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When opportunities backfire: Alternatives reduce perseverance and success in task completion☆

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We consider an agent who needs to finish one task under a time constraint. Would she benefit from having several alternatives of which she only needs to complete one, or is it better not to have options? We conjecture that agents will be worse off when having several options. In our experiment, the control group receives a single task to work on, while the treated group has two optional tasks to choose from. We find that having two alternatives negatively affects performance. Even when the additional task is substantially easier than the original one, having more options does not help. We discuss potential mechanisms and present evidence showing that many managers do not anticipate the negative effects.

1. Introduction

There are many tasks that can be successfully completed in more than one way. A theorem can be proved using different techniques, a new software application can be written in different programming languages, a new drug can be based on a variety of active ingredients, and so on. The pathways are different, but the end result is the same. In such cases, an important choice by the decision maker is how to divide attention over the different options. Should the research team choose one alternative and focus all resources on it, or divide resources between few alternatives? When proving a theorem, should full attention be devoted to one path, or should it be split between trying to prove the theorem and trying to find a contradiction?

Intuitively, compared to a single option, it cannot be worse to have more, equally promising options available, since one can always focus on one alternative, and ignore the others. Such behavior yields the same expected utility as having only a single option available. Making use of the option to switch therefore results in a (weakly) higher expected utility. Nevertheless, it is conceivable that (weakly) higher expected utility does not automatically lead to (weakly) higher expected

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earnings, because the decision maker may be willing to sacrifice earnings if it reduces effort costs. In a simple model, we show that for a rational decision maker, more options must nevertheless result in (weakly) higher expected earnings and better performance.

We conjecture that in practice, having more options can negatively impact performance. There are a few reasons to motivate our conjecture. People may suffer from a lack of stamina and get frustrated when their progress is slow. As a result, they may be tempted to switch tasks even when there are no clear gains from switching. In addition, alternative options may act as outside options. With the knowledge that there is a potential fallback option, dedication to the task may decrease.

To test our conjecture that more options can hurt performance, we designed a real effort laboratory experiment in which we manipulated the number of available options for participants. The task was to find ten differences between a set of two pictures. Participants were rewarded for completing the task within a time constraint and for completing it fast. We created three sets of pictures. Two sets were of comparable difficulty and relatively hard. The other set was relatively easy. The control group could only work on one, randomly selected, hard set of pictures. We compare their performance to treatment groups in which participants could work on two different sets of pictures. Participants in the treatment condition could freely switch back and forth between the two sets. Importantly, they were still only rewarded for completing one of the sets within the time constraint, just as in the control group.

We implemented two treatment groups that differed in the composition of pictures. In the first treatment, "Hard Options," we used the same sets of pictures as in the control group. Participants were told that the two sets of pictures were of comparable difficulty, but also said that some people might find one set easier and other people the other set. In the second treatment condition, "Mixed Options," one set of pictures was replaced with the easy set. The Mixed Options treatment tested a boundary of our prediction: can adding an alternative hurt performance even if the added alternative is substantially easier than the original one? In this treatment, participants were not told that one set was easier.

In line with our conjecture, we find a detrimental effect of having more options. Compared to the control group, participants in Hard Options were less likely to complete the task and on average ended up earning 35 percent less. Even in Mixed Options, where the added option was 38 percent easier (in terms of increased expected earnings), participants performed worse than if they had been randomly assigned a single easy or single hard task. This shows that the additional option needs to be much better in order to eliminate the detrimental effect.

What causes the decrease in performance? Given the nature of the task, there is no real reason for participants to spend much time on sampling the options before starting; the difficulty levels of the options are not easily assessed prior to working on them. We indeed find that initial sampling does not explain most of the decrease. We also find no evidence of decreased effort levels across treatments that could have occurred in the presence of a fallback option, and also no evidence of increased cognitive overload. Our results support the hypothesis that participants don't always have the stamina to keep focussed on one option. They are tempted to switch and look for alternatives that look easier when progress is slow. We find some suggestive evidence that participants who are sensitive to sunk costs perform better than others when there are alternatives. They are less willing to give up on the task once they made progress. A sensitivity to sunk costs usually comes at a cost. But people prone to the sunk cost fallacy fare better in an environment where others give up on a task too easily.

From a design perspective, our result suggests that restricting the set of available approaches may improve performance on projects. Workers may be better off focusing on a single approach, but will not do so without a commitment device.[1] Managers could improve performance by limiting the number of approaches available to workers. In an incentivized online survey, we find that many managers do not anticipate this, and are sometimes even willing to spend money to expand their workers' available options. This finding sheds new light on early work of Rotemberg and Saloner (1994) which demonstrates that firms can benefit from strategically narrowing the range of their activities and Rumelt (1974) who shows that inept managers seek to diversify, while competent managers do not.

