Ghafurian, M., & Reitter, D. (2016). Impatience induced by waiting: An Effect Moderated by the Speed of Countdowns.
In DIS '16: Proceedings of the Designing Interactive Systems. Brisbane, Australia: ACM.

Impatience Induced by Waiting: An Effect Moderated by the Speed of Countdowns

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ABSTRACT

Countdowns and progress bars provide computer users with estimates of remaining wait times. These types of feedback are intended to manage their expectations and allow users to direct attention elsewhere. We suggest that they also moderate user's impatience, which affects decision-making in the subsequent task. In an experiment with 421 participants, impatience in a timing decision task was effectively and systematically manipulated through a countdown, as it affected timing and performance of the user's actions in the task. The effect persisted even after users gained task experience. More rapid countdowns reduced impatience. Post-hoc analysis also showed increased task satisfaction with rising countdown speed and suggested greater task satisfaction with a rapid countdown than with no waiting period at all.

Author Keywords

Impatience; Rationality; Countdown; Decision-making; Task satisfaction

ACM Classification Keywords

H.5.2; D.2.2; H.1.2 User Interfaces; Design Tools and Techniques; User/Machine Systems

INTRODUCTION

Despite dramatic improvements in speeds of computers and data transmission, computer users still face regular delays, e.g., to fetch data or finish computations. Further, there are situations where waiting is designed intentionally, e.g. to watch advertisements before a movie starts. Countdowns are useful tools in these situations to manage expectations, specifically where progress bars cannot be used (e.g., due to limited screen size or where continuous feedback is ineffective). Figure 1 shows a few of such examples.

Intuitively, waiting impacts user satisfaction, loyalty, and patience. However, the consequences of impatience for what a user does following the wait are largely unknown. In this study, we ask 1) whether impatience is persistent, extending beyond the waiting period, and 2) how it affects the task that

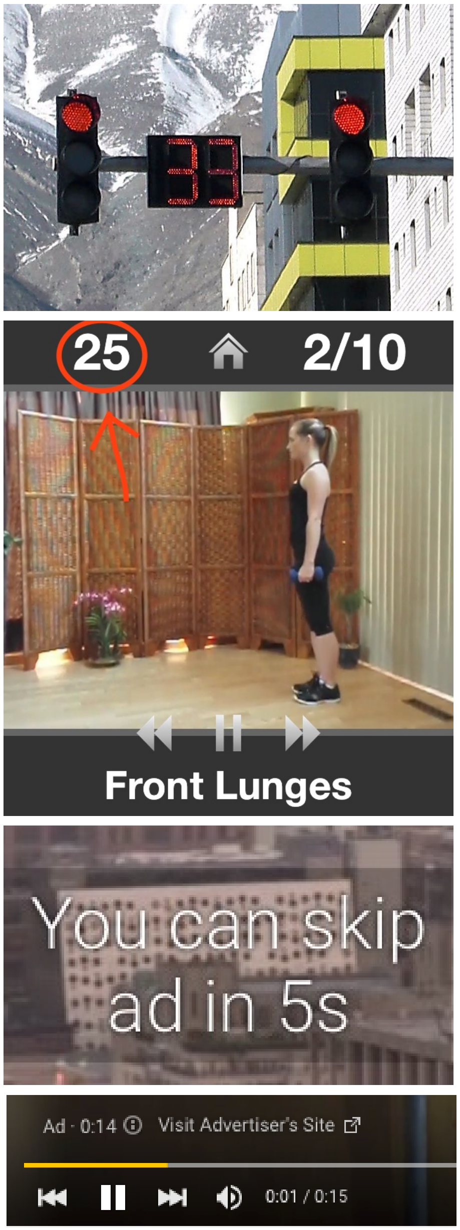


Figure 1. People face countdowns daily, such as at a red traffic light (photo taken by Sasan Geranmehr), in a gym workout video, or smartphone application showing the remaining time of an exercise (from *Ab Workout* app), or watching a commercial while waiting for a video to play (from *YouTube*).

DIS 2016, June 04–08, 2016, Brisbane, QLD, Australia

ACM 978-1-4503-4031-1/16/06…$15.00
DOI: http://dx.doi.org/10.1145/2901790.2901830

follows. If it negatively affects the following task, the next question is: what can a designer do about it? We study different ways to manipulate time perception in search for clear ways to decrease impatience and increase task satisfaction.

The situations we examine are those faced by regular computer users, although the implications go way beyond those interfaces. Delays are common when faced with technical systems (e.g., traffic lights and security checks), and people's decision-making may be severely affected [2, 8]. This is another good reason to make waiting more tolerable.

The hypothesis that countdowns can be manipulated to change time perception is backed by work on progress bars. Progress bars that speed up non-linearly were preferred by users [11]. Visually pulsating bars have been shown to decrease the perceived duration [12]. Studies in cognitive economics tell us that perception of duration is more influential when it comes to affective judgments than actual duration, and it is manipulated by presentation and other salient features of the task and wait period [6]. These studies seek to optimize human preferences, while we are also interested in actual decision-making: will computer users behave differently?

