The Effect of Video Loading Symbol on Waiting Time Perception

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Abstract. This study aimed to investigate the effect of different loading symbols and durations on waiting time perception of online video viewers. 60 young adults participated in this study and gave subjective ratings on waiting time perception through a 7-point Likert scale for 48 loading symbols (3 durations × 4 progress functions × 2 shapes × 2 embellishments). Results showed that duration and the progress function significantly influence the viewers' waiting time perception, while shape and embellishment do not. Loading symbols with the repetitive and linear progress functions are perceived longer than those of the power and inverse power progress functions. To indicate loading progress and to use manipulated progress functions are recommended, and design factors such as shape and embellishment are considered to be less effective. The findings of this study may serve as a useful input for loading symbol designers in creating better loading symbols.

Keywords: Video loading · Time perception · Symbol design · Progress indicators · Human-computer interface

1 Introduction

In these days, people watches a large amount of video media through video sharing websites and SNS services through personal mobile devices. Around 1/3 of China and 1/4 of U.S. internet users watch online videos every day [4]. The average time for US adults to watch digital videos was 21 min in 2011, and raised up to 76 min in 2015 [8].

Delay exists in every computer system, and many studies have shown that system delays can significantly affect user experience and performance [5, 22]. Users dislike delays [18] and web users start to lose interest in the current task at only 2 s of waiting [15]. In the same context, delayed video starts and stream interruptions have created a poor quality of experience for the viewer. Around 1/4 and 1/3 of viewers selected initial buffering and re-buffering respectively as the most frustrating aspect of internet video viewing [11]. Internet video viewers start to leave a website if the loading duration exceeds 2 s, and around half of them leave if the loading duration reaches 10 s [12].

The suffering from loading could be relieved by reducing the actual waiting time, but the actual waiting time cannot be shortened in many cases due to technical conflicts. An alternative approach to make users feel waiting time passes quickly can

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be attempted [17]. It was claimed that user experience is highly influenced by subjectively perceived time more than objective delay time [9, 23], because subjectively perceived time represents overall experience and extended waiting can arouse negative emotions [6].

Video loading symbols have been provided to notify the loading status and to relieve the boredom of viewers while waiting, but design guidelines for loading symbols were very limited. Therefore, arbitrarily designed loading symbols with repetitive progress have been popularly used among top video providers. However, many previous studies have argued the importance to provide feedback of loading progress to users [3, 15]. In addition, design factors of a loading symbol (such as its shape) may also influence the viewers' waiting time perception. In case of the web page usage, user experience and impression are highly influenced by the appearance [13], and users will leave if they feel frustrated with the design [16].

Some previous studies have found the effect of different loading progress behaviors on the progress bars in general human-computer interfaces. Myers reported that users had a strong preference for progress indicators in the graphical user interface during long tasks [14]. Harrison et al. also found that the loading with power progress function was perceived significantly shorter than the one with linear progress function [10]. However, very few studies have been conducted on the effects of different design factors (shape, progress function and embellishment) of a loading symbol on online video viewers' waiting time perception. The influential design factors, once identified, can be further considered in designing better loading symbols so that the waiting stress of online video viewers can be minimized.

The goal of this study is to examine the effect of different loading symbols on online video viewers' perception of waiting time. The effect of different loading durations on waiting time perception is also investigated in this study.

2 Methodology

2.1 Human Participants and Experimental Design

Sixty Koreans (26 males, 34 females) in the age range of 19-26 with normal or normal-to-corrected vision who are familiar with daily online video watching participated in the experiment. Forty-eight loading symbols (Fig. 1), one for each combination of levels of four factors were used as stimuli in a 3 (durations) × 4 (progress functions) × 2 (shapes) × 2 (embellishments) repeated measures design. The sequence of loading symbols was randomized across all participants.

