability, users will still change their assessment based on how the product actually functions. Furthermore, a study by Tuch described this occurrence stating, "Tractinsky's notion ('what is beautiful is usable') can be reversed to a 'what is usable is beautiful' effect under certain circumstances" (2012, p. 1604). This study differed from the others as it did not find an interface-aesthetic effect on perceived usability. This information implies that it possible for an unappealing product to appear more attractive after it obtains high usability ratings.

When designing a product, the age range of the target audience should be heavily considered. Different age groups tend to respond better to different qualities and perform better in different situations. A recent study showed that it took a great deal longer for older adults to locate targets on a computer display than younger adults (Liao, 2014, p. 602). Despite this reflection of younger age groups' adeptness to skill-based tasks in technology, they still benefit from simple interfaces. A study examining smart home user interfaces determined that younger users were more precise at accomplishing skill-based tasks when they used an interface of a low-intelligence level (Zhang, 2009, p. 247). Regardless of an age group's efficiency, users of all ages may benefit from uncomplicated interfaces.

Accessibility often helps groups outside their target demographic. Given that proficient groups benefit from simpler interfaces, designs that focus on accessibility may prove universally more usable. A study in 2015 found that users with learning disabilities tend to read all information in succession instead of scanning for important details (Williams, p. 681). With simpler interface designs, the most key information should be placed at the top — promoting higher usability for all users. This follows with the current design trend to consistently place the most significant content at the top left.

As designs continue to follow similar patterns, users are able to grow accustomed to the requirements of using popular designs. This fosters the intuitiveness that contributes to a product's usability. As stated by Liao, "users' experiences and familiarity with a complex interface certainly also play an important role in affecting their performance" (2014, p. 604). Product designs may be able to increase in complexity while still following the current trends in design. This familiarity increases when products are comparable in interface and model design. According to a study on product design, "consumer electronics manufacturers constantly launch similar products with lower price to sustain in the market" (Chien, 2016, p. 170). For example, mobile phones often have very similar designs and layouts. This makes it easier for users to switch or upgrade phones and add to manufacturers profits.

Younger users tend to be more efficient when using technology and interfaces designated for public use. A study in 2016 found that younger adults performed faster than older adults at keyboard and smartphone tasks, but both groups were equal in accuracy (Sonderegger, p. 297). This finding shows that older adults take longer to accomplish the same work. A study by Wagner involving website usability also reached similar conclusions with results pointing to age as a significant factor in the participants' ability to navigate the site (2014, p. 277). With age playing such a heavy role in user performance, it should be considered when improving an interface's usability.

However, this discrepancy in performance between age groups is not due to age alone. Wagner's study also determined declining spatial ability to be one of the causes of lower performance in older age groups (2014, p. 278). Accounting for abilities of older users could improve their performance time. The study regarding learning disabilities also found age to be influencing factor (2015, p. 681). Although, the age diversity in participants of that study were low.

Additionally, age can change how an individual reacts to a situation. Sonderegger attributes this possible change as an alteration in strategy where older adults may place more value on accuracy than speed (2016, p. 297). This denotes that not only does age play a factor in usability, but culture does as well. These attributes may be difficult to quantify as users differ in various ways. Wagner notes that, "aging is not a homogeneous process, and thus individuals at the same chronological age may differ in any number of ways" (2014, p. 271). To expand usability, it may be helpful to explore these differences and how they affect performance.

Overall, the quantity of literature regarding the correlation between usability and aesthetics is meager. Many studies were in agreement or were executed by the same authors. Aesthetics in interfaces are based on unanimous standards. Aesthetics can influence the perceived usability of an item, but the opposite is also possible. Accessibility can help improve the usability for all users, including those with disabilities. Users' age range can indicate performance level and can give insight to the accommodations that should be implemented to increase usability.