As a comparison to other types of feedback, countdowns are easy to manipulate. However, manipulating percentages is limited to changing their number from 1% to 100%, and deciding on a speed function for their progress. We face similar limitations for the design of progress bars. Given limited screen resolution and perceptual acuity, progress bars will either seem to move very slowly, or will be designed to move step-wise, pausing once or several times. If the delay is too long (in either percentages or prgoress bars), a pause will definitely occur at some point. Countdowns offer better flexibility. It is possible to start the countdown from a very large number and avoid having a pause, which can provide a better indication that the task is still in progress. That is why we believe it can be beneficial to use countdowns either along with progress bars or instead of percentages.

A previous study by the same authors suggested that impatience affects decision-making in the subsequent tasks. In this paper we manipulate countdowns and assess their effects on impatience, as well as on user satisfaction. We study the typical case of a program, where an exact estimate of the remaining time is unavailable or not necessary to convey.

BACKGROUND

People do not perceive time objectively [27], a bias that can mean over-estimating time intervals, especially in impulsive individuals [27]. As studies in cognitive psychology have shown, time perception depends on several factors. For instance, a user's level of attention influences time estimation and accuracy of the perceived time intervals [16, 4]: since information processing uses attentional resources, a high level of activity leaves people with fewer resources for time estimation, which leads to underestimating the time intervals. As a result, people pay less attention to the passing of time when they are processing a significant amount of information [1, 14]. So, people's perception of the speed of passing time changes with their level of activity. This is a reason why a person waiting in a line will find 10 minutes long compared to a person with only 10 minutes left to make an important deadline [3, 4, 19]. We expect that impatience can increase when a user perceives a delay to be longer than it is. However, when a delay sets the pace and provides a comparison interval for the actual task, that actual task might be perceived as shorter than it is. Conversely, the biases might also provide a mechanism to manipulate perceived waits and perceived task duration.

Perceived waiting time and the information provided in case of delay indirectly impact service satisfaction. This is because they affect the waiting time satisfaction of the users. Waiting time satisfaction is important as it moderates the effect of service satisfaction on costumer loyalty [2]. Furthermore, delays may have negative behavioral and emotional consequences. They can result in a significant deterioration of performance and negatively affect work productivity and work satisfaction [22]. Some user interfaces are also affected by impatience and associated dissatisfaction. Errors in speech recognition have been reported in telephony speech applications as a result of impatience caused by waiting. These errors were related to the duration of silence [7]. Ultimately, once impatience affects people's decision-making during critical tasks, it will have consequences for their health and security.

The presence of feedback extends users' tolerable waiting time [18]. In many tasks, the feedback shown during a delay is provided to users by showing a progress bar, countdown, or the percentage of the task being completed. Progress bars have been modified to reduce the perceived waiting time. Harrison et al. (2007) manipulated the speed of completion of the progress bars and reported significant effects on user perception of process duration. Users showed a strong aversion to pauses, especially towards the end [11]. In addition, the visual augmentation of progress bars are modified to reduce the perceived time. In another paper, Harrison et al. (2010) suggested that a backwards moving and decelerating progress bar has the best performance [12]. Further, Hurter et al. (2011) suggested the use of a temporary task while users are waiting. They propose an active progress bar design, where people can switch to a temporary activity (such as watching an animation or playing a game) while waiting [13].

To summarize, we know that people perceive time passing more slowly when their level of activity is low, such as while waiting for a task to start [4]. Further, we know waiting itself affects time judgments [4]. In the present experiment, we examine whether it is possible to influence people's impatience by manipulating countdowns. We hypothesize that waiting could affect people's experience negatively and affect the rationality of their future actions.

METHOD

In this section, we discuss in detail a task used to evaluate a user's impatience by eliciting timing decisions. We then describe how impatience was manipulated using a countdown that varied by experimental condition.

The timing task

The target task we give users requires deep cognitive processing and is designed to put them in situations where they have to make choices about *when* to act rather than how, as would be more common in many economic or behavioral decision-making tasks. As in many real-life situations encountered by, e.g., business or security professionals, decisions are made against the backdrop of a changing, stochastic environment. The task we selected allows us to compare the participants' timing choices in relation to a defined, non-obvious optimal strategy.

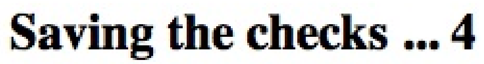
The task is a game, which we proceed to describe first in abstract terms, and then, in the next section, in its concrete scenario. It is inspired by the *FlipIt* game of "stealth takeover" [25]. *FlipIt* is a two player game, where players need to make one or more *moves* during a finite time span. These *moves* come at a constant cost, plus a variable payoff. The payoff depends on the actions of the players. One player's payoff is the lowest when preceding the other player, and highest when following it immediately. Thus, the players have to anticipate the other player's move (from previous experience) and trade the risk of wasting a move (by acting too early) against the benefits of acting early enough. This game has been used as a dynamic environment to study timing decisions under uncertainty [10, 20], even though it was conceived as a computer security simulation.

