When an Hour Feels Shorter: Future Boundary Tasks Alter Consumption by Contracting Time

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Consumers often organize their time by scheduling various tasks, but also leave some time unaccounted for. The authors examine whether ending an interval of unaccounted time with an upcoming task systematically alters how this time is perceived and consumed. Eight studies conducted in both the lab and field show that bounded intervals of time (e.g., an hour before a scheduled meeting) feel prospectively shorter than unbounded intervals of time (e.g., an hour with nothing scheduled subsequently). Furthermore, consumers perform fewer tasks and are less likely to engage in relatively extended (though feasible) tasks during a bounded compared to an unbounded interval of time—even in the face of financial incentives. Finally, making a longer task easier to separate into subtasks attenuates this effect.

Keywords: subjective duration, prospective time perception, time consumption, scheduling

One of the authors recently had a free hour and decided to use this time to design a study for her dissertation. The next night, she once again had a free hour and another study to design. However, this time her hour had a scheduled endpoint—at the end of the hour, she needed to leave the office to meet a friend for a drink. She had nothing to do to prepare and did not need to leave before the end of the hour, making the full hour objectively available to her. However, unlike the night before, she found herself feeling reluctant to design her study and instead worked on a few small tasks, managing to answer a few quick emails. Both nights, she had objectively the same amount of time to work, yet she consumed each interval very differently.

In the present article, we examine this type of behavior by differentiating between *bounded time*, an interval (e.g., an hour) that ends with a scheduled task (e.g., drinks with a friend), and *unbounded time* (e.g., an hour that is not followed by a scheduled task). We find that bounded and unbounded time intervals are perceived and consumed differently. Compared to unbounded time intervals, during bounded intervals of time consumers (1) perceive that they have prospectively less time, (2) perform fewer tasks, and (3) are less likely to engage in extended tasks, even when such tasks can feasibly be accomplished and are more lucrative. We provide evidence that contracted perceptions of time drive the time consumption effects by creating ambiguity about the ability to complete a given task during the available time. However, we acknowledge that the effects on both time perception and consumption could be

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multiply determined, which we address in the General Discussion. Thus, our goal in this article is to focus on the effects of boundaries on time perception and on time consumption, but not to offer a definitive explanation for why these effects occur.

BOUNDED VERSUS UNBOUNDED TIME

Time is the most cherished resource at consumers' disposal, yet it presents many challenges. There are many demands for one's time, and how consumers choose to spend their time has important implications for their happiness and well-being (Aaker, Rudd, and Mogilner 2011; Mogilner 2010). Consumers often have several goals for their time that they must try to balance, including maximizing enjoyment (Kahn, Ratner, and Kahneman 1997), feeling productive (Keinan and Kivetz 2011), and remaining busy (Bellezza, Paharia, and Keinan 2016). Yet relatively little is known about how consumers choose which activities to spend their time on at any particular point in time. Prior research has studied related but distinct topics, like decisions of when to engage in a given task (Liberman and Trope 1998; Loewenstein 1987; Zauberman and Lynch 2005) and in what order to experience different tasks (Kahn et al. 1997; Loewenstein and Prelec 1993; Ratner, Kahn, and Kahneman 1999). In the present research, we examine the choice to engage in a particular task as a function of whether the current time interval ends in a scheduled activity and is thus bounded.

When individuals are deciding whether to take part in an activity, a primary concern is their ability to complete the activity within the available time. Consumers prefer to engage in tasks that they feel they can complete within the available time (Straub and Karahanna 1998; Webster and Kruglanski 1994; Zauberman and Lynch 2005), and they dislike being interrupted or forced to stop a task before it has been completed (Jhang and Lynch 2015; Nelson and Meyvis 2008). Importantly, when consumers judge an interval to be shorter, they tend to have ambiguity over what can be accomplished within this time (Bilgin and LeBoeuf, 2010). We suggest that boundary tasks likewise create ambiguity about whether tasks can be accomplished by making the preceding interval feel shorter, thus altering consumption of this time.

The presence of a boundary task could affect how much time consumers think they have both objectively and subjectively. Boundary tasks could influence the amount of objective time in a couple of different ways. First, transitioning between tasks can at times have time or mental costs (Leroy 2009). For instance, attending a meeting might require physical preparation (e.g., getting ready, traveling) and/or mental preparation (e.g., getting excited or calm for the task). If consumers factor in such costs, they might expect to have objectively less time during bounded intervals. Relatedly, consumers might plan for taking a mental break between two tasks. An expected break could also decrease the expected amount of objective time and cast doubt on the potential completion of a task. While cognizant of these factors likely playing a role in the utilization of bounded intervals, we propose that subjective time perception—whereby consumers perceive bounded intervals to be subjectively shorter—will have an effect above and beyond the factors that could alter the amount of objective time.

Subjective time is distinct from objective time. Subjective time refers to one's own perception/feeling of the duration of a given interval (Le Poidevin 2015). Subjective time often deviates from objective time, and subjective estimates of time are relatively insensitive to changes in objective duration (Zauberman et al. 2009). Subjective perception of future duration is influenced by a variety of factors, including the number of events during an interval (May 2017), emotional intensity (Van Boven et al. 2010), and arousal (Kim and Zauberman 2013). Building on this prior work, we suggest that the presence (vs. absence) of a scheduled boundary task is a unique driver of prospective time perception.

Scheduled boundary tasks are perceived to have strict start and end times (Tonietto and Malkoc 2016). Thus, a scheduled task would act as a hard stop to any activity performed during the preceding interval. In decisions about whether to engage in a task, the stopping point is an important and relevant factor. As such, it might receive more attention and do so at the expense of the surrounding time. Since objects of attention feel psychologically closer (Cole, Riccio, and Balcetis 2014; Wu, Ooi, and He 2004), the scheduled task may thus loom nearer in time, making the interval feel shorter. Importantly, we would expect this time contraction even when the objective time is known and held constant (Kim and Zauberman 2013). Note that attention allocated to the boundary task is one potential driver of time perception, which is likely multiply determined. We focus here on demonstrating the core effect and discuss this and other potential drivers in more depth in the General Discussion.

Regardless of its exact driver, we propose that contracted time perception will decrease consumers' perceived ability to complete considered tasks, decreasing the likelihood of consumers performing tasks during bounded time. If this is the case, then we can make a few important predictions. First, consumers should be less willing to perform a task that is relatively long and cannot easily be divided into shorter subtasks. While longer tasks would feel less accomplishable during bounded time, both a distinct subtask of a longer task and a single short task should feel similarly accomplishable, even when time is subjectively contracted. Thus, consumers should be just as likely to complete short tasks and subtasks of longer tasks, but be less likely to complete relatively long tasks, during

bounded (vs. unbounded) intervals. While one short task may feel accomplishable, each consecutive short task should feel increasingly less accomplishable during bounded (vs. unbounded) time intervals. Accordingly, we expect consumers to engage in *fewer* short tasks (or subtasks) when their time is bounded. Finally, if the reluctance to perform relatively extended tasks is indeed driven by concerns about the ability to accomplish such tasks during the available time, then considering tasks that do not need to be completed all at once should mitigate the effect. If an extended task can easily be divided into shorter subtasks, consumers should feel more confident about their ability to complete at least one subtask (where the other subtask(s) could be completed at another time) and thus should be more willing to take part in the task.

We next report results from eight studies examining the effect of boundary tasks on consumers' (1) subjective perception of time and (2) willingness to engage in a variety of tasks. In all of our studies, we operationalize temporal boundaries by utilizing scheduled tasks. Note, however, that scheduled tasks are not the only temporal boundaries one could face. For example, the end of a workday or a temporal landmark (i.e., a personally relevant date such as a birthday or holiday; Dai Milkman, and Riis 2014; Peetz and Wilson 2013) can also create salient ends to one's time. We focus predominantly on scheduled tasks both because of their prevalence in consumers' daily lives, and because they provide an empirically clean experimental paradigm.

