# Procrastination and the Non-Monotonic Effect of Deadlines on Task Completion

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13 August 2021

# Procrastination and the Non-Monotonic Effect of Deadlines on Task Completion

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August 31, 2021

**Abstract:** We conduct a field experiment to test the non-monotonic effect of deadline length on task completion. Participants are invited to complete an online survey in which a donation goes to charity. They are given either one week, one month or no deadline to respond. Responses are lowest for the one-month deadline and highest when no deadline is specified. No deadline and the one-week deadline feature a large number of early responses, while providing a one-month deadline appears to give people permission to procrastinate. If they are inattentive, they might forget to complete the task.

**Keywords:** deadlines; task completion; charitable tasks; charitable giving; inattention; procrastination; forgetting; field experiment

**JEL Codes:** C93; D64

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## 1. Introduction

Deadlines often help us organize our lives by motivating us to perform tasks that we have been procrastinating over (O'Donoghue and Rabin, 1999). Certain tasks, like filing tax returns, must be completed; otherwise the consequences or penalties can be severe. Other tasks, such as redeeming vouchers, donating money to charity, or completing a survey, are not compulsory, and we sometimes end up not completing them even though there would be a benefit to us or other people. Whether a task gets completed or not, and the timing of the completion, could be influenced by the associated deadline, however the relationship is not necessarily trivial as various behavioral factors are likely to play a role. For example, while increasing the deadline length gives a person more time to complete the task, it also means that the task could be postponed until later and possibly forgotten. Despite some recent theoretical developments regarding the impact of deadlines on task completion, there is not much empirical evidence documenting the nature of this relationship.

The idea that deadline length affects completion rates was proposed by Taubinsky (2014), whose model of inattention incorporates the possibility of people forgetting to take an action and missing the deadline. Taubinsky argues that "a decision maker may form a clear intention for how he would like to act in the future, but then fails to follow through on that intention because it is not top of mind" (p. 13). We test the model's predictions in a field experiment in which we invite a nationally representative sample of 3,276 people to give up five minutes of their time to answer an online survey, and, in doing so, earn $10 that will be donated to charity by the researchers.[1]

Our experiment consists of three conditions: a one-week deadline (short deadline), a one-month deadline (intermediate deadline), and no deadline at all (infinite deadline). Taubinsky's model (discussed in more detail in Section 3) predicts completion rates to be non-monotonic in the deadline length. In particular, for naïve individuals who are unaware of their inattention problem, completion rates will be lowest for deadlines of intermediate length whereas the task is more likely to be completed under the shorter deadline as it is going to be on people's minds. If the probability of being attentive is non-zero (e.g., there is a chance of

[1] Hence, the task could be thought of as either completing a survey (benefitting those doing the research) or giving up a small amount of time to earn money for charity (benefitting the charity and those who are helped by the charity's work).

encountering a cue, such as hearing about a charity in a different context), longer deadlines will not reduce the probability of completing the task. In fact, as the deadline approaches infinity, or if there is no deadline at all, the task will eventually get completed, assuming the decision maker intends to do it. The model further predicts that responses for an infinite deadline will not be lower than short deadlines and will be higher than intermediate deadlines. If decision makers interpret the lack of deadline as meaning they can take as long as they like (i.e., the deadline is infinite), then the model predicts completions will be higher than for the intermediate deadline as people will eventually remember to perform the task, assuming they had intended to. In this case, there will be a non-trivial number of (very) late completions.

Taubinsky (2014) does not test the prediction of the model regarding the impact of the deadline length on completion rates. Instead, his experiment focuses on testing whether cues (reminders) reduce the gap in task completion rates for a longer versus shorter deadline, in the context of a personal-benefit task. He finds this is indeed the case and thus provides evidence for the existence of inattentiveness among his subjects.[2] Our primary aim, on the other hand, is to test the predictions related to non-monotonicity of deadline effects. Incorporating a no-deadline treatment, which has not been studied experimentally in a charitable task setting, allows us to test whether completion rates will be lower for deadlines of intermediate length than for short or infinite deadlines.

The current study is part of our research program on procrastination in charitable tasks. In our earlier work (Knowles and Servátka, 2015) we varied the deadline length (one hour, one day or one week) for a charitable donation in a laboratory experiment. The project focused on the interplay of transaction costs and the opportunity cost of time at the moment of solicitation. This earlier work did not include a treatment with no deadline. To incorporate a no-deadline treatment in the context of a charitable task we conduct a field experiment instead of a laboratory experiment. A laboratory experiment arguably imposes an implicit deadline (e.g., end of the semester, academic year or one's undergraduate studies) even if this is not explicitly stated in the experimental instructions. 'Stepping outside the lab' allows more

[2] Sonntag and Zizzo (2015) also find that reminders reduce inattentiveness in the context of charitable giving, but that weekly reminders are no more effective than monthly reminders. They do not, however, analyze the effect of different deadlines on completion rates.

control over participants' expectations in a situation when no deadline is specified, a cornerstone of the current study.

To the best of our knowledge our current study is the first to document the non-monotonic effect of deadline length on response rates (in any context, whether personal-benefit or charitable) and also the first to find that deadline length impacts the completion of a charitable task.[3] In particular, we find responses (representing task completions) are substantially higher for our short (one-week) deadline compared to our long (one-month) deadline. This result is in line with existing results in the literature for personal-benefit tasks (Tversky and Shafir, 1992; Taubinsky 2014; Shu and Gneezy, 2010; Janakiraman and Ordóñez, 2012). Interestingly, whereas having no deadline has been found to reduce response rates for personal-benefit tasks (Tversky and Shafir, 1992), we find that having no deadline *increases* response rates, relative to both a short and a long deadline.

Regarding the timing, while a large number of responses in the *No Deadline* and *One Week* treatments come in early, responses in *One Week* drop off sharply after the deadline. In the *One Month* treatment, there are very few prompt responses. While Taubinsky's model predicts that if given a long enough time horizon, people will eventually remember to complete the task, our *No Deadline* treatment leads to only three very late responses.[4] Late responses are thus not the main driver behind the effectiveness of not imposing a deadline. Instead, we observe that almost half of all responses come in within the first three days.

[3] We use the term "charitable tasks" to refer to cases where the benefit of undertaking the task goes to someone else (e.g., completing a survey or donating to charity) and the term "personal-benefit tasks" to refer to tasks which principally benefit the person undertaking them.

[4] We periodically monitor the website to check whether any new responses come in. There have not been any new entries following the three late responses. The experiment was run in 2014.

