Time for a change

Reducing perceived waiting time by making it more active

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ABSTRACT

When one has to wait for a system to respond this is mediated by spinners, progress bars, skeleton-screens and other means. This project studies experiencing longer waits along the lines of "no activity" (progress bar), "passive waiting" (reading) and "active waiting" (doing something). For the latter, a novel method is introduced: users swipe an image and content underneath unveils, as if it were a scratch card. A between-subjects experiment (n=410) was conducted using a mobile website in 3 conditions to gauge the effects on estimated waiting time and enjoyment. The "no activity" and "active waiting" conditions were estimated faster than the "passive waiting" condition. The "passive" and "active" waiting condition were more enjoyable than the "no activity" condition. When combining waiting time estimation (short is preferable) and enjoyment (higher is preferable) the "active waiting" condition yielded better results.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **HCI theory, concepts and models**;

KEYWORDS

time experience, enjoyment, mobile, active waiting, passive waiting, progress indicators, swiping

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1 INTRODUCTION

Humans are terrible at estimating time. Sometimes time flies, other moments seem to take ages. Waiting time during artefact use e.g. a website or an installation process is experienced as annoying. A question then is how waiting can be more enjoyable or be utilized *in a positive way*. Nowadays bandwidth is huge, but when on the go, complex queries (plane ticket brokerage site, credit card statements) still easily take up to 15-20 seconds. This project investigates the concept of waiting in an *on-the-go* touch/swipe situation. Firstly, relevant theories from psychology concerning the experience of time and time estimation in general are reviewed, after which the experience of time in HCI is discussed. Some of the possibilities to improve the user experience during waiting periods are tested in an online experiment.

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2 RELATED WORK

2.1 Experiencing time

One can distinguish between prospective and retrospective estimation. In the former, the time an event takes is estimated beforehand, while in the latter one is unaware of timing until afterwards. Retrospectively, short time intervals are often overestimated, while longer intervals are underestimated. In HCI, short intervals are typically less than 2 seconds and longer intervals more than 4 seconds. *Flow Theory* states that when one engages in a highly challenging task while one's skill for this task is equally high, a *state of flow* is experienced. A factor of flow is "*a distortion of temporal experience*" where subjective experience of time changes. This is characterized by *"an intense and focused concentration on the present moment"* [12]. As this concentration takes up (nearly) all attention, not much attention is left for temporal cues one can loose the sense of time, mostly seen as a good thing since it indicates full task commitment.

2.2 Experiencing time in HCI

[10] introduced concepts for the relation between response time and episodic user experience: *subjective response time* and *subjectively experienced time*, the assessment of response time based on time estimation, past experiences and environment information. These concepts seem related to constructs proposed by [7]: perceived waiting duration, affective response to the wait and acceptability of the wait, where subjectively experienced time represents the latter two. [14] proposes to indicate that a system is busy when a delay is longer than 1 second. Delays longer than 10 seconds should have a 'percentage-done indicator' and a way to interrupt the operation. [16] propose slightly adjusted thresholds: 50-150 milliseconds for tasks requiring continuous feedback (instantaneous), one second for simple tasks (immediate), two to four seconds for common tasks (continuous), and eight to twelve seconds for complex tasks (captive).

2.3 Waiting and providing feedback

Delays interrupt flow and reduce "feeling control and engagement", leading to negative feelings [1]. To counter this, there are loading screens with progress indicators, providing *visibility of system status* [14] and indicate progress [15]. Loading content can happen up-front or in-between. Up-front loading is mainly performed through splash screens when an application starts. Users could perform another task during loading, further reducing *perceived* waiting time.

2.3.1 Types of progress indicators. Google [9] mentions 2 indicator types: determinate (actual progress) and indeterminate (system 'busy'). Sherwin [15] proposed for 'instantaneous' actions (< 1 second) one should *not* provide feedback, for actions between 1-10 seconds indeterminate progress indicators are advised. With actions longer than 10 seconds a determinate progress indicator is recommended (users quickly grow impatient). Others suggest that spinners should only be used for duration up to 5 seconds as longer durations break continuity [16], [9]. These indicators are common:

Static text - One of the simplest ways of providing an indication of the system responding is through showing a static text, e.g. "Loading…". However, this method shows no actual progress [15].

