E-Companion to
"Born to wait? A study on allocation rules in booking systems"

A Proof of Proposition 1

Let $t(y)$ denote the symmetric equilibrium strategy; that is, a participant with time valuation y bids $t(y))$ units of time in the queue for slots. For any participant i, to win a slot in the equilibrium, her time valuation must exceed the m-th largest of the remaining $n-1$ participants' time valuations. Let H and h respectively denote the cumulative distribution function and the density function of the m-th largest value among $n-1$ independent draws from F:

$$H(y) = \sum_{\ell=n-m}^{n-1} \binom{n-1}{\ell} [F(y)]^{\ell} [1-F(y)]^{n-1-\ell}.$$

If a participant i bids b_i units of time in the queue, her winning probability will be $H(t^{-1}(b_i))$. No matter she wins or not, she needs to pay $b_i \cdot w_i$, the opportunity cost of time. Assuming that the other participants follow the equilibrium strategy, i needs to solve the following problem:

$$\max_{b_i} \left[H(t^{-1}(b_i))y_i w_i - b_i w_i\right], \tag{1}$$

which is equivalent to

$$\max_{b_i} \left[H(t^{-1}(b_i))y_i - b_i\right]. \tag{2}$$

The first-order condition to (2) is

$$h(t_{nr}^{-1}(b_i))\frac{dt_{nr}^{-1}(b_i)}{db_i}y_i - 1 = 0. \tag{3}$$

In equilibrium, this equation holds when $b_i = t(y_i)$. So $t^{-1}(b_i) = y_i$ and $\frac{dt^{-1}(b_i)}{db_i} = \frac{1}{t'(y_i)}$.

Then

$$t'(y_i) = h(y_i)y_i. \tag{4}$$

Given the boundary condition $t(\underline{y}) = 0$, we obtain

$$t(y_i) = \int_{\underline{y}}^{y_i} h(s)s\,ds = y_i H(y_i) - \int_{\underline{y}}^{y_i} H(s)ds. \tag{5}$$

B Additional Figures

Figure B1: The evolution of percentage of time spent on the booking system

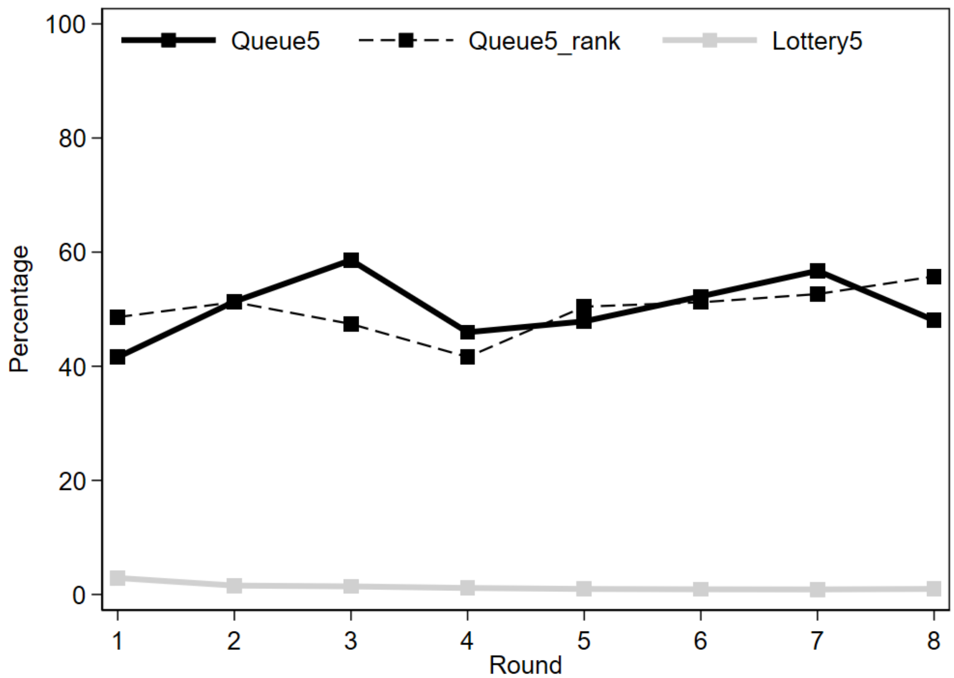


Figure B2: The evolution of effective and ineffective queuing time in Queue5_rank

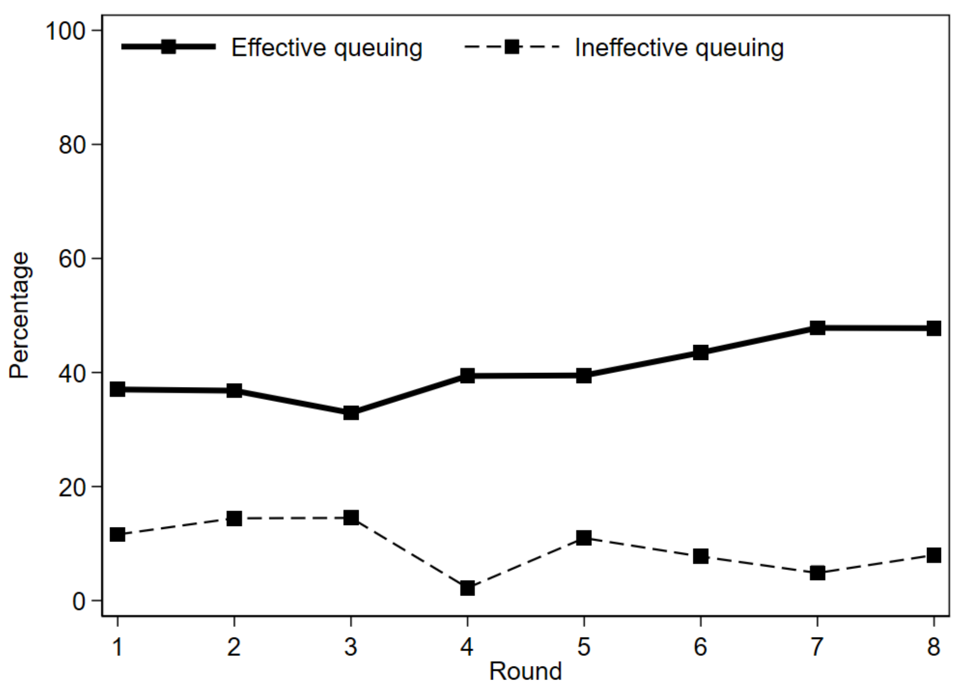


Table B1: Random effects regressions on the switching frequency in Queue5_rank

	Queue5_rank
Time valuation	0.738
	(0.685)
Constant	18.254***
	(2.422)
Clusters	6
N	480

Notes: Standard errors clustered at the session level are in parentheses. We rescale the slot valuation and time cost per minute by dividing them by 100. The time valuation is the ratio of the slot valuation and the time cost per minute.

Table B2: Random effects regressions on effective queuing time

	Queue5		Queue5_rank	
Time valuation	29.089***		8.687***	
	(2.022)		(1.631)	
Slot valuation		26.559***		11.559***
		(3.685)		(1.067)
Time cost per minute		-106.358***		-23.386**
		(5.612)		(9.614)
Constant	-75.606***	42.932**	3.259	10.403
	(7.044)	(16.800)	(6.413)	(14.059)
Clusters	6	6	6	6
N	480	480	480	480

Notes: Standard errors clustered at the session level are in parentheses. We rescale the slot valuation and time cost per minute by dividing them by 100. The time valuation is the ratio of the slot valuation and the time cost per minute.

C Instructions of Experiment 1

In the following, we translate the original instructions in Chinese into English for all treatments.

C.1 Instructions for Queue5 and Queue5_rank

The text that differs between Queue5 and Queue5_rank is highlighted in red.

General Information

You are taking part in a decision-making experiment. Please read the instructions carefully. The instructions are the same for every participant. Please do not communicate with each other during the experiment. Turn off your mobile phone and put it into the envelop on your desk. If you have a question, feel free to raise your hand, and an experimenter will come to help you.

You have earned 15 RMB for showing up on time. In addition, you can earn more money in this experiment. The amount of money you earn will depend upon the decisions you and other participants make. Your earnings in this experiment are expressed in EXPERIMENTAL CURRENCY UNITS, which we will refer to as ECUs. At the end of the experiment you will be paid using a conversion rate of 1 RMB for every 12 ECUs of earnings from the experiment.

Your final payment will be paid to you via bank transfer within 2-3 days on completion of today's experiment. All decisions are anonymous. That is, other participants will not know about your identity or your final payment.

Overview of the experiment

The experiment consists of 8 rounds. Each round lasts 4 minutes. A clock on the upper-right corner of the screen shows the time already past in each round. Each round has two tasks and each participant's earnings are sum of the earnings from the two tasks. At the beginning of each round, you can choose which task to start with: Task 1 or Task 2. The two tasks are displayed on different screens. You may freely switch between the two task screens at any time you want. But you cannot see both task screens at the same time.

Task 1 is about booking an appointment slot at a public office such as hospital. In each round, you will be randomly matched into groups of five participants each. This means that your group members will most likely be different in each round. Each group has three appointment slots available and each participant can only book up to one slot. In each round, the private valuation for a slot is determined randomly and independently for each participant, and will be a natural number between (and including) 400 to 600 ECUs. Each participant is only informed about her own valuation, but not about other group members' valuations. A participant who books a slot will receive ECUs equivalent to her valuation and the one who does not will receive 0. We will discuss the booking procedure in Task 1 in more detail.

Task 2: In addition to the appointment booking task, You can also enter Task 2. In each round, your income from Task 2 depends on the time you spend on the task interface. Specifically, your total income from this task = total time spent on the Task 2 interface (in seconds) $\times$ income per second. The income per second is an independently and randomly drawn number between 1.50 and 2.50 (accurate to two decimal places) and is randomly selected for each round. Each person only knows their own income per second but not that of others. Meanwhile, when you are on the Task 2 interface, you can participate in a simple counting game: counting the number of white dots in a series of dark-shaded squares. You will enter the number of dots into the box next to the table. After you have entered the number, you can click the NEXT button. No matter whether the answer is correct or not, a new square will be generated. Please note that you can also choose not to participate in this game and just stay on the Task 2 interface. Your income from this task is not related to the number of questions answered or whether they are correct or not.

We will now describe in more detail the appointment booking system in Task 1.

Start from 00:00 (minutes: seconds), end at 04:00. The 3 slots will become immediately available at 04:00 and will be assigned on a first-come-first-served basis in the following way: Each participant can choose to switch to and stay on the booking screen to reserve a position in a queue. Those who switch to the booking screen earlier reserve a front position. However, if a participant switches to the counting-dots task screen and then back to the booking screen, he will have to go to the back of the queue. [Queue5_rank only: When you enter the appointment system, the interface will display the current number of people in line and your position in the queue.] When 4:00 is reached, the slots will be assigned as follows:

1. If the number of participants staying in the queue > 3, each of the first three in the queue will obtain a slot.
2. If the number of participants staying in the queue ≤ 3, each of them obtains a slot. Any remaining slot(s) will be wasted.