Related work shows that people can be worse off when presented with many choice options (see e.g. Iyengar and Lepper, 2000; Sethi-Iyengar et al., 2004; Shah and Wolford, 2007; Haynes, 2009). An important difference with our work is in the psychological mechanism. In our setup, subjects do not suffer from an overload of choices, but the alternative project is an enticing distraction that prevents people from taking a difficult hurdle they have to pass. More closely related is the work by Toussaert (2018). In an experiment, she finds that average performance is lower when there is a tempting alternative option available (reading a story instead of working on a tedious task). In contrast to our work, the alternative option is never productive. She also finds evidence that the mere presence of the tempting alternative can impair productivity. This is consistent with a cost of self-control in order to resist the temptation. Gerhards and Gravert (2015) investigate the role of grit in an anagram solving task. Subjects can work on the hard version of the task, skip a task, or switch to solving easier but less rewarding anagrams. They find that subjects that score higher on grit tend to have higher earnings. Unlike our paper, they do not have a treatment where subjects cannot switch, and they do not answer the question whether the availability of options deteriorates performance.

Closely related is also the literature on multitasking. In theoretical work, Coviello et al. (2014) show how "task juggling" can reduce the agent's effort level. Buser and Peter (2012) investigate empirically how multitasking affects people's

[1] Note that the temptation is of a different nature than the type of temptation problems typically studied. There, the focus is usually on intertemporal temptation, i.e., early versus delayed costs or benefits (see, e.g., O'Donoghue and Rabin, 1999). In our setup, the payment is always at the end. See Ashraf et al. (2006) and Bryan et al. (2010) for reviews on commitment strategies in more standard self-control problems.

performance.[2] In multi-tasking problems, workers need to determine the optimal sequence of tasks, with the objective of completing all those tasks. This is different from our setting, where the problem that the agent faces is how to divide attention over different alternatives, and where the objective is to complete one of those alternatives (i.e., the alternatives are substitutes). Interestingly, Buser and Peter (2012) find that completing tasks in a predetermined order results in better performance than multi-tasking (i.e., switching often between tasks). Stoet et al. (2013) replicate the result that people perform less well when they work on multiple projects simultaneously instead of sequentially. Bray et al. (2016) study judges' case scheduling decisions and find that a scheduling policy that prioritizes the oldest hearings and thereby reduces multitasking considerably decreases case duration.[3]

2. Theoretical framework and hypotheses

In this section, we briefly sketch a theoretical underpinning for our claim that a rational decision maker must (weakly) benefit from having multiple alternatives available in terms of expected utility and performance. A more formal treatment is provided in Appendix B.

We consider an agent that can work on a set of tasks. For simplicity we only consider two available tasks. A task can either result in a success ($y = 1$) or a failure ($y = 0$). Completing one of the tasks successfully yields some bonus b. There is also a bonus β for faster completion, proportional to time. We think that a bonus for faster completion is natural, because time is costly and the agent can start working on another profitable task if self-employed, or the agent's career perspectives may improve if he successfully finishes tasks quickly in a firm. Working on the task yields disutility c, and if the agent switches then he incurs switching costs λ. The task requires some investment phase before it can be completed. The exact difficulty level of each task is unknown to the agent at the start, but he knows the distribution of difficulty levels and learns more about the difficulty by working on a task.

Note first that a simple revealed preference argument shows that the agent's expected utility cannot be lower when he has more options. An agent that has both tasks available can always randomly select one of the tasks and work only on that task, guaranteeing the same expected utility as an agent who can only work on a single task. If the agent decides to switch, it must be because it results in a (weakly) higher expected utility.

Less obvious is that a higher expected utility translates into higher expected performance and earnings. To see this, consider an agent who switches once (the argument generalizes to multiple switches). Suppose this changes expected output and cost by respectively Δy and Δc, and let $\Delta\beta$ be the expected change in the bonus β for completing the task quickly. The agent switches if:

$$b\Delta y + \Delta\beta \geq \Delta c + \lambda. \tag{1}$$

From the above inequality it appears that the agent may be willing to sacrifice earnings ($\Delta y < 0$) by switching to another task, provided this is compensated with a lower expected cost ($\Delta c < 0$). However, in Appendix B we show that in our setup lower expected cost implies an increase in expected performance and a decrease in completion time. Intuitively, lower expected effort cost implies that the agent expects to complete the task faster, increasing expected earnings. This yields the following proposition:

Proposition 1. *Giving the agent options weakly increases expected performance and earnings compared to assigning a single, randomly chosen task. The increase in expected performance and earnings is strict if switching between tasks occurs with positive probability.*

The above result holds for a rational agent with standard preferences and accurate beliefs. In practice, people exhibit behavioral biases. Here, we consider a bias that seems prevalent and particularly relevant in the current setting: *frustration cost*. Frustration arises because people tend to be 'cognitive misers' (Fiske and Shelley, 1984). They are inclined to search for the easy path to success and get frustrated if there is a lack of progress. In other words, they lack the stamina to stay focussed on a single option. In a simple extension of our model, we show that the existence of frustration cost can result in lower performance with more options. This is the basis of our main hypothesis, which we test experimentally:

Hypothesis: Having more options can result in lower performance and lower earnings.

