Understanding the Effect of Animation and its Speed on User Enjoyment

by

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ABSTRACT

Providing the user with good user experience is complex and involves multiple factors. One of the factors that can impact the user experience is animation. Animation can be tricky to get right and needs to be understood by designers. Animations that are too fast might not accomplish anything and having them too slow could slow the user down causing them to get frustrated.

This study explores the subject of animation and its speed by trying to answer the following questions – 1) Do people notice whether an animation is present 2) Does animation affect the enjoyment of a transition? and 3) If animation does affect enjoyment, what is the effect of different animation speeds?

The study was conducted using 3 prototypes of an application to order bottled water in which the transitions between different brands of bottled water were animated at 0ms, 300ms and 650ms. A survey was conducted to see if the participants were able to spot any difference between the prototypes and if they did, which one they preferred.

It was found that most people did not recognize any difference between the prototypes. Even people who recognized a difference between the prototypes did not have any preference of speed.

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Introduction

With so many products that do similar things, one can make their product stand out by providing the best user experience possible. Krug (2018) explains that the user experience of a product can be improved by taking measures such as – (i) Ensuring that tasks are simple and clear, (ii) Providing a pleasing aesthetic, and (iii) engaging the user in the task. Lalmas, O'Brien, and Yom-Tov (2014) emphasize the importance of hedonic and experiential factors in technology. Animation tends to facilitate all of the above (Chang & Ungar, 1995).

Animation can reduce cognitive load by providing feedback that an action has occurred. For example, clicking an event on a crowded google calendar opens a pop-up with details about the event. Importantly, the pop-up occurs while giving the illusion of originating at the clicked event and moving to an adjacent spot. Additionally, the animation can prevent change blindness, as the motion captures the user's attention and directs it to what has changed (Scott & Neil, 2009). For example, when a text message is sent on an iPhone, the message does not just appear in the chat window, it moves from the editing space to the chat window. Finally, animation can add moments of fun or delight to engage the user. For example, animating the refresh screen which is usually considered quite boring can keep the user engaged.

Along with all of these advantages, animation can come with a cost. For example, animation can be expensive to implement. Direct cost includes the time and resources, in terms of people and money, it takes to implement animation or motion design as it is called. Worse, animation that is overdone can have the opposite effect as intended. For

instance, it could potentially force the user to wait too long for a task to complete, creating an unnatural break in their flow. One expert, Dan Saffer (2013) advises that animation should not be used if it is not necessary. Achieving this balance can be nuanced and needs further research.

One of the main factors affecting the quality of an animation is its speed, or the duration of the animation (Hoberman, 1982). Speed can differentiate a good animation from a bad one. In the Google Calendar example discussed above, the event details slide onto the screen to reveal more information about the event. The speed of this animation is crucial. If it's too slow, the user will be left waiting for the information to appear, potentially distracting the flow of their task. If it's too fast, the user will barely notice it. Consequently, understanding the ideal timing of these types of animations can help designers achieve their goals of user engagement and feedback.

Even though speed is such an important factor for animation, its complex nature makes it difficult to implement efficiently. The process of deciding the speed is mostly through gut feel. While some say that animations should be as short as possible, some say that longer animations can provide an illusion of a faster workflow. This is why it is important to understand if one speed works better than the other.

Perfection lies in details and these animations are the details that contribute to a seamless user experience. Like Dan Saffer (2013) says, although paying attention to these details may not be the reason one would choose to buy or use a product, but it is adding on and supporting the core functionality of the product to a large extent. As Lalmas et al. (2014) mention, in order to effectively design for engagement, a common understanding of how the user engages with the interface is needed.

For the purpose of this paper, we will be focusing on the speed of the animations. This paper tries to understand the scale of enjoyment of different speeds of animation through a prototype of an application to order bottled water. There are 3 versions of the prototype, each varying only with respect to the speed of their transition animation. The speed of the animations are 0ms, 300ms and 650ms. By asking the user to perform the task of ordering bottled water in all of the prototypes and asking them to rate the prototypes based on enjoyment, we attempt to find out the effect that animation has on the user's experience as well as the preference to the different speeds of animation.