Payoff

At the end of each round, your round payoff is the sum of the payoffs from the two tasks. At the end of the experiment, one randomly chosen round will be paid out, in addition to the show-up fee.

This completes the instructions. To ensure every participant understand the instructions, please answer the quiz on your screen. If there is any question, please raise your hand. Once everyone correctly answers the quiz, we will start the experiment.

C.2 Instructions for Lottery5

General Information

You are taking part in a decision-making experiment. Please read the instructions carefully. The instructions are the same for every participant. Please do not communicate with each other during the experiment. Turn off your mobile phone and put it into the envelop on your desk. If you have a question, feel free to raise your hand, and an experimenter will come to help you.

You have earned 15 RMB for showing up on time. In addition, you can earn more money in this experiment. The amount of money you earn will depend upon the decisions you and other participants make. Your earnings in this experiment are expressed in EXPERIMENTAL CURRENCY UNITS, which we will refer to as ECUs. At the end of the experiment you will be paid using a conversion rate of 1 RMB for every 12 ECUs of earnings from the experiment.

Your final payment will be paid to you via bank transfer within 2-3 days on completion of today's experiment. All decisions are anonymous. That is, other participants will not know about your identity or your final payment.

Overview of the experiment

The experiment consists of 8 rounds. Each round lasts 4 minutes. A clock on the upper-right corner of the screen shows the time already past in each round. Each round has two tasks and each participant's earnings are sum of the earnings from the two tasks. At the beginning of each round, you can choose which task to start with: Task 1 or Task 2. The two tasks are displayed on different screens. You may freely switch between the two task screens at any time you want. But you cannot see both task screens at the same time.

Task 1 is about booking an appointment slot at a public office such as hospital. In each round, you will be randomly matched into groups of five participants each. This means that your group members will most likely be different in each round. Each group has three appointment slots available and each participant can only book up to one slot. In each round, the private valuation for a slot is determined randomly and independently for each participant, and will be a natural number between (and including) 400 to 600 ECUs. Each participant is only informed about her own valuation, but not about other group members' valuations. A participant who books a slot will receive ECUs equivalent to her valuation and the one who does not will receive 0. We will discuss the booking procedure in Task 1 in more detail.

Task 2: In addition to the appointment booking task, You can also enter Task 2. In each round, your income from Task 2 depends on the time you spend on the task interface. Specifically, your total income from this task = total time spent on the Task 2 interface (in seconds) $\times$ income per second. The income per second is an independently and randomly drawn number between 1.50 and 2.50 (accurate to two decimal places) and is randomly selected for each round. Each person only knows their own income per second but not that of others. Meanwhile, when you are on the Task 2 interface, you can participate in a simple counting game: counting the number of white dots in a series of dark-shaded squares. You will enter the number of dots into the box next to the table. After you have entered the number, you can click the NEXT button. No matter whether the answer is correct or not, a new square will be generated. Please note that you can also choose not to participate in this game and just stay on the Task 2 interface. Your income from this task is not related to the number of questions answered or whether they are correct or not.

We will now describe in more detail the appointment booking system in Task 1.

Start from 00:00 (minutes: seconds), end at 04:00. Every participant can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. When 4:00 is reached, the slots will be assigned as follows:

1. If the number of applicants > 3, all applications will be put into a virtual urn. Then, one by one, applications are randomly drawn from the urn to fill the three slots.
2. If the number of applicants ≤ 3, each applicant obtains a slot. Any remaining slot(s) will be wasted.

Payoff

At the end of each round, your round payoff is the sum of the payoffs from the two tasks. At the end of the experiment, one randomly chosen round will be paid out, in addition to the show-up fee.

This completes the instructions. To ensure every participant understands the instructions, please answer the quiz on your screen. If there is any question, please raise your hand. Once everyone correctly answers the quiz, we will start the experiment.

D Detailed Report on Experiment 2

D.1 Design of Experiment 2

To validate the results from Experiment 1, we conduct Experiment 2, incorporating two main features. First, we extend the one-stage booking design to a two-stage design. Second, we replace the abstract-effort task with a real-effort task. Building on these two common features, we also manipulate two additional factors: the competitiveness of securing a slot and whether a solo-track or dual-track system is implemented. Furthermore, similar to Experiment 1, each participant can acquire at most one slot per round, with their slot valuation drawn independently from a uniform distribution of integers between 400 and 600 Experimental Currency Units (ECUs).

Two-Stage Booking System

In each round, the booking task consists of two stages, each lasting four minutes.

- **Stage 1**: the first stage is the same as that in Experiment 1. The only difference is that now the unassigned slot in stage 1 is not wasted, instead, it becomes available for stage 2 of the booking task at the beginning. Moreover, if at least one slot is allocated in stage 1, one slot will be randomly selected and canceled at a random moment in stage 2 and then becomes immediately available in the booking system. The participant whose slot is canceled will still obtain a payoff equivalent to her valuation and cannot book a slot again.[1]

- **Stage 2**: Only participants who have not obtained a slot in stage 1 can participate in the booking task in stage 2. In this stage, available slots consist of those unassigned after stage 1 and a slot created by the random cancellation of an assigned slot. The unassigned slots are available in the booking system from the start of stage 2, whereas the canceled slot becomes available at the moment of cancellation.

  Under the *queue rule*, participants can enter the booking system at any time and observe the number of currently available slots. If a slot is available, a participant can book it immediately. However, if the system shows no available slot, participants cannot be certain whether this is because all slots have already been assigned or because the cancellation has not yet happened.

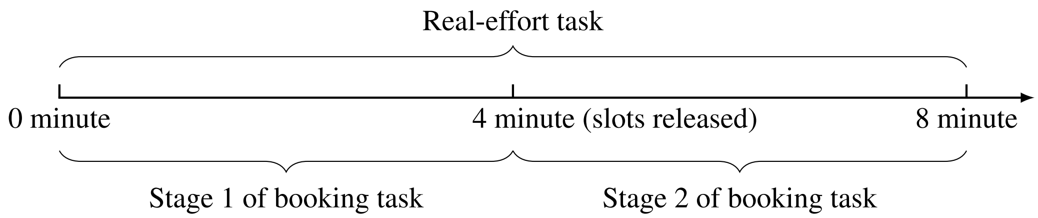
  In contrast, under the *lottery rule*, participants can enter the booking system at any time and apply by pressing the application button, even if the system shows no currently available slots. All applications are collected in a virtual urn. At the end of stage 2, applications are randomly drawn from the urn one by one to fill any available slots.

The timeline of Experiment 2 in each round is shown in Figure D1.

Real-Effort Production Task

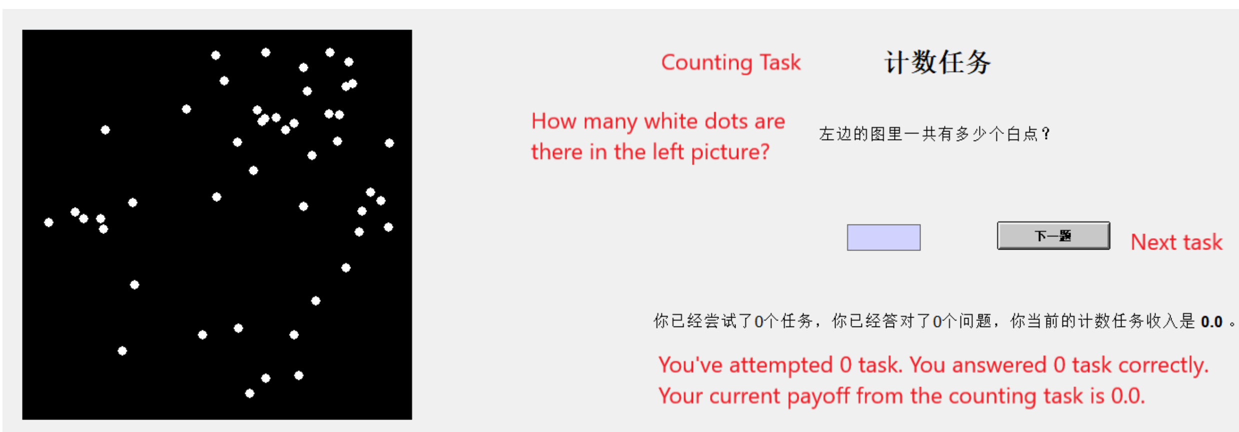
[1] This setup is designed to mimic real-life situations in which people with allocated appointments may cancel these appointments, making these appointments available to others. To simplify our decision-making environment, we determine a cancellation, as opposed to a participant choosing to cancel, as the cancellation source is not essential for our research purposes.

Figure D1: Timeline of the dual-tasking environment



In the production task, we ask participants to count the number of white dots in a series of dark-shaded squares (see Figure D2). In each square, both the total number (between 35 and 54, inclusive) and the positions of dots are randomly generated. Each correct answer is rewarded by 35 ECUs.[2] This task is designed to mimic the type of task that may compete with a queuing activity for a participant's time. To build task familiarity and thus help participants gain a sense of their productivity level, participants are asked to work on the production task for five minutes at the beginning of each session without any reward.[3]

Figure D2: Screenshot of the counting-dots task



D.1.1 Treatments

In Experiment 2, we implement a 2×2 design by varying the allocation rule (Queue vs. Lottery) and whether a solo-track or dual-track system is used in stage 1. Within the solo-track treatments, we also vary the level of market competitiveness. Under low market competitiveness, each group consists of five participants vying for three slots. We refer to the treatment adopting the queue (lottery) rule and low competitiveness as *Solo-Queue5* (*Solo-Lottery5*). Under high market competitiveness, each group consists of seven participants contending for two slots. We refer to the treatment adopting the queue (lottery) rule and high competitiveness

[2] The piece rate is chosen so that the expected payoffs from working only on the production task and from obtaining a slot in the booking task are largely comparable. This payoff selection is intended to highlight the trade-off in time allocation between the two tasks.

[3] The average per-minute productivity for our full sample (n = 344) in the five-minute trial round is about 1.12 correctly-answered squares (s.d. = 0.59), compared to 1.72 (s.d. = 0.58) in the payment rounds.

as *Solo-Queue7* (*Solo-Lottery7*). The comparisons between Solo-Queue5 and Solo-Lottery5 and between Solo-Queue7 and Solo-Lottery7 allow us to study whether the lottery rule improves productive efficiency compared to the queue rule. Further, implementing different levels of market competitiveness allows us to study the robustness of our results.