3. Experimental design and procedures

Participants in our laboratory experiment worked on a task with a time constraint of 25 minutes. They were rewarded for completing the task within the time provided and for completing it fast. They received € 3 for completing it and 1 cent for every second they had still left upon completion.

[2] See Pashler (1994) for a review of the early literature on multitasking.

[3] Other related work studies how people perform in bandit problems (e.g. Weitzman, 1979; March, 1991; Chulkov and Desai, 2005; Forand, 2015). In these problems, agents repeatedly choose between options that yield different stochastic payoffs while at the same time they learn about the profitability of these options. These papers investigate how people deal with the trade-off between exploration (trying out each arm of a bandit to find the best one) and exploitation (playing the arm believed to give the best payoff). While exploitation is beneficial in the short run, it is found that a lack of exploration may be harmful in the long term (March, 1991; Chulkov and Desai, 2005). Our setting differs in that there is no additional payoff after a success on 1 arm.

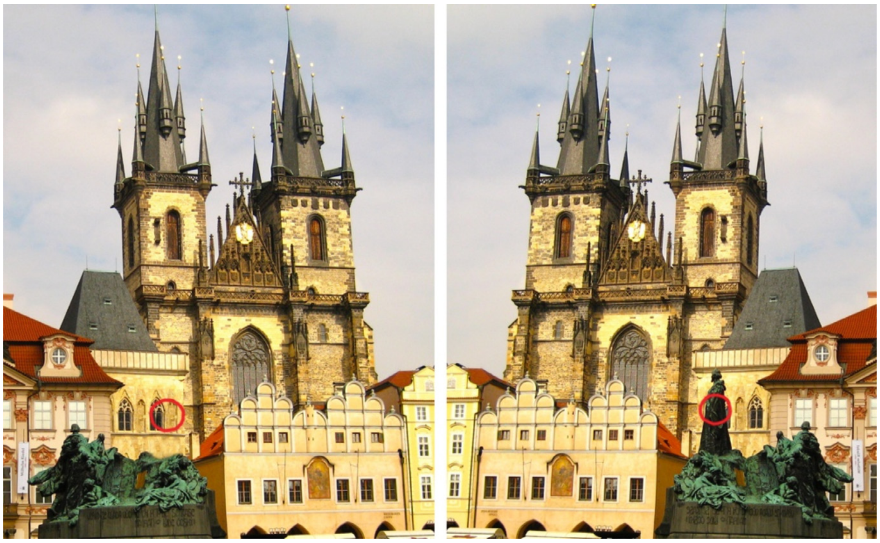

Fig. 1. "Spot the difference" task example.

Table 1
Treatments.

Treatment	Switching possible?	Set(s)	N
Hard Options	Yes	2 hard	49
Mixed Options	Yes	1 hard, 1 easy	60
Hard Control	No	1 hard	49
Easy Control	No	1 easy	27

Notes: In all treatments, there was a time limit of 25 minutes and participants had to complete one set of pictures to earn a bonus.

The task was to find ten differences between two pictures.[4] Fig. 1 shows an example. In total, we had three sets of pictures; two relatively hard sets and one relatively easy set.[5] The two hard sets were of comparable difficulty.

When a participant identified a difference, she had to click on the relevant spot of the picture to mark it. We encouraged subjects to click precisely, as the program only identified precise marks. Only when a participant had identified ten differences in a set, she could check whether she had solved the task correctly. In case of mistakes, the participant was not given information about the number and locations of mistakes. A participant could click on an existent mark again to remove it. A counter at the bottom-right corner indicated how many marks the participant had already placed on the current set.

We had three main treatments. In *Hard Control*, participants were randomly given one of the hard sets to work on. In *Hard Options*, participants were provided with both hard sets. They still had to complete only one of the sets, but they could freely switch back and forth between working on either set. Only one set was visible on the screen, and they could scroll up or down to the other set. If a participant switched back to a set on which she had previously worked, the old clicks were preserved. It was randomly determined which of the hard sets would appear on top. Participants in this treatment were told that the two sets were of comparable difficulty, but that it was nevertheless possible that some people would find one set easier while others would find the other set easier. They received a bonus as soon as they completed one of the two sets. In *Mixed Options* participants were also provided with two sets of pictures, but in this case one of the sets was the easy set.[6] Finally, to verify that the easy set was indeed easier, we had a group of participants that worked only on the easy set (*Easy Control*).