Methods:

A small population sample was used for this study. The participants had similar educational backgrounds and careers in technology. They did not have formal education in HCI and were all from the same workplace that heavily relied on the use of technology. The program testing and surveys took place remotely, with the participants and researcher in separate locations. This population was chosen deliberately, as they would most likely be able to complete the testing and survey without outside influence. Each participant was asked to give their initial impressions and post-experimental ratings of each calculator in terms of aesthetic attractiveness and usability. The average of these ratings would then be compared age groups of younger adults (people between the ages of 18–39) and older adults (people 40 years or older.)

This study was separated into two sets of surveys. They both followed the same steps with change made to the visuals of the calculators as well as a slight alteration to the survey questions asked for clarity. The programs allowed users to press a stopwatch button, perform their calculations and then stop the clock to record their time. Each set of surveys required the participants to individually assess the aesthetic attractiveness and usability of each calculator before using them in any way. After recording their initial impressions, the participants then used each calculator in the program while timed to perform specific equations. The participants then reassessed their views on each calculator's aesthetic attractiveness and usability.

In the first set of calculators, Calculator 1 was designed to be the more attractive, yet less useable model. The buttons on Calculator 1 were small and far apart, making them hard to read and difficult to click. Calculator 1's colors were unobtrusive and dark. Calculator 2 was designed to be less attractive, but more usable. The buttons were large and adjacent to each other. The calculator's colors were bright and uncomplimentary. In the second set of calculators, Calculator 1 was again designed to be more attractive and less usable than Calculator 2. Calculator 1 had a dark blue galaxy background and the same minimalistic buttons. Calculator 2 had a noisy background and far-reaching buttons with muddy colors of greens and taupe.
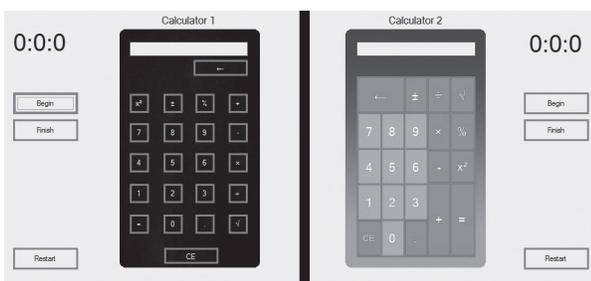
Results:

Figure 1: Calculator Set #1

For the first set of calculators as seen in Figure 1, survey results shown in Table 1 display that both young adults and older adults surprisingly declared Calculator 2 the "unattractive" calculator to be more aesthetically pleasing. The bright color use of Calculator 2 was more eye-catching as users passed over the dark and dull Calculator 1 to look straight to Calculator 2.

	Young Adults		Older Adults	
	Calculator 1	Calculator 2	Calculator 1	Calculator 2
Initial Attractiveness	33%	66%	33%	66%
Initial Usability	0%	100%	17%	83%
Equations Correct	95%	100%	100%	100%
Average Time	10.36 s	9.29 s	18.61 s	13.37 s
Final Attractiveness	42%	58%	50%	50%
Final Usability	0%	100%	0%	100%

Table 1: Survey Results for Calculator Set #1

The timed results found that younger adults were faster at completing the given equations than older adults with both calculators. Younger adults were on average 7.95 seconds faster at using the "attractive" model and 4.08 seconds faster at using the "unattractive" model. Both age groups on average performed faster on the "unattractive" calculator. However, older adults were more accurate at performing the calculations. On average, younger adults correctly computed 95% of the equations when using the first calculator. They correctly computed all equations on the second and more practical calculator. In contrast, Older adults correctly computed all equations on both calculators.

After testing the calculators, both age groups unanimously declared Calculator 2, the "unattractive" model as more useable. Young adults still preferred the aesthetics of Calculator 2, yet to a lesser degree. An average older adults viewed the aesthetics of both calculators as equal.
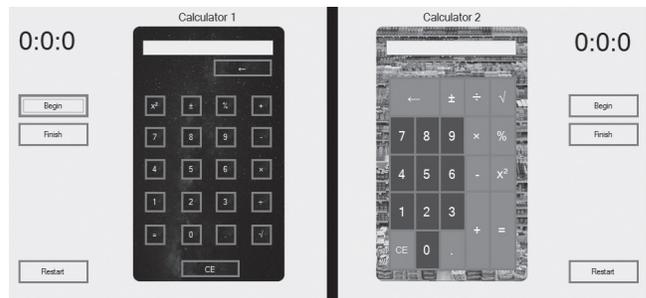

Figure 2: Calculator Set #2

For the second set of calculators as seen in Figure 2, survey results shown in Table 2 display that both age groups rated Calculator 1 the "attractive" calculator as more aesthetically attractive. Participants described the galaxy print as "pretty" and "soothing."