Spinner - Spinners that show the system is busy, reducing anxiety by indicating it has not 'frozen'. However, showing spinners for too long can result in increased anxiety as it might mean that the system stopped responding [15].

Progress Bar - Progress bars inform about progress and how much still is to be done. This is useful in longer waits as one can wait or do another task. Problematic with progress bars is that it is hard to determine how long the wait will exactly take [15], but they *do reduce* uncertainty about the system's status (facilitating e.g. multi-tasking). **Skeleton screens** - These are blank versions of pages into which information is gradually loaded, creating the sense of things happening. [11] and [4] suggest that skeleton screens are perceived faster and easier to navigate, while users create a mental model of the structure and can already interact with some elements while others are still loading [10].

2.4 Improving the user experience of time

2.4.1 Decreasing system response time. The most obvious way to make waiting less annoying is by making users wait less. Different software engineering practices have been developed on optimizing code but such activities cost time and money and users might not even notice improvements. When decreasing system response time is not feasible, another option is to *make users feel they waited less* by decreasing the *perceived* waiting time. Several studies have been conducted towards decreasing perceived waiting time. This can be done by providing additional information about the wait, enhancing the loading screens and progress indicators with animations and aesthetics or by distraction.

2.4.2 Additional information. Additional feedback helps adjusting to delays. If one can make sense of the delay, the experienced time changes, which influences the experience [10]. To understand the delay, feedback about *why* one is waiting and *for how long* (time remaining) must be communicated promptly when response times exceed a threshold.

2.4.3 Animation and Aesthetics. [17] found that waiting time for spinners is perceived shorter with high animation speed. [5] state that progress bars that are slow in the beginning and fast at the end are preferred. [4] suggests that skeleton screens with animation further decrease perceived waiting time. Also aesthetics play a role; a study by [3] showed that progress indicators featuring an 'attractive cartoon' lowered perceived waiting time, progress indication with cartoons was also preferred (65%) over progress bars and spinners.

2.4.4 Distraction. Another way to influence time perception is using the interference effect. Here, a non-temporal task competes for attentional resources with a temporal task, thus distorting time-keeping [2]. To distract, creating a waiting time "filler" can be done from within or outside the context of the current task. In longer waits it might be beneficial to aid users performing another task related to the main task, or a different task. Distractions can be 'passive' or 'active'.

Passive entertainment - A positive impact of passive entertainment on perceived waiting is mainly due to attention and affect [10]. An example is the quotes presented during loading the "Slack" app: users get something to read during the waiting time, thus directing attention towards this non-temporal quote, instead of the other temporal cues presented.

Active entertainment - [8] proposed active progress bars; when loading lasts at least 5 seconds (but often 20 or more) users are prompted with something to *-read* (passive), or to *do* (active). Participants presented with a control condition were less satisfied with the main task than with both *passive* and *active* entertainment. [6] showed that for waiting times of 10 seconds *interactive* animations are perceived faster and enjoyed more than progress bars or passive animations. An example of *active entertainment* during waiting is that players can practice free kicks while the game FIFA loads.

2.5 Research question

Experiencing time is at the heart of the user experience. Waiting less than a second is generally not perceived as waiting, waiting 1 to 5 seconds can be managed by spinners. For waiting 5-10 seconds progress bars work, for longer than 10 seconds it is unclear. Experiencing waiting can be improved with elaborate feedback and enhanced progress indicators e.g. animations and visuals. Another option is distraction by providing a passive or active task during the wait. Most studies focus on desktop/laptop, whilst much internet traffic flows through mobile devices where interactions occur through touching and swiping. It is exactly *touching and swiping* (doing something) that we treat as "active waiting". Different aspects of experiencing (longer) waiting are taken into consideration, see 3.1.2. The research question is:

"With longer waits on mobile devices, is there a difference between how waiting is experienced between different waiting strategies (no activity, passive waiting or active waiting)?