Literature Review

Role of Animation

Lomakina (2017) elaborates on the role that animation can play which includes visual feedback and creating delight. (i) Visual feedback is provided to the user. For example, on an iPhone when you long press on an app icon, it takes you to the app-organize mode where you can delete or re-arrange apps. This state is differentiated from the regular state by adding an animation where all the apps are 'shaking'. This lets the user know that they are not in the regular state. (ii) When elements are animated effectively, it adds a factor of delight to the user's experience. For example, the buttons that are clicked to react to any post on Facebook have slight animations associated with each of them and are not just static images representing the type of reaction. Both of these factors lead to better user experience (Norman & Nielsen, 2019).

Head (2016) adds that even the smallest amount of motion can help the user understand what has happened on the interface. He adds that it can help the user focus on

this motion and the element that is undergoing change. Harley (2014) adds that animation can add to the brand of the product and creates the perception of the product's brand as updated and knowledgeable. He also says that it can be shown to understand how one element might relate to another. Chang and Ungar (1995) suggest that using animations can make transitions feel natural and smooth. They say that static digital interfaces are not the best for conveying a change in state. Thomas and Demczuk (2000) add that visual changes are easier to understand when the user's attention is directed towards the objects undergoing a change in the interface. All of this research proves that there is a benefit in applying animations to digital interfaces correctly.

Transitions

A transition communicates events like navigation and orientation in the interface (Baecker, Small & Mander, 1995). Arvila (2015) defines a transition as an event that maps one visual state to another. Chang and Ungar (1995) say that there is a lot that goes into designing elements and interfaces, but less thought is given to the transitions between them. When the changes between interfaces cannot be tracked, it is difficult to understand how the current screen elements are related to the previous ones. Any sudden change can take the user by surprise and break their task continuity. For example, even if the user expects that clicking an icon will open a window, they are still taken aback if it happens suddenly and takes a moment to get back to their task. Eliminating sudden changes reduces the chances of the user being surprised, thus improving the user experience. Scott and Neil (2009) state that transitions are necessary to communicate

with the user and keeping them engaged. This is why animation in transitions should be better understood.

Alvre, Gouveia and Sousa (2017) studied if animation can make a difference or not by comparing two prototypes, one with animation and one without to see if it had an impact. Although they found an overall positive response to the prototype with animation, they said that it might be beneficial to understand the impact of each animation separately because, for some interactions, animation had a negative effect. From this feedback and seeing the importance of transitions, the study focuses on transitional animations.

Principles of Animation

There are some aspects of cartoon animation that can be applied to digital interfaces (Chang & Ungar, 1995). Cartoon animation is theatrical, and this kind of animation can be exaggerated, but it also proves its point without being bound by practical and physical constraints. Cartoons are also engaging which as we've discussed is important for the user as well. The medium that cartoon animation is mostly seen in is 2D, just like the screens that we are designing for. In these ways, taking inspiration from traditional animation can be beneficial.

Disney's principles of animation are summarized by Hoberman (1982). They are Easing, Squash and Stretch, Arcs, Anticipation, Follow Through and Overlapping action, Secondary Action and Timing, Exaggeration, Staging, Solid Drawing, and Appeal. These principles can be implemented to make the animations more realistic and amusing.

Other principles to keep in mind are not to keep the user waiting while the animation plays out. Chang and Ungar (1995) mention that animation should be designed in such a way that the user immediately has control over the task that is being done and is not just waiting.

Drawbacks of Animation

Animation may provide all these benefits mentioned, but effectively implementing animation is complicated. When done incorrectly, animation might degrade the user experience (Thomas & Calde, 2001; Baecker et al., 1995). Head (2016) says that it can waste the user's time and attention if they are too distracted from their main task. Baecker et al. (1995) says there is also a cost that comes with implementing animations. It takes time and people to implement these animations. Arvila (2015) also talks about the hardware resources required to implement motion design. Tversky, Morrison and Betrancourt (2002) hence say that the benefits of animation might not always be evident even when it is done in a technically correct manner. This is why animation cannot blindly be used and we must check for its effects before implementing it on a large scale.

Speed of an Animation

Speed impacts any animation on a digital interface. Looking back to the example of the iPhone message, getting the speed right in this case is essential. Animating the transition too slowly would distract the user from their task. Animating it too fast might not give the user visual feedback. In the other example of the refresh screen on a mobile

phone, animating this action would engage the user, but having it too slow would prevent the page from actually loading. If the animation is too fast, it would not serve its purpose of engaging the user. In order to achieve the benefits of animation, its speed must be optimized. Brutlag (2009) ran an experiment to see how adoption rate would change with the change in speed and found that inducing animation latency in Google search results from 100ms to 400ms reduced the number of searches per user from 0.2% to 0.6%. This shows that the speed of an animation can have huge implications on adoption rates.