In the dual-track treatments, we examine only the high market competitiveness environment because it provides greater scope for us to observe if there is any tendency among participants to prefer one track over the other. Specifically, each track in stage 1 under high market competitiveness has exactly one available slot. In the *Dual-Queue* (*Dual-Lottery*) treatment, we implement the queue (lottery) rule in stage 2. Observing how participants make track decisions in stage 1 allows us to examine whether participants generally prefer the lottery rule over the queue rule. We also compare behavior under each track in the dual-track system with behavior in the corresponding solo-track system. This allows us to see whether the dual-track system finds the sweet spot between improving overall productive efficiency (compared to the solo-track queue treatments) and respecting distinct individual preferences (i.e., whether participants with high valuations select the queue track). Finally, we examine whether the stage 2 rule affects participants' track decisions and behavior in stage 1. Table D1 summarizes the main features of our experimental design.

Table D1: Design of Experiment 2

Treatments	**Allocation rule**	**Competitiveness**	**# of participants**	**# of matching groups**
Solo-track:				
Solo-Queue5	Queue	Low	60	6
Solo-Lottery5	Lottery	Low	60	6
Solo-Queue7	Queue	High	56	4
Solo-Lottery7	Lottery	High	56	4
Dual-track:				
Dual-Queue	Dual (stage 1) Queue (stage 2)	High	56	4
Dual-Lottery	Dual (stage 1) Lottery (stage 2)	High	56	4

D.1.2 The dual-track booking system

While we expect that participants in our experiment will achieve higher productive efficiency under the lottery versus queue rule, it is possible that they may still choose the queue rule if given a chance to choose. First, people may dislike the uncertainty inherent in the lottery rule and choose the queue rule to feel a sense of control over the process, even at the cost of productive efficiency. Second, participants may have concerns about the transparency of a lottery. While this concern is unlikely to matter in our lab environment, it may have traction outside of a lab setting if manipulation or corruption are suspected, especially in high-stakes situations. Finally, an abrupt transition from one rule to another may be perceived as a violation of the moral principle of free-will decision-making.

While addressing all these practical concerns is challenging and out of the scope of our paper, to provide some resolution to the question of rule preference from the market design perspective, we design a novel *dual-track* booking system and implement it in the lab. The basic idea behind the dual-track system is that people can freely choose between the two allocation rules. This system can balance productive efficiency with participant preferences and free choice. Further, our dual-track system allows people to learn both rules, building familiarity with lottery systems for the later potential transition. Under the dual-track environment, our main interest is to observe whether participants are more likely to choose the lottery rule after having gained experience with both rules.

The dual-track system differs from the solo-track system in that participants can choose either a lottery or queue track at the beginning of stage 1. Each track has the same number of available slots. After all participants in a group make their track decisions, they are placed into subgroups under their given track, where they are informed of the number of participants in their subgroup. Stage 1 then proceeds in the two separate subgroups with one implementing the queue rule and the other the lottery rule. Note that if one track is not chosen by any participant, the slots in that track transfer over to stage 2.

In stage 2, we merge the two subgroups and implement only one allocation rule. To keep the cancellation procedure comparable to that of the solo-track systems, only one of the assigned slots in stage 1 is randomly selected to be canceled at a random moment. We do not apply a dual-track system in stage 2 as it is likely that the canceled slot will be the only available slot.[4]

The dual-track system combines the queue and lottery rules in stage 1 and implements one of these rules in stage 2, depending on the treatment condition. The system is comprised of the following components.

- **Track decision**: At the beginning of each round, each participant chooses to enter either the track with the queue rule or the track with the lottery rule. This decision is binding for that round.
- **Stage 1**: After all participants have made their track decisions, one track assigns slots according to the queue rule while the other track uses the lottery rule. Any unassigned slots from the two tracks are transferred to stage 2.
- **Stage 2**: Participants who have not received slots in stage 1 are allowed to book a slot in stage 2. Depending on the treatment condition, stage 2 uses either the queue rule or the lottery rule.

D.1.3 Procedure

Experiment 2 was conducted at the Nanjing Audit University Economics Experimental Lab with a total of 344 university students, using the software z-Tree. Each session consists of two independent matching groups of 10 participants (for Solo-Queue5 and Solo-Lottery5) or 14 participants (for Solo-Queue7, Solo-Lottery7, Dual-Queue, and Dual-Lottery). Within each matching group, participants are randomly re-matched in each round according to the group size stipulated by the treatment. After every round, all

[4]Suppose we keep our dual-track system in stage 2. If the canceled slot comes from one track in which each member has obtained a slot in stage 1, then this slot will be wasted if we do not allow members from the other track to book it. Because we want to use the same cancellation procedure across all treatments, keeping the stage 2 rule comparable across treatments helps avoid such logistic subtleties.

participants receive feedback about whether they were allocated a slot, whether an allocated slot of theirs was cancelled, and what their respective booking and production payoffs are. In the dual-track treatments, they also learn the number of participants and the average payoff in each track. At the end of a session, one round is privately and randomly chosen for each participant and the participant receives her payoff from that round.

During the experiment, as participants arrived, they were randomly seated at a partitioned computer terminal. The experimental instructions were given to participants in printed form and were also read aloud by the experimenter. Participants then completed a comprehension quiz before proceeding. At the end of the experiment, they completed a questionnaire concerning their demographics and a number of psychological measures. For every 10 ECUs, participants earned 1 RMB. A typical session lasted about 2 hours with average earnings of 80.7 RMB, including a show-up fee of 15 RMB.

D.2 Evaluation Criteria and Hypotheses

D.2.1 Evaluation criteria

Same as Experiment 1, we also use allocative efficiency and productive efficiency in Experiment 2. Since we use real-effort, the productive efficiency loss can occur through strategic and behavioral efficiency loss. *Strategic efficiency loss* is measured as the opportunity cost of time spent on the booking system:

$$\text{Strategic efficiency loss} = \textstyle\sum_{i=1}^{n} \mathbb{E}[t_i w_i].$$

We expect that participants' productivity may change over time in our experiments, and in particular, there may be productivity change due to behavior factors. On the one hand, subjects may get to "rest" while waiting in the queue (as opposed to working continuously on the productive task)which could lead to increased productivity after a period of waiting.[5] On the other hand, there might be productive loss due to mental distraction in stage 2 of the queue treatments. Though such differences can go either way, we refer it as *behavioral efficiency loss*. Formally, in stage 2, let w_i^{actual} denote the actual productivity of participant i in the production task, and let t_i^2 denote the amount of time that i spends on the booking task. Then,

$$\text{Behavioral efficiency loss} = \textstyle\sum_{i=1}^{n} \mathbb{E}[(T - t_i^2)(w_i - w_i^{actual})].$$

Consistent with Experiment 1, in terms of efficiency, the queue rule is expected to achieve a higher level of allocative efficiency than the lottery rule in Experiment 2. However, the queue rule may yield greater productive efficiency loss than the lottery rule. Examining the components of productive efficiency, the queue rule requires participants to spend valuable time queuing for slots in stage 1 and competing by speed (and luck) to obtain available slots in stage 2, leading to a loss in strategic efficiency. By contrast, the lottery rule requires only a few seconds on the booking system to press an application button. In addition, we are agnostic towards the direction of behavioral efficiency loss.

Table D2 summarizes the comparisons between the two solo-track rules in terms of efficiency.

[5] We thank an anonymous referee for suggesting this possibility.

Table D2: Efficiency and Fairness under Queue and Lottery

<table>
<tr><th colspan="2"></th><th>Queue</th><th>Lottery</th></tr>
<tr><td colspan="2">Allocative efficiency loss in the booking system</td><td>Low</td><td>High</td></tr>
<tr><td rowspan="2">Productive efficiency loss in the production task</td><td>Strategic</td><td>High</td><td>Low</td></tr>
<tr><td>Behavioral</td><td colspan="2">Not Sure</td></tr>
</table>

Next, we discuss our evaluation criteria for the dual-track system. We introduce a dual-track system as both a structure that addresses practical concerns and a useful compromise between the queue and lottery rules. While the lottery rule yields better productive efficiency, the queue rule gives participants who value a slot more than productive efficiency the opportunity to express their preference and potentially increase their welfare.[6] This welfare improvement, however, is not guaranteed since they still face a risk of losing the competition for a slot.

D.3 Experimental Results

We first present the results from the four solo-track treatments that implement either the queue rule or the lottery rule, and then quantify and compare the different sources of efficiency loss across these treatments. We then present the results from the two dual-track treatments.

D.3.1 Solo-track treatments

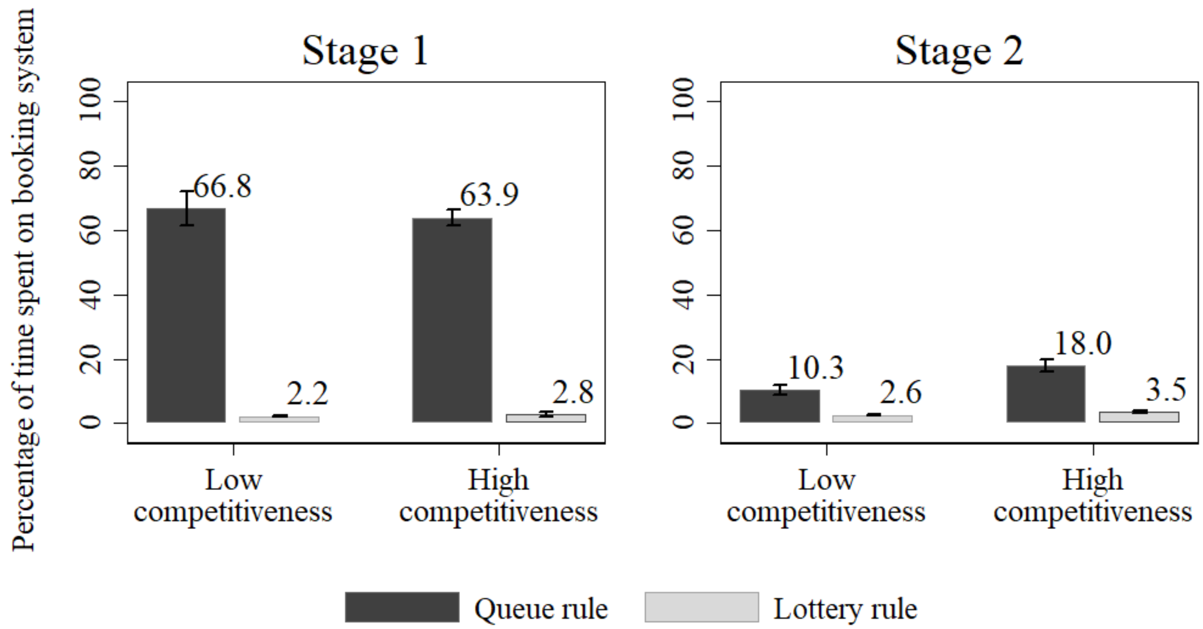
We first examine how participants allocate their time between the booking task and the production task in both stages (Figure D3). In stage 1, regardless of the level of market competitiveness, we see that participants in the queue treatment spend almost two-thirds of their time on the booking task. By contrast, participants in the lottery treatment spend only a few seconds on the booking task. This substantial behavioral difference translates into a much lower production task output in the queue versus lottery treatment. When market competition is low, the average output in the production task is 2.6 in stage 1 under the queue rule, compared to 6.1 under the lottery rule ($p = 0.004$, Wilcoxon rank-sum test).[7] The gap is even greater when market competition is high, with an average output of 2.2 under the queue rule and 6.8 under the lottery rule ($p = 0.021$).

