Shorter Wait Times: The Effects of Various Loading Screens on Perceived Performance

Jess Hohenstein
Sibley School of Mechanical and Aerospace Engineering
Cornell University
Ithaca, NY
jch378@cornell.edu

Hani Khan
Kramer Canfield
Sam Tung
Rocio Perez Cano
Department of Information Science
Cornell University
Ithaca, NY
hk862@cornell.edu
ktc36@cornell.edu
sat83@cornell.edu
rp529@cornell.edu

CHI'16 Extended Abstracts, May 07-12, 2016, San Jose, CA, USA
ACM 978-1-4503-4082-3/16/05.
http://dx.doi.org/10.1145/2851581.2892308

Abstract
Loading screens are unavoidable in modern software applications, and providing graphical user feedback during wait times is a well-established way to increase perceived performance. Previous research has indicated that perceived performance is essential to the success of an application, and progress bars have been specifically shown to decrease perceived wait time. This study is the first to examine the effect of animated loading screens on perceived wait time as compared to the popular progress bar. Study participants compared a progress bar with both a passive and interactive animation. Results suggest that with an interactive animation, perceived wait time is shorter and user satisfaction is higher than with a progress bar or passive animation.

Author Keywords
Design; Human Factors; Perceived Performance; Perception; Loading.

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: User Interfaces. – Graphical user interfaces (GUI).

Introduction

Perceived performance refers to how quickly software appears to perform a given task and is an integral element of building user trust and holding attention [3, 4]. One of the most fundamental aspects of perceived performance is waiting time. When delays are experienced, a user can easily become annoyed and believe that their security has been compromised [3]. Besides damaging user trust and satisfaction, long waits can also result in revenue loss, as 36% of US smartphone users reported abandonment of a mobile transaction due to slow loading times [12]. A user's tolerance for latency also decreases with increased duration of system interaction, so it is especially important to understand cumulative frustration when designing software with included wait times [3].

Related Work

Methods to Shorten Perceived Wait Times

Users have been shown to experience less frustration when they are given feedback during a wait time [3]. Progress indicators alert the user that their request has been processed and accepted, an interpretation of the request has been made, and the system is now busy working to provide a result [16]. When a user is provided visual feedback, their attentional resources are divided, and less attention is paid to the wait itself [6].

While waiting, users have been shown to prefer progress indicators to no progress indicators [16]. Progress bars have specifically been found to significantly increase users' tolerable waiting time when compared against no wait time feedback [6,9]. In an examination of various progress bars, Harrison et al. found that a progress bar with a backwards moving and decelerating ribbed pattern resulted in the best perceived performance among users [9]. Progress bars are universally deployed in many popular applications and websites [7, 10].

Besides progress bars, some systems use other methods to give users feedback during wait times. One of the most innovative current methods is to provide the user with an entertaining animation, which works to divide their attentional resources while simultaneously providing entertainment and/or reinforcing a brand. An example of this is Hipmunk, which shows an animated cartoon chipmunk (the company logo), along with a progress bar [10]. Examples of creative animations during a wait time accompanied by some kind of progress bar or numerical progress indicator are extensive, including the websites for the Museum of Science and Industry, SectionSeven Inc., and Platin [15,19,21]. This seems to indicate a preference among designers for providing quantitative feedback to users regarding overall progress.

Work has also been done to investigate how users perceive wait times when performing other tasks. The interference effect occurs when users are required to perform a nontemporal task during a wait interval. This has been shown to draw their attention away from timekeeping and result in a shorter perceived wait time [4]. This effect can likely be accounted for by the attentional allocation model, which states that users will perceive a greater time duration when more attention is allocated to it [4]. Performance of a nontemporal task draws attentional resources away from timekeeping, with more difficult tasks being associated with shorter time judgments [4].

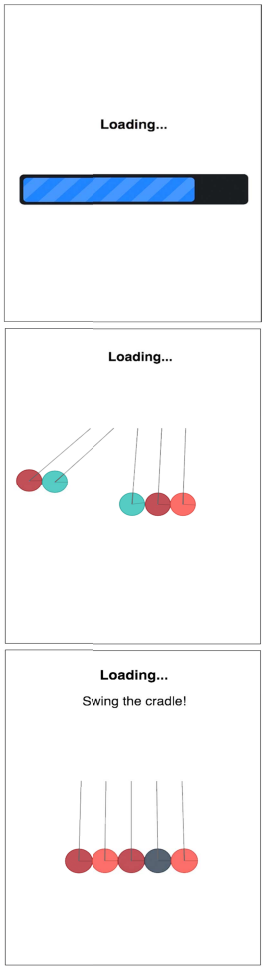

Figure 1: Three loading screens were tested: progress bar, passive animation, and interactive animation.