Procedures 185 subjects participated (51.1 percent female, mean age 22). Table 1 shows the number of participants in each treatment. We had more participants in Mixed Options so that we can test for order effects (whether the easy or hard

[4] Before the start of this project, we ran an experiment for the mphil thesis of the second author in which participants' task was to complete one of two Sudoku puzzles. With that different task, we found that people's previous experience with solving Sudoku puzzles was very predictive about whether they would succeed or not. For the participants without experience, the task was very difficult, and even without options they did quite poorly, which left little room for performance to become worse when participants had the option to switch. Vice versa, for experienced participants it was so easy to solve the puzzles that there was little room left for the treatment without options to make things better. We therefore decided to use another task that makes it possible to test the hypothesis meaningfully.

[5] To determine the difficulty level of each set, we recruited 91 participants on an online platform (Prolific.ac.uk). Each participant worked on only one set and was incentivized to complete the task as fast as possible. Based on their performance, we selected the two hard sets and the easy set for our main experiment.

[6] We ran this treatment after running Hard Options. The subject pool is comparable. Within treatments, we do not detect a time trend on performance.

set was on top). The Easy control treatment had fewer participants as it only served to verify that the easy set had a lower difficulty level than the hard sets.

In each session, we ran two treatments at the same time, and participants were randomly allocated to one of the treatments. After the main task, we asked a hypothetical question that measures the sensitivity to the sunk cost fallacy.[7] The question read: "Suppose you paid 30 euros for 5 cello lessons. After the first lesson you realize that you really don't like it. What do you do? You cannot get the money back." Possible answers were to stop going to the lessons or to attend 1, 2, 3 or all 4 remaining lessons. Those attending more lessons are considered to be more prone to the sunk cost fallacy. The mean reported number of lessons was 3.17 (s.d. 1.71).[8]

We also asked participants some questions related to stamina and attention. To measure their level of focus, we asked them how often they get distracted during lectures (on a 5-point scale, from "never" to "multiple times during most lectures"). We reverse-score this so that a higher score means more focus. A related question was how often they had to retake exams (on a 5 point scale from "never" to "more than 7 in 10 courses"). This question is also reverse-scored so that a higher score means fewer retakes. Another question captured the extent to which they like to be challenged, where they could choose between many easier problems or a few more challenging options (on a 4-point scale from "I prefer to solve 20 straightforward problems" to "I prefer one extremely tricky problem"). In later sessions this last question was replaced with a short grit measure taken from Duckworth and Quinn (2009) which is a more standard way of measuring stamina.[9]

At the end, participants were asked to complete a short questionnaire, where we collected basic demographics (age, gender, nationality, field of study and previous experience with similar tasks). Participants in the treatments in which switching was possible were also asked about their reasons for (not) switching. The complete list of questions can be found in Appendix E.

Sessions were run between January and April of 2017. The experiment was computerized and programmed in PHP/MySql. Sessions lasted about 1 h. Participants who completed the task had to wait until the end of the session. Average earnings were € 15.47 (including a fixed show-up fee of € 6).

Summary statistics. The two hard sets were calibrated to be of comparable difficulty. Mean earnings for the two sets in Hard Control were not significantly different (€ 9.25 versus € 10.16 excluding the fixed fee, $p = .555$, Wilcoxon rank-sum test). The easy set also proved to be easier than the hard sets. Average earnings in Easy Control are 38 percent higher than in Hard Control (13.38 versus 9.73), and the difference is significant ($p < .001$, Wilcoxon rank-sum test). In the treatments with more options, we randomized which set appeared on top. In neither one of the treatments did we find an order effect ($p = .754$ in Hard Options and $p = .464$ in Mixed Options, Wilcoxon rank-sum tests).

4. Results

4.1. Performance

The left bars of Fig. 2 show the average earnings in the treatments Hard Control and Hard Options. Our first main finding is that average earnings in Hard Options (€ 7.19) are lower than in Hard Control (€ 9.73). Thus, giving participants fewer options to work on resulted in 35 percent higher earnings. The difference is substantial and statistically significant ($p = .020$, Wilcoxon rank-sum test).

As a boundary test, in Mixed Options we replaced one of the tasks by an easier one. We compare participants' performance in this treatment to the expected performance of participants if they would be randomly assigned to either the hard or easy task, which we will refer to as *Mixed Control*. Mixed control is thus composed of participants from Hard Control and Easy Control. Mean earnings in Mixed Options (€ 9.35) were lower than in Mixed Control (€ 11.55), see Fig. 2 (right bars). The difference is again significant ($p = .004$).

Giving more options hurts performance. This effect is so big that even when the added option is substantially easier, earnings do not improve. Compared to Hard Control, those in Mixed Options have an extra option to work on that is almost 40 percent easier. Nevertheless, they earn about the same ($p = .796$).[10]

Differences in earnings between treatments can arise because of differences in completion rates and average time needed. Fig. 3 (left panel) shows that the difference is mainly due to completion rates. In Hard Control and Mixed Options, only 4 percent and 8 percent of participants fail to complete the task, respectively. By contrast, 24 percent of participants in Hard Options fail to complete the task. The difference between Hard Options and the other treatments is significant ($p = .004$ for

[7] The question was inspired by the type of questions used in Bornstein and Chapman (1995). We scaled down the amount initially invested to make it more in line with the stakes of the experiment. Following Tait (2015), we also frame it in the first person rather than asking in the third person what another person should do after having made an investment.