## 2. Existing Evidence on the Effects of Deadlines

In this section we discuss the relevant details of previous studies on deadline length and highlight the differences with respect to the focus and/or design of our field experiment. We begin by reviewing studies in the context of charitable giving, an obvious example of a charitable task. Damgaard and Gravert (2017) conduct a field experiment in which solicitation emails and texts are sent to people who have previously donated to a Danish charity, to test the effect of deadlines on response rates. Participants are told their monetary donation will be matched if it is made by a specified deadline. The deadline length varies depending on whether the solicitation is by email or text. In the email treatment the short deadline is three days, the intermediate deadline 10 days and the long deadline 34 days. When the solicitation is by text, the short deadline is two days, the intermediate deadline three days and the long deadline 34 days. In contrast to our results, they find no evidence of deadline length affecting donations, but instead find what they term a "now or never" effect; people either tend to donate promptly or not at all. Importantly, the context of this field experiment also differs from ours in that we ask participants to give up their time to answer a survey, and in doing so earn money for a charity. Requiring people to spend time is a better way place to study procrastination than requiring people to send money. Although sending money also takes time, it is generally much less than filling out a survey.

Damgaard and Gravert's study does not include a no-deadline treatment. Instead, the authors argue that their long deadline (34 days, which is only six days longer than our one-month deadline) is non-binding; that is, it is effectively the same as having no deadline at all. To back this claim they cite Huck and Rasul's (2011) field experiment analyzing the effect of matching subsidies and the presence of a lead donor on charitable giving. Huck and Rasul implement treatments where subjects are told that if they make a donation within four weeks, the donation will be matched by an anonymous donor. In other treatments there is no deadline and no matching subsidy. Huck and Rasul suggest that this four-week deadline likely does not affect donor behavior as 97% of those who donate do so within the four-week deadline, with the median donation time being within one week. Huck and Rasul also point out that they observe no differential effects on the time for donations to be received between the treatments specifying a four-week deadline, and those where no deadline is given. However, this comparison of treatments with and without a deadline is confounded by the fact that the

treatments with a four-week deadline also include a matching subsidy, whereas the treatments with no deadline do not include a matching subsidy.

In Knowles and Servátka (2015) we also find no difference in charitable giving for deadline lengths of one hour, one day and one week in a laboratory experiment, suggesting that if deadlines are to have a behavioral effect, they need to be properly calibrated. The design of that study does not include a no-deadline treatment, meaning the data cannot be (and are not intended to be) used to test the effects of a stated (long or short) deadline versus no deadline. Unlike a laboratory experiment, where, from the perspective of student subjects there is always an implicit deadline (e.g., the end of the semester or academic year), a field experiment allows us to implement a treatment with a truly non-binding no-deadline treatment.

Karlan et al. (2011) focus mainly on the effect of matching subsidies on donations, but they also consider the effect of adding a message to the solicitation indicating urgency. The wording is either "now is the time to give" or "now is the time to join the fight". Including this message does not increase donations compared to a control without this wording. Subjects in one mail-out are also given different deadlines by which the donation has to be made to qualify for the matching subsidy. The solicitation letters are sent out in September, with some subjects given until the end of October to respond and others till the end of December. These are obviously both relatively long deadlines that could give people permission to procrastinate. The different deadline length has no statistically significant effect on donations, possibly because solicitations included a message regarding urgency.

In the context of personal-benefit tasks, Tversky and Shafir (1992) test whether giving people more time enhances the tendency to delay action. They offer students $5 to complete and return a lengthy questionnaire, with students given either five days, three weeks or no deadline by which to complete the questionnaire. While the task employed in Tversky and Shafir's experiment is similar to ours, students receive the payment in their context, rather than the funds going to a charity on our participant's behalf. The other two notable differences between Tversky and Shafir's study and ours are slightly shorter deadlines (if specified) and a different population of participants. Unfortunately, Tversky and Shafir do not provide details about how their experiment was implemented and whether there was a physical letter (as in our study) or other natural reminders to make people comply. They also

do not report the timing of responses. The rates of return are 60% with five-days deadline, 42% with three-weeks deadline, and 25% with no deadline, indicating the more time people have to complete the task, the lower the response rate. Their result, of response rates monotonically declining with deadline length, contrasts with our setting, in which we find that *No Deadline* treatment raises response rates.

Shu and Gneezy (2010) give subjects vouchers to either a café or, in a different experiment, to a movie theatre, and find that vouchers are more likely to be redeemed for the short expiry date (three weeks in the café experiment and two weeks in the movie experiment) than for the long expiry date (two months in the café experiment and six weeks in the movie experiment). Janakiraman and Ordóñez (2012), in a series of experiments, find that reducing the amount of time subjects are given to return goods they are not happy with increases the probability that goods will be returned. Finally, in Taubinsky (2014) subjects are invited to take part in a survey, for which they have to register online, but cannot complete it until the next day at the earliest. The experiment uses a 2 × 2 design that varies the deadline length (two days vs 21 days) and whether subjects are sent a reminder or not. The shorter deadline increases the probability of completion from 42% to 59%, with reminders increasing the completion rate by 31 percentage points for the long deadline and 15 percentage points for the short deadline. In contrast to the studies on charitable giving, these studies all find that increasing deadline length reduces response rates, with Tversky and Shafir finding that specifying no deadline reduces response rates even more.

## 3. Theoretical Framework, Hypotheses, and Experimental Procedures

Taubinsky's (2014) model of inattention provides an intuitive theoretical framework for analyzing why people might not get around to taking an action, and we use this model to develop our testable hypotheses. While Taubinsky's general model does not explicitly mention the case of charitable tasks, we adapt the narrative to this context.

In the one-off-task-with-deadlines version of the model the Decision Maker (DM) receives the solicitation in time period 0. The task can be performed any time from period 1 until a specified deadline. In each time period, beginning in period 1, the DM decides whether or not to undertake the task, comparing the benefits of completing it (in the context of charitable giving this would be the warm-glow or the utility derived from the recipient's consumption) to the opportunity cost of doing so. However, there is a non-zero probability that the DM will

be inattentive, and not consider completing the task during that time period. Sophisticated DMs are aware of the possibility of future inattentiveness and will take steps to protect against this (such as completing the task early or creating reminders, knowing that if they do not, they may well forget about it). Naïve DMs, on the other hand, mistakenly assume that they will be attentive in all time periods, so may put off the task that they fully intend to perform, but never get around to doing so.

In this framework, the probability of task completion depends on the probability of still being attentive as well as the probability of the task completion cost being sufficiently low. Consequently, how the likelihood of being attentive changes over time becomes important in determining the effect of a change in the deadline length. If the probability of being attentive is bounded away from zero, for example due to mental recall or reminders, infinitely long deadlines will not reduce the probability of responding. In other words, as the deadline approaches infinity, the naïve DM will eventually respond. If this is combined with exponential decay in attentiveness over time, response rates will be lowest for deadlines of intermediate length.[5] This is because with a longer deadline the naïve individual does not realize that she will be significantly less likely to think of the task at a later point in time, and thus put off the task more than she should. Regarding this implication of the model, Taubinsky notes that it is difficult to test empirically, as it is not obvious when the non-monotonicity will set in. We take a conservative approach and calibrate the 'intermediate length' based on the previous charitable giving experiments to be one month. If the non-monotonicity actually sets in earlier than one month, this will make it *ex ante* more difficult to identify a statistically significant difference between treatments.