Multiple Perspectives on Perceived Wait Time

As discussed previously, several methods exist for alleviating the perceived wait time in the user experience, with designers seeming to have a preference for progress bars and/or passive animations [7,10,15,19,21]. The perceived user wait time for various types of progress bars has been investigated, and design recommendations have been made based on the results [9]. However, questions still remain about which type of loading screen results in the shortest perceived wait time and which provides the most satisfaction to the user. The main goal of the present study is to address these questions by gaining user insights on different types of loading screens.

Examining Other Influences

Creative thinkers have been shown to differ from analytical thinkers in their use of attentional resources. When attentional resources must be divided, creative people show more difficulty completing a task than analytical thinkers, who are capable of maintaining a more narrow focus [1]. It is also believed that there are fundamental differences in demographics, personalities, and personal tastes between Mac and Windows users [13]. This study also aims to investigate the effect of these supposed differences on loading screen preference.

Visual appearance can be crucial to consumer response [2] and often results in judgments about the elegance [5] and functionality [14] of the product. This illustrates that user enjoyment can be directly related to perceived performance. In order to make robust suggestions for designers implementing new interfaces, overall user enjoyment was also investigated.

Method

Participants

Participants included 145 students from a large research university in the northeastern United States. Their ages ranged from 18-29 (M=20.12), and 68% were female. Students were recruited via an on-campus web-based recruitment system and received course credit for participating.

Materials

We explored three types of loading screen designs, as shown in Figure 1. Each participant was shown all three loading screens through an internet-connected web browser in the order shown and answered the same survey questions.

LOADING SCREENS

The first loading screen design featured a blue progress bar. A progress bar with a backward-moving decelerating ribbed pattern was used, as this has been found to have the shortest perceived time when compared to other progress bar types [9]. The progress bar served as a control to compare against the other loading screens.

The second loading screen design featured an animation of a colorful Newton's cradle. The animation was not interactive, and participants simply watched the swinging cradle. The final loading screen featured the same animation, but users were given an instruction to "Swing the cradle!" and had the ability to interact with it through clicking and dragging each ball in any way that they chose. The Newton's cradle animation was chosen because of its simplicity, lack of emotion-inducing qualities, and ability to serve as both a passive and interactive animation.

Loading Screen	Rating
Progress Bar	3.56±0.092
Passive Animation	3.38±0.11
Interactive Animation	4.35±0.11

Table 2: Average ratings of speed for individual loading screens. The interactive animation had the highest perceived speed rating.

Loading Screen	Rating
Progress Bar	3.47±0.093
Passive Animation	4.01±0.12
Interactive Animation	4.78±0.11

Table 2: Average ratings of enjoyment for individual loading screens. The interactive animation had the highest enjoyment rating.

SURVEY

After viewing each loading screen for 10 seconds, participants were asked a series of questions about the specific screen they had just seen, including Likert scale ratings (1-7) of perceived speed and enjoyment. After all loading screens were shown, participants were taken to a final page of questions that asked for forced comparisons of all of the loading screens. Because these questions were answered after all loading screens had been seen, much of the order bias that may have been present in the results from the individual loading screen questions was eliminated. Participants then provided demographic information and took a TIPI (Ten Item Personality Measure) test [8]. This test helped us to gauge participants' personality traits through a series of ten questions.

PROCEDURE

The prospective paradigm occurs when users are informed at the start of an experiment that they will be judging time. It causes them to focus their attention specifically on the passage of time and often induces self-generated time-keeping strategies [4]. For this reason, participants were told that they would be judging different loading screens and were not informed that the perceived time for each screen would be a specific focus of the study.

After giving their consent to participate, participants were immediately sent to the first loading screen and completed the abovementioned survey. Sequential presentation of the loading screens with intermittent questions was necessary to hide the fact that the loading screens were all shown for the same time duration. The decision to not present the loading screens in a random order was made because of the situation in which a participant would see the interactive animation before the passive animation. In this case, the user would likely be confused about why they could no longer interact with the animation, and feelings of annoyance or anger might unfairly influence their perception of the loading screens. The entire process took about 45 minutes to complete.

Results and Discussion

The data suggests that a loading screen with an interactive animation will be perceived as faster and liked more than a loading screen with a progress bar or passive animation.

Which loading screen do users perceive as the fastest?

