Animated UI Transitions and Perception of Time – a User Study on Animated Effects on a Mobile Screen

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ABSTRACT
The capability to present advanced graphics in the present mobile devices can be utilized to improve their usability and overall user experience. Mobile devices have limitations compared to PCs due to their inferior computing power and small screens, but a successful design of animated transitions can hide processing delays and make the user experience smoother. In this paper, we describe the design of animated transitions and present a user study on how they are perceived. The results show that in the transition between two images, bringing up the next image earlier dominates the perception of a fast transition over other variables examined in the study.

Author Keywords
UI design, UI animations, UI transitions, user studies.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors.

INTRODUCTION
Mobile devices introduce special challenges for user interface (UI) designers because of their limiting physical form factor and technical performance, which is inferior to a PC. One way to overcome the challenges in UIs has been to apply multimodality, and, e.g., adding auditory cues [5] has been found to improve usability. The possibilities in graphics design have also improved with increased display resolutions and increased computing power that allows the use of more advanced graphics. In this paper, we investigate the use of animations to gain an understanding on the optimal characteristics for screen transition design.

Animations can be used to make the application more pleasing by creating a perception of natural and smooth movements on the UI [4], as well as to improve the usability and efficiency of the user interface. Objects too large to fit to the screen as such can be presented with animations [6], and the user's attention can also be guided as her eyes are caught by the movement [1]. Animated transitions can also be used to fill the latency times caused by data transfer or processor delay. Changing from one user interface view to another is a common stage for delays to occur. A transition animation can be used to patch the moment and the user feels time passing faster than it does, as done, e.g., with progress bars [7]. Moreover, it has been found that the acceleration of an animation makes its duration feel shorter [3].

In this paper we describe our user study on animated transitions using fading and zoom effects between two different views. The transition from one image to the next one represents a transition between two UI states that are visually completely different, e.g. browsing images or replacing a menu UI with an application UI. The paper presents our findings on user perceptions of the speed of the transitions, revealing which kind of animated effects could be used in order to gain the smoothest transition between two states of a graphical user interface (GUI).

USER STUDY
In our experiment we measured how different timings of fade out and fade in of the image affect the experienced speed in a mobile image browser demo (Figure 1). The test setting consisted of emulating a mobile phone UI with flash demo running on a laptop PC. Participants were comparing two transitions and decided which of them felt faster.

In the actual user test, we used 96 random images taken from Internet image services, mainly from Flickr.com. The photographic quality of the images was relatively high because we wanted to maintain the users' attention during the test. The subjects of photos can be divided roughly into four groups: people, landscapes, animals and artificial objects. We avoided very dark images and adjusted the brightness levels and color saturation to make sure that all images had a consistent visual appearance. The photos were also cropped to fit on the 240x320 screen of the Nokia N95 mobile phone.

Figure 1. There were two phones on the screen of the test application. The phone on the left showed the first transition and the one on the right showed the second transition. The number code was only for moderator use.

There were three variables that were changed during the tests:

- Three different timings for changing the screen shot (equal, late and early), see Figure 2.
- 25% difference in total duration (fast vs. slow)
- Zoom effect (with or without zoom)

In the actual study we had a total of 24 combinations of transitions to compare. Three of them contrasted different timings only, nine varied timing and total duration, and the remaining 12 compared the timing and zoom effect in the fade out section at least in one of the transitions. Unanimated transitions, such as direct switch from one GUI state to another, were not included in the comparisons. With an animated transition, the UI response is immediate in contrast to the unanimated null case. With the transition delays we used, the results would have been trivial. The earlier research on progress indicators, e.g. [3, 7] have also omitted this test setting.

To reduce the effect of possible favoring of either the first or the second one, the research program randomized the order of the pairs in every comparison. Time scale changed randomly by a maximum of 20% between tasks to prevent the learning effect, so the shortest transitions were 1.4 seconds long and the longest 2.2 seconds. The average durations of slow and fast transitions were 2.0 and 1.6 seconds, respectively.