In Taubinsky's model, the DMs cannot complete the task in time period 0, when they first learn about it. However, in many everyday contexts, including charitable tasks, it is possible to complete the task immediately, yet many people still postpone it and eventually forget. Due to our focus on charitable tasks we decided to allow our participants to respond immediately upon receiving the solicitation letter. An alternative would have been to not allow the participants to fill out the survey until a certain date. Since our survey solicitations were sent by regular mail, such an approach would have likely resulted in a loss of control as some people would receive the letter earlier than others and thus would have to wait more

[5] See Taubinsky (2014) for details.

days to complete the survey, which could make them more likely to forget. Moreover, instructing people that they could not respond until a certain date would seem unnatural for the type of solicitation we implemented.

Our participants were randomly selected from the New Zealand electoral roll and invited to take part in an online survey on charitable giving, which would take approximately five minutes of their time. Participants were told that if they completed the survey the researchers would donate $10 to charity. We designed the experiment with a simple binary choice to complete a survey rather than to make a cash donation, in part to rule out the complication that participants might choose to change the size of their donation to try to make up for having delayed in responding.

Participants were able to choose whether the donation was made to World Vision or the Salvation Army.[6] The letter (provided in Appendix A) included a URL for the survey website, with a different URL given for each treatment. In addition, each letter contained a unique alphanumeric code that participants were required to enter into the survey. It was explained in the letter that this was to ensure that no one completed the survey more than once. The electoral roll contains information on people's gender and age so we ensured an equal number of letters per treatment were sent to males and females, and an equal number of letters sent to those aged 18-35, 36-65 and 66 and over.[7] Apart from employing a solicitation method that would allow us to reach a sample representative of the population, we were interested in a solicitation that would involve a natural reminder (i.e. a visual cue of seeing a letter on the table in the to-do pile or attached to the fridge) as a conservative test of postponing the task potentially leading to not remembering to respond. If we are to observe deadlines affecting the response rates with a letter solicitation, one can expect that deadline effects would be more pronounced with a solicitation via email where it is less likely that people would randomly come across the solicitation email in their inbox and read it, after it has already been read.

[6] Both charities are well known in New Zealand. The key difference between the charities is that World Vision works to assist families in need in the developing world, whereas the Salvation Army's focus is on assisting families in need in New Zealand. The Salvation Army was chosen by 72 percent of participants. Participants were given the opportunity to comment on the reason for their charity choice. We analyze these data in a separate paper (Knowles and Sullivan, 2017). Note that there is no statistically significant relationship between the charity participants chose to support and the deadline (p-value = 0.842, Fisher's exact test).

[7] For advantages of stratification in randomized experiments, see Athey and Imbens (2016).

We conducted three mailouts that were a few weeks apart and involved sending out 300, 390, and 402 letters per treatment in the first, second, and third mailout, respectively.[8] In the *One Week* treatment people were given 10 days from when the letters were sent to complete the survey; as the letters would take one to three days to be delivered, this gave them seven to nine days to respond. The deadline in the *One Month* treatment was three weeks longer than in the *One Week* treatment, ensuring that the deadline was the same day of the week in each case. The *No Deadline* treatment did not specify a deadline by which the survey had to be completed. Letters were sent when no major holidays occurred that would interfere with returning the letters.

To sum up, our field experiment allows us to look for the non-monotonicity in deadline that Taubinsky's theory pointed out as a possibility. Given our experimental design, we test the following hypotheses in terms of response rates:

**Hypothesis 1:** *One Week* > *One Month*
**Hypothesis 2:** *No Deadline* > *One Month*
**Hypothesis 3:** *No Deadline* ≥ *One Week*[9]

## 4. Results

### *4.1. Impact of deadline length on completion probability*

In total, 1092 letters were sent out per treatment, across the three mail-outs. Some letters were returned because the person was no longer at that address. In addition, in four cases we were contacted by phone or email and informed that the person the letter was addressed to had died. We omit both groups of people, i.e., those whose letters were returned and those who died (29 in *One Week*, 26 in *One Month* and 22 in *No Deadline*) from the denominator when calculating response rates. Two people completed the survey twice; in both cases the second survey was completed within a few minutes of the first, so it is likely these people were unsure if they had correctly submitted their response the first time. We included their first

[8] We find no differences in response rates between the three mailouts. The details are available upon request.
[9] Hypothesis 3 allows for the possibility that *No Deadline* might do better than *One Week*, in line with Taubinsky's theoretical assumption that people who want to complete the task will eventually remember with an infinite deadline.

response in our data set. There were three responses made after the deadline in *One Week* (these were one day late, two days late and eight days late), but none in *One Month*. As it is likely charities will accept late donations (and researchers accept late responses to surveys, as long as they are not too late), we treat these three late *One Week* responses as valid, but also analyze how sensitive our results are to their inclusion. We omit from our analysis the small number of people who either failed to enter their alphanumeric code (three people, all in *No Deadline*) or entered an invalid code (one person, in *One Month*), or who did not choose a charity (three people; one from each treatment).

The overall response rate is 6.82% if the three late responses are treated as valid and 6.72% if they are not. The response rates by treatment are presented in Table 1. We treat the three late responses in *One Week* as being valid, but report in square brackets what the response rate (and statistical significance tests) would be if these responses were treated as invalid. The response rate is highest when no deadline is specified (8.32%) and lowest with the deadline of one month (5.53%). The test statistics reported in Table 1 suggest that the observed differences in response rates are statistically significant on the basis of a joint test.

**Table 1: Response Rates per Treatment**

| Treatment | Number of Responses | Letters Sent Minus Letters Returned | Response Rate |
|---|---|---|---|
| *One Week* | 70<br>[67] | 1063<br>[1,063] | 6.59<br>[6.30%] |
| *One Month* | 59 | 1,066 | 5.53% |
| *No Deadline* | 89 | 1,070 | 8.32% |
| Joint test of the hypothesis of equal response rates across treatments:<br>p-value for Fisher's exact test: 0.038 [0.032]<br>Stone test of equal odds: $\lambda^2 = 6.65$ [7.02] with p-value= 0.038 [0.0301] | | | |

Note: the numbers in square brackets are for when the three late responses in *One Week* are treated as non-responses.