Arvila (2015) says that the animation cannot be so short that it goes unnoticed and cannot be too long either. Scott and Neil (2009) say that if too much time is spent on the animation, the user's attention will be lost. There are some guidelines available for achieving this optimal animation speed, but with digital interfaces being so complex, speed is very dependent on the context and the content of the task that is being performed. This has resulted in a lot of designers choosing the speed of an animation by gut feel. This may or may not lead to a positive response as explained in the role and drawbacks of animation.

Scott and Neil (2009) suggest arriving at a best guess for the duration of the animation, reduce it by half and reduce it by half again. It was found that designers easily get caught up in the effect of it and tend to lose focus on the main intention of the animation. Cutting it down by half prevents over-emphasizing the animation. They claim that the faster the animation is, the better it is. Chang and Ungar (1995) mention animation should not be so long that the user is waiting for it to play out and complete their task. If possible, the user should always be allowed to complete their task despite any animation that is taking place.

It was found that a human's perception of 100ms is considered an instant (Miller, 1968; Card, Moran & Newell, 1983). Anything less than that might not be recognized by the human brain. Norman (1994) adds that when the computer takes somewhere between 100ms and 1000ms to complete a task, the user is under the impression that the computer is causing something to happen. Although they notice the delay, their thought flow is not interrupted. Google's Material Design (2015) provides a detailed breakdown of speed guidelines that can be used for different screen sizes and the nature of the element that is being animated based on research that they have conducted. For a phone screen size, they recommend 200-300ms. They say that the speed of an animation depends on the size of the screen as the distance covered in the same amount of time is different. Card, Moran, and Newell (1983) developed the Model Human Processor which says that 70-700ms is the time it takes for the eye to recognize something and move to it.

Klein and Bederson (2005) conducted a study to see if users would find some scrolling animation speeds more useful than others. They tested 4 different speeds – 0ms, 100ms, 300ms, and 500ms. He concluded that the 300ms and 500ms seemed to improve reading times. Shanmugasundarm and Irani (2008) found that the task processing time was aided by a zoom animation, but there was no significant difference in different speeds of the zoom animation. It was concluded that since the smallest duration they tested for was 250ms, animation speeds can be as fast 250ms and still be of assistance.

From the above literature, it seems like the window for the appropriate duration is in between 100 and 1000ms. Google's Material Design (2015), Klein and Bederson (2005), and Shanmugasundarm and Irani (2008) found around 300ms to be a suitable duration. Klein and Bederson (2005) also found that 500ms assisted users by providing

better reading times. It would be interesting to see what kind of reaction anything slower 500ms but within 700ms (based on the Model Human Processor) would have and if 300ms applies to transitional animations as well.

User preference

Norman and Nielsen (2019) say that the two requirements for good user experience are the ability to give the user what they want in an easy manner and creating a feeling of joy to own and use. User preference is given importance in this study as we are trying to see what the first impression is of using the applications. If an application is not enjoyable to a user and there are better applications in the market which provide the same function, the user can easily switch to better applications. User preference has been used as a measure of efficiency by Myers (1985) in a study to measure the usefulness of a progress bar. A scale of 1-9 varying from “useless” to “very useful” was used to measure two versions, one with a progress bar and one without. A significant amount of people found the version with the progress bar to be more usable. Arvila (2015) conducted a study in which two versions of a website were made, one without animations and one with animations in various places. The preference of the user was taken for each animation and it was found that for the animations they tested, users preferred the animated prototype.

User preference data can be limited as derivations still have to made to understand the motivations of the user. People are also not always able to articulate their emotions and actual knowledge and are subject to social biases (Schiessl, Duda, Thölke & Fischer, 2003). User preference is still a good first step to understand the first impression of the

impact of animations. Liu, White and Dumais (2010) found that users can leave a website in as less as 10 seconds if they do not like it. First impressions are therefore quite important and studying user preference can help us gauge this.