3 METHOD

3.1 Experimental design

To answer the research question an experiment was designed focused on using mobile phones. A mobile website in the style of the

(a) Travel website **(b) No activity** **(c) Passive waiting** **(d) Active waiting**

Figure 1: Parts of the mobile website (a) and the three conditions in the experiment (b, c, d)

National Railways was created where one can book a train journey using their smartphone (see Fig. 1a). The experiment is between-subjects with the independent variable "waiting strategy" in three conditions: *no activity*, *passive waiting* and *active waiting*. Online queries often are complex and take time, and users know this. According to [13] a long delay (> ten seconds) would cause users to lose interest and possibly perform another task in the meantime.

3.1.1 Independent variable: Waiting strategy (3 conditions).

(1) *No activity* - For this (control) condition (see Fig. 1b) the most common form of progress indication was picked: a progress bar. In addition, a simple informational feedback text was displayed (translated) “We are searching for you…”.
(2) *Passive waiting* - Here participants saw a text with facts about the destination (Fig. 1c). Reading a text is a temporary task with a relatively low cognitive load. The text was 44 words. An average person reads about 4 words per second, so reading it takes about 11 seconds. The total waiting time was set at 12 seconds.
(3) *Active Waiting* - Participants interact actively: scratching a photo by swiping over the screen to reveal a fact about the city (Fig. 1d). Because of switching between sub-tasks (read instructions, scratch photo, reading), this waiting activity might be more distracting (entertaining, duration *seeming* shorter) than the other two conditions.

3.1.2 Dependent variables. To measure the waiting experience participants answered three questions:

- **Perceived waiting time** (feeling) - *What do you think of the duration of the waiting?* A 7-point Likert-scale ranging from ’very long’ to ’very short’ is used.
- **Estimated waiting time** (seconds) - *How many seconds do you think you have waited?* Participants saw a grid with values one to twenty where they had to select a number .
- **Enjoyment** (feeling) - *What do you think of the waiting in general?* A 7-point Likert-scale ranging from ’very boring’ to ’very entertaining’ was used to determine the user’s affective response to the waiting experience.

3.2 Participants, Material, Task and Procedure

410 Participants were divided over the three conditions: No activity n=134, Passive waiting n=142 and Active waiting, n=134). The mobile website resembled the current design of the National Railways app to provide feelings of familiarity. The task was to book a trip to Paris. After 4 pages the query was processed, and participants experienced the wait (in the 3 conditions). Afterwards participants rated the time and enjoyment experiences via a questionnaire.

4 RESULTS

4.1 Perceived waiting time, Estimated waiting time and Enjoyment

Three dependent variables were used: Perceived waiting time (feeling) Estimated Waiting time (estimate in seconds) and Enjoyment (feeling) as experienced. There was no significant difference between the scores on Perceived waiting time between the 3 conditions when estimated with a 7-point Likert scale (very slow) to (very fast), $F(2,407)=1.79$, $p=.17$). As can be seen in figure 2 (dark blue bars), Perceived waiting time in the No activity condition ($M=4.82$, $SD=1.59$) is very close to that of the Active waiting condition ($M=4.87$, $SD=1.51$) and Passive waiting condition ($M= 4.54$, $SD=1.61$). There was a significant effect of condition on the Estimated waiting time (in seconds) ($F(2,407)=25.72$, $p<.001$). A post-hoc Tukey test showed that in the Passive waiting condition ($M=10.54$, $SD=3.90$) this duration was estimated significantly longer than in *both* the No activity condition ($M=7.65$, $SD=4.01$) *and* the Active waiting condition ($M=7.67$, $SD=3.65$). Time was estimated equally in the No activity condition and the Active waiting condition (black line, figure 2).

There was a significant effect of waiting condition on enjoyment ($F(2,407)=29.20$, $p<.001$) measured through a 7-point Likert-scale (very boring to very entertaining). A post-hoc Tukey test showed that the No activity condition ($M=4.41$, $SD=1.39$) was perceived significantly less enjoyable than *both* the passive ($M=4.41$, $SD=1.39$) *and* active conditions ($M=4.54$, $SD=1.30$). The passive and the active condition were both perceived equally enjoyable (red bars, fig. 2).