We explore the dependence of the response rate on the deadline given to respondents by estimating a probit model. Our regression analysis controls for the gender and age of the respondents, the only two variables for which we have data for those who did not respond to the survey. We cluster standard errors by mail-out. Table 2 presents the average marginal effects of the variables included in the regression. The omitted treatment is *One Week*. In Column (1) we include age and gender but omit these variables in Column (2).[10] The results are similar irrespective of whether age and gender are controlled for.[11]

In Column (3) of Table 2 we explore how sensitive the results are to the inclusion of the three late observations in *One Week*. In the first two columns these responses are treated as positive responses, whereas in Column (3) these are treated as non-responses. How these three observations are treated has little effect on the results. In the following discussions we focus on the Column (1) results.

Recalling that the omitted category is *One Week*, the results in Table 2 show that participants were less likely to respond in *One Month* than in *One Week* and more likely to respond in *No Deadline* than in *One Week*. We also perform a Wald test to test the equality of the marginal effects of *One Month* and *No Deadline* obtained in the full model in Column (1), and strongly reject the null hypothesis (the chi-square test statistic is 23.08 with a p-value of <0.0001). This confirms that participants were more likely to respond in *No Deadline* than in *One Month*.

Giving a one-month deadline as opposed to a one-week deadline lowers the average probability of responding by 1%. Having no deadline, on the other hand, increases the average probability of responding by 2% compared to having a one-week deadline. Considering that the average probability of responding is 6.7%, the impact of having no deadline is both statistically and economically significant. Also of interest, we find that females and participants in the age group 36-65 are more likely to respond.

[10] There were two participants who entered a different gender in the survey than was recorded for them on the electoral roll, and six people who entered a different age. One possible explanation is that the survey was completed by a different household member than the one the survey was sent to. Our results in Column (1) are based on the age and gender recorded in the survey. Estimates using age and gender as recorded in the electoral roll, available on request, are very similar.

[11] Note that the marginal effects are almost identical if we interact age with treatment and gender with treatment. These results are available on request.

We now summarize how the results discussed above relate to the hypotheses regarding deadline length on completion probability, posed earlier in the paper.

**Result 1:** Specifying a one-week deadline increases the probability of responding compared to a one-month deadline.

Our first key result states that a short deadline results in a higher response rate than a longer deadline. The result provides support for the prediction developed in Taubinsky's (2014) inattention model for naïve individuals when the likelihood of being attentive decays over time (Hypothesis 1).

**Table 2: Marginal Effects on the Likelihood of Responding**

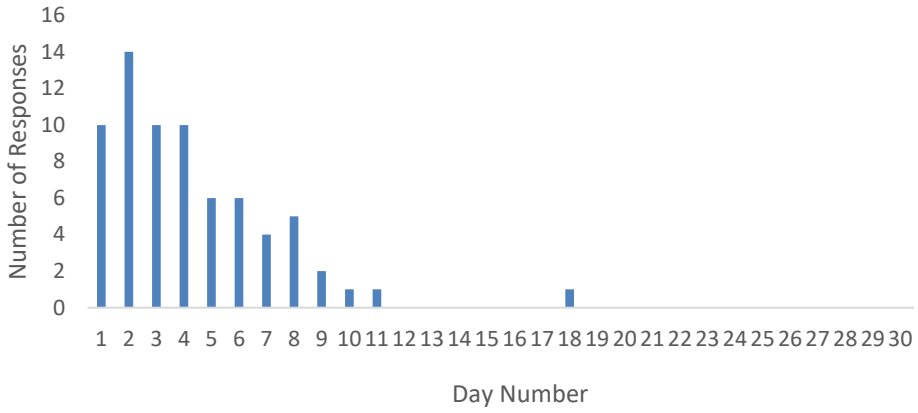
| | (1) | (2) | (3) |
|---|---|---|---|
| Female | 0.0358*** | | 0.0352*** |
| | (0.00688) | | (0.00748) |
| *One Month* | -0.00995** | -0.0105*** | -0.00720** |
| | (0.00345) | (0.00281) | (0.00237) |
| *No Deadline* | 0.0184*** | 0.0173*** | 0.0212*** |
| | (0.00320) | (0.00351) | (0.00390) |
| Age 36-65 | 0.0347*** | | 0.0338*** |
| | (0.00682) | | (0.00664) |
| Age 66+ | 0.0110 | | 0.0119 |
| | (0.00928) | | (0.00993) |
| *N* | 3199 | 3199 | 3199 |

Standard errors (clustered by mail-out) in parentheses

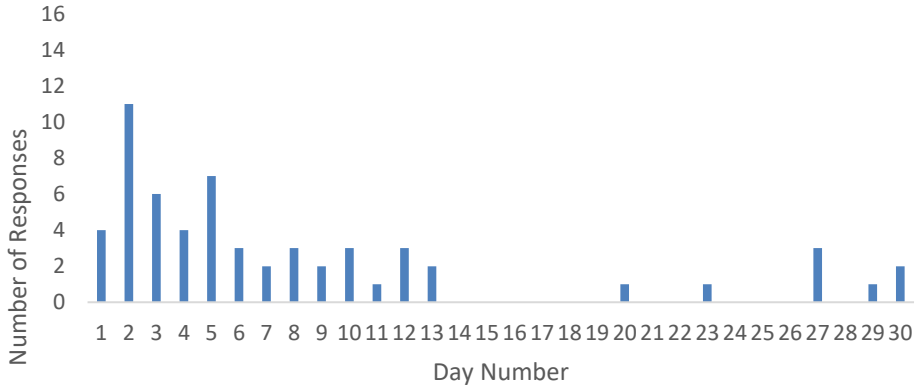
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Figure 1: Timing of Responses for Each Treatment**

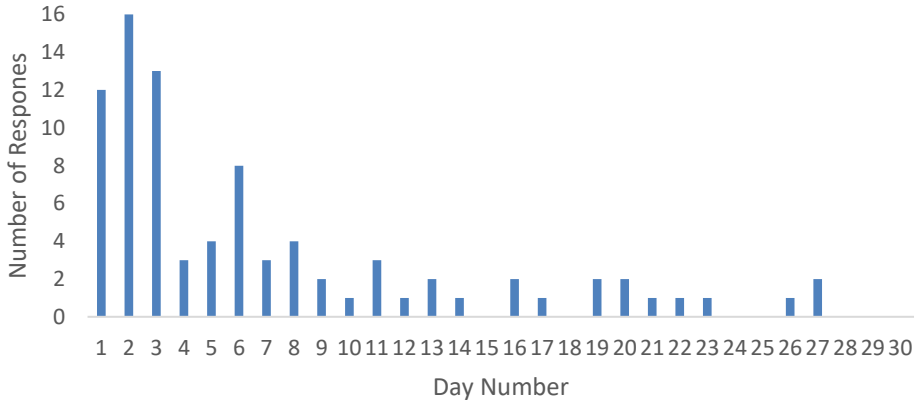
*Panel A: One Week*




*Panel B: One Month*




*Panel C: No Deadline*




Note: Figure 1 shows the response times in the *One Week* (Panel A), *One Month* (Panel B) and *No Deadline* (Panel C) treatments, respectively. As letters took one to three days to get delivered, we truncate the figure on Day 30. Panel A includes the three late observations in *One Week*, which occurred on Days 10, 11 and 18. Panel C does not include the three observations occurring after one month, which occurred on Days 38, 52 and 145 (and which are consistent with Taubinsky's theory that there will be late responses as inattentive people will eventually remember to respond).