We first examine the role of boundary tasks on subjective time perception using correlational field data (study 1A) and experimental lab data (study 1B). Next, we examine the effect of boundary tasks on time consumption. We demonstrate that consumers choose shorter over longer (though feasible) tasks when time is bounded (studies 2A and 2B) and are less likely to perform relatively long (but not relatively short) tasks during bounded intervals (studies 3A and 3B), even in the face of monetary incentives (studies 2A and 2B). We also provide evidence for the mediating role of time perception (study 2A). Finally, we examine the role of perceived ability to complete tasks within bounded intervals (studies 4A and 4B), finding that task divisibility mitigates the behavioral effects (study 4A) and that consumers perform fewer total short tasks during bounded intervals (studies 4A and 4B). In doing so, we examine both hypothetical and incentive-compatible behavior in both the lab and field.

Taken together, the present work makes several important contributions. We contribute to the growing literature examining the potential benefits (Fernbach, Kan, and Lynch 2015; Milkman et al. 2012; Southerton 2003) and costs (Tonietto and Malkoc 2016) of scheduling (for a review, see Malkoc and Tonietto 2019). So far, this literature has studied the effects of scheduling on the individual scheduled tasks, but has yet to examine how scheduling influences the consumption of the *unaccounted* time remaining. Our work is the first to examine the effect of scheduling on the perception and consumption of unaccounted time. Our work also contributes to research on time perception by identifying a unique driver of prospective time perception. Furthermore, much of the prior research on prospective duration judgments has examined estimated task completion times, or how long consumers predict a particular task will take them to complete (Halkjelsvik and Jørgensen 2012; Roy, Christenfeld, and McKenzie 2005). In contrast, we examine how unaccounted time intervals are perceived and thus ultimately consumed. Thus, we also contribute to prior research examining how consumers choose tasks to perform at any particular point in time (Jhang and Lynch 2015; Kahn et al. 1997; Loewenstein and Prelec 1993) while also adding to the existing knowledge about the link between time perception and time consumption (Bilgin and LeBoeuf 2010; Zauberman and Lynch 2005).

STUDIES 1A AND 1B: TIME PERCEPTION OF BOUNDED VERSUS UNBOUNDED INTERVALS

The purpose of studies 1A and 1B was to examine whether the presence of a scheduled boundary task leads the preceding time to feel subjectively shorter. We predicted that participants who had a future scheduled event (bounded) would perceive the same amount of time preceding the event as significantly shorter than those who did not have a scheduled future event (unbounded) and tested this with a correlational field study (1A) and an experimental lab study (1B).

Study 1A

Method and Procedure. Sixty-three conference attendees took part in this two-cell (interval: bounded vs. unbounded) correlational design. As part of the conference agenda, there was a break occurring from about 4:00 p.m. until 4:45 p.m., with a presidential address taking place at 4:45 p.m. At the beginning of the break, participants were stopped and asked to complete a short survey. They first indicated whether they were planning to attend the presidential address at 4:45 p.m. (yes, no, maybe). Next, participants indicated time perception ("How long do you consider the duration between now and 4:45 p.m.?") on a 50-point subjective scale (1 = very little time, 50 = a lot of time; see appendix A for exact instructions). Note that prior research has used a variety of anchors and scales to elicit subjective duration estimates that have been shown to be highly correlated (Zauberman et al. 2009). We adopted this commonly used measure of subjective perception. Finally, because participants were surveyed over a period of time, the time when the survey was taken was recorded

and used as a control variable in the analysis. Note that current time was used as a statistical control only in this study, as it varied between participants. In future studies, objective time is carefully controlled, eliminating the need for this statistical control variable.

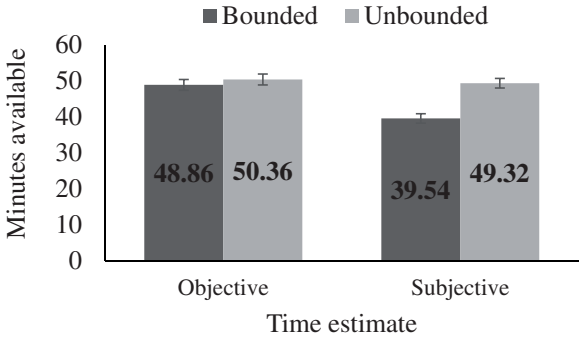
Results and Discussion. Of the 63 participants, 39 (61.9%) indicated that they planned to attend the presidential address and were thus classified as having a bounded interval. The remaining participants who indicated that they definitely were not (eight, 12.7%) or were maybe planning to attend (16, 25.4%) and who had thus not specifically scheduled the event were combined and were classified as *not* having a bounded interval. As predicted, those who considered this interval to be bounded rated it as significantly shorter ($M = 13.76$, $SD = 10.51$) than those who considered it to be unbounded ($M = 18.27$, $SD = 7.55$, $t(62) = 2.04$, $p < .05$). Our statistical control of current time showed the expected effect whereby those who were surveyed further from the scheduled task indeed perceived that they had more time than those who were surveyed closer to the scheduled task ($t(62) = 2.69$, $p < .01$). This study provides initial evidence in the field that bounded intervals feel subjectively contracted. However, due to the correlational nature of the design, it is possible that those planning to attend the upcoming event actually had objectively less time. We address this issue next by manipulating, rather than measuring, boundary tasks, and provide evidence that bounded intervals are subjectively, rather than objectively, shorter by measuring both objective and subjective duration estimates.

Study 1B

Method and Procedure. One hundred ninety-eight Amazon Mechanical Turk (MTurk) participants took part in this 2 (interval: bounded vs. unbounded; between-subjects) × 2 (estimate: objective vs. subjective; within-subjects) mixed design. In the bounded condition, participants imagined that it was 7:00 p.m. on a weeknight and their friend was coming over at 8:00 p.m. In order to emphasize that this hour was truly and objectively available to them, they also read that "you are all ready for your friend to come by." Participants in the unbounded condition instead imagined that it was 7:00 p.m. on a weeknight but that they did not have any plans for the evening and thus lacked any future boundary task. To provide a strict, direct test that the effect of boundary tasks reflects subjective rather than objective differences in available time, participants in this study were asked to estimate the number of available minutes, rather than the duration, of the interval. If consumers indeed perceive objective differences (real or inferred) between bounded and unbounded time, then they should estimate that there are objectively fewer available minutes for actual use during bounded intervals. If instead the effect is driven by subjective perception, then such an objective measure should not differ between bounded and unbounded intervals. To that end, following the boundary manipulation, all participants imagined that they decided to read a book during the next hour and indicated both the objective number of minutes they could spend reading ("Objectively, how many minutes could you spend reading your book during the next hour?"), as well as the subjective number of minutes they felt like they could spend reading ("Subjectively, how many minutes do you feel like you can spend reading your book during the next hour?"; adapted from Cheng and Cryder 2018). The order of the objective and subjective measures was counterbalanced. We expected to observe a difference in the subjective, but not in the objective, time measure.

FIGURE 1

STUDY 1B RESULTS



Results and Discussion. A mixed ANOVA revealed a significant main effect of boundary ($F(1, 196) = 10.77$, $p < .01$) such that overall, participants estimated fewer available minutes to read during the bounded interval ($M = 44.20$) than during the unbounded interval ($M = 49.84$). The main effect of measure type was also significant ($F(1, 196) = 24.81$, $p < .01$), such that overall, subjective estimates ($M = 44.43$) were lower than objective estimates ($M = 49.61$). Importantly, these main effects were qualified by the predicted interaction ($F(1, 196) = 15.85$, $p < .01$; see figure 1). We found that participants in the bounded condition felt that subjectively they could spend significantly fewer minutes reading ($M = 39.54$, $SD = 13.35$) than those in the unbounded condition ($M = 48.86$, $SD = 12.96$, $t(196) = 5.23$, $p < .01$). Importantly, when providing an objective estimate, participants in both the bounded ($M = 49.32$, $SD = 14.80$) and unbounded conditions ($M = 50.36$, $SD = 15.32$, $|t(196)| < 1$) indicated that they had a statistically equivalent number of minutes available to read their book during the next hour.