After viewing each individual screen, participants rated the perceived speed. The average ratings can be seen in Table 1. After viewing all of the loading screens, participants were forced to choose which they believed was the fastest. These responses can be seen in Figure 2. The interactive loading screen was seen as the fastest overall, and the passive animation was universally perceived as the slowest loading screen. The faster perceived speed of the progress bar compared with the passive animation could suggest that users prefer some type of progress indicator over a passive animation that gives no information regarding how much time remains.

Which loading screen is most enjoyable for users?

After viewing each individual loading screen, participants rated their level of enjoyment. The average ratings can be seen in Table 2. After viewing all of the loading screens, participants were forced to choose which of the loading screens they liked the most. These responses can be seen in Figure 2. Overall, the

interactive animation was the most liked of all the loading screens.

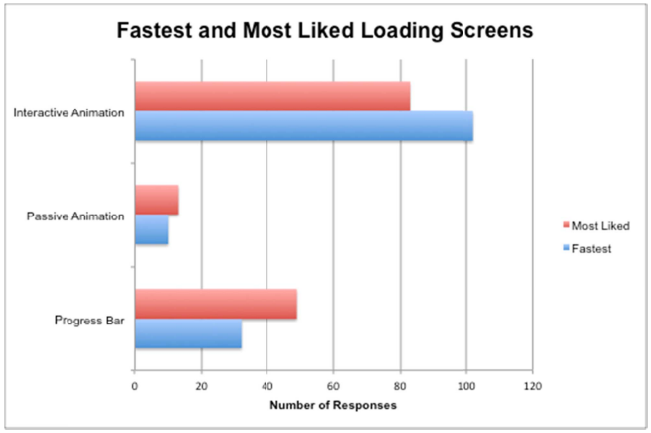

Figure 3: Responses for fastest and most liked loading screen. The interactive animation was perceived as the fastest and was most liked by a majority of participants.

Results in the Context of Other Factors

Last, we looked at the differences in results with respect to openness score, gender, and operating system used.

Openness to new experiences, one of the Big Five personality traits, is directly related to creative, reflective thinking [8]. Openness was measured using the TIPI method. Of the participants, 13 tested as definitively creative and 34 as analytical. A majority of participants were female, 67.6%, and 32.4% were male. Participants consisted of 80% Mac users and 19.3% Windows users. In all sub-populations examined, the interactive animation was perceived as the fastest and was the most liked, and the passive animation was perceived as the slowest and was the least liked. However, these results showed more variation than the overall results and need to be further investigated.

Implications for Design

Our primary design suggestion is to give users a simple, nontemporal task to perform during wait times. An interactive animation distracts users, and they devote less attentional resources to time-keeping. In this way, the loading time seems shorter, and the perceived performance of the application is improved.

Because of possible variations among perception and preference among sub-populations, designers might also want to consider who their software will be predominantly used by when making decisions about loading screen types.

Next Steps and Current Limitations

There are several limitations that should be considered when interpreting these results and used to motivate future work on this topic. First, the study was performed with students at a university in the northeastern United States, and the results might not generalize to other populations. However, college-aged young adults are the most active users of the internet [18], so this sample is useful for understanding everyday perception of performance. In the future, we encourage other researchers to study perceived wait times for various loading screens among different age groups that might perceive software performance differently and cultures that may perceive time differently [20].

A repeated measures ANOVA needs to be conducted to determine the significance of these preliminary

findings. Because participants were disproportionately female, analyses must be run controlling for gender.

Our research focused specifically on perceived performance of loading screens viewed through a web browser on a computer. The results found may not generalize to all loading screens, such as those found on mobile devices. Attentional resources are particularly fragmented in mobile HCI [17], and the effect of various loading screen designs in a mobile context should be examined.

This study examined three different loading screen designs separately. However, many applications use multiple design types at once [2,10,15,19,21], such as an animation with a simultaneous progress bar. Further work in combining various types of loading feedback and examining perceived performance will be useful in making more robust design suggestions.

The wait times experienced by participants in this study were a relatively short 10 seconds each, wherein it has been shown that waiting information (e.g. a duration or countdown estimate) is minimally helpful to users [11]. However, duration information has proven useful during medium and long waits, with countdown information being particularly beneficial during long waits [11]. It is recommended that the role of various loading screen designs for longer wait times be examined.

One surprising result was participants' overall perception of the passive animation, which was universally thought to be the slowest and least liked. We believe that the nature of the animation may be the cause of this result. The rhythmic, leisurely-swinging pendulum could have brought about feelings of slowness and lag. In a future study, it could be useful to try to examine an animation with no possible temporal association.