**Result 2:** Specifying no deadline at all increases the probability of responding compared to a one-month deadline.

Our second result supports (together with Result 1) Taubinsky's prediction regarding the non-monotonicity between the deadline length and the probability of completion (Hypotheses 1 and 2). This result is also counter to the assumption made in both Damgaard and Gravert's (2017), and Huck and Rasul's (2011) experiments, that a one-month) deadline is effectively the same as having no deadline at all.

**Result 3:** Not specifying a deadline increases the probability of responding compared to a one-week deadline.

The third result is consistent with Taubinsky's (2014) prediction that having an infinite deadline will not reduce the response rate compared to a short deadline, as giving people an infinitely long time to respond increases the probability that there will be a time period in which the benefits of responding exceed the costs, and people who want to respond but are inattentive will eventually remember to do so if the time horizon is long enough (Hypothesis 3). While our data provide support for this prediction from the perspective of the overall response rate, the timing of responses in the *No Deadline* treatment contradicts the details of Taubinsky's theory. In the model, the reason responses are higher for an infinite deadline compared to a deadline such as one month, is that with infinite time there will eventually be a time period in which the DM is attentive (and the task completion cost is sufficiently low). In this case, we would expect to see a higher number of responses after one month than we actually observe. We analyze the distribution of responses in the next subsection.

Our documented non-monotonic effect of deadlines on task completion differs substantially from the previous studies, many of which compare the effect of only two deadlines (a long and short deadline in Janakiraman and Ordóñez, 2012, Karlan et al., 2011, Shu and Gneezy, 2010; or a long and infinite deadline in Huck and Rasul, 2011) and thus cannot detect non-monotonicity. Most of these studies therefore draw the conclusion that completion rates are a decreasing (or non-increasing if there is no effect) function of deadline length. Tversky and Shafir (1992), who implement three deadline treatments observe monotonically declining completion rates with the lowest rate in their no-deadline treatment. In contract, we observe the completion in our *No Deadline* treatment to be the highest.

We suspect the difference between our result and that of Tversky and Shafir, who also used a survey in their experiment, could be driven by the experimental procedures (which we cannot compare given the lack of description in their paper). For example, our letter could have acted as a natural reminder to complete the survey. It is also possible that the lack of deadline is interpreted differently if the benefit goes to others (as in our case) or to oneself (as in Tversky and Shafir), even though the underlying task is the same.

*4.2 Distribution of completion times*

How promptly were responses made across the three treatments? Do their distributions differ within a particular time frame? As shown in Figure 1, a feature of all three treatments is that the highest number of responses occurs on Day 2. However, not all letters will have been delivered on the same day; people outside the main centers may have received their letters on what we have labelled as Day 2 (or possibly even Day 3), whereas for them it was really Day 1. Day 1 is a Thursday (in all three mail-outs), so Days 3 and 4 correspond to the weekend. While for all three treatments most responses come in the first few days, we do not find as strong a "now or never" effect as Damgaard and Gravert (2017). Responding early is consistent with Taubinsky's theory that sophisticated individuals who are aware of their inattention might take measures against forgetting to complete the task.

Importantly for our main results, the *No Deadline* treatment features a spike of responses at the beginning and a long tail of later responses, while the *One Month* treatment features almost no responses between Day 14 and Day 27, but a little spike on Days 27 to 30. The spike could be evidence of a small number of people either being attentive or possibly being sophisticated and setting a reminder for themselves.

The *One Week* treatment generates a slightly lower number of responses than the *No Deadline* treatment during the first three days, after which *One Week* slightly dominates on Days 4-10 (except for Day 6), but overall the two treatments are approximately tied over the first 10 days. After Day 10 responses in the *One Week* treatment fall off while *No Deadline* gets on average approximately one additional response per day during Days 11-30, which drives the higher response rate.

When comparing *One Week* to *One Month*, *One Week* has higher responses every single day for the first nine days (except for Day 5), at which *One Month* starts to dominate (as it is past the one-week deadline) and remains dominant through the remaining time period. The initial difference is so strong that *One Month* never catches up.

We next analyze whether these differences are statistically significant and comment further on whether the observed patterns are consistent with the intuition presented in Taubinsky (2014). Figure 1 shows there are fewer prompt responses in *One Month*, compared to the other treatments. Only four people responded on Day 1 in *One Month*, compared to 10 in *One Week* and 12 in *No Deadline*. However, given that not all participants will have received the letter on Day 1, we focus on the number of responses made in the first three days (i.e., we hold the truncation point constant across treatments): 21 in *One Month*, 34 in *One Week* and 41 in *No Deadline*. The difference in response rates for the first three days is statistically significant (p-value = 0.014, two-sided Fisher exact test) between *One Month* and *No Deadline*, but not for *One Week* and *No Deadline* (p-value = 0.481).[12] For *One Week* and *One Month* the difference is weakly statistically significant (p-value = 0.077).[13]

Relatedly, in the *No Deadline* treatment, a small number of responses continued to come in some weeks after the letter was sent out, with three being received after a month (one of which was after several months). While the number of these very late responses is low, their timing is consistent with the notion that some participants interpreted no deadline as meaning they had an infinite amount of time to respond, lending some weight to Taubinsky's prediction that completions will be highest in infinite time. However, if Taubinsky's model was the main explanation for why we observe a higher response rate for *No Deadline* than *One Month*, we would expect to observe a higher number of very late responses than we do. Note also that Figure 1 shows a significant number of prompt responses for *No Deadline* rather than people eventually remembering to respond. These prompt responses in Days 1-3 are the real benefit of *No Deadline* over *One Month*, although *No Deadline* also dominates

[12] Response rate = number of Day 1 + Day 2 + Day 3 responses/number of letters sent out (less those returned because the person was deceased, etc.).

[13] We also analyze the distribution of responses times using Kaplan-Meier estimates of survival probabilities and find that giving a one-week deadline or no deadline as opposed to a one-month deadline influences how promptly participants complete the survey, with the results being evident for not only the first three days but also for the entire duration of the *One-Week* treatment. The details are presented in Appendix B.

between Days 6-22 (except for Days 10 and 12).[14] We note that while early responses are consistent with participants being simultaneously inattentive and sophisticated, the observed pattern of higher early spikes in *No Deadline* and *One Week* than in *One Month* is not explained by sophistication, where a sophisticated-inattentive person is more likely to respond early, the higher the probability of being inattentive and missing the deadline.