Turning to our stage 2 results, we see from Figure D3 (right panel) that, while queue participants still spend significantly more time on the booking task than do lottery participants (10.3% versus 2.6%, $p = 0.004$ in the low competitiveness environment; 18.0% versus 3.5%, $p = 0.021$ in the high competitiveness environment, Wilcoxon rank-sum test), the gap is much smaller than that observed in stage 1. This likely reflects the lower number of participants who still need a slot in this stage. It may also reflect the design feature that participants can choose to freely switch between the booking and production tasks in stage 2. Moreover, the greater ratio of participants to slots in the high competitiveness environment means the average time spent on the booking system is significantly higher compared to the low competitiveness environment (18.0%

[6] It is worth noting that the preference for one system over the other may be influenced with strategic considerations. For example, subjects may opt for the queue if they believe that the majority would choose the lottery.

[7] Unless otherwise stated, we treat each matching group as a unit of observation in all reported statistics.

Figure D3: Percentage of time spent on the booking system in the solo-track treatments

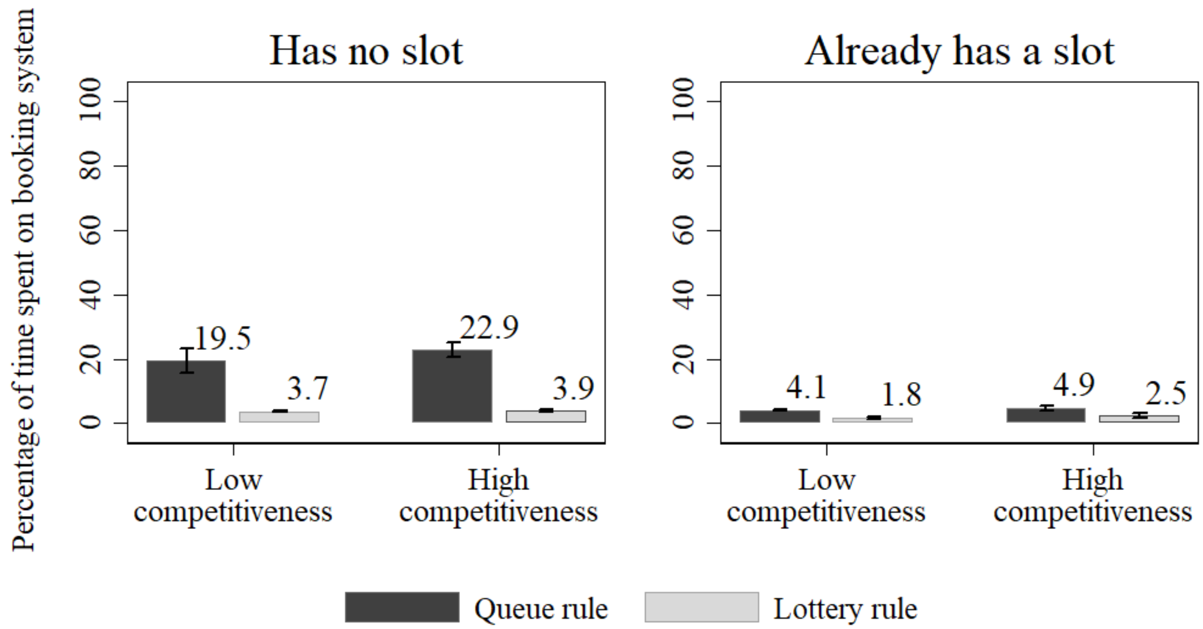


Notes: Error bars represent one standard error of means clustered at the matching group level. Low competitiveness is defined as a market with 5 participants and 3 slots (Solo-Queue5 and Solo-Lottery5), while high competitiveness is defined as a market with 7 participants and 2 slots (Solo-Queue7 and Solo-Lottery7).

versus 10.3%, $p = 0.019$). Finally, we verify that the overall time allocation pattern in stage 2 is driven by those seeking slots in this stage. Figure D4 shows the percentage of time spent on the booking task separately for those who have (have not) obtained a slot in stage 1. It is clear that the overall pattern in stage 2 is driven mainly by participants seeking slots. Regardless of the level of market competitiveness, these participants spend significantly more time on the booking task under the queue rule than the lottery rule (19.5% versus 3.7%, $p = 0.004$ in the low competitiveness environment; 22.9% versus 3.9%, $p = 0.021$ in the high competitiveness environment, Wilcoxon rank-sum test). By contrast, participants who obtain a slot in stage 1 spend only slightly more time on the booking task under the queue rule than the lottery rule (4.1% versus 1.8%, $p = 0.007$ in the low competitiveness environment; 4.9% versus 2.5%, $p = 0.083$ in the high competitiveness environment). While this may reflect curiosity about the allocation process for the remaining slots, the screen layout under the lottery rule is similar in both stages and no information about allocations is revealed until the end of each stage. In sum, while not as pronounced as in stage 1, the opportunity cost of time in stage 2 is still higher under the queue rule than the lottery rule, especially when slots are scarcer. Altogether, we observe consistent results with Result 1 in the main text.

Next, we examine the relationship between time valuation and the chance of winning a slot. Before presenting the results, we explain how the time valuation is calculated for each individual. We first measure individual productivity considering productivity in stage 1 as well as in stage 2 if a participant has obtained a slot in stage 1, since we expect productivity under these two cases is unlikely to be influenced by the book-

Figure D4: Percentage of time spent on the booking system in stage 2 in the solo-track treatments



Notes: Error bars represent one standard error of means clustered at the matching group level. The graph is drawn both for participants who failed to obtain a slot in stage 1 (left) and for those who already have secured a slot in stage 1 including ones whose slots are later canceled (right). Low competitiveness stands for markets with 5 participants and 3 slots (Solo-Queue5 and Solo-Lottery5), while high competitiveness stands for markets with 7 participants and 2 slots (Solo-Queue7 and Solo-Lottery7).

ing system.[8] Specifically, in stage 1 we observe participants either work on the production task continually or stay on the booking system, with few instances of distractive switching (on average, less than one switch per round). Likewise, in stage 2, when some participants have already obtained a slot, their productivity is unlikely to be influenced by the booking system. Thus, to measure individual productivity, we first take the average of each individual's productivity across stage 1 and stage 2 (if the individual has obtained a slot in stage 1) weighted by the respective time spent on the production task. We then take the average of each individual's productivity across all eight paying rounds to obtain our measure of individual (time-invariant) productivity. Finally, we calculate the time valuation for each individual in each round as the ratio of the monetary valuation to individual productivity. Figure D5 shows the distribution of the computed time valuation across all treatments, showing a relatively smooth and left-skewed distribution.

Table D3 report random effects probit regression where the dependent variable is whether a subject obtains a slot and the independent variable is her time valuation, separately for when a slot is obtained in either stage and when it is obtained in stage 1. We observe little evidence for a positive correlation between individuals' time valuations and their likelihood of obtaining a slot in either Solo-Queue5 or Solo-Queue7. This result is different from Result 2 of Experiment 1. To explore this finding in greater depth, we compare participant

[8] The lack of a performance incentive in the trial round precludes its use as a productivity indicator. Furthermore, if we use only stage 1 productivity as our measure of individual productivity, a significant portion of participants' productivity will not be measured since they have chosen to spend almost all their time queuing in stage 1 in almost all rounds.

Figure D5: Distribution of the computed time valuation across all treatments

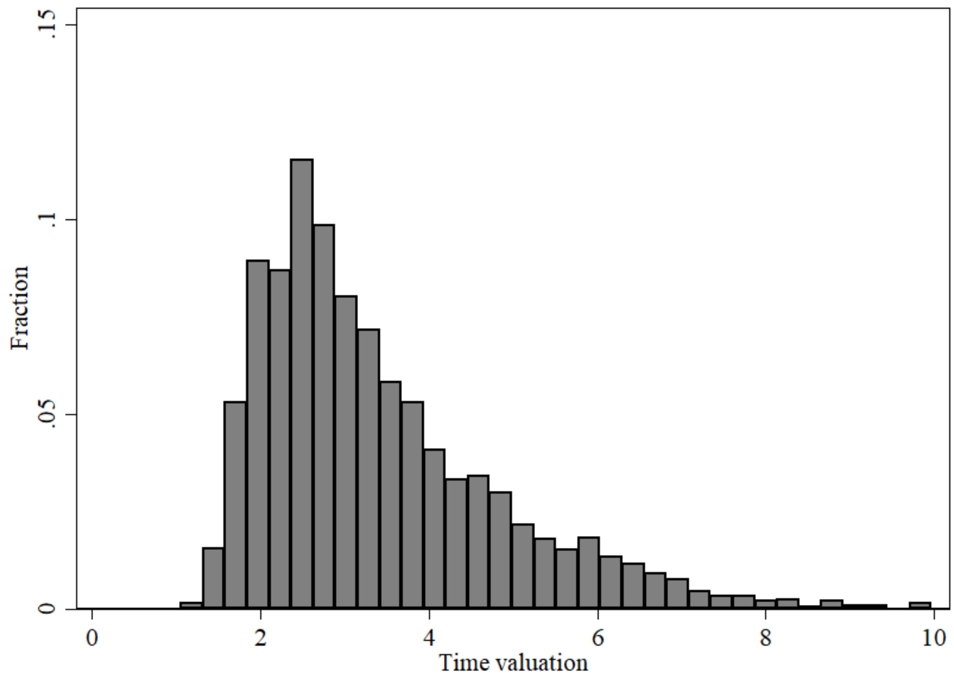


Table D3: Random Effects Probit Regressions on the Likelihood of Obtaining a Slot