Note that while participants in both the bounded and unbounded conditions estimated that they had objectively the

same amount of time, those in the bounded condition subjectively felt they had less time to read their book. Importantly, in the bounded condition, subjective estimates of time were significantly lower than the objective estimates ($t(196) = 6.34$, $p < .01$). However, this was not the case in the unbounded condition ($|t(196)| < 1$), indicating that participants in the bounded condition recognized that they had objectively more time than they subjectively felt. It is important to note that in both conditions, participants estimated that they had objectively less than 60 minutes. That is, it appears that in both the bounded and unbounded intervals, participants left a window of time, perhaps to use if needed to transition into the next interval. However, subjective time perception for the bounded interval was shorter above and beyond objective estimates of time.

Study 1B demonstrates that the effect of boundaries is driven by estimates of subjective time. We observe a strong effect of boundary tasks on subjective time perception. Importantly, participants' estimation of available objective time for the same time intervals did not differ. While participants recognized that they have objectively equivalent time during bounded and unbounded intervals, bounded intervals felt subjectively contracted. These findings indicate that the effect on subjective time occurs above and beyond possible differences in estimated objective time.

This study also provides evidence for the direction of the effect, establishing that bounded intervals feel contracted rather than unbounded intervals feeling expanded. If unbounded intervals felt expanded, then one would expect subjective estimates of available time to exceed objective estimates. However, we find no differences between objective and subjective time estimates for the unbounded interval. Providing further evidence that the observed effect is driven by temporal contraction, we find in an additional study (reported in web appendix A) that a bounded hour ($M = 25.38$, $SD = 20.63$) feels significantly shorter than both an unbounded ($M = 29.20$, $SD = 23.57$, $t(120) = 2.89$, $p < .01$) and an average baseline hour (i.e., an hour lacking any context from one's schedule; $M = 29.26$, $SD = 21.49$, $t(120) = 2.98$, $p < .01$), where the latter two did not differ ($|t(120)| < 1$). Taken together, the results thus far provide consistent evidence that bounded intervals are subjectively contracted.

Discussion of Studies 1A and 1B

Combined, studies 1A and 1B provide evidence that bounded intervals of time feel subjectively contracted compared to unbounded time intervals. We further find that objective differences in available time cannot account for the full effect. Note that in studies 1A and 1B, we studied the subjective duration perceptions of a single time interval (e.g., 11 a.m.–12 p.m.) that borders a task (e.g., at 12 p.m.). We did not explicitly study other time intervals that precede the task but are earlier in the day (e.g., 10 a.m.–11 a.m.). This was useful to isolate the effect, but it was also simplistic. However, it could be that boundary tasks also exert an influence on intervals preceding, but not directly ending in, the task. We tested this notion in a separate study (reported in web appendix B). The study was fully within-subjects and participants rated the perceived duration of four randomly ordered time intervals surrounding a planned five-hour picnic scheduled from 12 p.m. to 5 p.m. (i.e., 10 a.m.–11 a.m., 11 a.m.–12 p.m., 5 p.m.–6 p.m., and 6 p.m.–7 p.m.). Two of the intervals preceded the scheduled task (where one ended when the scheduled task began), while the other two intervals followed from the scheduled task (where one began when the scheduled task ended). We found that the 11 a.m.–12 p.m. interval ($M = 32.46$, $SD = 23.04$), which ended in the scheduled task, felt shorter than the 10 a.m.–11 a.m. interval ($M = 34.87$, $SD = 22.65$, $t(300) = 2.26$, $p < .05$), which preceded, but did not directly border, the scheduled task. Both of the preceding intervals felt shorter than the intervals following the task (which lacked any upcoming boundary task; $M_{5pm–6\,pm} = 38.68$, $SD = 24.81$, $M_{6pm–7\,pm} = 38.84$, $SD = 25.72$, all $ps < .001$), which did not differ ($|t(300)| < 1$). Thus, we find a gradient effect, whereby time intervals felt shorter as they approached the scheduled task.

In addition to demonstrating subjective time perception effects, study 1B also takes a first step at examining how consumers will plan and use their time once it is bounded. We find that boundary tasks decrease the number of available minutes participants feel they have to perform a task. If subjective perceptions of time drive time consumption, then participants would be less likely to perform tasks when they feel they have less time. In the remaining studies, we examine the choice of tasks, likelihood to perform individual tasks, and the number of tasks performed within bounded (vs. unbounded) intervals of time.

STUDIES 2A AND 2B: CHOOSING TASKS FOR BOUNDED VERSUS UNBOUNDED TIME

We next sought to examine consumers' choices between shorter and longer tasks within bounded intervals of time. We predicted that consumers would choose shorter tasks over feasible longer tasks, even in the face of incentives to perform the longer task. To that end, we presented participants with the choice of an extended task with a higher average rate of pay, or a shorter task with a lower rate of pay, using both hypothetical (2A) and probabilistic real outcomes (2B). We predicted that participants in the bounded condition would be less likely to select the higher pay task despite having enough time to complete this option.

Study 2A

Method and Procedure. Two hundred MTurk participants took part in this two-cell (bounded vs. unbounded) study. We manipulated boundary task using the same instructions as in study 1B. MTurkers imagined that during the next hour, they decided to do a survey on MTurk and chose between a 30 minute task that pays $2.50 (i.e., $5.00/hour) and a 45 minute task that pays $5.00 (i.e., $6.67/hour). Following this choice, participants were asked to indicate the perceived duration of the next hour on a 100-point sliding scale (1 = very short, 100 = very long).

Results and Discussion. Looking first at task choice, we found the predicted effect of boundaries: significantly fewer participants in the bounded condition (78/100) selected the 45 minute task with a higher average rate of pay compared to the unbounded condition (91/100, $\chi^2 = 6.45$, $p = .01$). Thus, participants in the bounded condition became less likely to choose the longer, financially superior option. Note that in study 1B, which used the exact same manipulation of boundedness, participants indicated that during both a bounded and an unbounded hour they could objectively perform a task for about 50 minutes. Even considering 50 minutes (rather than the full one hour) as the benchmark, participants in the bounded condition became less likely to perform a lucrative 45 minute task for which they had sufficient time.

We next examined subjective time perception. Replicating our previous results, we found that the bounded hour ($M = 47.56$, SD = 26.67) felt significantly shorter than the unbounded hour ($M = 55.38$, SD = 24.54, $t(198) = 2.16$, $p < .05$). Finally, we tested whether changes in survey choice operated through subjective time perception using a bootstrapped mediation with 5,000 samples (see figure 2 for full regression results). Condition was dummy-coded (unbounded = 0, bounded = 1). We found a significant indirect effect of boundedness on choice of the longer task, operating through time perception (95% [CI] = –.454, –.019). Thus, bounded time felt subjectively contracted, reducing the likelihood of engaging in the longer, but feasible and more lucrative, task. Next, in study 2B, we replicate this effect on task choice while examining real behavior in an incentive-compatible design.

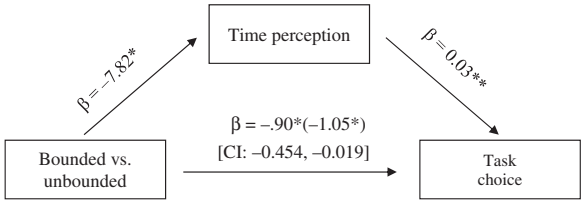
Study 2B

Method and Procedure. Seven hundred fifty-six MTurkers participated in this 2 (bounded vs. unbounded) between-subjects design. Participants were recruited for an "academic study about scheduling behavior" that was described as targeting "workers who regularly schedule and use an electronic calendar." We recruited participants on this basis because all participants were asked to provide their schedule for the following day, and we wanted to ensure that they would be more likely to have (1) at least one scheduled task and (2) their calendars on hand to be able to accurately provide their schedules for the following day. All participants were first presented with a calendar for the day divided into half-hour time slots starting from 8:00 a.m. and extending to 10:00 p.m. and were asked to fill in the time slots with all of their scheduled tasks for the following day (see appendix B, panel A, for exact instructions). Next, for each scheduled activity, participants were asked to indicate (1) the exact start time for each of their scheduled tasks and (2) the time that they would need to begin to transition into or prepare for their scheduled tasks (see appendix B, panel B, for exact instructions). We calculated transition time by subtracting the time they would start preparing for the task from the task's start time. We collected this measure in order to eliminate participants who needed too much transition time and thus would be objectively unable to complete the longer task. We intended to include only those participants who had objectively sufficient time to participate in either task (described in detail below). Participants then answered a series of filler demographic questions (time zone, state of residence, age, gender, etc.) in order to create a short distraction task between filling out their calendar and the dependent measure (choice of a task to perform at a certain point in time) in order to reduce possible demand effects.