[8] This approach is close to how the sunk cost fallacy was originally measured by Arkes and Blumer (1985). In this approach it cannot be excluded that some subjects who according to the question suffer from a sunk cost fallacy would also have continued in a case where they had not paid for the lessons.

[9] All attention related questions are only weakly correlated with each other, with correlation coefficients below 0.150 (except for focus and the grit index, with a correlation coefficient of -0.330 and a $p-$value of 0.002.)

[10] Earnings are determined by the moment that a participant checked the answer. Most participants check the solution soon after finding the tenth difference (56 percent checks within 3 seconds, and over 80 percent checks within 10 seconds. Results are very similar if we use the moment of finding the tenth difference. Average earnings are then € 9.84 (Hard Control), € 7.38 (Hard Options), € 9.63 (Mixed Control), and € 11.64 (Mixed Options). The p-values of differences are 0.035 (Hard Control vs Hard Options), 0.944 (Hard Control vs Mixed Options), 0.009 (Mixed Control vs Mixed Options).

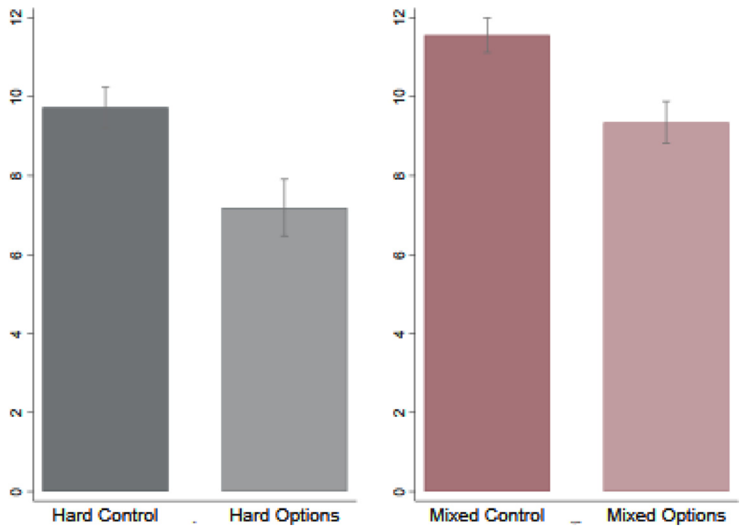

Fig. 2. Average earnings by treatment. Earnings exclude the fixed show-up fee. Error bars indicate +/- 1 s.e. Mixed Control is computed as the average of participants working on a hard task (Hard Control) and on an easy task (Easy Control).

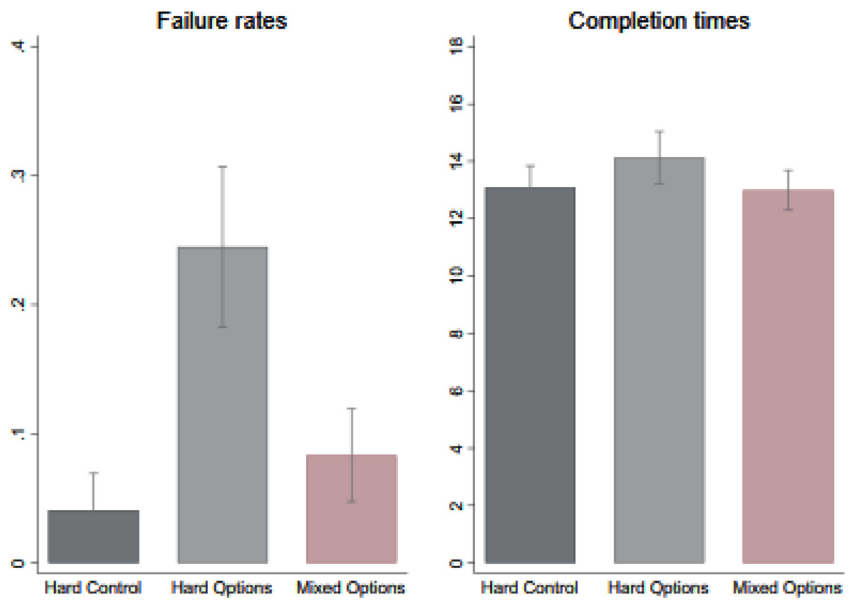

Fig. 3. Failure rates and completion times. Left panel: fraction of participants who do not complete the task within the time constraint. Right panel: Average time needed (in minutes) to complete the task (conditional on completing the task). Error bars indicate +/- 1 s.e.