Lastly, the interactive animation in this study was not meant to be mentally challenging for users and was simply meant to divide their attentional resources by giving them a nontemporal task to perform during the wait time. It could be useful to examine the effect of having users perform more cognitively intensive tasks during a loading time, as this has been shown to decrease perceptions of time [4].

Acknowledgments

We thank Susan Fussell for support and feedback and acknowledge Liam Brummitt (The MIT License) for the open source JavaScript code used in the animations.

References

1. Pamela I. Ansburg and Katherine Hill. 2003. Creative and analytic thinkers differ in their use of attentional resources. *Personality and Individual Differences* 34, 7: 1141-1152.
2. Peter H. Bloch. 1995. Seeking the Ideal Form: Product Design and Consumer Response. *Journal of Marketing* 59, 3: 16-29.
3. Anna Bouch, Allan Kuchinsky, and Nina Bhatti. 2000. Quality is in the eye of the beholder: meeting users' requirements for Internet quality of service. 2000. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (CHI '00), 297-304. http://dx.doi.org/10.1145/332040.332447
4. Scott W. Brown. 1997. Attentional resources in timing: Interference effects in concurrent temporal and nontemporal working memory tasks. *Perception & Psychophysics* 59, 7: 1118-1140.

5. Del Coates. 2003. *Watches Tell More Than Time: Product Design, Information and the Quest for Elegance*. McGraw-Hill, London, UK.
6. Fiona Fui-Hoon Nah. 2004. A study on tolerable waiting time: how long are Web users willing to wait? *Behaviour & Information Technology* 23, 3: 153-163.
7. Gmail. 2015. Retrieved November 2,2015 from http://mail.google.com
8. Samuel D. Gosling, Peter J. Rentfrow, and William B. Swann Jr. 2003. A very brief measure of the Big-Five personality domains. *Journal of Research in Personality* 37, 504-528.
9. Chris Harrison, Zhiquan Yeo, and Scott E. Hudson. 2010. Faster progress bars: manipulating perceived duration with visual augmentations. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '10), 1545-1548. http://dx.doi.org/10.1145/1753326.1753556
10. Hipmunk. 2015. Retrieved November 2, 2015 from http://www.hipmunk.com
11. Michael K. Hui and David K. Tse. 1996. What to Tell Consumers in Waits of Different Lengths: An Integrative Model of Service Evaluation. *Journal of Marketing* 60, 81-90.
12. Jumbio. 2015. $24.5 Billion in Revenue Left on the Table by U.S. Retailers and Financial Services Last Year Due to Poor Mobile User Experience. Retrieved November 2, 2015 from https://www.jumio.com/2015/08/24-5-billion-in-revenue-left-on-the-table-by-mobile-businesses-and-financial-services-last-year-due-to-poor-user-experience
13. Mashable. 2011. How Are Mac & PC People Different [infographic]. Retrieved December 2, 2015 from: http://mashable.com/2011/04/23/mac-vs-pc-infographic/#DxU6BfhLwPqu
14. Rune Monö. 1997. *Design for Product Understanding – The Aesthetics of Design from a Semiotic Approach*. Liber, Stockholm, Sweden.
15. Museum of Science and Industry Chicago. 2015. Simple Machines. Retrieved November 2, 2015 from http://www.msichicago.org/fileadmin/Activities/Games/simple_machines/
16. Brad A. Myers. 1985. The importance of percent-done progress indicators for computer-human interfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '85), 11-17. http://dx.doi.org/10.1145/317456.317459
17. Antti Oulasvirta, Sakari Tamminen, Virpi Roto, and Jaana Kuorelahti. 2005. Interaction in 4-second bursts: the fragmented nature of attentional resources in mobile HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '05), 919-928. http://dx.doi.org/10.1145/1054972.1055101
18. Pew Research Center. 2014. Internet User Demographics. Retrieved November 3, 2015 from: http://www.pewinternet.org/data-trend/internet-use/latest-stats
19. Platin. 2015. Retrieved November 2, 2015 from http://www.erguvanplatin.com/
20. Katharina Reinecke, Minh Khoa Nguyen, Abraham Bernstein, Michael Näf, and Krzysztof Z. Gajos. 2013. Doodle around the world: online scheduling behavior reflects cultural differences in time perception and group decision-making. In *Proceedings of the 2013 conference on Computer supported cooperative work* (CSCW '13), 45-54. http://dx.doi.org/10.1145/2441776.2441784
21. SectionSeven Inc. 2015. Retrieved November 2, 2015 from http://sectionseven.com/index2.html