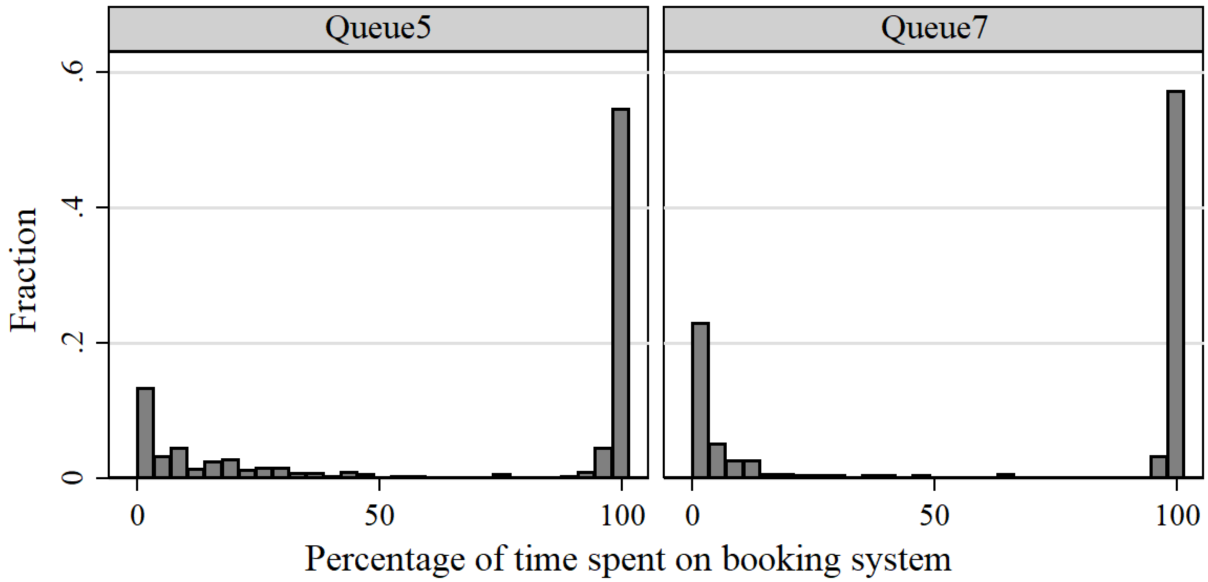
	Average marginal effects			
	Solo-Queue5		Solo-Queue7	
	Both stages	Stage 1	Both stages	Stage 1
Time valuation	-0.027	0.009	-0.009	-0.004
	(0.017)	(0.026)	(0.011)	(0.007)
Clusters	6	6	4	4
N	480	480	448	448

Notes: Standard errors clustered at the matching group level are in parentheses. We rescale the time valuation by dividing it by 100.

time allocations in stage 1 for our two queue treatments. The findings in Figure D6 show a pattern of bimodal behavior in both queue treatments: participants spend either very little time or almost all of their time on the booking task. Specifically, we find that 66.0% (77.2%) of our observations in Solo-Queue5 (Solo-Queue7) consist of those at the extremes (either fewer than 5 seconds or more than 235 seconds). In theory, this bimodal behavior would happen if participants' time valuation follows a bimodal distribution with peaks at both ends. However, this is clearly not what we observe in our experiment. Thus, the tenuous relationship between the time valuation and the likelihood of obtaining a slot is likely due to the weak relationship between the time valuation and the time spent on the booking system. This is supported by Figure D7 which show the weak association between time valuation and total queuing time in stage 1.

To further investigate this bimodal behavior, in Table D4 we report results from regressions of the bimodal behavior on the time valuation. We find that the time valuation is only positively associated with more full

Figure D6: Distribution of time spent on the booking system in stage 1 of the queue treatments



investment behavior in Solo-Queue7 but not in Solo-Queue5. By doing a similar regression analysis as in Table D3, we also find that the time spent on the booking system is positively associated with a higher likelihood of obtaining a slot. Therefore, the logical connection from a higher time valuation to more time spent on the booking system and then to a higher likelihood of obtaining a slot appears to be established in Solo-Queue7. However, this chain of relationship, albeit logically sound, is not sufficiently strong to make a statistical difference. Intuitively, since more than 50% of participants chose to spend all the time on the booking system irrespective of their time valuations, the slot allocation was essentially the outcome of a lottery, and this is especially true in Solo-Queue7 in which there are only two slots in each group of seven participants. Altogether, though we also observe bimodal behavior in Experiment 2, different from Experiment 1 where participants with high (low) time valuation spend all (zero) time. Participants in Experiment 2 choose to all-in regardless of their time valuation. One possibility is that the nature of real-effort production makes it difficult for them to correctly evaluate their time valuation.

Table D4: Random effects probit regressions on the likelihood of full time investment

	Average marginal effects	
	Solo-Queue5	Solo-Queue7
Time valuation	0.056	0.074^{**}
	(0.047)	(0.033)
Clusters	6	4
N	317	346

Notes: Standard errors clustered at the matching group level are in parentheses. The binary dependent variable is 1 if the total time spent on the booking system in stage 1 is no less than 235 seconds (full time investment), and 0 if it is no more than 5 seconds (dropping-out). We rescale the time valuation by dividing it by 100. *** $p < 0.01$.

Finally, we compare the different types of efficiency losses at the group level across the two allocation rules.

Figure D7: Relationship between time valuation and percentage of queuing time in stage 1

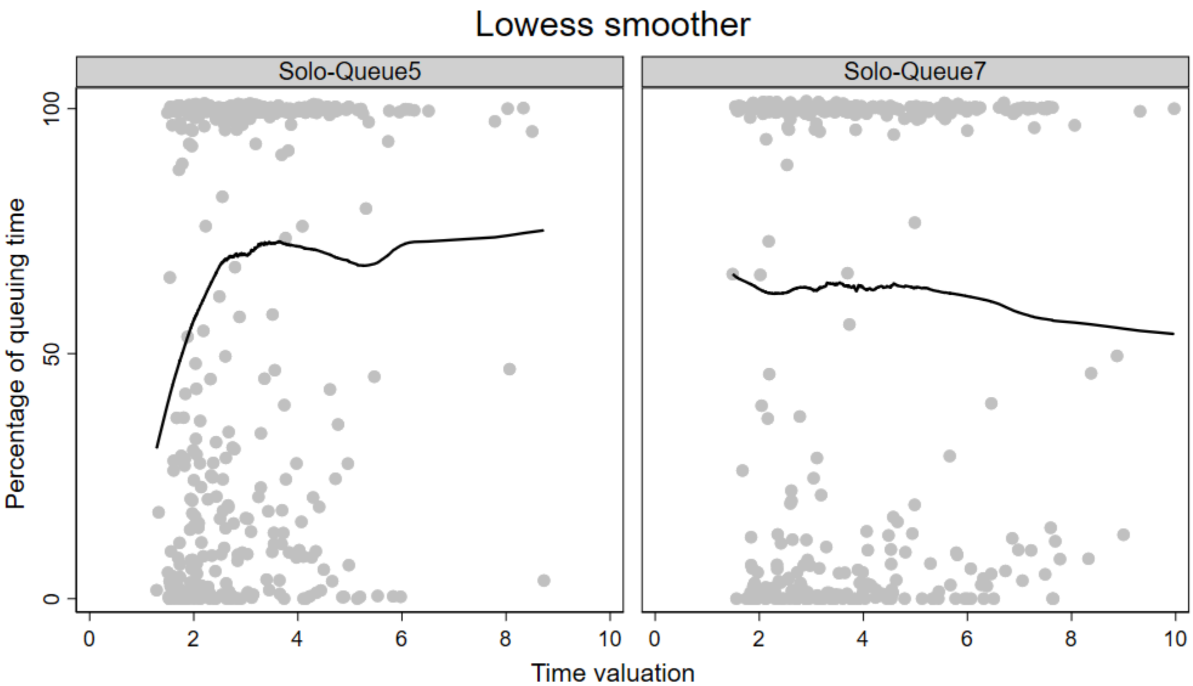


Table D5 reports the quantified efficiency loss (in ECUs) of each type for each solo-track treatment. In addition, the table reports the total efficiency loss, which is the sum of the three types of efficiency losses. For strategic efficiency loss, we further distinguish our results by stage. For behavioral efficiency loss, we also separate our results by participant subgroups: one in which participants have already obtained a slot in stage 1 and the other in which participants have not obtained a slot in stage 1.

From Table D5, we see that the strategic efficiency loss is approximately one order of magnitude larger than the allocative efficiency loss under the queue rule, while the two are very similar under the lottery rule. Further, as expected, we see that the strategic efficiency loss under the queue rule is driven mainly by queuing in stage 1, although the amount of loss in stage 2 is not negligible. The strategic efficiency loss in either stage is significantly larger than the allocative efficiency loss ($p < 0.001$ in each comparison, Wilcoxon signed-rank test).

Moreover, we find that the allocative efficiency loss is slightly higher under the queue rule than the lottery rule, although this difference is only marginally significant in the low market competitiveness environment (Solo-Queue5 versus Solo-Lottery5, $p = 0.070$; Solo-Queue7 versus Solo-Lottery7, $p = 0.483$; Wilcoxon ranksum test).

Finally, we find no evidence of behavioral efficiency loss under the queue rule. In Solo-Queue5, the behavioral efficiency loss does not differ from zero ($p = 0.452$, two-sided t-test). In Solo-Queue7, the behavioral efficiency loss is significantly lower than zero ($p = 0.025$), driven mainly by participants who have not ob-

Table D5: The Breakdown of Efficiency Loss in Each Solo-track Treatment

	Solo-Queue5	Solo-Queue7	Solo-Lottery5	Solo-Lottery7
Allocative efficiency loss	85.115	166.406	59.229	147.313
	(9.603)	(13.853)	(5.454)	(9.752)
Productive efficiency loss				
Strategic	978.675	1242.640	53.892	101.092
	(31.433)	(40.859)	(7.034)	(10.133)
(a) Stage 1	844.057	965.542	24.578	43.712
	(30.721)	(34.088)	(3.743)	(7.664)
(b) Stage 2	134.618	277.098	29.314	57.380
	(7.705)	(19.205)	(3.605)	(5.144)
Behavioral	-16.045	-67.570	-46.570	-32.914
	(21.221)	(29.468)	(19.124)	(25.022)
(a) Slot	-5.569	-13.991	-32.353	-1.310
	(15.073)	(13.766)	(14.024)	(11.171)
(b) No slot	-10.476	-54.016	-14.217	-31.604
	(10.961)	(21.27)	(8.601)	(19.587)
Total efficiency loss	1047.745	1341.476	66.552	215.490
	(37.655)	(56.442)	(22.868)	(28.941)
Obs. (group $\times$ round)	96	64	96	64

Notes: Standard errors are in parentheses.

tained a slot in stage 1 ($p = 0.014$). [9] More importantly, however, the magnitude of the observed behavioral efficiency loss or gain is one order of magnitude lower than that of the strategic efficiency loss.

Overall, our results show that the lottery rule is superior to the queue rule in terms of productive efficiency, which is consistent with Experiment 1. However, with the real-effort production task, it is even not inferior in terms of allocative efficiency.