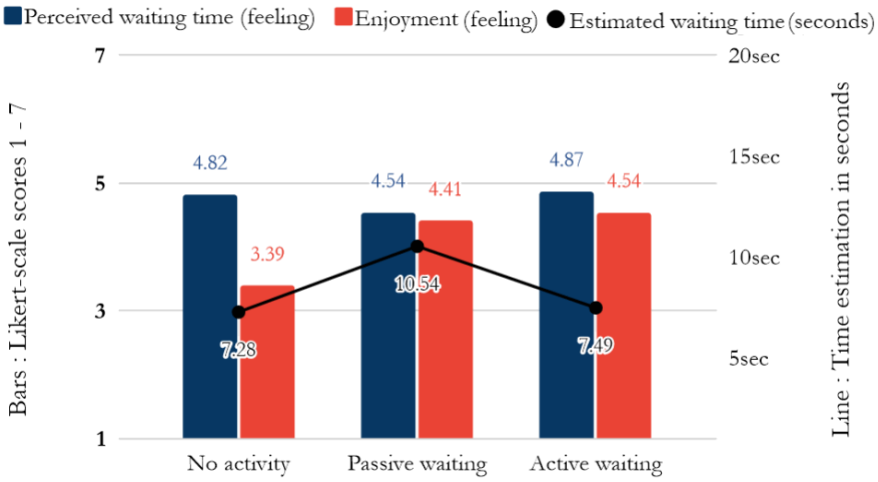

Figure 2: Scores on Perceived waiting time, Estimated waiting time and Enjoyment per condition

5 DISCUSSION

The dependent variable was the *deployed waiting* strategy users indulged. There were three conditions: *no activity* (progress bar), passive waiting (reading text) and active waiting (doing something). The dependent variables were user's Perceived waiting time (the feeling, short < > long), the Estimated waiting time (seconds) and Enjoyment (affective response, boring < > entertaining). "Perceived waiting time" expressed with adjectives and reflecting a feeling was scored equally across conditions. However, when participants were asked to express the waiting experience (Estimated waiting time) in *measurable units* (seconds) the story is different. The Passive condition was estimated longer than both the No activity and Active waiting conditions. An explanation could be the fact that the Passive condition lead participants to *think* this condition must have taken a long time as they read this text in the meantime and did *nothing else*. In the Active waiting condition participants were kept busy doing different things. In the No activity condition, we actually do not know what participants did during the wait since there was no instruction, only the well known progress indicator. Participants could have stared at the progress indicator, perhaps focusing on its animation, but also other things, such as checking their mail in the meanwhile (deciding how to spend the wait). In addition, the Passive condition was the only condition where visible cues were static. In the No activity condition the progress bar was animated and changed appearance over time, and in the Active waiting condition participants switched tasks three times (from reading swipe-instruction text to scratching the photo to reading the unveiled fact). Perhaps the earlier mentioned animation (which the progress bar contained) might have caused rather short time estimates as proposed by [4], at least shorter than in the Passive waiting condition. Concluding, apparently the act of sitting back and just read a presented text is estimated to take longer (seconds) than the Active waiting condition *and* the No activity condition. Concerning Enjoyment, the fact that when users had "something to do", be it passively reading a text, or actively scratching a photo to reveal something, lead to higher Enjoyment of the waiting time, higher than when watching (or not) a progress bar. But we can also see that when combining this with the scores on Perceived waiting time and Estimated waiting time it seems that a higher Enjoyment does not necessarily mean a shorter experience of the waiting.