For duration, 5, 10 and 20 s were chosen based on the fact that 5, 10 and 20 s of startup delay of the online video lead to around 20%, 50% and 70% of abandonment rate, respectively [12]. For progress function, three non-repetitive progress functions varying in rates of the progress (Fig. 1) [10] and one repetitive function were used. Repetitive function progresses at 0.5 cycle/second repetitively, and linear function progresses linearly without any changes in speed. Power function progresses slowly at first and then rapidly accelerates, and inverse power function progresses fast at first and then rapidly decelerates. For shape, circle and bar were chosen as the two most

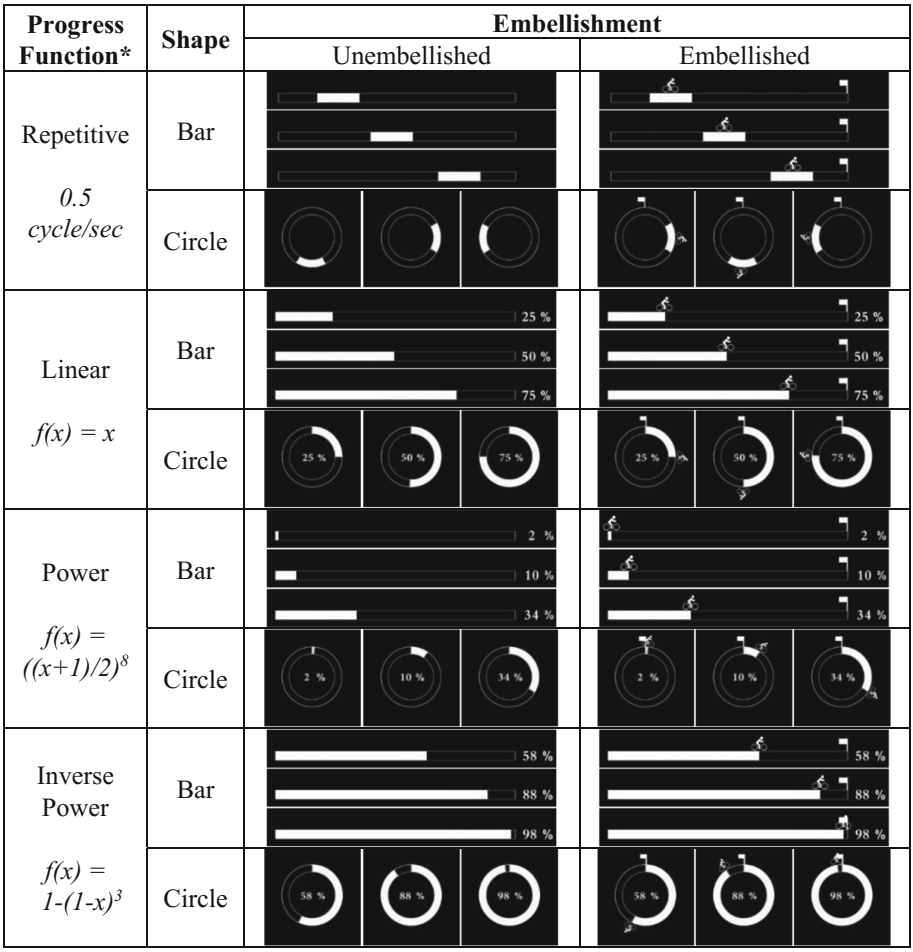

Fig. 1. Experimental stimuli of different loading symbols (Loading duration is not shown here due to the same symbol design) * *x: actual progress, f(x): displayed progress*

common shapes of the loading symbols used in online video platforms. For embellishment, a static small bicycle & flag figure was used. In order to minimize the influence of potential confounding variables, the length/width of the progress bar and size of figure/font were kept consistent for all loading symbols. All symbols were custom-made using Adobe Photoshop, After Effects and other computer programs.

2.2 Experiment Setting and Procedure

Loading videos were presented by a 24-inch monitor at 12 fps. Participants could freely decide the preferred sitting posture and the viewing distance to give close-to-real-life situations for more valid results.