The assumption of exponential decay in attentiveness over time (which is one of the drivers of the non-monotonicity prediction of Taubinsky's model) implies that a person is more likely to be inattentive at the deadline of *One Month* than at the deadline of *One Week.* A sophisticated-inattentive person is therefore more likely to respond early, leading to higher early spikes in *One Month* than in *One Week*, contrary to what we observe.

Taubinsky's assumption that the probability of being attentive is bounded away from zero (which is the other driver of the non-monotonicity prediction) implies that there is no reason for a sophisticated-inattentive person to respond early in the *No Deadline* treatment as eventually she will remember to complete the task. Early responses in *One Month* should thus be higher than in *No Deadline*, which is again not what we observe in the data. However, if one removes this assumption, and there is some chance that the person might forget forever, then the *No Deadline* treatment would produce more prompt responses from sophisticated inattentives.

**Result 4**: Specifying no deadline results in the most prompt responses, followed (albeit insignificantly) by specifying a one-week deadline. Specifying a one-month deadline leads to fewer prompt responses compared to a short one-week deadline or no deadline at all.

So far when discussing our results, we have done so in the context of the model of Taubinsky (2014) that successfully predicts the non-monotonic effect of deadlines on task completion. In the model, naïve inattentives, whose attentiveness decays exponentially with time, respond more frequently with a shorter than with an intermediate deadline. We observe higher responses in our *One Week* than in our *One Month* treatment. Under the assumption that if the time horizon is infinite inattentive people will eventually remember, the model also predicts responses in *No Deadline* to be higher than in *One Month* and not lower than in *One Week*.

[14] The Wilcoxon matched-pairs sign-rank test detects a higher number of responses on Days 6-22 in *No Deadline* than in *One Month* (p=0.036).

Accordingly, we find higher responses in *No Deadline* than in both *One Month* and *One Week*. However, the version of the model with naïve inattentives falls short when it comes to predicting the timing of responses. In particular, instead of seeing a long tail of late responses of inattentives who remembered when there was no deadline, we observe a large spike at the beginning.

The differences in response rates across treatments are driven by the higher early spikes in both *No Deadline* and *One Week* than in *One Month*, though *No Deadline* weakly dominates *One Month* also in (some) later periods after the first week. *No Deadline* and *One Week* are relatively tied for the duration of the *One Week* treatment with the real benefit of *No Deadline* coming after the one-week deadline.

The early responses could be explained by the presence of sophisticated inattentives, suggesting a possible mixture of types. However, under the assumptions of exponential decay in attentiveness and positive probability of being attentive in any period, the pattern of early spikes violates the intuition that sophisticated types would want to respond early as the probability of being inattentive and thus missing the deadline increases, which is in *One Month.* This is not what we see in our data as the early responses are lower in *One Month* than in *One Week* and *No Deadline*. While the high early spike in *No Deadline* could be explained by relaxing the second assumption and allowing for "forgetting forever", it does not explain the high spike in early responses in *One Week*.

### *4.3 Alternative explanations of our results*

Two recent models, both of which have been published after we ran our experiment, also analyze the effect of deadlines on completion probability. While our experiment was not designed to discriminate between the predictions of these models, the models describe additional factors that could also be at play in our environment.

Building on O'Donoghue and Rabin (1999), Damgaard and Gravert (2017) model the effects of deadlines specifically for charitable giving. While in Taubinsky's (2014) model the impact of deadlines operates through exponential decay of attention, Damgaard and Gravert incorporate present-biased preferences into their model to focus on how deadlines impact procrastination in charitable giving. Probabilistic transaction costs, warm-glow, and the benefits from consumption occur immediately whereas the altruistic utility is perceived only

once the ultimate recipient receives help. Naïve donors, who do not realize they have a self-control problem, may not donate in the time period with the lowest transaction cost if there is a future period in which costs are low enough their current selves believe their future selves would prefer to donate. A longer deadline thus increases the potential for procrastination but at the same time increases the probability of a sufficiently low random draw from the task-completion cost distribution to enable the task to be completed later. If this first effect dominates, a shorter deadline will increase responses, which is consistent with the comparison of *One Week* with *One Month* but does not explain why we observe higher responses in *No Deadline* than both *One Week* and *One Month*.

In terms of completions, Damgaard and Gravert's model predicts that in the presence of naïve present-biased donors, there will be a spike in donations as the deadline approaches. This is because people who have been procrastinating will respond just ahead of the deadline, as long as the benefits of responding exceed the costs in this time period. Recall that we observe a small spike at the deadline in the *One Month* treatment but not so much in *One Week* (in *One Week* there is a relatively steady decline in responses, although it is worth noting that the number of responses on Days 7-8 is slightly higher than in the other two treatments), so procrastination does not seem to completely explain the observed behavior.

Ericson's (2017) model is more general and not charitable-task specific. It allows for imperfect memory in addition to present bias: the individual will forget about the task with some probability and has a belief (correct or incorrect) about the probability of remembering. In contrast to Taubinsky's (2014) model of inattention, forgetting is modeled as an absorbing state, meaning that once a DM forgets, there is zero chance she will remember in the future. A longer deadline now might lower the probability of task completion since the additional delay from a longer deadline leads to forgetting and a failure to act, depending on parameters. Thus, longer deadlines can lower the probability of task completion for individuals with imperfect memory, for both time-consistent individuals and present-biased individuals. Sophistication (i.e., having a correct belief about one's imperfect memory or being aware of one's present bias) can mitigate forgetting as people might take actions to ensure the task gets completed, for example shortly after the request is received.

Our finding that the completion probability is higher for the *One Week* deadline than for the *One Month* deadline is consistent with the imperfect-memory version of Ericson's model.

The relatively small spikes at the *One Week* and *One Month* deadlines also support the presence of imperfect memory. However, imperfect memory on its own does not explain the probability of completion being higher in *No Deadline* than in *One Week* and *One Month* or the observed pattern of early responses across treatments. The higher probability of completion (but not the distribution of completion times) in *No Deadline* than in *One Week* and *One Month*, however, could be explained by perfect memory.

There are some features of our data that could be explained by a mixture of Ericson's types, assuming certain parameters. As imperfect memory is modelled as an absorbing state, the presence of sophisticated types who expect themselves to forget might explain the higher number of early responses in *No Deadline* than in *One Month* as well as the insignificantly higher number than in *One Week*. For certain cost distributions, while sophisticated forgetters might prefer to wait for a lower cost realization, they would accept a higher cost early on because of their awareness of the possibility of forgetting. However, since Ericson also models imperfect memory as an exponential decay in the probability the task will be recalled, the presence of sophisticated forgetters does not explain the higher early responses in *One Week* than in *One Month* since the probability of forgetting and thus missing the deadline (which is what sophisticated forgetters react to) is higher in *One Month* than in *One Week*. To accommodate the higher number of responses, including more prompt responses, in *One Week* than *One Month*, one needs the presence of the naïve-forgetter types for whom shorter deadlines can increase the probability of responding.