	Young Adults		Older Adults	
	Calculator 1	Calculator 2	Calculator 1	Calculator 2
Initial Attractiveness	75%	25%	66%	33%
Initial Usability	0%	100%	0%	100%
Equations Correct	93%	93%	93%	98%
Average Time	13.40 s	11.75 s	27.18 s	24.08 s
Final Attractiveness	75%	25%	62%	38%
Final Usability	0%	100%	33%	66%

Table 2: Survey Results for Calculator Set #2

Timed results found that younger adults were much faster at completing the given equations than older adults with both calculators. Younger adults were on average 13.78 seconds faster at using the "attractive" model and 12.33 seconds faster at using the "unattractive" model. Both age groups on average performed faster on the "unattractive" calculator. Again, older adults were slower, yet more accurate than younger adults. Younger adults correctly computed on average 93% of the equations one both calculator models. On average, older adults correctly computed 93% of equations on Calculator 1 and 98% of equations on Calculator 2.

In contrast to the previous set, both age groups declared Calculator 1, the "attractive" model, as more attractive. Again, both age groups unanimously deemed Calculator 2 as more useable. Unlike the first set of calculators seen in Figure 1, the participants' initial and post ratings had no noticeable disparities.

Findings:

With regard to the hypothesis, both surveys found that younger adults had no greater inclination towards the more aesthetically attractive calculator over the more usable calculator. The average times for younger adults when performing calculations on the "attractive" calculator with less usability were faster than the average times of older adults when using the "unattractive" calculator with higher usability. Despite being so much more efficient, younger age groups still valued the calculator with higher usability which yielded even faster results. Both age groups preferred a calculator that was more usable than simply aesthetically pleasing.

Unlike previous studies, the participants' post ratings of the calculators did not significantly differ from their first impressions. However, there was a slight change in the perceived attractiveness in the first set of calculators. Calculator 2 was initially deemed more attractive due to its shockingly bright colors that captured the users' attention. Though, after prolonged use this quality may no longer be as striking. It is possible that after testing out the calculators, the participants grew accustomed to the eye-catching colors and thus Calculator 2's aesthetic attractiveness diminished.

The results from the different sets of calculators differ greatly in the average times recorded. The average time to complete the given equations increased significantly in older adults using the second set of calculators. This can most likely be attributed to the change in participants for the second group. While the population was still the same, the older age group in the second test ranged from 40-69 years old as opposed to 40-59 years old in the first test. With adults of even greater age included, it is reasonable that the average time to complete the calculations would increase.

Discussion:

One limiting factor of this study was a small data sample. The first survey had only nine responses and the second survey had only ten. While the participant selection varied between surveys, the sample size is too small to accurately attribute the findings to a population of a larger scale. Additionally, while the similar background and workplace of the participants made it easier to conduct surveys remotely, this also contributes to limitations in the data sample. A greater quantity and more diverse range of participants would have improved the accuracy of this study.

Another limiting factor was the inconsistency of the questions on the survey. The final assessment of aesthetic attractiveness included an option for "no preference." This significantly altered the comparisons between the initial and final impressions. Furthermore, the final impression questions did not ask for a reason why the participants chose their answer. This proved limiting as only assumptions can be from their results. The survey would have been better written if each question was consistent and included an opportunity for the participants to explain the reasoning for their answer.