In relation to user interfaces, the literature raises three main questions: 1) Do people notice whether an animation is present? 2) Does animation affect the enjoyment of a transition? and 3) If animation does affect enjoyment, what is the effect of different animation speeds.

Method

To answer the questions raised, a study was designed with three prototypes – one with no animation or duration of 0ms, one prototype with 300ms duration and a slower prototype of 650ms. The participants were asked to use the three prototypes and then asked if they noticed any difference between them. They were also asked to rate the prototype from 1-7 (7 being the highest) based on how much they enjoyed it.

Participants

22 undergraduate and graduate students at Arizona State University volunteered as research participants. The undergraduates were provided 0.5 credit hours towards a Human Systems Engineering 101 research familiarization requirement. All participants were older than 18 years. Each participant expressed that they were familiar with browsing the internet and comfortable with reading English.

Materials

Common tasks for studying animations include searching and decision-making activities such as browsing through images in a shopping task (Shanmugasundarm & Irani, 2008; Arvila, 2015; Huhtala et al., 2010; Alvre, Gouveia & Sousa, 2017). Three software user interface prototypes, simulating an iPhone app, were developed in Flinto (Version 26.2.2, 2019), a popular tool in the industry for prototyping animations. These prototypes simulated the task of ordering various brands of bottled water.

Figure 1. Screenshot of Prototype Used.

Mobile interface was selected because most people are familiar with mobile phones. Its usage has grown 17-fold from 2012 to 2017 ("Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2017-2022 White Paper", 2019). Employing a prototype rather than actual apps (which might differ in various ways) allowed for better experimental control. The prototype enabled participants to select bottled water brands by clicking arrows to navigate from one product to another, and then clicking on the chosen bottle to add it to a shopping cart. For the animated prototypes,

navigation from one brand of bottled water to the other comes along with a motion of the old image disappearing from the screen with a sideways motion and the new image appearing on the screen with a sideways motion. The activity of adding a brand of bottled water to the cart was chosen because it was likely to be familiar to the participants and did not require a learning curve.

Procedure

Participants were run individually. To begin, each participant provided informed consent and then completed a demographic questionnaire. Next, they were shown the first of three prototypes. The prototypes were counterbalanced, so not everybody saw the prototypes in the same order. The participants were then asked to browse through the various bottled water options and to choose one to add to their shopping cart. After making their choice, participants rated how much they enjoyed the app on a scale of 1-7, with 1 being the lowest and 7 being the highest.

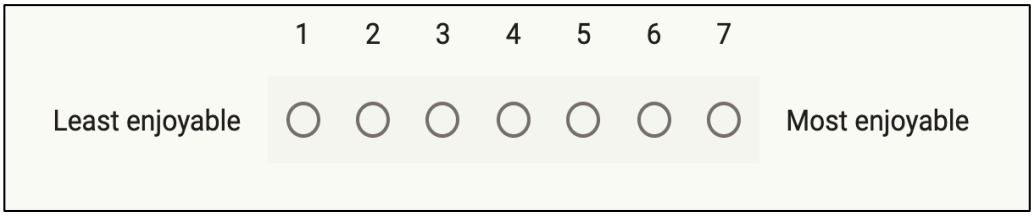

Figure 2. Scale Used for Users' Rating.

Following that, the participants repeated this process for the second and third prototypes. Each prototype was exactly the same except in the transition speed from one choice to the next. Specifically, the non-animated prototype had a transition speed of 0ms. The animated prototypes had speeds of 300ms and 650ms based on the literature review. They had a standard curve of Bezier (0.42; 0; 0.58; 1). The order in which

participants interacted with these prototypes was counterbalanced. Additionally, the order in which the bottled water brands were presented was different for every prototype that a participant received. This was done in order to prevent the participant from memorizing the order of the brands from previous prototypes that they have encountered and scroll through the options in the next prototype to find what they want. The participants were also instructed not to repeat the choices of bottled water in following prototypes.

Additionally, after using the second and third prototypes, participants were asked if they noticed any difference between the two prototypes they encountered so far and if so, what the difference was. Participants were also asked which prototype they preferred.

Results and Analysis

The survey results were stored in Excel for analysis. Out of the 22 participants, 18 were male and the rest were female. They were all between 21 and 27 years of age. 59% of all participants said that they used their phone for 1-3 hours per day, 27.3% said they used it for 4-6 hours and 13.6% used it for more than 6 hours.