The generic FlipIt game is symmetric (both players attempt to move as soon as possible after the opponent, and the game runs for a fixed duration). Our game, which we call the *Cookie Monster Game* is asymmetric and has only one human player, who plays against a computer opponent. The computer opponent makes a move exactly once per 30-second round at an oblique time point sampled from a uniform distribution. We will outline the framing for the task in the next section for additional clarity. In two different variants of the *Cookie Monster Game*, Ghafurian and Reitter (2014) found impatience as a bias that affected decision-making in individuals and led to irrational decisions.

Scenario and Instructions

Participants play the *Cookie Monster Game*. Their opponent in the game, Cookie Monster, is a familiar figure from children's TV. Each round of the game starts with the player in the kitchen, cooking. Meanwhile, Cookie Monster is waiting for the player in the living room. In the living room, the player has 3000 cookies that s/he wants to protect from the Cookie Monster. The player knows that the Cookie Monster will definitely start eating them at some point and with a constant pace of 100 cookies per second. However, s/he does not know when. The player needs to develop a strategy to check on Cookie Monster. Anytime the player checks on him, s/he needs to give him 100 cookies to cover up for not trusting him and the game continues with the player going back to the kitchen. If s/he catches Cookie Monster while eating the cookies, the game ends. The number of the remaining cookies will be the points the player earns in the game. The subjects are paid according to their performance in the game, which corresponds to the overall points they earn in all the rounds.

Participants play six rounds of the game, with the first one (round 0) being a practice round. Each round of the game lasts 30 seconds, and players start out with $30 * 100$ points (cookies). Participants decide on their strategy in advance by placing checks on the timeline before the round starts. The game ends after a successful check, and only the checks up to that point are associated with a cost for the player. Each second of latency in catching the opponent costs 100 points. So, e.g., for a 10-second game, with the opponent playing at $6.0s$, and the player checking twice at seconds 4.0 and 6.5, the payoff is $1000 - 0.5 * 100 - 200 = 750$ points. This setting creates an incentive to neither check too early, nor wait too long.[1]



Saving the checks ... 4

Figure 2. The countdown shown to participants, indicating that the delay is caused to save their selected checks.

Our game can be played as an online game where the player and the opponent make their moves as time progresses, or it can be played as a strategy game where the player pre-defines a strategy for each round. Both variants reflect different classes of real-life decision-making. To mirror realistic decision-making in tasks that general computer users would encounter, we have players define their strategy before watching it unfold. We expect that this motivates players to assess risks and timing more explicitly.

Countdown conditions

The experiment has a total of six between-participant conditions. Three of the conditions are the principal conditions of the experiment, one is the control condition, and the other two are the secondary conditions. In all except the control condition, we introduce a wait time of 15 seconds between defining the strategy (by setting checks) and actually watching the game. This delay is accompanied by a countdown, and a plausible explanation "Saving the Checks" (see figure 2). We define different speeds for countdowns to manipulate impatience and hypothesize that a faster countdown will moderate impatience.

In the three *principal* conditions, countdowns progress constantly, while the starting number of each countdown (and thus the pace of it) changes. The control and the principal conditions of the experiment are as follows:

- **NoWait (control)**: There is no delay (and thus no countdown) before the start of each round.

- **5CD**: There is a 15-second wait before start of each round, accompanied by an informational message "saving the checks" and a countdown from **5 to 1**. Therefore, each count lasts 3 seconds.

- **10CD**: A 15-second wait is accompanied by the same message and a countdown from **10 to 1**. Therefore, each count lasts 1.5 seconds.

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[1] Risk-taking in discrete decisions is affected by the polarity of incentives [24].

- **15CD**: A 15-second wait is accompanied by the same message and a countdown from **15 to 1**. Therefore, each count lasts 1 second.

In addition, we explore two secondary conditions where the pace of the countdowns is not constant. We adopt a speed function proposed by Harrison et al. (2007), which gives the proportion of the number space completed as a function of the proportion of the delay completed (x): $f(x) = (x + (1-x)/2)^8$. Based on Harrison et al.'s findings, this speed function made waiting more tolerable for users, comparing to a constant pace and several other speed functions [11]. We utilize this speed function in the following, secondary conditions:

- **5CDM**: A 15-second wait is accompanied by a countdown from **5 to 1**. In this condition the speed of countdown changes based on the aforementioned speed function: starting with a slow pace and increasing with each count. Therefore, the first number (5) would last the longest and the last count (1) would last the shortest amount of time.

- **15CDM**: A 15-second wait is accompanied by the same message as before and a countdown from **15 to 1**. The speed of the counts increases as in the 5CDM condition.

The start values of 5 and 15 are chosen for the secondly conditions to be compared to one fast countdown (15CD, where each count lasts 1 second), and one slow countdown (5CD, where each count lasts 3 second) in the primary conditions.