Before the real test starts, a practice session was given in order to familiarize the participant with the experimental procedure. In the real test, participants were asked to give a subjective rating for each of forty-eight different loading symbols for how long did they feel about the waiting time in a 7-point Likert scale (1 = very short, 2 = short, 3 = slightly short, 4 = moderate, 5 = slightly long, 6 = long, 7 = very long). During the test sessions, participants could watch loading symbols as many times as they want, and their behavior was not supervised or controlled by the experimenter to have a higher ecological validity than research in controlled environments [7].

2.3 Data Analysis

Subjective ratings of waiting time perception for each loading symbol were collected, and arranged for the statistical analysis. After removing outliers through a multivariate outlier detection using Mahalanobis distance, nonparametric analysis of variance (ANOVA) and post-hoc Tukey test from aligned rank transformed data were conducted to check the statistical significance of each factor effect on waiting time perception. The nonparametric statistical test was used due to the ordinal data from the experiment. ARTool [25] was used to perform aligned rank transform, and Minitab 16 was used to conduct all statistical analyses at a significance level of 0.05.

3 Results

Figure 2 shows the distribution of subjective rating averaged in each factor level. Viewers felt 5 s duration of loading as short (Median = 2.12), 10 s duration as slightly short ∼ moderate (Median = 3.41) and 20 s duration as slightly long (Median = 4.81). The median rating of progress function factor showed the difference of 0.83 between the highest (Median = 3.04 for power function) and the lowest (Median = 3.88 for repetitive function) ratings, which can be considered somewhat close to one level of the 7-point Likert scale. In addition, the difference of median rating between bar (Median = 3.46) and circle (Median = 3.52) was very small (0.06), indicating negligible practical significance on the subjective rating. There was almost no difference on median ratings between unembellished (Median = 3.54) and embellished (Median = 3.56) symbols.

Further nonparametric statistical tests (Table 1) showed that rating on waiting time perception significantly differed among different durations ($p < .001$), progress functions ($p < .001$) and shapes ($p < .001$). However, no significant difference in waiting time perception was found from different embellishments ($p = .233$). The Tukey post-hoc grouping analysis showed that loadings with 5 s duration were perceived as the shortest (group A), followed by those with 10 s duration (group B), and those with 20 s duration were perceived as the longest (group C). Loading symbols with power and inverse power progress functions were classified in a group (group C) which was perceived significantly shorter than the ones with linear progress (group B) and repetitive (group A) functions. The difference of median ratings between bar and circle was statistically significant in spite of its negligible practical significance. In addition,