The user triggered the transitions by pressing a button on the laptop. The screen turned black immediately after the transition was over. After both transitions in the pair had been shown, and the user had expressed her rating by stating it verbally to the test moderator, the user could move to the next pair by pressing a button on the laptop.

The study included 26 participants, involving both people working full time (the majority) and university students. Sixteen of the participants were male and 10 female, and their age varied between 23 and 52. Sixteen of the total number had corrected vision.

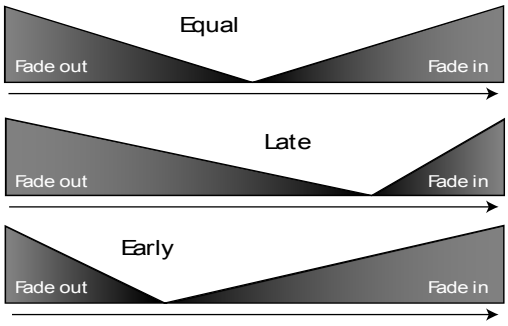

Figure 2. In equal timing, the fade in and fade out had the same length. Late timing changed the image when 75 percent of the time was elapsed, and early timing at 25 percent.

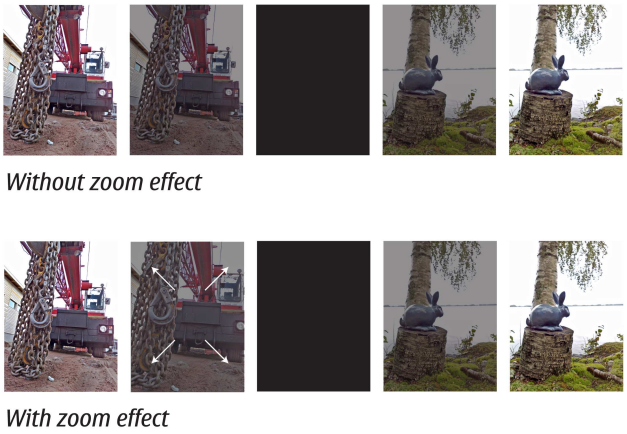

Figure 3. Part of the transitions included a zoom effect in the fade-out section.

ANALYSIS

Because we gathered only votes of which transition was perceived as the faster one, the data was binary. There was only one void answer in the set of 624 comparison tasks. After collecting the data, we compared transitions to each other in eight different groups. Six were comparing each timing to the other ones, and two were measuring zoom and the fast-slow difference without timing variation.

Table 1 presents the statistical results of comparing the transition variables. The statistical significance was calculated by means of binomial test.

The first row (marked gray), compares the perceived duration of transition (see Figure 2) when no other effect (i.e. zoom or duration) was used. In a portion of 81% (i.e 42 of the total of 52) of the cases, the Early transition was perceived as the fastest one when compared to the transition cases Equal and Late (pairs 1. and 3., see Figure 4.) Correspondingly, 31% of transition cases Late were perceived faster than the transition cases Early and Equal.

Table 1 also shows the statistics of the comparison between transition timing and zoom effect. When both transitions had a zoom effect, the Early timing was again perceived as

the faster one in 92% of the cases where it was compared to the Equal or Late transition timings. Moreover, when the zoom effect was applied to the Early timing, but not to the Equal and Late ones, the Early timing was again perceived as the fastest one (87% of the cases). The same results (87% of responds perceiving Early as the faster transition) was found with the symmetrical case, i.e. when the Early timing having no zoom effect was compared against the transitions of Equal and Late timing with zoom.

	Early	Equal	Late
None	**0.81**	*0.38*	**0.31**
Both zoom	**0.92**	*0.42*	**0.15**
Zoom Against No Zoom	**0.87**	*0.38*	**0.10**
No Zoom Against Zoom	**0.87**	*0.56*	**0.23**

Table 1. Proportions of the favored cases. Statistically significant results are bolded (p<.05).