Data Collection

442 North-America-based volunteers were recruited through Amazon Mechanical Turk (153 female, 288 male, and 1 unknown; age mean 33y, [18,77]). Each participant played 6 rounds of the game, where the first round (round 0) was labeled a practice round. A show-up fee of $0.40 and a bonus proportional to game performance were paid. Repeat participation was disallowed. 21 participants' data (6 female, 14 male, and 1 unknown) was discarded due to failure to fully attend to the game, according to the attention check (a performance criterion that was defined during the design phase). With participants typical work schedules and associated stress factors in mind, they were recruited and immediately run in several batches at approximately the same time of day, that is, in the afternoon in all North American time zones (4 p.m. Eastern time).

Study procedure

Participants first find and select the task (our experiment) on Mechanical Turk. At the beginning of the experiment, participants complete a survey with four demographic questions (e.g. age) , three basic integrity questions (e.g. "Please select the rightmost option"), and seven risk propensity assessing questions, which were developed and tested by Meertens & Lion (2008)[17]. The risk propensity questionnaire includes Likert-scale questions such as "I really dislike not knowing what is going to happen", or "I do not take risks with my health."

After submitting the survey, participants receive instructions with visual examples of how the game works. Figures 3 and 4 demonstrate similar visual feedback of the game that is shown to participants.

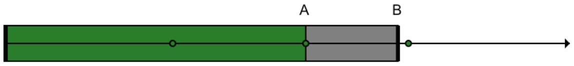

Figure 3. Visualization of a game in progress. The game has progressed to point B. The latest time the player has checked was at point A. No information about the situation after point A is known. The dots on the bar demonstrate the checks that were pre-set by the player.

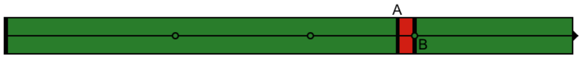

Figure 4. Feedback shown after a round, when the opponent played at point A and the player made their last check at point B. At time B, the (small) extent of the opponent's dominance of the game was revealed. The player's payoff is proportional to the green area.

The game starts after reading the instructions. In each round, participants first define their strategy by setting the check times. What follows is the countdown (if any, depending on the condition), and then they watch the game. The countdown (if any) always takes 15 seconds; the screen is labeled "Saving the checks...N" where N is a number counting down (Figure 2). The game begins after this countdown. With this design, participants did not see a countdown until after deciding on the strategy during the practice round, which allows us to assess the early effects of countdowns in the following round (round 1).

Using a between-subjects design, the participants were assigned to the aforementioned experimental conditions. In the conditions as described above, the starting number of the countdowns changed, and as a result, so did the pace of counts.

Participants are prevented from switching to other windows on their screen, and their attention is monitored by requiring them to press a key immediately after the end of each round (which is random).

At the end of the experiment, participants had a chance to voluntarily leave comments about the game, technical issues, and their personal opinion.

ANALYSIS

The hypothetical rational player

A *rational* player would make optimal decisions, assuming exactly the same knowledge of a specific round of the game (and lack thereof) that a human player has. It perfectly understands the game's rules, and it makes no biased assumptions. Unlike humans, it is not limited in computational power (e.g., [9]). The rational player finds the actions that would maximize the expected utility, which will optimize the payoff assuming an infinite number of rounds [21].

The rational player in this game is proposed by the authors in [8]: We assume that the game is running, and the opponent's check is not caught yet. Considering one per time unit ($1/100$ or a hundredth of a second) to be the pay rate, and d to be the maximum duration of a round (30 seconds). The iterative solution to calculate the expected utility of a move at time t given the latest previous, unsuccessful move at time t_p is:

Table 1. Rational Strategies

Duration	Number and timing of Checks	Expected U.
3000	5: (800, 1401, 1802, 2203, 2604)	2432

All times in hundredths of seconds.

$$
\begin{aligned}
U(t,t_p) = {} & -MoveCost \\
& + \sum_{k=t_p}^{t} \tfrac{1}{d-t_p}(k-t_p \; + \; d-t) \\
& + \max[0, \tfrac{d-t}{d-t_p} \max_{t<m<d} U(m,t)]
\end{aligned}
$$

This function iterates over all the possible opponent move times k up to the proposed check time t, whose probability is the inverse of the remaining time $d{-}t_p$. The payoff for these consists of the initial period until the opponent moves, and the time period after our own move. Rational future moves are assumed and calculated iteratively if the opponent has not played so far.

The predefined rational strategy for our 30-second game is shown in Table 1.

We assume that a player's personal preferences [23] and current impatience status affect the timing of his or her future checks. The rational player model serves us in evaluating the person's strategy, one check at a time. Note that unlike in standard decision-making tasks designed to contrast risk-averse or risk-seeking behavior, there is only one optimal choice at any given time, and any risk-seeking or risk-averse behavior will reduce the participant's payoff. This means that participants were adequately incentivized to play rationally.

Strategy Analysis

To contrast the effects of different countdowns, we evaluate the game strategies by comparing the player's timing choices to what a rational player would do. We use the concept of the rational player as described above in a dynamic way: a model that optimizes the expected outcome at any point in time. The dynamic rational model finds the next best check given *the players's actions so far* and *the remaining time* of the game.