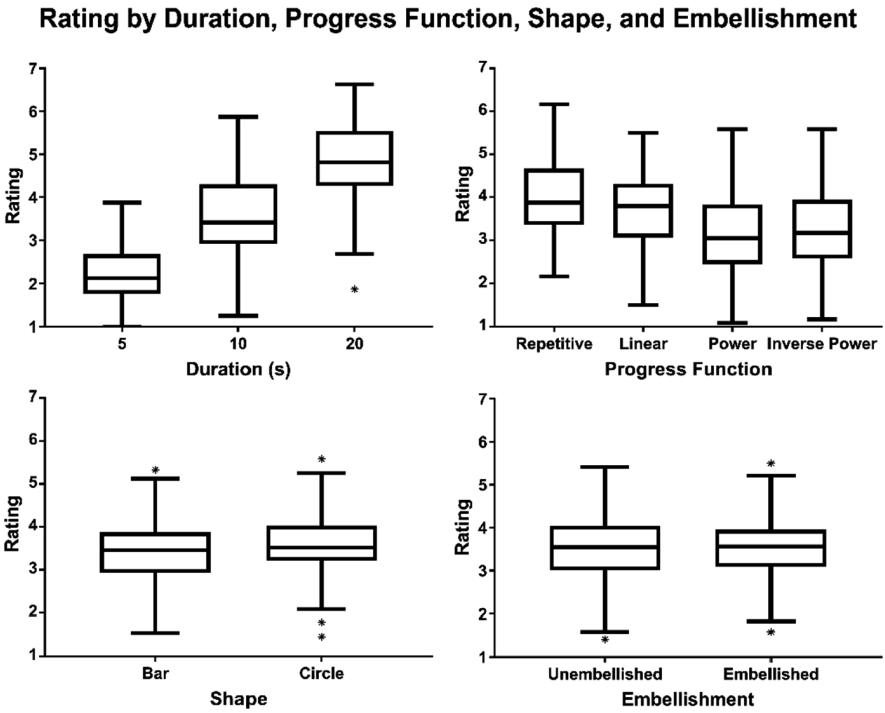

Fig. 2. Boxplot of average subjective rating for waiting time perception by each of duration, progress function, shape, and embellishment

Table 1. ANOVA results of effects of loading symbol factors on the rating for waiting time perception from aligned rank transformed data

Source	DF	F	P
Duration (D)	2	1825.84	**0.000**
Progress function (P)	3	117.32	**0.000**
Shape (S)	1	13.34	**0.000**
Embellishment (E)	1	1.42	0.233
D × P	6	3.15	**0.004**
D × S	2	2.00	0.135
D × E	2	0.51	0.602
P × S	3	4.55	**0.003**
P × E	3	2.12	0.095
S × E	1	1.22	0.269
D × P × S	6	0.82	0.556
D × P × E	6	0.70	0.647
D × S × E	2	0.11	0.898
P × S × E	3	0.56	0.643
D × P × S × E	6	0.72	0.636

significant interaction effects were found for duration × progress function (p = .004) and progress function × shape (p = .003). The distribution of subjective rating by duration, progress function, and shape is depicted in Fig. 3.

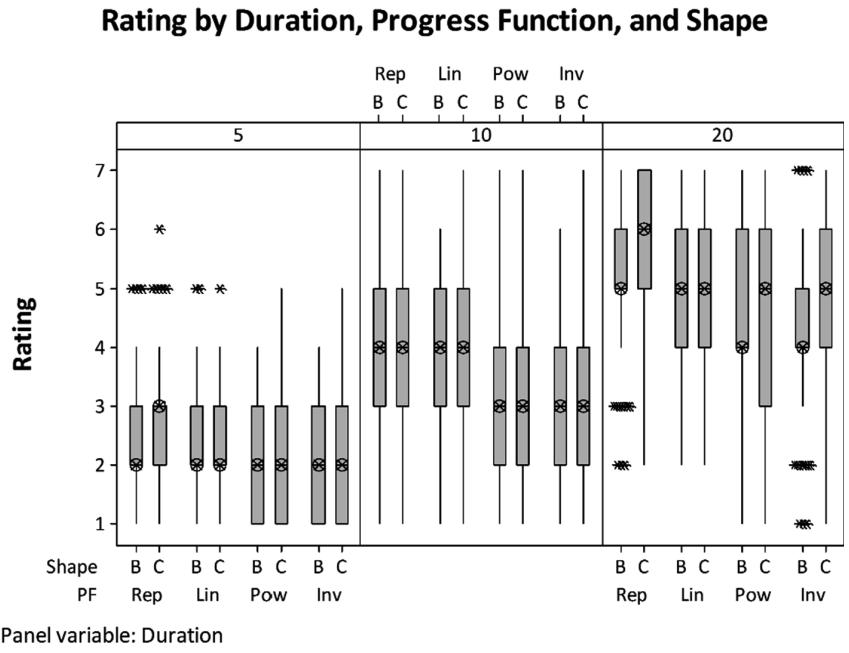

Fig. 3. Boxplot of duration, progress function, and shape on the subjective rating for waiting time perception. (Embellishment factor is not shown here due to the statistical insignificance.) *Note.* PF: Progress Function, B: Bar, C: Circle, Rep: Repetitive, Lin: Linear, Pow: Power, Inv: Inverse Power

4 Discussion

4.1 Main Effects

Non-repetitive loading symbols were perceived shorter than repetitive symbols, which is a consistent result with previous studies [3, 14, 15] that the user satisfies with the feedback on delay. Furthermore, loading symbols with power and inverse power progress functions were perceived significantly shorter than others. This result is partially consistent with the previous study [10] that found the power progress function was felt significantly faster than the inverse power and linear progress functions. The difference in their experimental settings (bar shape with 5.5 s duration only), evaluation methods (comparison between each pair of two progress functions) and tested populations might cause this inconsistency.