After these demographic questions, participants were thanked for their participation and presented with the choice to perform an additional MTurk survey the following day if they qualified. Participants were told that we were recruiting participants for two additional academic studies: (1) a 30 minute brief version of the study for $2.50 and 2) the 45 minute full study for $5.00. They were also presented with a third option to not sign up for either study. They further read that the studies would run only for a limited time and were presented with a specific hour (e.g., 9:30 a.m.–10:30 a.m.) during which the study would need to be completed (see appendix C for exact instructions). Participants were randomly assigned to conditions where those in the bounded condition were shown a target hour that ended in a scheduled task from their own calendar (e.g., they would be assigned 9:30 a.m.–10:30 a.m. if they had a scheduled task starting at 10:30 a.m., but had

FIGURE 2

STUDY 2A MEDIATION RESUTLS



9:30 a.m.–10:00 a.m. and 10:00 a.m.–10:30 a.m. free). Those in the unbounded condition were instead shown a target hour to complete the additional study that was separate from any of their scheduled tasks by at least half an hour (e.g., they would be assigned 9:30 a.m.–10:30 a.m. if they had 9:30 a.m.–10:00 a.m., 10:00 a.m.–10:30 a.m., and 10:30 a.m.–11:00 a.m. all free). If participants' schedules did not fit the criteria for their assigned condition, then the survey was ended and they were not presented with the primary dependent variable. Those participants who fit the criteria for their assigned condition then indicated which task they would like to complete during the specific bounded or unbounded hour during their schedule if they qualified (30 minute study, 45 minute study, or neither study). Due to budget constraints, we emailed 10% of participants the next day with a link to the task of their choice to be completed during their target hour, and these selected participants were paid accordingly upon completion. The remainder of the participants were informed that they did not qualify and therefore their chosen study was not available to them. Thus, their choice had real, probabilistic outcomes.

While participants were randomly assigned to be presented with either a bounded or an unbounded hour during their schedule, there is a potential for failure of this randomization based on the inclusion criteria for each condition. In particular, a participant with zero scheduled tasks would be included in the data if assigned to the unbounded condition, but would not be included if assigned to the bounded condition, because only those participants who had an hour available followed by a scheduled task were presented with the dependent measure for the bounded condition. Conversely, a participant with many scheduled tasks may be more likely to be included if assigned to the bounded condition, as this condition required a smaller amount of time free (one hour vs. an hour and a half). Thus, participants with particularly free schedules can be over-represented in the unbounded condition and participants with particularly busy schedules can be overrepresented in the bounded condition. In order to address this potential issue, we intended to include only those participants who had both a bounded and an unbounded hour in their schedule and who would therefore have been included irrespective of the condition they were assigned. Finally, participants indicated whether they had other plans that had to be performed within the bounded or unbounded hour they were presented. We collected this measure in order to examine only those participants for whom the presented time was truly unaccounted.

Results and Discussion. Of the 756 participants recruited, 455 were assigned to the bounded condition and 301 were assigned to the unbounded condition. We overpopulated the bounded condition, as we expected that it would be more difficult to find an available bounded hour to present them with the dependent measure. As discussed above, we included only the participants who fit the following three criteria: those participants who (1) had both a bounded and an unbounded hour in their schedule, (2) had no other tasks to do during the target time, and (3) had sufficient time to complete either task after accounting for required transition time to the next scheduled task. Three hundred fifty-five (out of 455) bounded participants had a free bounded hour available and were thus presented with the dependent measure, while 286 (out of 301) unbounded participants had an available unbounded hour and were thus presented with the dependent measure. Of the 355 participants in the bounded condition, 30 did not satisfy the first criterion, another 73 did not satisfy the second criterion, and another 100 did not satisfy the third criterion. In the unbounded condition, 51 (out of 286) participants failed to satisfy the first criterion, another 58 did not satisfy the second criterion, and another four did not satisfy the third criterion. The final sample thus included 152 bounded and 173 unbounded participants, all of whom had both a bounded and an unbounded time interval available in their schedules, were available during the target hour, and had objectively enough time to complete either task they might choose (i.e., 45 minutes or 30 minutes).

Examining the results, we found that while participants in both conditions were similarly likely to choose neither study (bounded = 5.92%, 9/152, unbounded = 5.65%, 10/173, $\chi^2 < 1$), those in the bounded condition were significantly more likely to select the 30 minute study (bounded = 15.79%, 24/152, unbounded = 8.09%, 14/173, $\chi^2 = 4.64$, $p < .05$) and significantly less likely to select the 45 minute study (bounded = 78.29%, 119/152, unbounded = 86.13 %, 153/173, $\chi^2 = 3.44$, $p = .06$). Thus, we replicate the results of study 2A using probabilistic, incentive-compatible outcomes.

Discussion of Studies 2A and 2B

Taken together, studies 2A and 2B demonstrate that consumers become less likely to choose more extended tasks during bounded time, even in the face of financial incentives. Employing both hypothetical (2A) and incentive-compatible choices (2B), we demonstrate that scheduled boundary tasks systematically alter the consumption of available time, leading consumers to forgo relatively extended tasks in favor of shorter, more easily accomplished tasks. We further find that subjective perceptions of time mediate this effect (study 2A), supporting a time contraction–based account.

STUDIES 3A AND 3B: PERFORMING TASKS DURING BOUNDED VERSUS UNBOUNDED TIME

Studies 2A and 2B examined consumers' choice of tasks within bounded and unbounded intervals. In studies 3A

and 3B we examine consumers' willingness to spend their time on individual tasks based on the length of time required to complete the task. We expected that participants would be less likely to engage in relatively extended (though feasible) tasks, but would be just as likely to engage in shorter tasks. We examined these predictions using both hypothetical (3A) and real (3B) outcomes, in both the lab (3A) and field (3B). Study 3A also aimed to better understand at what point a task becomes sufficiently long to feel less accomplishable during bounded time.

Study 3A

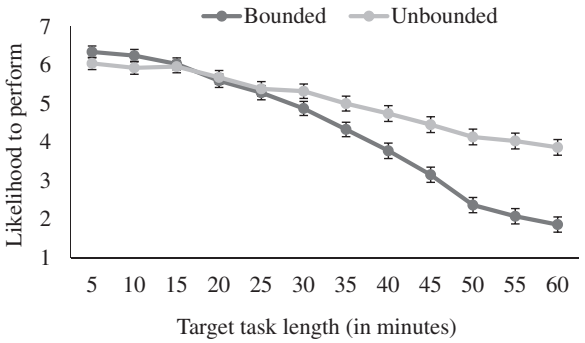
In this study, we examined participants' willingness to engage in varying lengths of tasks during bounded and unbounded time intervals. This allowed us to observe the switching point at which consumers deem a task is too long to complete during bounded time.

Method and Procedure. Two hundred MTurk participants took part in this 2 (interval: bounded vs. unbounded; between-subjects) × 12 (task length: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 minutes; within-subjects) mixed-design experiment. The same manipulation of boundary task was used as in studies 1B and 2A. After the manipulation, participants imagined that they had a task to complete for work. They indicated how likely they would be (on a seven-point scale where 1 = very unlikely, 7 = very likely) to work on this task during the next hour for different lengths of time that the task would take. They then saw 12 amounts of time from five to 60 minutes in five-minute increments and indicated their likelihood of working on the task for each amount of time (see appendix D for exact instructions).