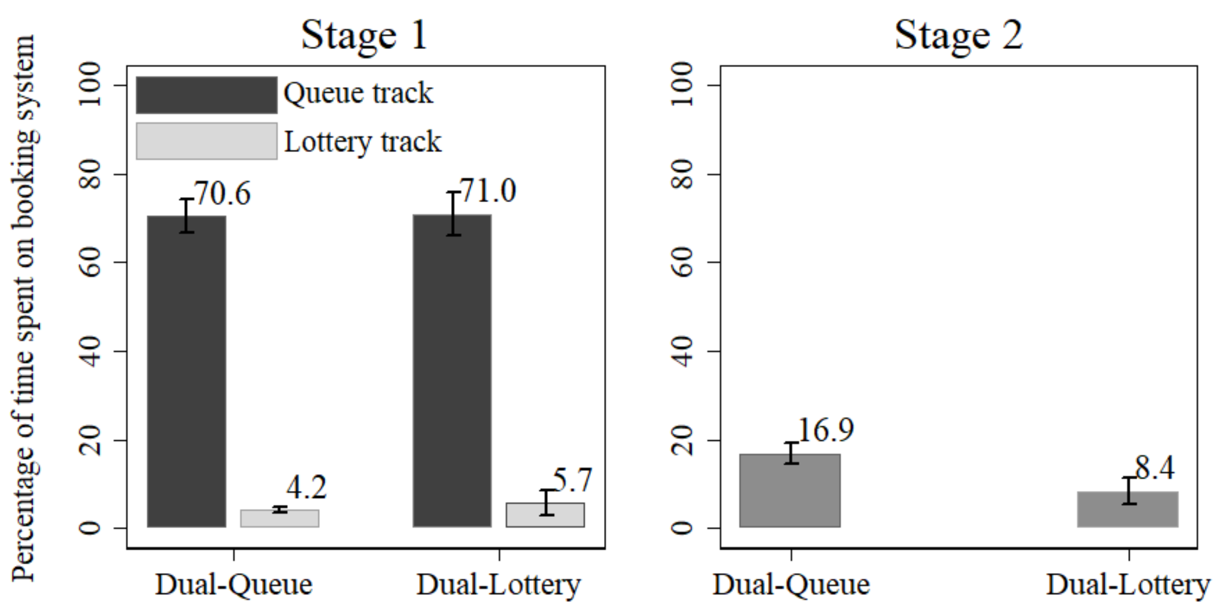
D.3.2 Dual-track treatments

We have shown in our solo-track treatments that the lottery rule yields higher efficiency than the queue rule in almost every aspect. In this section, we present our results from the two dual-track treatments which allow participants to choose between the queue rule and the lottery rule in stage 1. In particular, we expect that in stage 1 of the dual-track treatment, more participants choose the lottery track rather than the queue track, and those with higher time valuations are also more likely to choose the queue track than the lottery track.

[9] In the post-experimental questionnaire, participants were asked to indicate their level of anxiety in both stages on a scale from 1 (not anxious at all) to 7 (extremely anxious). On average, the reported level of anxiety is significantly higher in each stage under the queue rule than the lottery rule. Further, the reported level of anxiety is higher in stage 2 than in stage 1 of both queue treatments ($p < 0.001$, Wilcoxon signed-rank test). In the questionnaire, participants were also asked to indicate how the booking task had disturbed their performance in the production task on a scale from 1 (not disturbing at all) to 7 (extremely disturbing). On average, the reported level of disturbance is about 3.85 ($s.d. < 2.00$) in both queue treatments, suggesting no evidence for such a disturbance. These results provide some suggestive evidence that the increased anxiety level in stage 2 is mainly performance-enhancing.

Before presenting our main results, we briefly examine participants' behavior under each track. In general, we find similar behavior within an allocation rule across the solo- and dual-track systems. From Figure D8, we see that dual-track queue (lottery) participants spend two-thirds (5%) of their time on the booking task in stage 1. We further see that queue participants spend significantly more time on the booking task in stage 2 compared to lottery participants (16.9% versus 8.4%, $p = 0.083$, Wilcoxon rank-sum test).

Figure D8: Percentage of time spent on the booking system in the dual-track treatments



Notes: Error bars represent one standard error of means clustered at the matching group level.

Next, we examine the number of participants who chose each track over round. Figure D9 shows that, on average, participants are marginally significantly more likely to choose the lottery track than the queue track (Dual-Queue: 58.9% vs. 41.1%, $p = 0.066$; Dual-Lottery: 53.6% vs. 46.4%, $p = 0.068$, Wilcoxon signed-rank test).

Finally, we conduct random-effects probit regression analysis of participants' likelihood of choosing the queue track on their time valuations. The results in columns (1) and (3) of Table D6 show that those with higher time valuations are more likely to choose the queue track, though the effect is statistically significant only in the Dual-Lottery treatment. We conjecture that participants may be less sensitive to their productivity than their monetary valuation. Thus, we also investigate the separate effects of monetary valuation and productivity on a participant's choice of track. The results in columns (2) and (4) show that monetary valuation has a significantly positive influence on the likelihood of choosing the queue track: for example, in the Dual-Lottery treatment, a 100-ECUs increase in the monetary valuation increases the probability of choosing the queue track by 13.2%. On the contrary, productivity does not have a significant impact in either dual-track treatment.

Figure D9: Track choices in the dual-track treatments

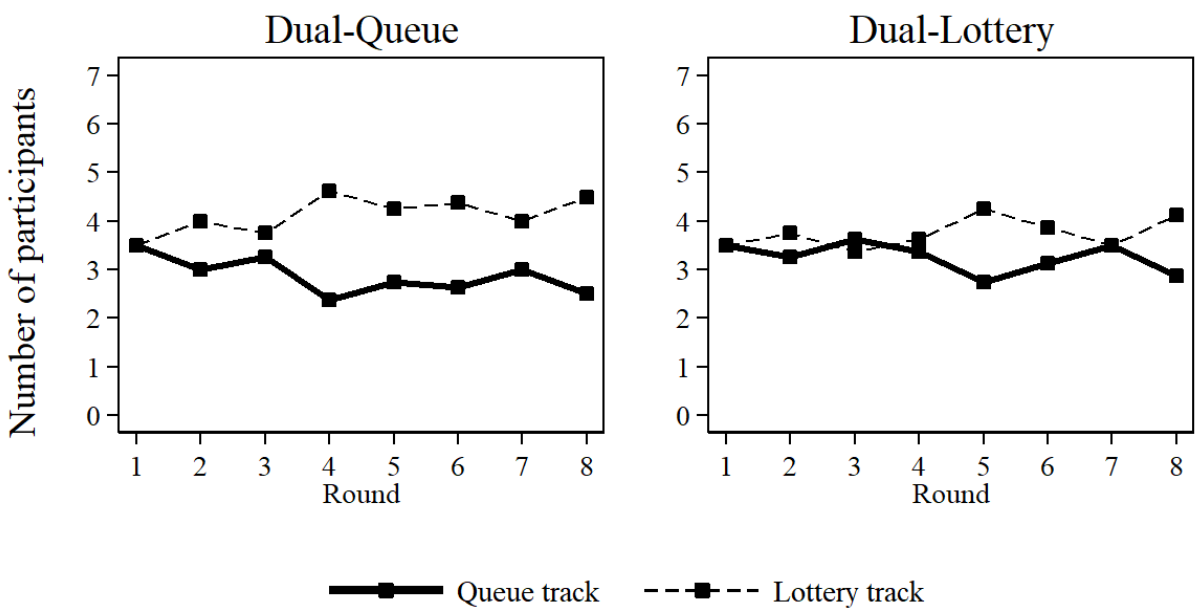


Table D6: Random-effects Probit Regressions on the Likelihood of Choosing the Queue Track

	Average marginal effects			
	Dual-Queue		Dual-Lottery	
	(1)	(2)	(3)	(4)
Time valuation	0.037		0.027**	
	(0.023)		(0.012)	
Monetary valuation		0.147***		0.132***
		(0.055)		(0.028)
Productivity		0.067		0.071
		(0.059)		(0.074)
Clusters	4	4	4	4
N	448	448	448	448

Notes: Standard errors clustered at the matching group level are in parentheses. We rescale the time valuation by dividing it by 100. *** $p < 0.01$.

Recall that, in the solo-track treatments, the allocative efficiency loss tends to be larger under the queue rule than the lottery rule, as over 50% of participants spend all their time on the booking task regardless of their time valuation. The fact that the queue track in the dual- track treatments does attract some participants with higher time valuations implies that the overall allocative efficiency might be improved compared to the solo-track treatments: on the one hand, more than half of participants chose the lottery track, which should lead to a similar level of allocative efficiency as in the solo-track lottery treatments; on the other hand, participants with higher time valuations should have a higher likelihood of obtaining slots in the queue track.

This conjecture is partially supported. Table D7 reports the breakdown of efficiency loss in the dual-track treatments. We observe a very similar level of allocative efficiency loss in the Dual-Lottery treatment and Solo-Lottery7 treatment ($p = 0.703$, Wilcoxon ranksum test). Thus, the presence of the queue track does not increase the allocative efficiency loss in this treatment. However, in the Dual-Queue treatment, we observe a level of allocative efficiency loss comparable to that in the Solo-Queue7 treatment ($p = 0.768$). Overall, we conclude that the dual-track system may reduce the allocative efficiency loss seen in the solo-track queue system.

Table D7: The Breakdown of Efficiency Loss in Each Dual-track Treatment

	Dual-Queue	Dual-Lottery
Allocative efficiency loss	164.750	143.703
	(14.509)	(10.066)
Productive efficiency loss		
Strategic	814.570	657.927
	(48.037)	(40.011)
(a) Stage 1	521.376	564.597
	(38.569)	(38.011)
(b) Stage 2	293.194	93.330
	(22.560)	(8.168)
Behavioral	-58.612	-68.880
	(25.787)	(31.606)
(a) Slot	-13.789	-12.285
	(10.694)	(13.694)
(b) No slot	-44.823	-56.595
	(20.429)	(23.509)
Total efficiency loss	920.709	732.750
	(53.893)	(52.022)
Obs. (group $\times$ round)	64	64

Notes: Standard errors are in parentheses.

Examining productive efficiency loss in the dual-track treatments, we see that the strategic efficiency loss remains substantial although fewer participants choosing the queue track leads to a lower total amount of efficiency loss compared to the solo-track queue treatment. Similar to the solo-track treatments, we find no evidence for behavioral efficiency loss, and again find that behavioral efficiency loss is significantly lower than zero ($p = 0.027$ and $p = 0.033$ for Dual-Queue and Dual-Lottery). Nevertheless, the behavioral efficiency gain is one order of magnitude lower than the strategic efficiency loss.