Recognition and significance of animation

Six of 22 people or 27.3% were able to distinguish between an animated prototype and a not animated prototype (see Figure 3 below). ‘Yes’ implies that they noticed a difference, ‘No’ implies that they did not notice a difference, and ‘Maybe’ implies that they were not sure if they noticed a difference.

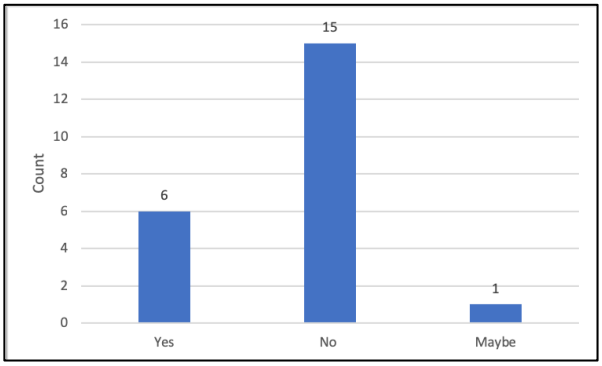

Figure 3. Breakdown of People Who Noticed Animations and Those Who Didn't.

This can be broken down further based on the speeds as follows: For N=22, 6 people (27.3%) noticed the difference between 0ms and 300ms speeds. 8 people (36.4%) noticed the difference between 0ms and 650ms speeds. 7 people (31.2%) of the participants were able to notice the difference between 300ms and 650ms speeds. Overall, 8 people were able to recognize the difference between at least one of the pairs of prototypes, 5 people were able to recognize the difference between all the prototypes and 14 people did not notice any difference at all.

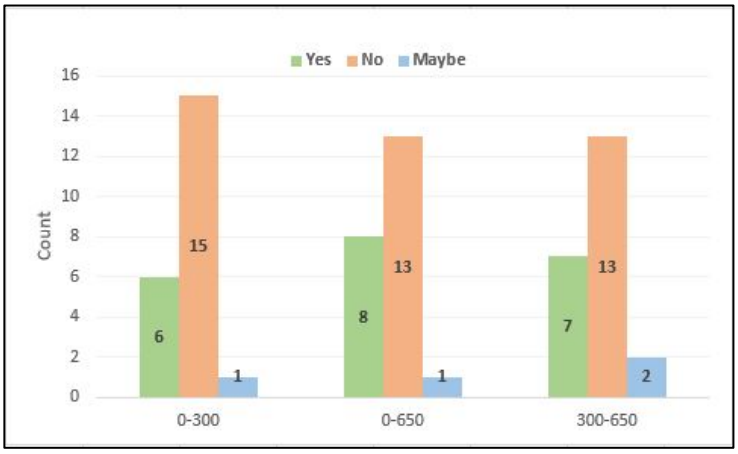

Figure 4. Breakdown of Noticing Differences Between All 3 Prototypes.

Satisfaction of prototype

The means and standard deviation for the enjoyment ratings of the prototypes are shown in Figure 5. From the data, it is clear that the ratings of the prototypes are not very different from each other.

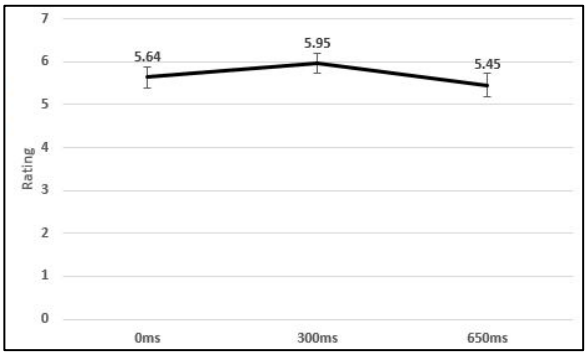

Figure 5. Means and Standard Deviations of Enjoyment Ratings for 22 Participants.

A single factor ANOVA for repeated measures was conducted to see if there was a significant difference in means. There is some debate about the applicability of ANOVA to Likert scale data (Sullivan & Artino, 2013). Specifically, some researchers worry that using an ANOVA on Likert data treats ordinal data like interval data. Norman (2010), however, addresses this issue in some detail, providing compelling evidence dating from the 1930s of parametric tests being robust for ordinal data, non-normal distribution, and small sample sizes. Further, Sauro (2016) concludes that in order to compare groups of data, the conclusions drawn are similar for mean, median and mode. This is why an analysis of variance was chosen to compare the enjoyment ratings provided by the participants.