Results and Discussion. Mixed ANOVA revealed a significant main effect of boundary task ($F(1, 198) = 13.78$, $p < .001$) such that, overall, participants in the bounded condition ($M = 4.33$) were less likely to take part in the target activity than those in the unbounded condition ($M = 5.05$). We also found a main effect of task length ($F(1, 198) = 274.59$, $p < .001$) such that participants became less likely to take part in the task as the length of the task increased. These two main effects were qualified by the predicted significant interaction ($F(1, 198) = 33.97$, $p < .001$). For task lengths of 25 minutes or less, we observed no reliable differences between bounded and unbounded participants. For a 30 minute task, a difference emerged ($M_{\text{Bounded}} = 4.87$, SD = 1.90, $M_{\text{Unbounded}} = 5.32$, SD = 1.78, $t(198) = 1.71$, $p = .089$), and it became reliable for tasks 35 minutes ($M_{\text{Bounded}} = 4.33$, SD = 1.96, $M_{\text{Unbounded}} = 5.00$, SD = 1.81, $t(198) = 2.51$, $p = .01$) and longer (see figure 3). When their time is bounded, consumers are less likely to perform a task that would consume half (or more) of their (objective) amount of time. However, for shorter tasks (that require less than half of the interval to complete), bounded consumers are just as likely to perform the task as unbounded consumers. Next, we test this reluctance to take part in relatively extended tasks (taking about half of the available time) using a correlational field design with incentive-compatible behavior.

FIGURE 3

STUDY 3A RESULTS



Study 3B

Method and Procedure. One hundred thirty-four participants were approached at Chicago O'Hare International Airport to volunteer to help a student in a two-cell (bounded vs. unbounded) measured design. A research assistant blind to the hypotheses approached participants sitting at their gate and asked whether they would be willing to help him by filling out a 15 minute survey for his thesis during the next half-hour. All participants were informed that, if they agreed, they must complete the survey within the next half-hour. The research assistant went to various gates within the airport either half an hour before the next flight from that gate was scheduled to board (bounded) or an hour prior to the next scheduled boarding time (unbounded). Thus, participants' boarding time served as the boundary task. In order to carefully control the amount of time available prior to boarding at each gate and to ensure that all participants approached had a sufficient amount of time to completed the 15 minute survey if they chose to do so, the research assistant approached participants no earlier than 35 minutes prior to the scheduled boarding time and no later than 20 minutes prior to the boarding time in the bounded condition and no earlier than 65 minutes prior to the scheduled boarding time and no later than 50 minutes prior to the boarding time in the unbounded condition. To confirm that participants were appropriately classified as bounded or unbounded, the research assistant recorded the time that the participant was approached as well as each participants' flight time. Whether or not they agreed to volunteer for the survey, all participants were asked their

flight time and all willingly disclosed this information. Those who agreed to volunteer were then given and completed the 15 minute paper-and-pen study. Thus, the decision was consequential and required an actual commitment of time. Note that all participants had a boundary task of boarding their plane, but were recruited so that the interval during which they were asked to complete the target activity either ended exactly with that boarding time or was separate from it. We predicted that bounded participants (for whom their boarding time represented the exact endpoint of the interval) would be less likely than unbounded participants (for whom their boarding time was separate from the interval by an additional half-hour) to volunteer 15 minutes of their time.

Results and Discussion. Of the 134 participants recruited, 65 participants were bounded and 69 were unbounded. As predicted, those participants approached during a bounded half-hour were significantly less likely to volunteer to help the student (26.15%, 17/65) than participants recruited during an unbounded half-hour (46.37%, 32/69, $\chi^2 = 5.90$, $p = .015$). In sum, utilizing a correlational field design with real behavior, we find further evidence that consumers are less willing to perform relatively extended tasks once time is bounded.

Discussion for Studies 3A and 3B

Taken together, studies 3A and 3B provide consistent evidence that consumers are less likely to take part in relatively extended tasks (i.e., those that require approximately half the objective interval or greater to complete) during bounded intervals using both hypothetical (3A) and incentive-compatible (3B) designs. We propose that the observed reluctance to take on relatively extended tasks is driven by the perception that such tasks are less accomplishable during bounded intervals. That is, once time feels shorter, consumers feel unsure about the sufficiency of the available time to complete relatively long tasks. Thus, they are just as likely to perform relatively short tasks, which feel accomplishable even if time feels subjectively contracted. One important assumption inherent in this prediction is that the presence of a boundary task affects behavior by altering the perceived length of the interval and not the perceived length of the target task to be performed. However, consumers are often poor at estimating how long a particular task will take (Buehler, Griffin, and Ross 1994, 2002), so it is possible they would predict that a task would take longer during a bounded interval. Thus, consumers may be less likely to take part in relatively extended tasks either because the interval feels shorter (as we suggest) or because they predict that a target task will take longer (or some combination of the two).

In order to isolate the effect of contracted time perception, we explicitly stated the time required to complete tasks in all of our studies so far. Nonetheless, we ran an additional study (reported in web appendix C) to examine whether providing the length of the task is sufficient to control for possible differences in estimated task length. Participants read the same manipulation of boundary task used in studies 1B, 2A, and 3A. Next, they considered a 45 minute online training task and indicated both (1) their likelihood to work on this task during the next hour and (2) how many minutes they thought the online training would take them to complete if they did work on it in a counterbalanced order. Replicating the results for relatively extended tasks in study 3A, we found that bounded participants were less likely to work on the task ($M = 4.96$, $SD = 1.91$) compared to unbounded participants ($M = 5.59$, $SD = 1.47$, $t(148) = 2.25$, $p < .05$). Furthermore, participants in both conditions estimated that the task would take a similar length of time to complete ($M_{Bounded} = 41.14$, $SD = 10.38$, $M_{Unbounded} = 42.15$, $SD = 13.95$, $|t(148)| < 1$), where the estimated completion time in both conditions was less than 45 minutes ($M_{Combined} = 41.63$, $t(149) = 3.38$, $p = .001$ compared to 45 minutes). This additional study therefore provides evidence that the possibility that consumers perceive that tasks will take longer during bounded intervals is not a necessary condition to the observed effect.

Building on the results of studies 3A and 3B, in the final set of studies, we next turn to further testing the role of perceived ability to accomplish the task as a driver of task consumption within bounded intervals. As outlined previously, if the likelihood of performing a given task during bounded intervals is indeed driven by whether the target task feels accomplishable during the subjectively contracted time, then we can make a couple of additional predictions. First, the reluctance to participate in extended tasks should be mitigated if the task can easily be divided into shorter subtasks, where one or more of the subtasks would feel accomplishable during the interval (albeit not the task in its entirety), and the task does not need to be completed all at once. Second, when consuming short tasks (or subtasks), consumers should be just as likely to take part in a single short task (as found in study 3A), but should consume fewer short tasks in total, as each consecutive short task should feel increasingly less accomplishable during bounded compared to unbounded time. We next test each of these predictions in studies 4A and 4B.

STUDIES 4A AND 4B: THE ROLE OF PERCEIVED ABILITY TO COMPLETE TASKS

Using both hypothetical (4A) and real (4B) behavior, we test whether the ability to break up a task into meaningful, shorter subtasks indeed mitigates the reluctance to take part in relatively extended tasks (4A) as well as whether

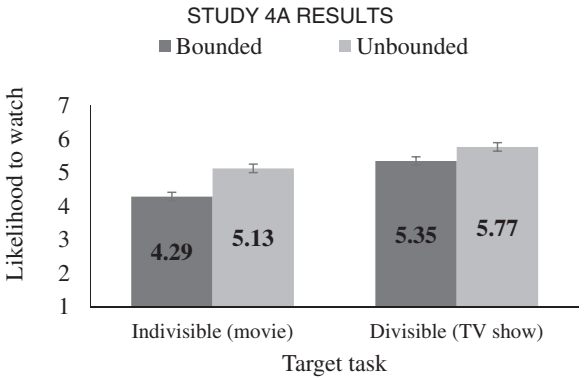
consumers participate in fewer total short tasks within bounded intervals (4A and 4B).