Assume that the participant has made the first check at time 300 (i.e., 3 seconds into the round). The time difference of participant's check to the rational model's check (Table 1) would be $\Delta t_1 = t_{rational} - t_{subject} = 800 - 300 = 500$. With 300 being the first check, the remaining time of the round would be 2700 and the dynamic rational model would check at times 1020, 1561, 2102, 2463, and 2644. Thus the next suggested rational check is at time 1020. If the participant's second check is earlier, at 700, then $\Delta t_2 = 1020 - 700 = 320$. The next remaining time is 2300, and the next rational suggestion would be to check at times 1312, 1925, 2385, and 2692. [2]

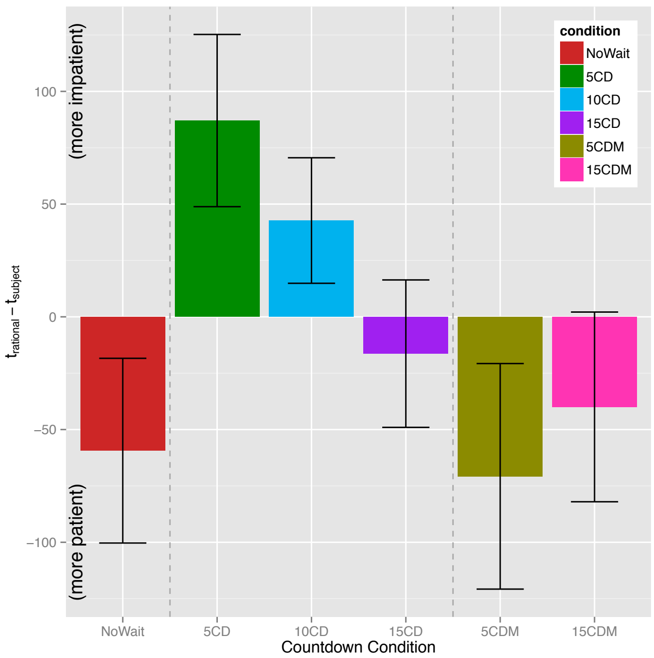

Figure 5. Δt, the deviation of check times from rational check times. Higher values indicate earlier checks. Participants who see the slower countdown chose earlier checks.

We report average Δt figures per round and condition. The measure is an indicator of how much people advance their timing in relation to a generally unknown, but anticipated time point. A high Δt implies earlier checks.

RESULTS

Δt for all participants and all conditions is shown in Figure 5. We first discuss the control and the principal conditions (NoWait, 5CD, 10CD, and 15CD) and then continue with discussing the secondary conditions (5CDM and 15CDM).

Results of the principal conditions

Δt for the principal conditions is shown in Figure 6. Slower counts increased participants' Δt , which implies reducing the waiting time between two checks.[3]

The first round, as the practice round, was removed from the analysis. However, participants first experienced waiting during this round.

Table 2. Regression model predicting the time difference between rational checks to the opponents' checks. Round number is centered.

Covariate	Estimate	SE	t	Pr ($>|t|$)
Intercept	-47.83	39.51	-1.210	0.227
CountDuration (s)	47.14	21.26	2.218	$< .05$
log (Round)	-27.39	11.40	-2.402	$< .05$

A regression model (Table 2) predicts Δt as a function of round number and the time that each count lasts in each condition

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[2] time units are 1/100 (or hundredths) of a second

[3] We evaluated participants' risk preferences using a standardized survey evaluating Risk Propensity. No correlation is observed between risk propensity and Δt, which confirms that impatience is a personal preference and emotional status that is independent of general risk propensity. See also [8] (Fig.3).

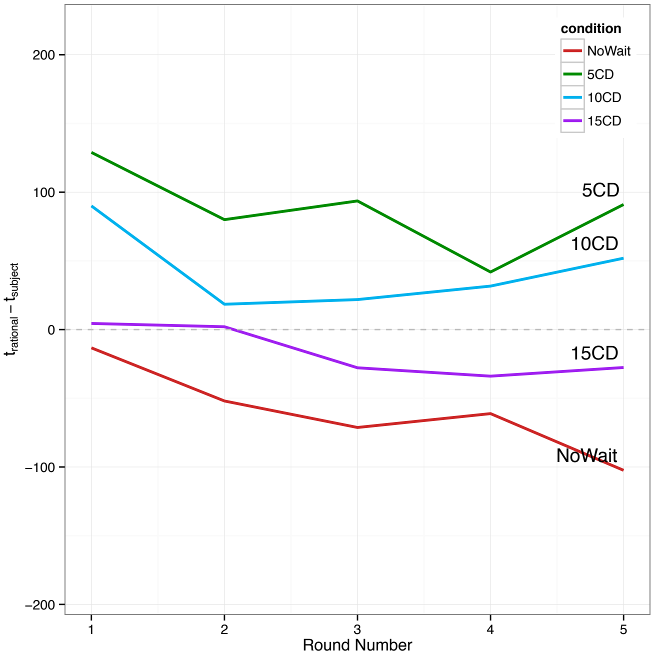

Figure 6. Δt for the principal conditions over all 5 scored rounds. See Table 2 for significance of differences.