Interestingly, adding the zoom effect in the disappearing image with the Equal or Late timing made the transition feel slower. This can be seen from results that are circled with a dashed line in Table 1. The bottom row presents a situation, where Late has no zoom, and Early/Equal have zoom. Here, Late is perceived faster in 23% of the cases. However, if also Late has zoom (as well as Early/Equal), Late is perceived faster only in 15% of the cases. Moreover, if only the Late transition has zoom and it is compared against Early/Equal with no zoom, Late is perceived faster only in 10% of the cases.

This finding is also supported by the results of the pair 24 in Figure 4. as the zooming in Late transition was perceived faster in only 35% of the cases when compared against Late transition with no effect.

	Early	Equal	Late
Fast	**0.94**	*0.63*	**0.38**
Slow	**0.67**	**0.29**	**0.08**

Table 2. Proportions of favored transition parameters. Statistically significant results are bolded (p<.05).

Table 2. shows the proportions of user preferences when the duration of the corresponding pair was either prolonged or shortened against its counterparts. This unveils the anticipated result that the fast transitions were also perceived faster than the slower ones.

The results reveal that the participants perceived the transitions with Early timing (i.e., that the latter screenshot was brought to the screen early) as faster ones. Even with the zoom effect, the Late timing was perceived slower. The same happed for both slow and fast transitions. (See the results circled with solid line, Table 1 and 2).

In Figure 4, all comparisons between different transition pairs in the study are presented.