Study 4A

Method and Procedure. Six hundred MTurk participants took part in this 2 (interval: bounded vs. unbounded) × 2 (task: divisible vs. indivisible) between-subjects design. Participants in the bounded condition imagined that it was 6:00 p.m. on a weeknight, and that their friend was coming over at 9:00 p.m. Similar to studies 1B, 2A, and 3A, they were also told that they were all ready for their friend to come by. Those in the unbounded condition instead imagined that it was 6:00 p.m. on a weeknight but that they did not have any plans for the evening. We next manipulated divisibility of the target task by telling half the participants (divisible condition) that they "have three episodes left of a TV show that you have been binge watching. Each episode is 55 minutes long (total of two hours and 45 minutes)." Participants in this condition then indicated how likely they would be to watch this TV show during the time from 6:00 p.m. to 9:00 p.m. (1 = very unlikely, 7 = very likely) and indicated the number of episodes (one, two, or three) that they would watch if they were to watch the TV show during that time. Thus, for the TV show (i.e., divisible task), we have two measures of consumption: (1) likelihood to watch and (2) number of episodes (i.e., subtasks) they would watch. Participants in the indivisible task condition instead read that "there is a movie that you have been meaning to watch that is two hours and 45 minutes long," and indicated how likely they would be to watch this movie during the time from 6:00 p.m. to 9:00 p.m. on the same seven-point scale. Thus, the total time required to watch all three episodes of the TV show was equivalent to watching the full movie. However, while the TV show is easily divided into three parts, making it easy to view in multiple sittings, the movie is harder to divide and would generally be viewed all at once. We predicted that being able to divide the task into smaller subtasks would mitigate the effect of boundedness on willingness to spend time on relatively extended tasks because one or more of the subtasks would feel accomplishable within the bounded interval, while the remaining subtask(s) could be consumed at a later time. However, completing the task in its entirety should feel less accomplishable within bounded intervals and consumers should thus be less likely to watch all three episodes of the TV show compared to unbounded consumers.

Results and Discussion. We found a significant main effect of boundary task ($F(1, 596) = 24.88$, $p < .001$) such that overall, participants were less likely to perform either task when time was bounded ($M = 4.82$) compared to when it was unbounded ($M = 5.45$). We further found a significant main effect of task type ($F(1, 596) = 45.52$, $p < .001$) such that participants were overall more likely to take part in the divisible task ($M = 5.56$) than the indivisible task ($M = 4.71$). These main effects were qualified by a marginal interaction ($F(1, 596) = 2.73$, $p = .099$; see figure 4) indicating that the magnitude of the difference between the bounded and unbounded conditions varied as a function of the divisibility of the target task. In particular, we found that while participants in both the divisible and indivisible conditions were less likely to engage in the target task during bounded compared to unbounded time, the effect was larger for the indivisible task ($M_{\text{Bounded}} = 4.29$, SD = 1.83, $M_{\text{Unbounded}} = 5.13$, SD = 1.44, $t(596) = 4.69$, $p < .001$) than for the divisible task ($M_{\text{Bounded}} = 5.35$, SD = 1.45, $M_{\text{Unbounded}} = 5.77$, SD = 1.39, $t(596) = 2.36$, $p = .02$).

FIGURE 4



Finally, we examined the number of episodes (one, two, or three) that participants indicated they would watch. Note that we are able to conduct this analysis only in the divisible condition, as this measure was not possible in the indivisible condition. We found that participants in both conditions were similarly likely to choose to watch one episode (bounded = 28.87%, unbounded = 26.75%, $\chi^2 < 1$), but that participants in the bounded condition were significantly more likely to watch two episodes (bounded = 38.73%, unbounded = 22.29%, $\chi^2 = 9.58$, $p < .01$) and significantly less likely to watch all three episodes (bounded = 32.39%, unbounded = 50.96%, $\chi^2 = 10.54$, $p < .01$). Put differently, bounded participants would watch fewer episodes on average ($M = 2.04$, SD = .79) than unbounded participants ($M = 2.24$, SD = .85, $t(297) = 2.18$, $p = .03$). In sum, we find that being able to divide the target task into shorter subtasks mitigates (though does not eliminate) the reduced willingness to spend bounded time on relatively extended tasks. We propose that this occurs because one or more of the subtasks feels accomplishable within the subjectively shorter time, but not the entire task. In line with this, we further find that bounded participants are less likely to consume all three subtasks of the divisible task.

Study 4A provides evidence that perceived ability to accomplish a task once initiated indeed plays a role in the consumption of bounded time, though such a concern to complete tasks cannot account for the full effect. It is important to note that this study utilized fun, enjoyable tasks that consumers may be particularly motivated to complete once initiated (Nelson and Meyvis 2008). Thus, one may wonder whether similar effects would be found for less desirable tasks. To test this, in an additional study (reported in web appendix D), we explicitly compared desirable and undesirable target tasks and find that participants are less likely to engage in both enjoyable leisure (i.e., TV episode; $M_{\text{Bounded}} = 5.09$, $\text{SD} = 1.68$, $M_{\text{Unbounded}} = 6.30$, $\text{SD} = 1.24$, $t(295) = 4.63$, $p < .01$) and less enjoyable work tasks (i.e., online training; $M_{\text{Bounded}} = 4.62$, $\text{SD} = 1.77$, $M_{\text{Unbounded}} = 5.32$, $\text{SD} = 1.58$, $t(295) = 2.73$, $p < .01$) that are relatively long but feasible to accomplish within an amount of bounded time. These results support the notion that overall, consumers are less willing to spend their available time on desirable or undesirable target tasks, as both tasks would feel less accomplishable within bounded time.

Study 4B

Building on the finding in study 4 A that bounded participants would consume fewer task subcomponents, in study 4B we tested whether consumers perform fewer tasks during bounded intervals of time using an incentive-compatible design. In this study, we kept the presence of a boundary task constant, but manipulated its salience. We predicted that participants would perform fewer tasks during their available time when the upcoming boundary was more salient.

Method and Procedure. One hundred fifty-eight undergraduates at Washington University in St. Louis took part in this two-cell (boundary task: salient vs. not salient) between-subjects study as part of a larger session. In particular, participants were brought into the lab to complete several unrelated studies in a half-hour session. At the start of the session, the experimenter (who was blind to hypotheses) told participants that the study sessions had been running faster than expected, so she would wait a few minutes to see if more participants arrived. In the boundary-not-salient condition, participants were told that they had "about five minutes to do whatever you want." Participants in the salient-boundary condition were instead told that they had "about five minutes *before we will get started.* You can do whatever you want *up until I tell you it is time to start*." Thus, in both conditions, participants had an upcoming task (i.e., starting the session), but in the bounded condition, we drew participants' attention to this otherwise implied boundary. After the allotted time had passed, participants were asked to write down all of the things that they had done during the five-minute interval. Qualitatively examining the responses, we found that participants performed various short activities within the time, such as checking their email, sending a text message, and visiting social media sites. Because there are only a limited number of tasks that can be performed in this short (five-minute) time interval, we focused on the number of (short) tasks performed as the primary measure of time consumption. Thus, the number of tasks participants performed were counted and served as the dependent measure. We predicted that participants in the salient-boundary condition would perform fewer (short) tasks during the available time than participants in the boundary-not-salient condition.

Results and Discussion. We found that participants in the salient-boundary condition performed fewer activities during the available time ($M = 1.86$, $\text{SD} = 0.98$) than those in the boundary-not-salient condition ($M = 2.38$, $\text{SD} = 1.17$, $t(116) = 2.62$), $p = .01$). Thus, examining actual behavior, where all participants had an upcoming boundary task (i.e., starting the session), we find that making that boundary task more salient led participants to perform fewer tasks within their available time.

Discussion of Studies 4A and 4B

Together, studies 4A and 4B provide evidence for the role of perceived ability to accomplish target tasks in the effect of boundaries on time consumption. In line with the idea that the ability to divide a target task into meaningful subtasks should make consuming at least part of the task feel more accomplishable, we find that task divisibility indeed mitigates the effect of boundaries on consumption of relatively extended tasks. Further, while task subtasks and relatively short tasks may individually feel more accomplishable, we find that consumers perform fewer total subtasks and short tasks during bounded intervals while examining both hypothetical and real behavior.