Furthermore, present-biased types who happen not to forget could explain the small number of responses around one-week and one-month deadlines. These additional responses appear to be comparable in magnitude to the number of responses after Day 30 in the *No Deadline* treatment. We note, however, that these numbers are quite low and thus the resemblance could be a mere coincidence. Finally, more early responses in *One Week* than in *One Month* could be interpreted as attempts to meet the deadline and accepting higher costs early on, though these higher costs could also reduce the total number of responses, if they exceed the perceived utility of responding.

The observed fewer responses that came in after the first week in *One Month* than in *No Deadline* can be explained by the presence of partially overconfident sophisticated procrastinators who recognize that they will forget, but do not realize how likely it is to

happen. With a one-month deadline they feel that they are more likely to remember at the deadline than with a very long or infinite deadline, which in turn makes them less likely to respond early. With no deadline they need to act early because they recognize that there is no deadline to make them respond and they would thus forget.

To summarize, we have discovered the first known example of the non-monotonic response rate predicted by Taubinsky (2014) in his model of inattention. However, his model fails to account for the pattern of early responses. Damgaard and Gravert's (2017) model of procrastination in charitable tasks predicts higher responses under a shorter deadline, which is inconsistent with the observed non-monotonicity. Ericson's (2017) model is capable of better explaining some of the detailed features of our data, but requires a multiplicity of different types (sophisticated forgetters, naive forgetters, and partially overconfident sophisticated forgetters). While we find Ericson (2017) to provide a better explanation for our data than Taubinsky (2017), we also note that our experiment was not explicitly designed to distinguish between these various theories.

Given that the task we implemented in our experiment is a charitable one, we speculate that contrasting it with personal-benefit tasks might provide some clues regarding the observed behavior. In particular, we conjecture that while the importance of personal-benefit tasks is usually known from the outset or can be approximated, with charitable tasks people might lack information about the task's importance to the beneficiary. If that is indeed the case, deadline length might convey cues about their importance, which would have an impact on the completion rate and on the timing of completions. To illustrate, placing a short deadline on a charitable task creates urgency to act, likely leading to an early completion. On the other hand, specifying a longer deadline may be interpreted as giving permission to delay, increasing the probability of both procrastination and forgetting to complete the task.

We further conjecture that with charitable tasks there exists a social norm to *promptly* help when asked if the social benefit outweighs the individual costs of help; for example, charitable organizations are often in urgent need of resources for providing assistance in emergency situations and solving acute social problems.[15] It is then possible that not specifying a deadline upholds the default urgency to complete the charitable task. Similarly,

[15] The conjecture that one should help promptly when asked is also consistent with Aumann's (2019) rule rationality.

it appears that imposing a short deadline upholds (and possibly also reinforces) this urgency as well, whereas specifying a long deadline relaxes it as a long deadline may be interpreted as giving permission to delay. A similar shift in the behavioral response mode has been documented when extrinsic motivation is introduced for tasks that include an element of intrinsic motivation (Gneezy & Rustichini, 2000a, 2000b; Gneezy, 2003).

## 5. Conclusions

This paper presents a field experiment demonstrating a non-monotonic effect of deadline length on task completion, predicted theoretically by Taubinsky (2014). Consistent with the theoretical prediction, we find responses to be high for the short one-week deadline, lowest for the one-month deadline and highest when no deadline is specified. However, Taubinsky (2014) falls short of predicting the observed distribution of completion times, as does Damgaard and Gravert (2017). Ericson (2017) can do a better job of accounting for the distribution of completion times, but only by allowing for a mixture of different types of decision makers. We therefore add our own speculation that the deadline length for charitable tasks may convey cues about the importance of the task, which then influences the completion rate. Tversky and Shafir (1992) provide the only other study of procrastination with a no-deadline treatment, but they find monotonic decreases in completion probability with deadline length. In contrast, for a charitable task we find that the completion rate is the highest when no deadline is specified. In our treatment with a longer (one-month) deadline, there were fewer very prompt responses than when we specified a short (one-week) deadline, or no deadline at all. We interpret this as evidence that specifying a longer deadline as opposed to a short deadline or no deadline at all, removes the urgency to act, which is often perceived by people, when asked to help. People therefore put off undertaking the task, and since they are inattentive or forget, postponing results in lower response rates.

While in our study we attempted to deal with participants' potential beliefs that there might be an implicit deadline by running a field rather than a laboratory experiment, it is possible that not specifying a deadline in our *No Deadline* treatment might still have led participants to assume that there is an implicit deadline. Future research could address this issue in either measuring beliefs about implicit deadlines and/or by explicitly stating that there is no deadline (as opposed to not mentioning a deadline at all as we did in the current study). Furthermore, one could also explore in detail how no deadline could lead to different

interpretations by participants, as some types (e.g., sophisticates versus naïfs) might interpret it as urgent while for others it might lead to even greater procrastination. As a thoughtful referee pointed out, the overall effect might then depend on the overall distribution of types in the sample and be quite susceptible to the framing of the solicitation letter.

Our results have important policy implications both for maximizing response rates for surveys and charitable giving. Researchers conducting surveys often specify a deadline by which the survey needs to be completed. Our results imply that survey response rates would be higher in the absence of a deadline. Charities typically do not specify deadlines by which donations need to be made and our results imply this is the optimal strategy when the solicitation is conducted by mail and the letter can act as a natural reminder. However, we note that the impact of deadlines may vary with the strength and saliency of natural reminders, something that we controlled for in our experiment. Our results suggest that charities should avoid setting long deadlines of a month or so, by which donations have to be made. Charitable campaigns, however, might sometimes be limited in terms of their duration if the charity is using matching grants or if the campaign needs to close by a certain date and thus the no-deadline option might not always be feasible. If that is the case, our results reinforce Tversky and Shafir's (1992) and Damgaard and Gravert's (2017) finding that shorter deadlines are preferred over intermediate ones.

**Acknowledgements:** An earlier version of this paper previously circulated under the title "Deadlines, Procrastination, and Forgetting in Charitable Tasks: A Field Experiment. Funding for this project was provided by the Department of Economics, Otago Business School, University of Otago. An earlier version of the paper was presented at the 2nd MERIT Conference of Field Experiments (Monash University, 2015), New Zealand Association of Economists conference (Wellington, 2015), Economic Science Association meetings (Sydney, 2015; Dallas, 2015, Jerusalem, 2016), and in the Economics Seminar Series at the University of Canterbury (Christchurch, 2015), University of Economics in Bratislava (2016), RMIT (Melbourne, 2017), Hitotsubashi University (2018), University of Alaska-Anchorage (2018), University of Alabama (2018), and University of Auckland (2019). We are grateful to conference and seminar participants for the useful feedback. We are also grateful to Co-Editor David Reiley, and to Andrew Gray, Ella Iosua, Lyla Zhang, and two anonymous referees for detailed comments that have helped us improve the quality of the paper and Matt Foster for research assistance. For their kind hospitality, Maroš Servátka thanks University of Alaska-Anchorage.