The ANOVA conducted for the enjoyment ratings showed no significant effect of condition for enjoyment of prototype ($F_{(2,42)} = 2.414$, $p = 0.102$).

Table 1

Anova Result for Enjoyment Ratings (N=22)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Factor (speed)	2	2.818	1.4091	2.414	0.102
Residuals	42	24.515	0.5837		

Of the 5 people who noticed all of the differences between the prototypes, one participant rated the 650ms prototype higher, 2 participants rated the 300ms prototype higher, and 2 participants rated the non-animated prototype higher. The means and standard deviations are shown in Figure 6:

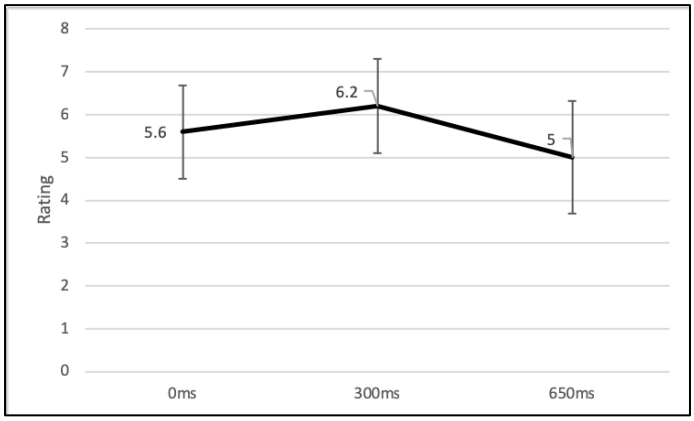

Figure 6. Means and Standard Deviations of Enjoyment Ratings for 5 Participants That Noticed Differences Between All 3 Prototypes

An analysis of variance was also conducted to determine if there was a significant difference in means between the prototypes. The ANOVA showed no differences among conditions for enjoyment ($F_{(2,8)} = 1.161$, $p = 0.361$).

Table 2

ANOVA Result for Ratings for People Who Correctly Noticed All the Difference (N=5)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Factor (speed)	2	3.6	1.8	1.161	0.361
Residuals	8	12.4	1.55		

From this small sample size of people who did notice all the differences, it is difficult to arrive at a conclusion with respect to which prototype might be preferred even if they did notice differences between animation and its speed. The participants were also asked what difference was noticed between the prototypes if any. Of the 5 people that were able to identify differences, the difference they noticed was either in 'switching between the drinks' or in the 'animations'. But 2 participants attributed characteristics to the animation as "fancy animations" or "smooth transitions". Both of these participants gave a higher rating to prototypes with animation.

Order of prototypes presented

Considering the order in which the prototypes are presented to the user to be categorical, using linear regression, we found the R-squared value to be 0.247 and p-value of 0.433 which is greater than 0.05 making the model not significant. This suggests

that the order in which the prototypes are presented had little to no impact on the outcome of recognition.

Discussion

The purpose of the study was to answer the following questions 1) Do people notice whether an animation is present? 2) Does animation affect the enjoyment of a transition? and 3) If animation does affect enjoyment, what is the effect of different animation speeds.

The first research question focused on whether participants would notice animations in prototypes. The results showed that 15 of 22 or 68% of the participants did not notice any differences among the three prototypes, suggesting that animations are not very noticeable.

An analysis of variance revealed no significant differences in means of the enjoyment ratings given to each of the prototypes. Failing to find a preference in the prototypes could be a direct result of not noticing the differences between the prototypes, to begin with. Without consciously noticing an animation, there was little difference between the ratings for the prototypes of different speeds.

The data showed that 8 people correctly noticed differences between at least one pair of prototypes, and 5 people correctly identified all of the differences. From this small sample size of 5 people, it is difficult to conclude how animation speed affects enjoyment when it is noticed. However, an analysis of variance was conducted to see if there was a significant difference in means of enjoyment ratings of different prototypes. It was found that there was no significant difference in means. We find that even among people who

did notice animation between all three prototypes, there was no preference for a prototype of a particular speed.