GENERAL DISCUSSION

Across eight studies, we examine how intervals of unscheduled time are perceived and consumed as a function of boundary tasks (see table 1 for a summary of results). We consistently find that intervals that end in a scheduled task feel subjectively contracted and are consumed differently. Using a correlational field design (study 1A) and an experimental lab design (study 1B), we find that participants who have a future scheduled task perceive time to be shorter than those who do not have a scheduled task. Further, we find that objective differences in available time cannot account for the full effect. Objective time estimates did not change with the presence of a boundary task, while subjective estimates contracted (study 1B).

TABLE 1

SUMMARY OF RESULTS

Panel A: Results for time perception

Study	Measure	Bounded	Unbounded	Key takeaways
1A	Duration perception	13.76 (10.51)	18.27 (7.55)**	Bounded intervals feel shorter (field evidence)
1B	Available minutes	Subjective: 39.54 (13.35) Objective: 49.32 (14.80)	Subjective: 48.86 (12.86)*** Objective: 50.36 (15.32)	Bounded intervals feel subjectively, but not objectively shorter
2A	Duration perception	47.56 (26.67)	55.38 (24.54)**	Time perception mediates the effect of boundary task on time consumption

Panel B: Results for time consumption

Study	Measure	Bounded	Unbounded	Key takeaways
2A	Choice of longer over shorter task	78.00%	91.00%***	Consumers are less likely to perform extended, lucrative tasks during bounded time
2B	Choice of longer task, shorter task, or neither (real behavior)	Longer task: 78.29% Shorter task: 15.79% Neither: 5.92%	Longer task: 86.13%* Shorter task: 8.09%** Neither: 5.65%	Consumers are less likely to perform extended, lucrative tasks during bounded time, real behavior
3A	Likelihood to perform a target task	5min task: 6.34 (1.44) 25min task: 5.28 (1.92) 30min task: 4.87 (1.90) 35min task: 4.33 (1.96) 60 min task: 1.86 (1.67)	5min task: 6.04 (1.70) 25min task: 5.38 (1.81) 30min task: 5.32 (1.78)* 35min task: 5.00 (1.81)*** 60min task: 3.87 (2.31)***	Consumers are less likely to perform extended tasks, but just as likely to perform short tasks during bounded intervals
3B	Choice to perform a target task	26.15%	46.37%**	Consumers are less likely to volunteer for a task during bounded intervals, field evidence
4A	Likelihood to perform a target task	Indivisible: 4.29 (1.83) Divisible: 5.35 (1.45)	Indivisible: 5.13 (1.44)*** Divisible: 5.77 (1.39)**	Consumers are less likely to perform extended tasks during bounded intervals, esp. indivisible tasks
4B	Number of tasks performed (real behavior)	1.86 (0.98)	2.38 (1.17)***	Consumers perform fewer short tasks during bounded intervals, real behavior

NOTE—Numbers in parentheses represent standard deviations
*$p < .10$
**$p < .05$
***$p < .01$; Significance reported compared to bounded condition

We further find that consumption patterns differ systematically between bounded and unbounded intervals. Consumers become less likely to choose relatively extended, though feasible, tasks even when longer tasks are financially incentivized (studies 2A and 2B), and contracted time perception mediates this effect (study 2A). While consumers are less likely to take part in feasible tasks that are relatively extended (study 3A and 3B), they are just as likely to take part in relatively short tasks (study 3A) during bounded and unbounded intervals. This reduced willingness to perform a relatively extended task is mitigated when the task can easily be divided into shorter subtasks (study 4A). Importantly, while consumers are just as likely to perform a single short task during bounded intervals, they perform fewer total short tasks (studies 4A and 4B). Taken together, our results—using both hypothetical and incentive-compatible designs—identify a unique driver of time perception and consumption, establishing that the structure and organization of one's day has important implications for how free time is consumed.

Scheduling

Prior research on scheduling has demonstrated several of its benefits (for an exception, see Tonietto and Malkoc 2016). Scheduling is associated with lower anxiety and may help time-pressed consumers cope with busyness (Bond and Feather 1988), increases the likelihood of completing tasks (Milkman et al. 2012; Tonietto and Malkoc 2016), and promotes efficiency by helping consumers explicitly prioritize and plan steps necessary to complete tasks (Fernbach et al. 2015). Prior research, however, has primarily examined the effect of scheduling on the scheduled

tasks. Thus, we contribute to this literature by examining how scheduling impacts the perception and ultimate consumption of available time surrounding scheduled tasks.

We also contribute to prior research that finds that temporal cues (e.g., temporal landmarks; Dai et al. 2014; Peetz and Wilson 2013) can at times alter consumer behavior. For instance, consumers often become less motivated to pursue their personal long-term goals in the time leading up to a temporal landmark (i.e., significant dates such as one's birthday; Dai et al. 2014). This line of work, however, mainly considers personally relevant temporal landmarks or significant holidays, the presence of which creates a discontinuity in self-perception (Dai et al. 2014; Libby and Eibach 2002). In contrast, we study relatively mundane events that affect how consumers spend their time throughout the day, finding that the presence of a scheduled task systematically alters the tasks consumers are willing to engage in during the preceding time.

Potential Drivers of Subjective Time Perception

As with many temporal phenomena, the effect of scheduled boundary tasks on time perception is complex and likely multiply determined. In our studies, we provide robust evidence for the effect of boundary tasks on time perception. Here, we provide a more specific discussion of the potential drivers of this effect.

Attention. Consumers devote attention to future tasks they will perform (Brenner 1973), which may contract time. Prior work has found, for example, that devoting greater attention to an object makes it feel physically closer (Cole et al. 2014; Wu, Ooi, and He 2004). Given that time and space are perceived analogously, a future scheduled task might also feel psychologically closer (Liberman and Trope 2008; Trope and Liberman 2010). Therefore, focusing attention on the endpoint of the interval (i.e., on the scheduled task) could lead the endpoint to loom nearer in time, thus making the interval feel shorter. Further, attention could account for the gradient observed in web appendix B, because attention should increase as one nears the task, but decrease once it has been completed (Brenner 1973).

Motivation. A scheduled task can be construed as goal-relevant. Goal-relevant objects feel physically closer (Balcetis and Dunning 2010) and focusing on a goal reduces perceived psychological distance to the goal (Cheema and Bagchi 2011). Like attention, motivation would also predict a gradient in time perception leading up to the scheduled task, because motivation increases as one nears a goal (Kivetz, Urminsky, and Zheng 2006), but diminishes once the goal is complete (i.e., the boundary task has been performed; Ferguson and Bargh 2004). Consumers could be motivated to approach the scheduled task (either because they wish to reach a desirable outcome or because they wish to get an undesirable task over with). However, this is not a cut-and-dried prediction. A savor/dread account (Loewenstein 1987) would predict that consumers would push away desirable tasks and approach the undesirable ones, while a regulatory focus account (Higgins 1998) would predict that consumers would approach the desirable tasks and avoid the undesirable ones.

Inferences about Time. When consumers pay less attention to the passage of time, time feels as though it has passed more quickly (Sackett et al. 2010; Zakay, Nitzan, and Glicksohn 1983), an effect consumers are often aware of. For example, consumers have the lay belief that "time flies when you're having fun," leading them to expect time to pass more quickly when they engage in enjoyable tasks (Sackett et al. 2010). Thus, it might be possible for consumers to make inferences about intervals preceding a scheduled task. Consumers may predict that they will be distracted by the upcoming task, leading them to devote less attention to the passage of time, and thus to predict time will pass more quickly. As a result, they may prospectively rate the interval as shorter (e.g., "the time will fly by, so overall it's shorter"). Such a possibility poses an opportunity for future research to examine the potential ways that different temporal judgments (e.g., experienced time and prospective time) might feed into and influence each other.

Potential Alternative Accounts to Time Consumption Effects

As with time perception, the effect of scheduled boundary tasks on time consumption is complex and likely multiply determined. While we provide evidence for the role of time perception, whereby feeling like one has less time creates ambiguity about the ability to complete tasks, several other factors might still be operating in tandem. Although we carefully controlled for several alternative drivers throughout our studies, a couple still remain.