Overall, our results show that the dual-track system can substantially reduce the total amount of productive efficiency loss compared to the solo-track queue system. Moreover, the dual-track system can also reduce potential allocative efficiency loss by channeling some participants with higher time valuations to compete for slots in the queue track.

D.4 Instructions of Experiment 2

In the following, we translate the original instructions in Chinese into English for the Solo-Queue7, Solo-Lottery7, Dual-Queue and Dual-Lottery treatments. The instructions for Solo-Queue5 and Solo-Lottery5 are omitted because they are exactly the same as Solo-Queue7 and Solo-Lottery7 except for the different number of group members and appointment slots.

D.4.1 Instructions for Solo-Queue7

General Information

You are taking part in a decision-making experiment. Please read the instructions carefully. The instructions are the same for every participant. Please do not communicate with each other during the experiment. Turn off your mobile phone and put it into the envelop on your desk. If you have a question, feel free to raise your hand, and an experimenter will come to help you.

You have earned 15 RMB for showing up on time. In addition, you can earn more money in this experiment. The amount of money you earn will depend upon the decisions you and other participants make. Your earnings in this experiment are expressed in EXPERIMENTAL CURRENCY UNITS, which we will refer to as ECUs. At the end of the experiment you will be paid using a conversion rate of 1 RMB for every 10 ECUs of earnings from the experiment.

Your final payment will be paid to you via bank transfer within 2-3 days on completion of today's experiment. All decisions are anonymous. That is, other participants will not know about your identity or your final payment.

Overview of the experiment

The experiment consists of 8 rounds. Each round lasts 8 minutes. A clock on the upper-right corner of the screen shows the time already past in each round. Each round has two tasks and each participant's earnings are sum of the earnings from the two tasks. At the beginning of each round, you can choose which task to start with: Task 1 or Task 2. The two tasks are displayed on different screens. You may freely switch between the two task screens at any time you want. But you cannot see both task screens at the same time.

Task 1 is about booking an appointment slot at a public office such as hospital. In each round, you will be randomly matched into groups of seven participants each. This means that your group members will most likely be different in each round. Each group has two appointment slots available and each participant can only book up to one slot. In each round, the private valuation for a slot is determined randomly and independently for each participant, and will be a natural number between (and including) 400 to 600 ECUs. Each participant is only informed about her own valuation, but not about other group members' valuations. A participant who books a slot will receive ECUs equivalent to her valuation and the one who does not will receive 0. We will discuss the booking procedure in Task 1 in more detail.

Task 2: In addition to the appointment booking task, in each round you can also work independently on a counting-dots task: counting the number of white dots in a series of dark-shaded squares. The figure below shows the task screen. You will enter the number of dots into the box next to the table. After you have entered the number, you can click the NEXT button. No matter whether the answer is correct or not, a new square will be generated. You will earn 35 ECUs for each square you solved correctly. If you enter a wrong number for a square, you will earn 0 for that square. Thus, in each round your earnings from the counting-dots task = the number of correct answers $\times$ 35 ECUs.

We will now describe in more detail the appointment booking system in Task 1, which consists of two steps.

Step 1: Start from 00:00 (minutes: seconds), end at 04:00. The 2 slots will become immediately available at 04:00 and will be assigned on a first-come-first-served basis in the following way: Each participant can choose to switch to and stay on the booking screen to reserve a position in a queue. Those who switch to the booking screen earlier reserve a front position. However, if a participant switches to the counting-dots task screen and then back to the booking screen, he will have to go to the back of the queue. When 4:00 is reached, the slots will be assigned as follows:

1. If the number of participants staying in the queue > 2, each of the first two in the queue will obtain a slot.
2. If the number of participants staying in the queue ≤ 2, each of them obtains a slot. Any remaining slot(s) will become available in Step 2.

Step 2: Start from 04:00, end at 08:00. Every participant who has not obtained a slot in Step 1 can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. The number of available slots will be shown on the screen and updated in real time. (Note that you will need to wait for a slot to become available to book.) Those who have obtained a slot in Step 1 can still switch to the booking screen. But they will not see the BOOKING button as they do not need to book again.

The available slot(s) in Step 2 can be any number from 1 to 2 and have two sources:

1. Cancelled slot: To mimic the real-world situation in which people may choose to cancel their appointments, one participant who has obtained a slot in Step 1 will be randomly chosen by the computer to cancel her slot at some point in Step 2 (the timing is again randomly chosen by the computer). The cancelled slot will be released and become available in the booking system. The participant whose slot is cancelled will still receive ECUs equal to her valuation of the slot. But he will not be allowed to book another slot in Step 2. Furthermore, he will be notified of the cancellation whenever he switches to the booking screen.
2. Unassigned slot(s): The unassigned slot(s) may come from Step 1 if there are fewer than 2 participants staying in the queue in Step 1 before the end of 04:00. There will be no unassigned slot if the two slots have been assigned in Step 1.

Until 08:00 is reached, the available slots will be assigned on a first-come-first-served basis by pressing the BOOKING button. In particular, the cancelled slot will become available on the book screen at the moment when the cancellation happens. The unassigned slot(s) will become immediately available at 04:00.

Payoff

At the end of each round, your round payoff is the sum of the payoffs from the two tasks. At the end of the experiment, one randomly chosen round will be paid out, in addition to the show-up fee.

This completes the instructions. To ensure every participant understand the instructions, please answer the quiz on your screen. If there is any question, please raise your hand. Once everyone correctly answers the quiz, we will start the experiment. Also, in order to help participants familiarize themselves with the counting-dots task, there will be one practice (non-paying) round consisting of a 5-minute counting-dots task only.

D.4.2 Instructions for Solo-Lottery7

General Information

You are taking part in a decision-making experiment. Please read the instructions carefully. The instructions are the same for every participant. Please do not communicate with each other during the experiment. Turn off your mobile phone and put it into the envelop on your desk. If you have a question, feel free to raise your hand, and an experimenter will come to help you.

You have earned 15 RMB for showing up on time. In addition, you can earn more money in this experiment. The amount of money you earn will depend upon the decisions you and other participants make. Your earnings in this experiment are expressed in EXPERIMENTAL CURRENCY UNITS, which we will refer to as ECUs. At the end of the experiment you will be paid using a conversion rate of 1 RMB for every 10 ECUs of earnings from the experiment.

Your final payment will be paid to you via bank transfer within 2-3 days on completion of today's experiment. All decisions are anonymous. That is, other participants will not know about your identity or your final payment.

Overview of the experiment

The experiment consists of 8 rounds. Each round lasts 8 minutes. A clock on the upper-right corner of the screen shows the time already past in each round. Each round has two tasks and each participant's earnings are sum of the earnings from the two tasks. At the beginning of each round, you can choose which task to start with: Task 1 or Task 2. The two tasks are displayed on different screens. You may freely switch between the two task screens at any time you want. But you cannot see both task screens at the same time.

Task 1 is about booking an appointment slot at a public office such as hospital. In each round, you will be randomly matched into groups of seven participants each. This means that your group members will most likely be different in each round. Each group has two appointment slots available and each participant can only book up to one slot. In each round, the private valuation for a slot is determined randomly and independently for each participant, and will be a natural number between (and including) 400 to 600 ECUs. Each participant is only informed about her own valuation, but not about other group members' valuations. A participant who books a slot will receive ECUs equivalent to her valuation and the one who does not will receive 0. We will discuss the booking procedure in Task 1 in more detail.

Task 2: In addition to the appointment booking task, in each round you can also work independently on a counting-dots task: counting the number of white dots in a series of dark-shaded squares. The figure below shows the task screen. You will enter the number of dots into the box next to the table. After you have entered the number, you can click the NEXT button. No matter whether the answer is correct or not, a new square will be generated. You will earn 35 ECUs for each square you solved correctly. If you enter a wrong number for a square, you will earn 0 for that square. Thus, in each round your earnings from the counting-dots task = the number of correct answers $\times$ 35 ECUs.

We will now describe in more detail the appointment booking system in Task 1, which consists of two steps.

Step 1: Start from 00:00 (minutes: seconds), end at 04:00. Every participant can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. When 4:00 is reached, the slots will be assigned as follows:

1. If the number of applicants > 2, all applications will be put into a virtual urn. Then, one by one, applications are randomly drawn from the urn to fill the two slots.

2. If the number of applicants ≤ 2, each applicant obtains a slot. Any remaining slot(s) will become available in Step 2.

Step 2: Start from 04:00, end at 08:00. Every participant who has not obtained a slot in Step 1 can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. The number of available slots will be shown on the screen and updated in real time. (Note that you do not need to wait for a slot to become available to apply.) Those who have obtained a slot in Step 1 can still switch to the booking screen. But they will not see the BOOKING button as they do not need to apply again.

The available slot(s) in Step 2 can be any number from 1 to 2 and have two sources:

1. Cancelled slot: To mimic the real-world situation in which people may choose to cancel their appointments, one participant who has obtained a slot in Step 1 will be randomly chosen by the computer to cancel her slot at some point in Step 2 (the timing is again randomly chosen by the computer). The cancelled slot will be released and become available in the booking system. The participant whose slot is cancelled will still receive ECUs equal to her valuation of the slot. But he will not be allowed to book another slot in Step 2. Furthermore, he will be notified of the cancellation whenever he switches to the booking screen.

2. Unassigned slot(s): The unassigned slot(s) may come from Step 1 if there are fewer than 2 applicants in Step 1 before the end of 04:00. There will be no unassigned slot if the two slots have been assigned in Step 1.

When 08:00 is reached, the slots will be assigned as follows:

1. If in Step 2 the number of applicants > the number of available slots, all applications will be put into a virtual urn. Then, one by one, applications are randomly drawn from the urn to fill the available slots.
2. If in Step 2 the number of applicants $\leq$ the number of available slots, each applicant obtains a slot.

Payoff

At the end of each round, your round payoff is the sum of the payoffs from the two tasks. At the end of the experiment, one randomly chosen round will be paid out, in addition to the show-up fee.

This completes the instructions. To ensure every participant understand the instructions, please answer the quiz on your screen. If there is any question, please raise your hand. Once everyone correctly answers the quiz, we will start the experiment. Also, in order to help participants familiarize themselves with the counting-dots task, there will be one practice (non-paying) round consisting of a 5-minute counting-dots task only.

D.4.3 Instructions for Dual-Queue

General Information

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You have earned 15 RMB for showing up on time. In addition, you can earn more money in this experiment. The amount of money you earn will depend upon the decisions you and other participants make. Your earnings in this experiment are expressed in EXPERIMENTAL CURRENCY UNITS, which we will refer to as ECUs. At the end of the experiment you will be paid using a conversion rate of 1 RMB for every 10 ECUs of earnings from the experiment.