On the other hand, two of the five people who noticed all the differences between the prototypes described the animated prototypes as ‘fancier’ or ‘smoother’ than the others, suggesting a positive assessment of the animated prototype. This suggests that, for some, animation could lead to positive user experiences.

These results suggest that animation does not affect how much the user enjoys the product initially. It is possible, though, that animation and animation speed could have effects on enjoyment with continued use. Further studies should be done in these areas in order to understand how animation relates to enjoyment and other aspects of user experience.

From this study, we can conclude that animation is not immediately noticed by a majority of people, and hence different speeds are also not noticeable to them. Even among the people who did notice the animations and the difference in speed, there was little difference in their ratings for the prototypes. If there are any effects that animation of transitions is having on the enjoyment of the product, it could be happening without the user being conscious of it. This tells us that in order to efficiently use animation to increase the usability and enjoyability of a product, we need to study aspects like how animation impacts the ease of a task or how users perceive the quality of the product.

The time and resources spent in designing and developing animation in software products are immense. Therefore, understanding exactly the kind of impact it has on users is essential in order to effectively use the abundant technology available. Knowing

that users do not immediately notice animation in a product, can also help designers prioritize their efforts.

This study was a first step in understanding how animations in transitions and its speed can impact the enjoyment of the product. However, it is worth noting a few limitations of this study. First, participants were provided with the task of choosing a brand of bottled water from a set of five, by scrolling from one to the other. This is a goal-oriented task, in which the user is simply interested in making a choice. If instead, this was an app meant for leisure, participants might have been more likely to notice the animation. On a related note, participants purchased only one item per condition. Perhaps if they interacted with the prototypes longer, they would have noticed differences and their enjoyment would have been affected.

Additionally, only one dependent measure – enjoyment – was used in this study. It would have been useful to test how animations affect other measures, such as the ability to complete the task, error frequency, and so on. Doing this would have required a more challenging task. Similarly, users could have been interviewed or provided with questionnaires about other aspects of the user experience. Recall, for example, that two of the participants described the transitions as ‘fancy’ or ‘smooth’. It would have been helpful to gather other subjective opinions about the users’ experience for each condition.

Finally, because each condition had different animation speeds, the participant’s preference could have been affected by the number of times they clicked on the ‘Next’ or ‘Back’ buttons. Regrettably, this data was not recorded. Spending a longer time on the app could make the differences in animation speed more noticeable. This impacts the

numbers of times they see the animation which, in turn, could impact whether or not they prefer a kind of animation.

There are many opportunities to extend and improve upon this initial work. Animation in user interface design is complex, with many factors involved. As per the limitations, the impact that time spent on the app has on the preference to an animation speed can be important to know. The time spent on a real application could be more than what was tested for. Another way to test if time spent on a product impacts speed preference is by increasing the length of the task by increasing the number of categories. For example, giving the user a task like choosing one brand of soda, and one brand of chips in addition to bottled water.

Attributes that participants associate to a particular speed of animation can be collected along with user preference and usability measures. As mentioned in the limitations, including a question about the other descriptive terms for the prototype like ‘simple’, ‘luxurious’ or ‘fun’ and so on could help us understand the users experience better.

Additionally, a single transition can be animated with not just different speeds but also different styles. Other animation styles that can be explored are bounce animations and angular animations. Seeing the effect of these different styles on the user can be helpful. The trust of the user on any product could also possibly be impacted by the presence or style of animation which could in turn impact their buying behavior or purchase intent. Understanding these factors can help us design products which are easy to use and enjoyable to the user.

To summarize, in this study, we found that most people do not notice animations and did not have a preference for speed of animation for transitions. This study is a start and can help understand the users' first impression of products. To completely understand how animation could impact the user experience, and to provide guidelines for designers on aspects of animation like speed, the above research has been suggested.

References

Alvre, P., Gouveia, L. B., & Sousa, S. (2017). A study on using interface animations in online shopping sites. *Dias da Investigação na UFP*.

Arvila, H. (2015). Animated transitions in web applications.

Baecker, R., Small, I., & Mander, R. (1995). Bringing icons to life. In *Readings in Human–Computer Interaction* (pp. 444-449). Morgan Kaufmann.

Brutlag, J. (2009). Speed matters for Google web search.