(CountDuration: 1 for 15CD, 1.5 for 10CD, and 3 for 5CD). All predictors are centered. Round number is log-transformed due to the nature of learning effect. Count Duration is positively correlated with Δt, which indicates that having slower counts results in checks that are earlier than what would be rational. A random intercept grouped by subject was fitted (as this is a repeated-measures study).

Further, the performance of participants in the 5CD condition is significantly different from the control (NoWait) condition ($se = 0.565, t = 2.513, p < 0.05$). However, as the speed of the countdown increases, this difference decreases. We do not see a significant difference between the performance of people in 15CD and the control (NoWait) condition ($se = 0.478, t = 0.857, p = 0.393$).

Results of the secondary conditions

We next evaluate the effect of a non-linear countdown speed. We use the secondary conditions to compare the effect of our proposed linear, fast countdowns to a nonlinear function that is proposed to be more tolerable for users when used in progress bars [11]. The secondary conditions 5CDM and 15CDM are compared to two of the principal conditions 5CD and 15CD. We consider 15CD as a fast countdown (each count takes 1 second), and 5CD as a slow countdown (each count takes 3 seconds). 5CDM and 15CDM use the same number of counts as 5CD and 15CD, but apply a dynamic countdown speed.

Δt values over rounds are shown in Figure 7.

People in the secondary conditions choose longer wait times between checks, meaning later check points compared to rational times (Δt). Participants in the 15CD condition make their moves closest to the rational player compared to the others (Fig. 5).

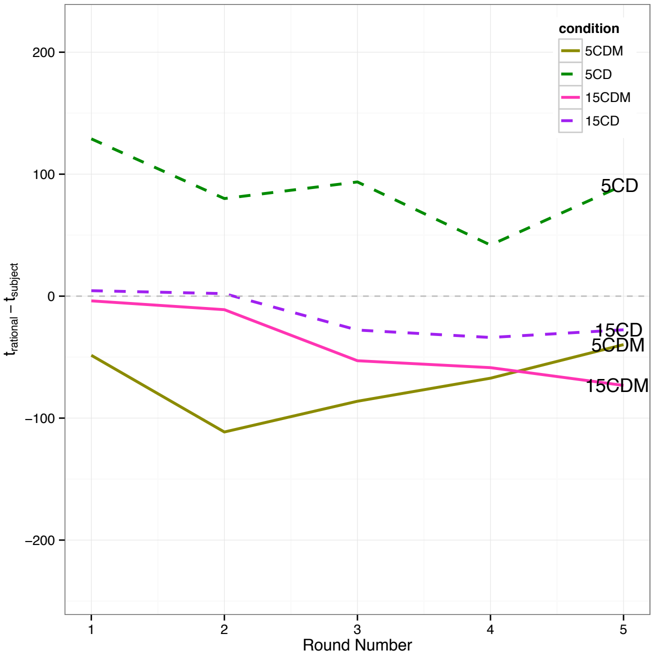

Figure 7. Participant's checks compared to the dynamic rational strategy for 5CDM, and 15CDM conditions. 5CD and 15CD from Fig.6 are shown for comparison. See Table 3 for significance of differences.

Table 3. Model of the effect of nonlinear speeds in the rapid and slow countdown conditions.

Covariate	Estimate	SE	t	$\Pr(>\lvert t\rvert)$
15counts	-0.144	0.322	-0.449	0.654
5counts	0.864	0.40	2.167	$< .05$
log (Round)	-0.361	0.156	-2.318	$< .05$
15counts:nonlinear	-0.254	0.512	-0.495	0.621
5counts:nonlinear	-1.5786	0.587	-2.690	$< .01$

A mixed-effects regression model was fitted to the data matching two principal conditions (5CD, 15CD) and their two secondary counterparts (5CDM, 15CDM), coded as 5counts and 15counts, respectively (Table 3). Random intercept grouped by subject were fitted. The nonlinear speed significantly delayed people's check times in the slow countdown (5counts:nonlinear, $p < 0.05$), but this influence does not exist for the faster countdown (15counts:nonlinear, $p = 0.621$). These results also emphasize on the positive effects of fast countdowns.

Task satisfaction

We present a post-hoc study on participants' comments. Since leaving a comment was not required, many participants left without leaving one. A common type of comments was merely a copy of the ending message as is typical for studies on Mechanical Turk. We analyzed the remaining comments. Comments were pre-classified according to positive and negative sentiments using automated keyword spotting and manual verification. We found 82 positive comments. Some examples of these comments are: "very fun!", "Thanks. It was very fun & unique.", ”interesting study”[4]. (Negative comments pertained to technical issues; they were rare.)