There could be two possible explanations for the reason why manipulated progress functions were perceived shorter. While static standard functions are relatively easy to

conjecture when the loading will be ended, dynamic manipulated functions show continuous changes and make viewers difficult to know the expected end time of loading and to put more attention on subsequent changes in the loading speed. When a stimulus that requires more attentional resources is presented, the individual tends to perceive time intervals shorter [19, 26, 27]. Meanwhile, viewers are likely to satisfy more with manipulated progress, as it gives a rapid sense of conclusion through illusions caused by the adjusted progress. Users' perceptions about elapsed waiting time is strongly associated with overall satisfaction of the service [2, 21]. For these reasons, it is recommended to apply manipulated progress as power or inverse power functions rather than common repetitive or linear functions.

Even though the bar shaped symbol showed statistical significance to be perceived shorter than the circle shaped symbol, the practical significance was marginal considering a minor median difference of 0.06. On the other hand, the embellishment factor did not show significant difference in this study, which was contrary to our initial expectation and findings from the previous studies. When an interesting stimulus or a stimulus that requires more attentional resources is presented during the interval to be estimated, the individual tends to underestimate the temporal intervals [1, 19, 24]. A possible explanation for this surprising result is that the inserted bicycle figure used in this study might not be attractive enough for participants or they could get bored by watching the same static image for many times continuously. Overall, it can be concluded that shape and embellishment are less critical to be considered in design by taking practical significance into account.

4.2 Interaction Effects

A significant interaction was found between duration and progress function ($p = .004$). According to the distribution of rating, linear progress function seemed to be perceived shorter than repetitive progress especially at 20 s duration. A significant interaction between shape and progress function ($p = .004$) was also found, indicating tendency that the loading with a circle shaped symbol tends to be perceived a bit longer than the one with a bar shaped symbol especially at repetitive and progress functions. This leads to a surprising fact that the circle shaped symbol with a repetitive progress function, which is most commonly used in online video websites, showed worse performance than other loading symbols (Fig. 3).

4.3 Design Implications

It is better for loading symbol designers to provide feedback of loading progress to viewers, and apply manipulated progress of power or inverse power functions to effectively control viewers' perception for relief of stress from waiting. Harrison et al. investigated the effect of nine different progress functions of the progress bar with 5.5-second duration on user preferences [10], and found that the progress bar with the power progress function was significantly preferred than most of others. The effect of manipulated progress functions was validated at the broader use context including

longer durations of 10 and 20 s, repetitive progress function, circular progress bar and embellishment. Design factors such as shape and embellishment can be considered to have less impact on designing a shortly perceived loading symbol. Even though this study was focused on loading symbols of the online videos, the findings of this study could be extended to other human-computer interfaces such as web page and mobile App loadings.

4.4 Limitations

Several limitations are inherent in this study. First, the main video content, which usually appears at the end of the loading, was not included in the stimuli. Second, a dynamic figure that can easily attract interest of viewers can be used as the embellishment. Third, some important factors that can influence the time perception such as user expectations [6] and predictivity [20] were not considered in this study.

5 Conclusion

This study shows that the duration and progress function of a loading symbol significantly affect viewer's perception of waiting time. Especially, loading of power and inverse power progress functions were felt significantly shorter than the repetitive and linear progress functions. It is suggested to provide feedback on progress and utilize adjusted progress functions to incite optimistic expectation of viewers. Design factors such as symbol shape and embellishment are less important for designing a better loading symbol. It should be noted that the circle shaped symbol with a repetitive progress function, which is most commonly used in online video websites, showed significantly worse performance than other loading symbols. The findings of this study may serve as a useful input for video service providers and loading symbol designers in creating shortly perceived loading symbols.

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