Future studies can be done to show if users react differently to tangible products in contrast to interactive programs. It is possible that users may have a greater response to the aesthetics of something that is material. The studies can examine if similarities between name brand products and the value of aesthetics over usability exist. However, it would also be important to determine whether a product that is too similar to a name brand item is viewed negatively as a knock-off.

Conclusion:

Overall, regardless of age, all users prefer a product of higher usability than attractive aesthetics. While the reasons for this preference in both younger and older adults are indeterminate, some factors can be considered. Younger people may value the time efficiency a product of higher usability offers. Older people may value the improved accuracy a product of higher usability offers. Additionally, from this study it can be understood that users involved in technology are able to accurately gauge the usability of common and simple products without a background in HCI.

References

Bruun, A., Raptis, D., Kjeldskov, J., & Skov, M. B. (2016). Measuring the coolness of interactive products: The COOL questionnaire. *Behaviour & Information Technology, 35*(3), 233-249. doi:10.1080/014492 9X.2015.1125527

Chien, C., Kerh, R., Lin, K., & Yu, A. P. (2016). Data-driven innovation to capture user-experience product design: An empirical study for notebook visual aesthetics design. *Computers & Industrial Engineering, 99*, 162-173. doi:10.1016/j. cie.2016.07.006

Fezzani, K., Albinet, C., Thon, B., & Marquie, J. -. (2010). The effect of motor difficulty on the acquisition of a computer task: A comparison between young and older adults. *Behaviour & Information Technology, 29*(2), 115-124. doi:10.1080/01449290701825139

Khan, R. F., & Sutcliffe, A. (2014). Attractive agents are more persuasive. *International Journal of Human-Computer Interaction, 30*(2), 142-150. doi:10.1080/1 0447318.2013.839904

Liao, M., Wu, Y., & Sheu, C. (2014). Effects of perceptual complexity on older and younger adults' target acquisition performance. *Behaviour & Information Technology, 33*(6), 591-605. doi:10.1080/014492 9X.2013.847974

Sauer, J., & Sonderegger, A. (2011). The influence of product aesthetics and user state in usability testing. *Behaviour & Information Technology, 30*(6), 787-796. doi:10.1080/0144929X.2010.503352

Shamim, A., Balakrishnan, V., Tahir, M., & Ahsan Qureshi, M. (2016). Age and domain specific usability analysis of opinion visualisation techniques. *Behaviour & Information Technology, 35*(8), 680-689. doi:10.1080/0144929X.2016.1141235

Sonderegger, A., Sauer, J., & Eichenberger, J. (2014). Expressive and classical aesthetics: Two distinct concepts with highly similar effect patterns in user–artefact interaction. *Behaviour & Information Technology*, 33(11), 1180-1191. doi:10.1080/014492 9X.2013.853835

Sonderegger, A., Schmutz, S., & Sauer, J. (2016). The influence of age in usability testing. *Applied Ergonomics,* 52, 291-300. doi:http://cletus.uhh. hawaii.edu:2074/10.1016/j.apergo.2015.06.012

Tuch, A. N., Roth, S. P., Hornbæk, K., Opwis, K., & Bargas-Avila, J. A. (2012). Is beautiful really usable? toward understanding the relation between usability, aesthetics, and affect in HCI. *Computers in Human Behavior,* 28(5), 1596-1607. doi:http://cletus. uhh.hawaii.edu:2074/10.1016/j.chb.2012.03.024

Wagner, N., Hassanein, K., & Head, M. (2014). The impact of age on website usability. *Computers in Human Behavior,* 37, 270-282. doi:http://cletus.uhh. hawaii.edu:2074/10.1016/j.chb.2014.05.003

Williams, P., & Hennig, C. (2015). Effect of web page menu orientation on retrieving information by people with learning disabilities. *Journal of the Association for Information Science & Technology,* 66(4), 674-683. doi:10.1002/asi.23214

Zhang, B., Rau, P. P., & Salvendy, G. (2009). Design and evaluation of smart home user interface: Effects of age, tasks and intelligence level. *Behaviour & Information Technology,* 28(3), 239-249. doi:10.1080/01449290701573978