The proportion of positive comments of the participants in each condition is calculated. (The proportions are low as participants were not required to leave comments.) While we cannot assume anything about the silent participants, we can be sure that people who voluntarily spent time to leave even a simple, positive comment such as “thanks” actually did enjoy the task.

Figure 8 visualizes the proportion of positive comments for each condition. We see that in the principal conditions (5CD, 10CD, and 15CD), the rate of positive comments significantly decreases as the speed of countdown decreases ($se = 0.246, z = -1.984, p < 0.05$). Further, using the nonlinear function for the slow countdown (5CDM) significantly affected participant’s decision-making and impatience during the game (compared to 5CD). However. it did not affect the rate of positive comments, or in other words, users’ task satisfaction ($se = 0.615, z = 0.183, p = 0.855$).

To make sure that positive comments are not affected by the bonus participants received, and the difference is due to the manipulation of countdowns, we fit a regression model, predicting positive comments based on the amount of bonus received. We do not observe an effect of the payment on the positive comment ($se = 316, z = 0.232, p = 0.816$).

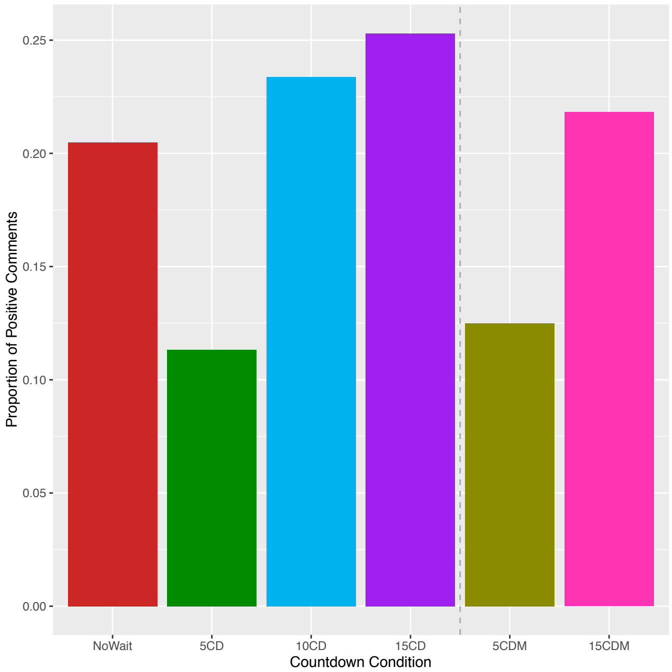

Figure 8. The proportion of the positive comments to all the comments for each condition. (Only one binary data point per participant.)

DISCUSSION

While waiting affects user’s satisfaction and can result in negative behavioral and emotional consequences, the perceived waiting time plays an important role in moderating those consequences [2, 22]. In many situations people see countdowns during a delay or while waiting for a task to be started/completed. Examples of these countdowns are not limited purely to situations where the user is inactive, such as waiting at a traffic light. They are also used to show the remaining time of a task, such as a workout. While people’s perception of the speed of time passing changes based on their level of activity [4, 3, 19], manipulating impatience and reducing it would be useful in all situations, regardless of activity.

In this study, we manipulated countdowns, which affected the computer users’ impatience or their perception of delays. While the duration they actually waited was kept constant, the starting number of the countdown (and thus the speed of the counts), was different from condition to condition. Faster countdowns reduced impatience and resulted in a better decision afterwards, while people in the conditions with slower counts became more impatient and played more frequently.

In addition, we received a higher rate of positive comments from participants in the faster countdown conditions. This shows that this manipulation not only affected people’s impatience and time perception, but also affected their task satisfaction.

Surprisingly, participants who experienced a 15-second delay and received rapid countdowns were more positive about the game compared to people who did not experience any delay (NoWait). Akin to a website with a faux progress bar, which gives the impression that a computer program is hard at work, participants may have been impressed by the system. The message saying "saving the checks" may have made the system seem more sophisticated. This suggests that experiencing a small delay accompanied by an appropriate UI design does not necessarily affect users negatively, and it can even impress users and affect their task satisfaction positively.

Finally, nonlinear countdowns used in the secondary conditions only improved decision-making in the slow countdown (5CDM), but it neither affected decision-making in the fast countdown (15CDM vs. 15CD), nor affected task satisfaction. This evidence suggests that making countdowns faster is more effective than making them non-linear, which we believe might also be true for progress bars.

More questions about the mechanisms behind the effect remain. Specifically, we cannot be sure about how time perception is affected by the countdowns, and whether a manipulation of duration perception or of expectations leads to altered judgments of the subsequent task duration. The alternative, simpler interpretation would be that persistent impatience is created that affects subsequent decision-making.

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[4] Some other examples of the positive comments are: "Thanks. It was very fun & unique", "C is for cookie!! nom nom nom!", ”Thanks, this was a really fun HIT!”, and ”I am struggling to contain my laughter from the first page of the study. The animated gif is NOT helping. Typos, ’bellow’(below)”

IMPLICATIONS FOR THE DESIGNER

The applications of these results are evident. An aforementioned example is adding fast countdowns while an advertisement is being played. As it makes waiting more tolerable for the users, this would be beneficial to both users and the advertising companies. We suggest using faster countdowns in situations where knowing an exact estimate of the remaining time is not beneficial (e.g. for a short advertisement, for downloading a file, or for specific softwares that are being installed).