Hard Options versus Hard Control, $p = .021$ for Hard Options versus Mixed Options, two-sided test of proportions). The right panel of Fig. 3 shows that conditional on completing the task, participants need somewhat more time in Hard Options than in the other treatments. In Hard Control, participants need on average 785 seconds. Participants in Hard Options manage to complete the set on which they are successful in 738 seconds, but spend on average 110 seconds on the other set. They therefore end up spending 848 seconds on average, 63 seconds longer than those in Hard Control. This would account for 63 cents (24 percent) of the difference in earnings. The difference in total completion times (785 seconds versus 848 seconds) is not significant, however ($p = .463$, Wilcoxon rank-sum test).[11]

Table A1 in Appendix A shows in a regression analysis that these results are robust to controlling for gender, age, and self-reported expertise in similar tasks.

[11] The difference in net time needed to complete the set (785 versus 738 seconds) is also not significant ($p = .444$, Wilcoxon rank-sum test).

Table 2
Descriptive statistics of switching behavior.

	Hard Options	Mixed Options
Mean number of switches	7.5	6.6
Median number of switches	6	5
Mean number of switches (>5 seconds)[a]	3.2	2.9
Mean time between switches (seconds)	73	69
% participants who never switch	2	12

Notes: [a]) Excluding switches where a participants returns to a set within 5 seconds.

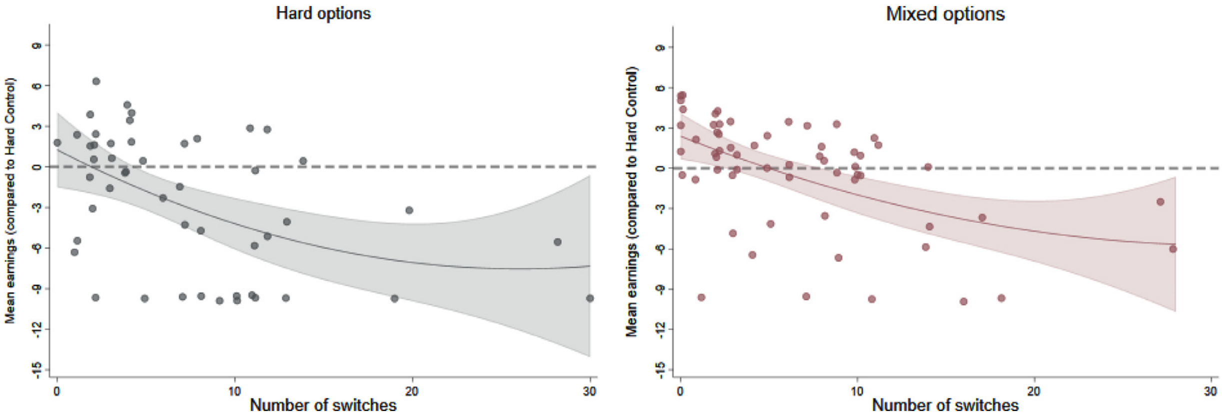

Fig. 4. Absolute difference in earnings compared to Hard Control by the total number of switches. Lines are based on a quadratic fit, with the 95 percent CI around them. Dots are jittered.

Participants who failed to complete the task in Hard Options often made substantial progress on at least one set. They all found at least 7 differences on one of the sets, and on average they found 8.5 differences on the set on which they found most. On the other set, they spent on average 268 seconds (median 188) and found on average 3.1 differences.

4.2. Switching behavior

Participants in the Options treatments can switch between sets and most of them do this. Table 2 provides some descriptive statistics. On average, participants switch 7.5 times in Hard Options and 6.6 times in Mixed Options. The median number is 6 in Hard Options and 5 in Mixed Options. This switching behavior includes cases in which participants take a quick peek at the other set. If we exclude cases where participants return to a set within 5 seconds, the average number of switches are 3.2 (Hard Options) and 2.9 (Mixed Options). Only few participants never switch (1/49 in Hard Options and 7/60 in Mixed Options). Fig. A1 in the Appendix shows the cumulative distributions of the number of switches. The average time between switches is about 70 seconds.

We find a strong negative correlation between earnings and the number of times that a participant switched. In Hard Options the Spearman rank correlation coefficient is -0.433 ($p = .002$) and in Mixed Options it is -0.538 ($p < .001$). Fig. 4 plots the earnings by the total number of switches. The solid curve is based on a quadratic fit. We show the difference in earnings compared to participants in Hard Control. For participants who switched only very few times, earnings are comparable to those in Hard Control. As they switch more often, earnings fall below those in Hard Control.

Participants in Hard Options who failed to complete the task switched more often than those in the same treatment who succeeded (11.25 versus 6.27 switches on average) and the difference is significant (Mann-Whitney test, $p = .012$).

4.3. Potential drivers

The previous analysis demonstrated the negative effect of having more options on performance. In this section, we explore several potential explanations for this finding. Our focus is on the comparison between Hard Control and Hard Options. That is the cleanest comparison, because all participants worked on the same level, and it gives us relatively many observations. We also report results for Mixed options, but since we need to control for the difficulty level of the task, we have relatively few observations.