Card, S., MORAN, T., & Newell, A. (1986). The model human processor- An engineering model of human performance. *Handbook of perception and human performance,* 2(45–1).

Chang, B. W., & Ungar, D. (1995). Animation: from cartoons to the user interface.

Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2017-2022 White Paper (Rep.). (2019, February). Cisco. Retrieved from https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual networking-index-vni/white-paper-c11-738429.html

Flinto (Version 26.2.2) [Computer software]. (2019, February 6). Retrieved from https://www.flinto.com

Harley, A. (2014, September). Animation for Attention and Comprehension [Web log post]. Retrieved February 4, 2019, from https://www.nngroup.com/articles/animation-usability/

Head, V. (2016). *Designing Interface Animation*. Rosenfeld Media.

Hoberman, J. (1982). Disney Animation: The Illusion of Life. *Film Comment*, *x*(1), 67.

Huhtala, J., Sarjanoja, A. H., Mäntyjärvi, J., Isomursu, M., & Häkkilä, J. (2010, April). Animated UI transitions and perception of time: a user study on animated effects on a mobile screen. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1339-1342). ACM.

Sauro, J. (2016, May). Can you take the mean of ordinal data? Retrieved from https://measuringu.com/mean-ordinal/

Klein, C., & Bederson, B. B. (2005, April). Benefits of animated scrolling. In *CHI'05 Extended Abstracts on Human Factors in Computing Systems* (pp. 1965-1968). ACM.

Krug, S. (2018). *Don't make me think!: Web & Mobile Usability: Das intuitive Web.* MITP-Verlags GmbH & Co. KG.

Lalmas, M., O'Brien, H., & Yom-Tov, E. (2014). Measuring User Engagement. *Synthesis Lectures on Information Concepts, Retrieval, and Services*, *6*(4), 1-132.

Liu, C., White, R. W., & Dumais, S. (2010, July). Understanding web browsing behaviors through Weibull analysis of dwell time. In *Proceedings of the 33rd international ACM SIGIR conference on Research and development in information retrieval* (pp. 379-386). ACM.

Lomakina, M. (2017). Defining microinteractions: animation in UX.

Material Design (2015, June 25). Retrieved from https://material.io/design/motion/customization.html#speed

Merz, B., Tuch, A. N., & Opwis, K. (2016, May). Perceived user experience of animated transitions in mobile user interfaces. *In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*(pp. 3152-3158). ACM.

Miller, R. B. (1968). Response time in man-computer conversational transactions. *Proc. AFIPS Fall Joint Computer Conference* (*1*) (pp. 267-277).

Myers, B. A. (1985, April). The importance of percent-done progress indicators for computer-human interfaces. In *ACM SIGCHI Bulletin* (Vol. 16, No. 4, pp. 11 17). ACM.

Nielsen, J. (1994). *Usability engineering*. Elsevier.

Norman, D. & Nielsen, J. The Definition of User Experience [Web log post]. Retrieved February 4, 2019, from https://www.nngroup.com/articles/definition-user-experience/

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in health sciences education*, *15*(5), 625-632.

Saffer, D. (2013). *Microinteractions: designing with details*. O'Reilly Media, Inc.

Schiessl, M., Duda, S., Thölke, A., & Fischer, R. (2003). Eye tracking and its application in usability and media research. *MMI-interaktiv Journal*, *6*, 1-10.

Scott, B., & Neil, T. (2009). *Designing web interfaces: Principles and patterns for rich interactions*. O'Reilly Media, Inc.

Shanmugasundaram, M., & Irani, P. (2008, May). The effect of animated transitions in zooming interfaces. *In Proceedings of the working conference on Advanced visual interfaces* (pp. 396-399). ACM.

Sullivan, G. M., & Artino Jr, A. R. (2013). Analyzing and interpreting data from Likert-type scales. *Journal of graduate medical education*, *5*(4), 541-542.

Thomas, B., & Demczuk, V. (2000). *Evaluation of animation effects to improve indirect manipulation. Proceedings First Australasian User Interface Conference. AUIC 2000 (Cat. No.PR00515),* (pp. 110-117). IEEE.

Thomas, B. H., & Calder, P. (2001). Applying cartoon animation techniques to graphical user interfaces. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *8*(3), 198-222.

Whitaker, H., & Halas, J. (2013). *Timing for animation*. CRC Press.