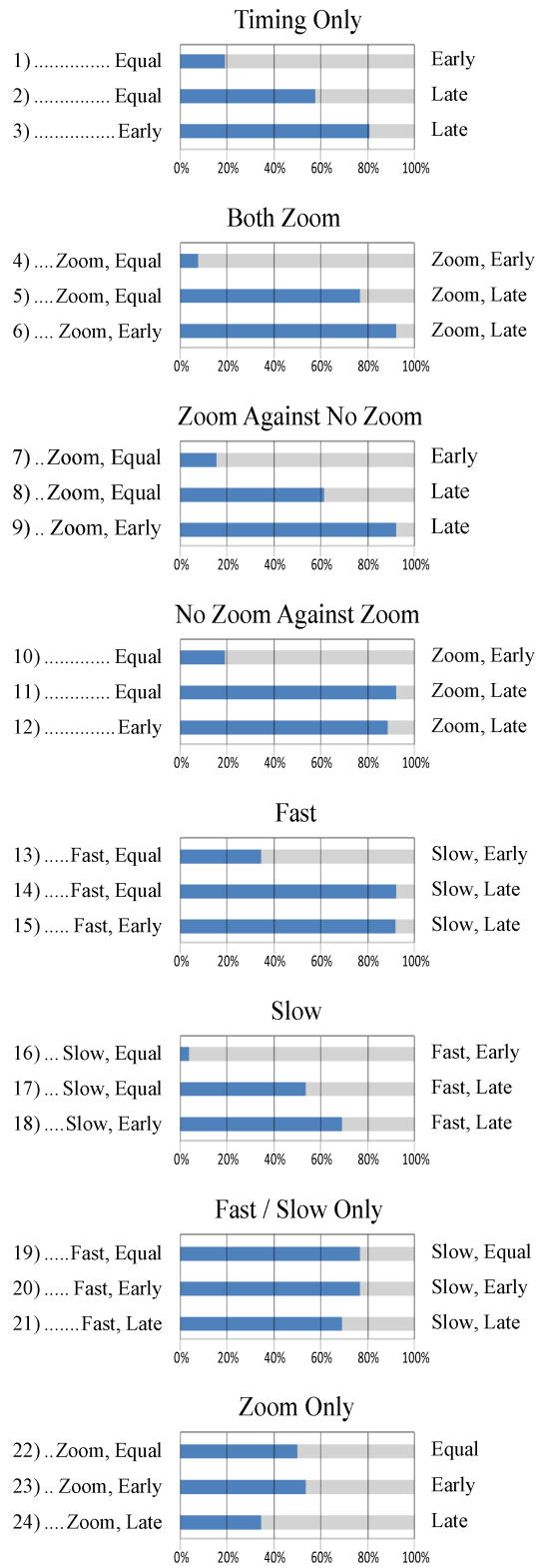

Figure 4. Bars on the figure show how many percent of answers indicated that the first transition was faster.

In figure 5, we present an overview of the fast vs. slow pairs results by using the illustration technique used in the progress bar studies [3].

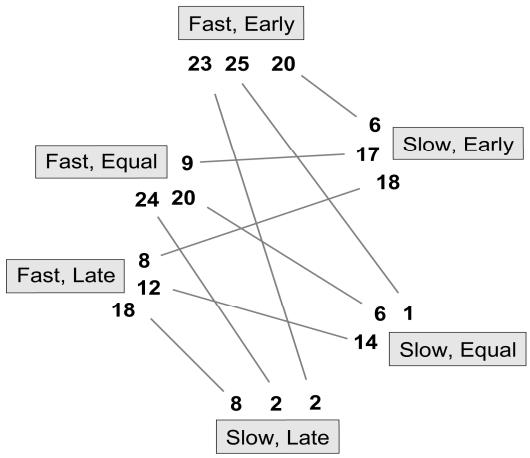

Figure 5. Rough hierarchy and the numbers of users favoring each timing with total duration change. The difference of total duration between fast and slow transitions was about 25%.

DISCUSSION

Animation can be used to create an illusion of continuity in the browsing experience in cases where the UI responds slowly because of technical reasons. The research presented in this paper aims to provide information that can help designers in concealing the delays and slow response times. Animations can also add aesthetic pleasure, which contributes to the overall user experience. It has been shown that perceived aesthetics has a correlation with the perceived usability [8], although the relationship is a quite complex one, as Angeli et al. report [2].

Creating a natural and controllable test setting was challenging, because the two sequential transitions on the same small screen seemed very confusing. Two phones side by side provided a good environment for comparisons, but holding them manually would have been very difficult. Reliable and accurate timing was also a problem in the S60 phone, because the flash application did not provide fast enough image processing capabilities. Therefore, a laptop PC was used for displaying the real-size mobile phones with transitions.

The results show that users tend to rate the transitions fast if the first image disappears quickly. The fade-in speed of the next view is secondary. According to the results, it is most important to bring at least a glimpse of the new content to the screen as quickly as possible. Our findings indicate that the psychological mechanism of transitions is completely different from progress bars [3]. Progress bars seem to perform best when the bar accelerates towards the end. The effect is opposite with UI transitions. The key element is how quickly the new view is presented to the user.

In equally structured transitions, the zoom effect had no influence on the results. However, the difference of the user ratings in well distinguished pairs was stronger, which may be a sign that movement has some effect on the perceived duration.

CONCLUSIONS

The use of animations in mobile UI is getting more popular with improved displays and computing power, and can be used to improve both aesthetics and usability. In this paper, we have investigated how fast animated transitions in mobile UIs are perceived. We used animated fade out – fade in transitions of 1.4–2.2 seconds with different timings, and a zoom effect. Our findings suggest the following:

- New content should be brought up rather earlier than later despite of the effects of transition or overall duration.
- People are not easily tricked - we are pretty good in noticing that content appearing late feels slower despite of the animation.

The generalization of our findings is limited because of the number of variables and comparison pairs in the study. These were chosen in order to control the variables as well as to keep the users focused during the study. However, we believe that the obtained results are still indicative, and can provide help when designing animated transitions for mobile UIs. Comparison of different animated effects provides an interesting area for further research.

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