Importantly, consumers often desire not only to take part in tasks, but also to get the most from those tasks (Malkoc and Tonietto 2019). If they engage in tasks prior to a boundary, consumers may be concerned that they will not be mentally ready to engage in the boundary task, thus risking decreased performance. Alternatively, consumers may fear that they will be distracted and thus unable to fully enjoy a leisure activity or perform a work activity well prior to a boundary. Both of these concerns could reduce their willingness to spend bounded intervals of time. In studies 3B and 4B, we demonstrated the effect with relatively low-involvement tasks that require little mental preparation—boarding time (study 3B) and an experimental session (study 4B). Further, in study 3A, participants self-selected the tasks that they performed during the interval. Even if participants potentially chose tasks for which distraction is less of a concern, we find that they still overall perform fewer tasks during bounded time. Thus, we

find evidence for the effect above and beyond potential concerns over performing tasks well.

Potential Boundary Conditions

Accounted versus Unaccounted Time. We exclusively studied the contraction of intervals of unaccounted time. One might wonder, however, whether time periods that are accounted for would also show a similar contraction prior to scheduled tasks. That is, would a scheduled task also feel shorter if it ended in another, back-to-back scheduled task? We ran an additional study in order to directly test this possibility (reported in web appendix E). We found that while a bounded interval of unaccounted time felt shorter ($M_{\text{Bounded}} = 24.79$, $\text{SD} = 18.56$, $M_{\text{Unbounded}} = 29.44$, $\text{SD} = 19.97$, $t(199) = 3.33$, $p < .01$), a bounded interval of accounted time did not ($M_{\text{Bounded}} = 40.49$, $\text{SD} = 26.98$, $M_{\text{Unbounded}} = 40.56$, $\text{SD} = 27.81$, $|t(199)| < 1$).

Longer Time Intervals. Throughout our studies, we have examined intervals of time of no more than a few hours. Thus, one may wonder whether the observed effect of boundaries might extend to longer intervals (e.g., a full day, weeks, or years). However, a task may reasonably draw much less attention and be much less motivating when it is far out into the future. Hence, when a longer interval of time ends in a scheduled task (e.g., a doctor's appointment at the end of the week), it may no longer exert influence over time perception for the preceding interval. Such an examination of interval length may pose a fruitful avenue for future research, and may potentially help to tease apart alternative drivers of the effect.

Deadlines. In our studies, we consistently find that consumers are less willing to spend their time once it is bounded by a scheduled task. However, situations may exist where one might expect the opposite such that an upcoming task and the perception that time is short increases consumers' motivation to perform a target task. One such instance is when the boundary task serves as a deadline, or when the target task must be completed prior to the start of the scheduled task (Ariely and Wertenbroch 2002). In our studies, we have examined the consumption of target tasks that are not directly related to the boundary task, thus not posing the *need* to have a task completed before the boundary. The effect of boundary tasks may potentially be mitigated (or even reversed) if instead the target task was something that must be completed prior to the scheduled task. Future research might explore this possibility.

Consumer Implications

Our results also offer important implications for consumers looking to get the most from their available time, especially because how consumers perceive and spend their time is directly tied to their happiness and well-being (Aaker et al. 2011). Further, one of the reasons why consumers engage in scheduling is to maximize and expand their available time as well as to fit in more of their desired activities. In the present research, we find that scheduling can instead lead time to feel contracted and reduce the consumption of available time. Our results therefore indicate that if the goal is to maximize time perception and consumption, consumers can benefit from minimizing the number of temporal boundaries (e.g., through back-to-back vs. intermittent scheduling). Note, recent research has distinguished between activity maximization (i.e., maximizing the number of tasks consumers engage in, which boundary tasks can decrease for the preceding time) and outcome maximization (i.e., maximizing enjoyment of leisure tasks and performance on work tasks; Malkoc and Tonietto 2019). Future research could work to uncover the net effect of different organizational strategies to inform these two primary time management goals.

DATA COLLECTION INFORMATION

The first author collected the data for all studies, with the exception of study 3B, which was collected by a research assistant at The Ohio State University, and study 4B, which was collected by research assistants at Washington University in St. Louis, both under the supervision of the first author. The studies were conducted from spring 2015 through summer 2017. Multiple participant populations were used in these studies, including Washington University in St. Louis undergraduates (study 4B), MTurk workers (studies 1B, 2A, 2B, 3A, 4A), academics at the 2015 SJDM conference (study 1A), and travelers at Chicago O'Hare International airport (study 3B). All data was analyzed by the first author.

APPENDIX A

STUDY 1A INSTRUCTIONS

Are you planning to attend the presidential address at 4:45 p.m.?

☐ Yes ☐ No ☐ Maybe

How long do you consider the duration between now and 4:45 p.m.? *(check a circle)*

Very little time — A lot of time

APPENDIX B

STUDY 2B INSTRUCTIONS

Panel A: Calendar fill-in instructions

We are interested in how people use calendars and organize their scheduled tasks throughout the day.

In the calendar below, please enter all of your scheduled meetings and appointments for tomorrow. ***Only*** *include those meetings and appointments that are specifically scheduled with a specific and firmly set start time (e.g., Dr. appointment at 3:00 p.m., lunch at 12:00 p.m., starting work at 9:00 a.m., meeting at 1:30 p.m., etc.).*

Included meetings and appointments should be those that have a fairly strict start time and for which you would plan to be on time.

Panel B: Transition time instructions with example

At what time, specifically, does each of the scheduled tasks you entered start?

	Hour	Minute	AM/PM
Lunch	12 ▾	00 ▾	PM ▾
Meeting	4 ▾	00 ▾	PM ▾

If you will have any preparation or transition immediately before your plans (e.g., getting dressed, travelling, etc.), what time will you start those preparations?

For example, if you have plans to meet a friend at 6:00pm, but will start getting ready to head over there at 5:30pm, then you would select "5:30pm"

Please select the same time as above if you do not have any preparation or transition immediately before your plans (e.g., in the example, the response for both times would be "6:00pm")

	Hour	Minute	AM/PM
Lunch	11 ▾	30 ▾	AM ▾
Meeting	3 ▾	55 ▾	PM ▾

APPENDIX C

STUDY 2B DEPENDENT MEASURE

Thank you for completing this study!

Based on your responses, you may qualify for an additional HIT. We are recruiting participants for two additional academic studies that will be running tomorrow (Wednesday December 21st). If you are interested, you can sign up for the chance to be included in one of these studies.

In the additional, optional studies, we are interested in your personality, opinions, values, and behaviors. As such, you will be asked a series of questions about how you tend to think, feel, and behave.

We are looking for participants to complete one of the two studies:

1. either a 30 minute brief version of the study for $2.50
2. or the 45 minute full study for $5.00

Both of these studies will run for a limited time—from 9:30 a.m. to 10:30 a.m. tomorrow—and **must be completed within that time.** If you qualify, you will receive an email alerting you when the study you chose is posted on MTurk tomorrow.

If you qualify, would you like to sign up to participate in one of these studies from 9:30 a.m. to 10:30 a.m. tomorrow?

- 30 minute study that pays $2.50
- 45 minute study that pays $5.00
- Neither study

APPENDIX D

STUDY 3A INSTRUCTIONS

Imagine that you have a task to complete for work.

Below is a list of different lengths of time that this task might take. For each length of time, please indicate how likely you would be to work on this task *during the next hour*.

How likely would you be to work on this task *during the next hour* if the task would take each of the following amounts of time?

	Very Unlikely	Unlikely	Somewhat Likely	Undecided	Somewhat Likely	Likely	Very Likely
5 minutes	○	○	○	○	○	○	○
10 minutes	○	○	○	○	○	○	○
15 minutes	○	○	○	○	○	○	○
20 minutes	○	○	○	○	○	○	○
25 minutes	○	○	○	○	○	○	○
30 minutes	○	○	○	○	○	○	○
35 minutes	○	○	○	○	○	○	○
40 minutes	○	○	○	○	○	○	○
45 minutes	○	○	○	○	○	○	○
50 minutes	○	○	○	○	○	○	○
55 minutes	○	○	○	○	○	○	○
60 minutes	○	○	○	○	○	○	○

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