(*i*) *Inspection time*. Prior to starting to work on a set, participants spend time inspecting both sets. On average, it takes participants in the Hard Options treatment 27 seconds more to find the first difference. This can account for 13 percent of

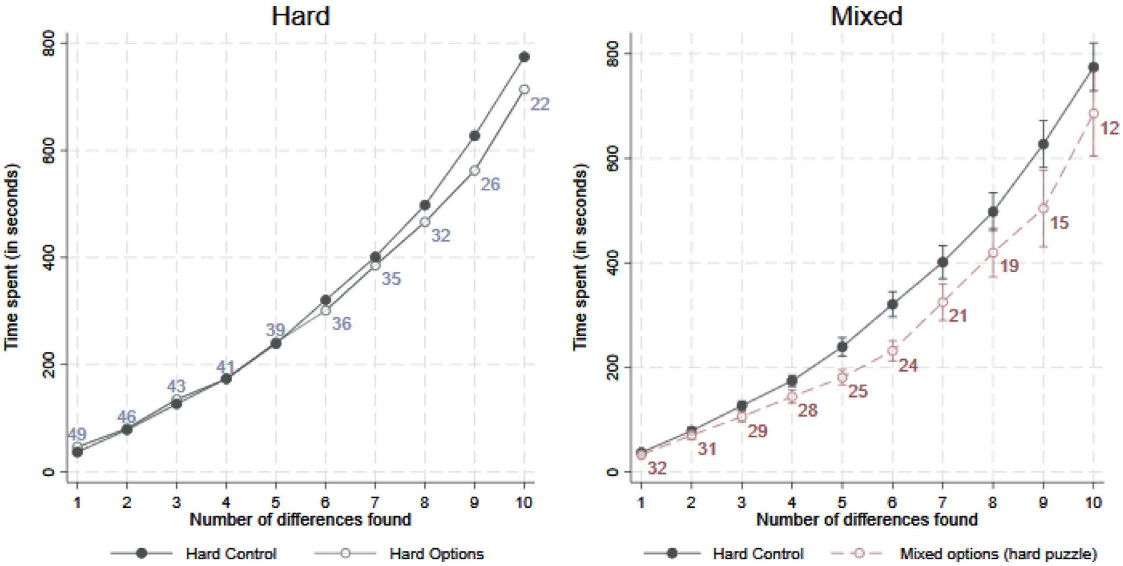

Fig. 5. Average net time spent to find a given number of differences (conditional on finding that number of differences). Time spent is net time (excluding time spent looking at the other set). Hard Options and Mixed Options includes all participants working on a hard set until the moment that they found a difference on the other set (numbers next to the dots indicate the number of observations). Error bars indicate +/- 1 s.e.

the difference in earnings compared to Hard Control.[12] Participants in Mixed options spend 7 more seconds before finding a difference compared to Hard Control, and 2 more seconds compared to Mixed Control.

(*ii*) *Fallback Option*. The presence of an alternative option creates a fallback option. This may diminish a participant's level of dedication. If this were the case, one would expect participants to perform worse in Hard Options compared to Hard Control from the start, even before they start working on the other option. To investigate this possibility, we compare the average time needed to find a certain number of differences. For the Hard Options treatment, we define the starting set as the set on which they find the first difference, and include participants until they find a difference in the other set. As finding the first difference is relatively easy, finding it is a good proxy of having paid attention to that set. For a clean comparison, we look at *net* time spent on a set, which excludes the time that a participant was looking at the other set.

We do not find evidence of decreased dedication levels in Hard Options. Fig. 5 (left panel) shows that performance in Hard Control is similar to that of participants in Hard Options before they switch. They need the same amount of time to find a certain number of differences. Notice that the figure is most informative when the number of differences is small, because in Hard Options there is some potential selection along the way: participants who switch may be those that struggle most. However, even for the first few differences performance is very similar, and selection cannot have played an important role yet. The right panel of Fig. 5 shows participants in Mixed Options who started working on the hard set (to keep it comparable to Hard Control). For the first few differences, there is no indication of decreased performance. When the number of differences found is higher, performance in Mixed Options is below that of participants in Hard Control, but the number of observations become relatively small and selection may play a more important role. Overall, the results suggest that the presence of an alternative task does not substantially harm participants' motivation from the start.

(*iii*) *Cognitive load.* Performance may be reduced after a participant started working on the other set and then switched back. By cognitive load, we mean that unfinished tasks may still get attention (Leroy, 2009), possibly harming performance. To investigate this, we look at the performance (in terms of number of differences found) of participants in Hard Options who switched to working on the other set of pictures and then returned to the original set.[13] We compare this to the performance of participants in Hard Control that worked on the same set but could not switch. We again subtract the time spent looking at the other set to get net times spent. Thus, we compare people that worked on the same set and for the same amount of time. The only difference is that one group spent time working on the other set in the meantime, while the other group did not.