6 CONCLUSION

If the objective is experiencing time going faster, the Passive waiting condition (reading text) is not ideal. Active waiting yielding lower time estimations than the Passive waiting did not come as a surprise. However, the fact that Active waiting time in *seconds* was equal to the No activity condition, is peculiar. Results on Estimated waiting time and Enjoyment are influenced by the dependent variable: waiting strategy. In any case, the Active waiting condition scores equally well, or higher than the other conditions. Probably the most important conclusion is that either an animated progress bar or active entertainment during waiting time is advantageous regarding waiting time estimation, and presenting a text to read in is not. However, when also taking enjoyment during waiting into account, a *real activity during waiting time* is more enjoyable than a progress bar. Therefore waits of around twelve seconds or more, giving users something to actively interact with in the meantime seems a good idea. Findings in literature combined with our results, can provide UX designers with guidelines of when to use which progress indicator and how to enhance these to make the waiting experience a less annoying. The novel waiting strategy we introduced looks promising in certain situations; in the active waiting situation (digital scratch card) users perform an activity *and* read. What we do not know is whether this keeps being enjoyable over time. Scratching can be seen as a form of gamification of waiting durations. It could be interesting to see if small mini-games have a similar effect. Because of the touch/swipe paradigm, we chose for a mobile context. We will focus on translating the innocent joy of unveiling a piece of information by swiping to other contexts (e.g. voice, gestures. Currently huge strides are being made with Virtual/Augmented Reality. On laptops/pc's, "natural" swiping is not the standard, but in immersive environments this could be interesting since gestures and touch are central here.

REFERENCES

[1] Russell.J. Branaghan and Christopher. A. Sanchez. 2009. Feedback preferences and impressions of waiting. *Human factors,* (2009), 528–538.

[2] Scott. W. Brown. 1997. Attentional resources in timing: Interference effects in concurrent temporal and nontemporal working memory tasks. *Human factors,* (1997), 1118–1140.

[3] Chien-H. Chen and Sasha Li. 2020. The effect of visual feedback types on the wait indicator interface of a mobile application. *Displays* 61, 10 (2020).

[4] Bill Chung. 2018. *Everything you need to know about skeleton screens.* https://uxdesign.cc/what-you-should-know-about-skeleton-screens

[5] Chris Harrison, Brian Amento, Stacey Kuznetsov, and Robert Bell. 2007. Rethinking the progress bar. In *Proceedings of the 20th annual ACM symposium on User interface software and technology*. 115–118.

[6] Jess Hohenstein, Hani Khan, Kramer Canfield, Samuel Tung, and Rocio Perez Cano. 2016. Shorter Wait Times: The Effects of Various Loading Screens on Perceived Performance. In *Conference Extended Abstracts on Human Factors in Computing Systems*. 3084–3090.

[7] Michael Hui and David Tse. 1996. What To Tell Consumers in Waits of Different Lengths. *Journal of Marketing* 60 (04 1996), 81–90.

[8] Christophe Hurter, Benjamin Cowan, Audrey Girouard, and Nathalie Henry Riche. 2012. Active Progress Bar: Aiding the switch to temporary activities. In *Proceedings of the 26th Annual BCS Interaction Specialist Group Conference on People and Computers*. 99–108.

[9] Google Inc. 2016. *Progress Indicators.* https://material.io/components/progress-indicators

[10] Lassi Liikkanen and Paula Gómez. 2013. Designing interactive systems for the experience of time. *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces, DPPI 2013* (09 2013), 146–155. https://doi.org/10.1145/2513506.2513522

[11] Thomas Mejtoft, Arvid Långström, and Ulrik Söderström. 2018. The effect of skeleton screens: Users' perception of speed and ease of navigation. In *Proceedings of the 36th European Conference on Cognitive Ergonomics*. 22. https://doi.org/10.1145/3232078.3232086

[12] Jeanne. Nakamura and Mihaly Csikszentmihalyi. 2001. *Flow Theory and Research.* 195–206. https://doi.org/10.1093/oxfordhb/9780195187243.013.0018

[13] Jacob Nielsen. 1994. Enhancing the explanatory power of usability heuristics. In *Proc. of SIGCHI conf. on Human Factors in Comp. Systems*. 152–158.

[14] Jacob Nielsen. 1994. *Usability engineering.* Morgan Kaufmann.

[15] Katie Sherwin. 2014. *Progress indicators make a slow system less insufferable.* https://www.nngroup.com/articles/progress-indicators/

[16] Ben Shneiderman and Catherine Plaisant. 2010. *Designing the user interface: strategies for effective human-computer interaction.* Pearson, India.

[17] Ulrik Söderström, Martin Bååth, and Thomas Mejtoft. 2018. The Users' Time Perception: The Effect of Various Animation Speeds on Loading Screens. In *Proc. of the 36th European Conference on Cognitive Ergonomics (ECCE'18).* Association for Computing Machinery, NY, USA, 4 pages.