Your final payment will be paid to you via bank transfer within 2-3 days on completion of today's experiment. All decisions are anonymous. That is, other participants will not know about your identity or your final payment.

Overview of the experiment

The experiment consists of 8 rounds. Each round lasts 8 minutes. A clock on the upper-right corner of the screen shows the time already past in each round. Each round has two tasks and each participant's earnings are sum of the earnings from the two tasks. At the beginning of each round, you can choose which task to start with: Task 1 or Task 2. The two tasks are displayed on different screens. You may freely switch between the two task screens at any time you want. But you cannot see both task screens at the same time.

Task 1 is about booking an appointment slot at a public office such as hospital. In each round, you will be randomly matched into groups of seven participants each. This means that your group members will most likely be different in each round. Each group has two appointment slots available and each participant can only book up to one slot. In each round, the private valuation for a slot is determined randomly and independently for each participant, and will be a natural number between (and including) 400 to 600 ECUs. Each participant is only informed about her own valuation, but not about other group members' valuations. A participant who books a slot will receive ECUs equivalent to her valuation and the one who does not will receive 0. We will discuss the booking procedure in Task 1 in more detail.

Task 2: In addition to the appointment booking task, in each round you can also work independently on a counting-dots task: counting the number of white dots in a series of dark-shaded squares. The figure below shows the task screen. You will enter the number of dots into the box next to the table. After you have entered the number, you can click the NEXT button. No matter whether the answer is correct or not, a new square will be generated. You will earn 35 ECUs for each square you solved correctly. If you enter a wrong number for a square, you will earn 0 for that square. Thus, in each round your earnings from the counting-dots task = the number of correct answers $\times$ 35 ECUs.

We will now describe in more detail the appointment booking system in Task 1, which consists of two steps.

Step 1: At the beginning of each round, each participant must choose one of the following two tracks for booking slots.

- Track 1: This track has one slot which will be assigned on a first-come-first-served basis.
- Track 2: This track has one slot which will be assigned based on applications.

Note: You can only choose one of the tracks. Your choice cannot be changed during a round. You will be informed about how many group members choose Track 1 and how many choose Track 2.

Rules in Track 1: Start from 00:00 (minutes: seconds), end at 04:00. One slot will become immediately available at 04:00 and will be assigned on a first-come-first-served basis in the following way: Each participant who chooses Track 1 can choose to switch to and stay on the booking screen to reserve a position in a queue. Those who switch to the booking screen earlier reserve a front position. However, if a participant switches to the counting-dots task screen and then back to the booking screen, he will have to go to the back of the queue. When 4:00 is reached, the slot will be assigned as follows:

1. If the number of participants staying in the queue > 1, the first one in the queue will obtain the slot.
2. If the number of participants staying in the queue ≤ 1, the one in the queue obtains the slot. If no one waited in the queue, the slot will become available in Step 2.

Rules in Track 2: Start from 00:00 (minutes: seconds), end at 04:00. Every participant who chooses Track 2 can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. When 4:00 is reached, the slot will be assigned as follows:

1. If the number of applicants > 1, all applications will be put into a virtual urn. Then, one application is randomly drawn from the urn to fill the slot.
2. If the number of applicants ≤ 1, this applicant obtains the slot. If no one applied for the slot, the slot will become available in Step 2.

Step 2: Start from 04:00, end at 08:00. Every participant who has not obtained a slot in Step 1 can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. The number of available slots will be shown on the screen and updated in real time. (Note that you will need to wait for a slot to become available to book.) Those who have obtained a slot in Step 1 can still switch to the booking screen. But they will not see the BOOKING button as they do not need to book again.

The available slot(s) in Step 2 can be any number from 1 to 2 and have two sources:

1. Cancelled slot: To mimic the real-world situation in which people may choose to cancel their appointments, one participant who has obtained a slot in Step 1 will be randomly chosen by the computer to cancel her slot at some point in Step 2 (the timing is again randomly chosen by the computer). The cancelled slot will be released and become available in the booking system. The participant whose slot is cancelled will still receive ECUs equal to her valuation of the slot. But he will not be allowed to book another slot in Step 2. Furthermore, he will be notified of the cancellation whenever he switches to the booking screen.
2. Unassigned slot(s): The unassigned slot(s) may come from Step 1. There will be no unassigned slot if the two slots have been assigned in Step 1.

Until 08:00 is reached, the available slots will be assigned on a first-come-first-served basis by pressing the BOOKING button. In particular, the cancelled slot will become available on the book screen at the moment when the cancellation happens. The unassigned slot(s) will become immediately available at 04:00.

Payoff

At the end of each round, your round payoff is the sum of the payoffs from the two tasks. At the end of the experiment, one randomly chosen round will be paid out, in addition to the show-up fee.

This completes the instructions. To ensure every participant understand the instructions, please answer the quiz on your screen. If there is any question, please raise your hand. Once everyone correctly answers the quiz, we will start the experiment. Also, in order to help participants familiarize themselves with the counting-dots task, there will be one practice (non-paying) round consisting of a 5-minute counting-dots task only.

D.4.4 Instructions for Dual-Lottery

General Information

You are taking part in a decision-making experiment. Please read the instructions carefully. The instructions are the same for every participant. Please do not communicate with each other during the experiment. Turn off your mobile phone and put it into the envelop on your desk. If you have a question, feel free to raise your hand, and an experimenter will come to help you.

You have earned 15 RMB for showing up on time. In addition, you can earn more money in this experiment. The amount of money you earn will depend upon the decisions you and other participants make. Your earnings in this experiment are expressed in EXPERIMENTAL CURRENCY UNITS, which we will refer to as ECUs. At the end of the experiment you will be paid using a conversion rate of 1 RMB for every 10 ECUs of earnings from the experiment.

Your final payment will be paid to you via bank transfer within 2-3 days on completion of today's experiment. All decisions are anonymous. That is, other participants will not know about your identity or your final payment.

Overview of the experiment

The experiment consists of 8 rounds. Each round lasts 8 minutes. A clock on the upper-right corner of the screen shows the time already past in each round. Each round has two tasks and each participant's earnings are sum of the earnings from the two tasks. At the beginning of each round, you can choose which task to start with: Task 1 or Task 2. The two tasks are displayed on different screens. You may freely switch between the two task screens at any time you want. But you cannot see both task screens at the same time.

Task 1 is about booking an appointment slot at a public office such as hospital. In each round, you will be randomly matched into groups of seven participants each. This means that your group members will most likely be different in each round. Each group has two appointment slots available and each participant can only book up to one slot. In each round, the private valuation for a slot is determined randomly and independently for each participant, and will be a natural number between (and including) 400 to 600 ECUs. Each participant is only informed about her own valuation, but not about other group members' valuations. A participant who books a slot will receive ECUs equivalent to her valuation and the one who does not will receive 0. We will discuss the booking procedure in Task 1 in more detail.

Task 2: In addition to the appointment booking task, in each round you can also work independently on a counting-dots task: counting the number of white dots in a series of dark-shaded squares. The figure below shows the task screen. You will enter the number of dots into the box next to the table. After you have entered the number, you can click the NEXT button. No matter whether the answer is correct or not, a new square will be generated. You will earn 35 ECUs for each square you solved correctly. If you enter a wrong number for a square, you will earn 0 for that square. Thus, in each round your earnings from the counting-dots task = the number of correct answers $\times$ 35 ECUs.

We will now describe in more detail the appointment booking system in Task 1, which consists of two steps.

Step 1: At the beginning of each round, each participant must choose one of the following two tracks for booking slots.

- Track 1: This track has one slot which will be assigned on a first-come-first-served basis.
- Track 2: This track has one slot which will be assigned based on applications.

Note: You can only choose one of the tracks. Your choice cannot be changed during a round. You will be informed about how many group members choose Track 1 and how many choose Track 2.

Rules in Track 1: Start from 00:00 (minutes: seconds), end at 04:00. One slot will become immediately available at 04:00 and will be assigned on a first-come-first-served basis in the following way: Each participant who chooses Track 1 can choose to switch to and stay on the booking screen to reserve a position in a queue. Those who switch to the booking screen earlier reserve a front position. However, if a participant switches to the counting-dots task screen and then back to the booking screen, he will have to go to the back of the queue. When 4:00 is reached, the slot will be assigned as follows:

1. If the number of participants staying in the queue > 1, the first one in the queue will obtain the slot.
2. If the number of participants staying in the queue ≤ 1, the one in the queue obtains the slot. If no one waited in the queue, the slot will become available in Step 2.

Rules in Track 2: Start from 00:00 (minutes: seconds), end at 04:00. Every participant who chooses Track 2 can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. When 4:00 is reached, the slot will be assigned as follows:

1. If the number of applicants > 1, all applications will be put into a virtual urn. Then, one application is randomly drawn from the urn to fill the slot.
2. If the number of applicants ≤ 1, this applicant obtains the slot. If no one applied for the slot, the slot will become available in Step 2.

Step 2: Start from 04:00, end at 08:00. Every participant who has not obtained a slot in Step 1 can switch to the booking screen at any time and apply for one slot by pressing the BOOKING button. The number of available slots will be shown on the screen and updated in real time. (Note that you do not need to wait for a slot to become available to apply.) Those who have obtained a slot in Step 1 can still switch to the booking screen. But they will not see the BOOKING button as they do not need to apply again.

The available slot(s) in Step 2 can be any number from 1 to 2 and have two sources:

1. Cancelled slot: To mimic the real-world situation in which people may choose to cancel their appointments, one participant who has obtained a slot in Step 1 will be randomly chosen by the computer to cancel her slot at some point in Step 2 (the timing is again randomly chosen by the computer). The cancelled slot will be released and become available in the booking system. The participant whose slot is cancelled will still receive ECUs equal to her valuation of the slot. But he will not be allowed to book another slot in Step 2. Furthermore, he will be notified of the cancellation whenever he switches to the booking screen.

2. Unassigned slot(s): The unassigned slot(s) may come from Step 1. There will be no unassigned slot if the two slots have been assigned in Step 1.

When 08:00 is reached, the slots will be assigned as follows:

1. If in Step 2 the number of applicants $>$ the number of available slots, all applications will be put into a virtual urn. Then, one by one, applications are randomly drawn from the urn to fill the available slots.

2. If in Step 2 the number of applicants $\leq$ the number of available slots, each applicant obtains a slot.

Payoff

At the end of each round, your round payoff is the sum of the payoffs from the two tasks. At the end of the experiment, one randomly chosen round will be paid out, in addition to the show-up fee.

This completes the instructions. To ensure every participant understands the instructions, please answer the quiz on your screen. If there is any question, please raise your hand. Once everyone correctly answers the quiz, we will start the experiment. Also, in order to help participants familiarize themselves with the counting-dots task, there will be one practice (non-paying) round consisting of a 5-minute counting-dots task only.