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**Appendix A: Sample letter sent to participants**

Dear X

Are you interested in completing an online survey on charitable giving, and in doing so earning $10 for charity? If so, then read on.

Researchers at the [insert university names] are conducting a survey on charitable giving. Your name has been randomly chosen from the electoral roll to take part in this survey. Note, that in order to take part, you do not need to have made a donation to a charity before. We are interested in the responses both of people who do give money to charity, and those who do not. If you complete the survey by **8 August** the researchers will donate $10 to charity on your behalf. You will get to choose whether this donation is forwarded to World Vision or the Salvation Army.

The survey is an online survey. To complete the survey please go to **http://goo.gl/CPW1cr**

We estimate that the survey will take approximately five minutes to complete.

At the bottom of this letter is a code, which you will need to enter when completing the survey, in order for us to forward $10 to the charity of your choice. Requiring you to enter the code is to ensure that no-one completes the survey more than once. Each person we have written to has been given a different code. Please be assured, however, that we have not kept a record of who has been given which code (we have just kept a list of all the codes used), so we will have no way of knowing who has given which answers to the survey; that is, your responses will be completely anonymous.

Please note that because of the steps we have taken to guarantee your anonymity, we cannot provide you with a receipt for the money donated on your behalf.

Enclosed is an information sheet with some more information about this research project. Remember, in order for us to make a $10 donation to the charity you chose, you need to complete the online survey by **8 August**.

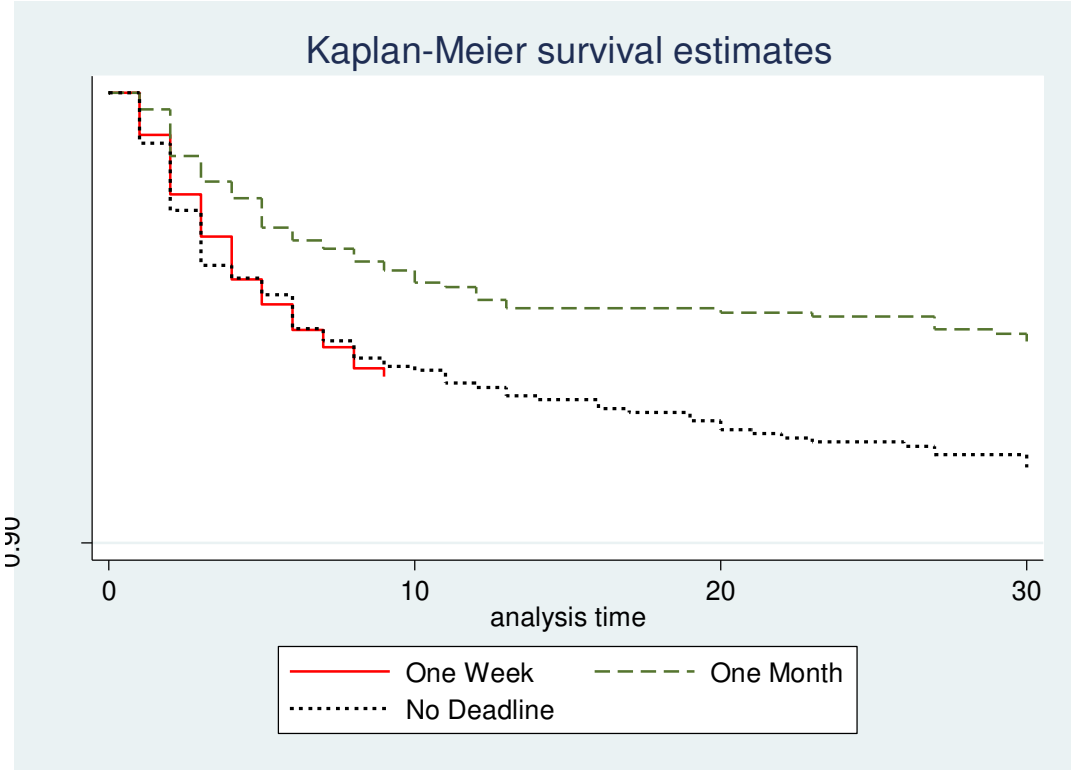
Your personal code is **AWF001**.

Thank you for considering this request. If you have any questions, please feel free to email [insert name of researcher and email address]

## Appendix B: Analysis of response times using Kaplan-Meier (KM) estimates of survival probabilities

We analyze the distribution of response times using Kaplan-Meier (KM) estimates of survival probabilities, which is the probability that a participant will not complete the task before a given day. We present the survival curves for all the treatments for the first 30 days in Figure 2. We observe that *One Month* has the highest survival probability for any one of the first 30 days across all the treatments. That is, the survival curve for *No Deadline* lies above the survival curves for the other treatments. The survival probability for *One Week* is higher than the survival probability for *No Deadline* for the first three days, but lower thereafter. For example, the probability that a participant will not respond before Day 3 is 0.968 with a one-week deadline, 0.98 with a one-month deadline, and 0.962 with no deadline.

**Figure 2: Kaplan-Meier Survival Curves**




*No Deadline* treatment censored on Day 30 for the figure (but not for the log-rank tests). Range = [0.90, 1.00].

We use the log-rank test to evaluate whether or not the Kaplan-Meier survival curves for different treatments are statistically equivalent, that is, whether or not the differences in survival probabilities across the treatments are statistically significant. We start with the hypothesis that all three survival curves for the three treatments are the same. The value of the chi-square test statistic is 7.41 with a p-value of 0.025, meaning that at least one of the survival curves is different.

We then perform the log-rank test to make pairwise comparisons between the treatments. We fail to reject the hypothesis that the survival curves for *One Week* and *No Deadline* are the same (p-value = 0.824). The lack of difference in estimated survival functions can be seen visually in Figure 2 by the *One Week* curve overlapping the *No Deadline* curve over its 10-day duration. This means that participants take just as much time to respond before any given day, whether they are given no deadline at all or a one-week deadline.

Continuing with the survival analysis we reject the equality of the survival curves when we compare *One Week* with *One Month* (p-value = 0.013) and *One Month* with *No Deadline* (p-value = 0.020). Therefore, giving a one-month deadline as opposed to a one-week deadline or no deadline seems to make a difference in terms of how promptly participants complete the survey. We note that while early responses are consistent with participants being simultaneously inattentive and sophisticated, the observed pattern of higher early spikes in *No Deadline* and *One Week* than in *One Month* is not explained by sophistication (which is based around the idea that an early response is more likely the higher the probability of being inattentive, meaning that the highest spike should be in the *One Month* treatment, contrary to what we observe).