As another example, we propose adding fast countdowns to red traffic lights. We know that Traffic safety is affected by impatience. Wissinger et al. (2000) investigated red light running and reported impatience as one of the most frequently mentioned reasons of red light running in focus groups [26]. Long et al. (2013) showed that lights with countdown assist drivers' decision-making and reduce hazardous maneuvers [15]. Chiou and Chang (2010) showed that red signal countdowns enhance intersection efficiency [5]. We suggest that using red lights with a faster speed of countdown can moderate impatience and affect the behavior of drivers and pedestrians.

The flexibility of a countdown is why we think they are beneficial, whether used alone or along with a progress bar. As it is discussed earlier, in situations where very long delays are expected, having a pause in progress bars and percentages is inevitable, due to their limitations. We believe that in those situations, using a fast countdown could have larger effects on time perception and impatience compared to a visual progress bar. We also suggest considering combining countdowns with progress bars (e.g. Figure 9). In addition, we point out that situations with long delays and a limited screen size exist where the speed of fast counts could have larger effects on time perception compared to a visual progress bar.

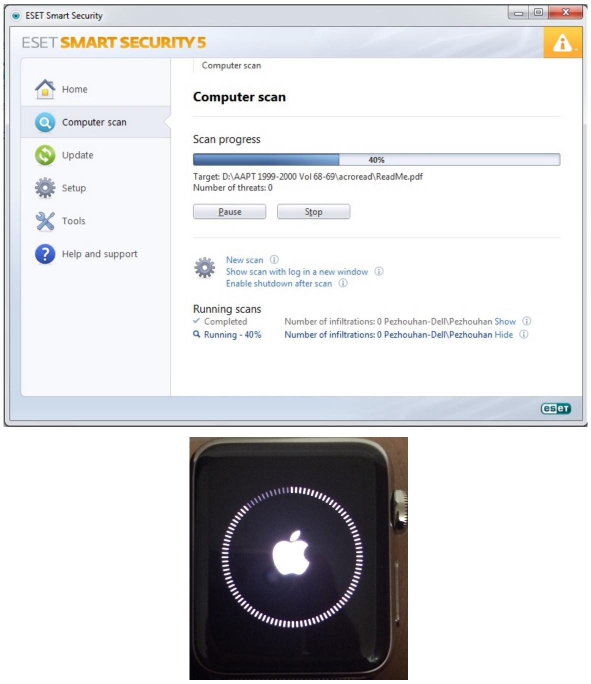
Finally, it is worth emphasizing that the context in which the countdowns are being manipulated is important. As an example, this would be a good manipulation for red lights (to decrease the level of both pedestrians' and drivers' impatience). We do not recommend this manipulation in situations where people need an accurate estimate of the remaining time (e.g., green light, where people need to estimate whether they have enough time to cross the street or not). If this manipulation is made in such contexts, it should be emphasized to people that the counts do not represent the remaining seconds.

CONCLUSION

Waiting for computers and technical systems to complete tasks is not only cause for annoyance, but also produces impatience that affects performance in subsequent tasks.

Manipulation of a common user interface device can mitigate this impatience: countdowns can be shown, and when they run more quickly or speed up towards the end, they can reduce impatience. This was visible, most importantly, in terms of task performance. User satisfaction was improved by greater speed of the countdown, but not by a nonlinear countdown.

The main contributions of this study are as follows. (1) We systematically induce impatience using a period of waiting and show that this impatience has knock-on effects on both decision-making in subsequent tasks and user satisfaction. (2) We demonstrate that a faster countdown shown during an equally-long waiting period reliably decreases user's impatience, evidenced by later decisions. (3) We present evidence that user satisfaction is improved by waits accompanied by rapid countdowns compared to having no waiting period at all.



Target: D:\AAPT 1999-2000 Vol 68-69\acroread\ReadMe.pdf
Number of threats: 0

✓ Completed Number of infiltrations: 0 Pezhouhan-Dell\Pezhouhan Show
Running - 40% Number of infiltrations: 0 Pezhouhan-Dell\Pezhouhan Hide

Figure 9. Progress bars used alone, or along with percentages. We recommend adding countdowns to them (e.g., above or below the progress bar in the first example, and in the middle of the screen in the second example). In the first example, impatience can result in stopping an important scan, which can endanger a users' security. The second example is an operating system being updated. For some of such firmware updates, stopping the process can cause harm to the system..

We believe this manipulation would be of interest in a wide range of situations, where people are waiting or face delays. Clearly perceiving a faster passage of time in these situations can result in a better user experience and improve the quality of work completed by the user in the context of such waits.

Acknowledgments

The authors thank Frank E. Ritter, Jens Grossklags, Jeremy Cole, and all anonymous referees for their comments on this study.

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