If cognitive load plays a role, one would expect to see a structural break before and after the switch. Fig. 6 shows the relative performance of participants before and after they switched, where 0 indicates the moment of switching. We show

[12] To compute this, we calculated the expected earnings in Hard control with the 27 seconds added to the participants' completion times. This decreases the time bonus for participants, and potentially the bonus for completion if the extra 27 seconds means they would not complete the task on time. Expected earnings would decrease by 32 cents.

[13] More precisely, we identify the 'original' set as the set on which a subject finds the first difference. The switch is identified as the moment that the participant starts working on the other set and finds a difference on that set (if the subject switches back and forth before finding a difference, we use the last time that (s)he switches to the other task). In the period after the switch, we keep all participants irrespective of whether they find more differences on the other set in the meantime.

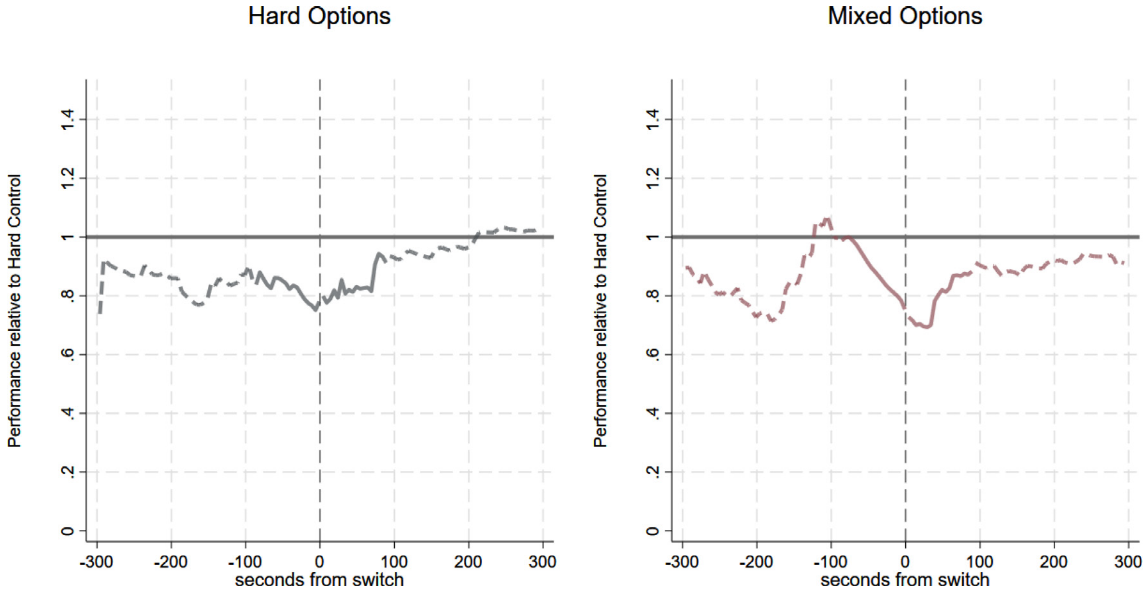

Fig. 6. Average Performance relative to Hard Control before and after the switching point (in bins of 5 seconds). Points are harmonic averages to avoid a potentially large impact of outliers. Mixed control only includes participants that started working on the hard set.

performance up to 300 seconds away from the switch, but focus on the 90 seconds before and after the switch. Prior to switching, performance in Hard Options is almost at par with that of participants in Hard Control who spent the same amount of time working on the same set. Right before the switch there is a negative trend, which can be expected since that is the reason to switch. When they return to the original set after having worked on the other set for some time, their relative performance shows a temporary drop, but their performance catches up afterwards. We see a roughly similar pattern for Mixed Options. In neither case seem participants to do structurally worse after the switching point.

(*iv*) *Stamina*. Participants may have little stamina, and be tempted to try something else once they become bored or frustrated by a lack of progress. This way, a lack of stamina results in excessive switching. This interpretation is supported by the negative correlation between earnings and number of switches that we reported earlier. Furthermore, in both Hard Options and Mixed Options, roughly half of the participants found at least one difference on each set, indicating that they divided their attention over the two sets. Those participants earn about 30–40 percent less compared to participants in the same treatments who only found differences on one of the sets, and the difference is significant ($p < .016$ in each treatment, Wilcoxon rank sum test).

Different motivations can underlie a lack of stamina, such as lack of focus, lack of challenge-seeking attitude, or frustration with a lack of progress. We do not find evidence that supports lack of focus plays an important role: There is no correlation between the number of switches and the survey questions related to focus (Spearman correlation coefficient $\rho = 0.023$, $p = .875$) or challenge seeking ($\rho = -0.028$, $p = .848$). We also do not find a correlation with the frequency of reported exam retakes ($\rho = 0.051$, $p = .726$), but this could also be because the answers are hard to interpret: fewer retakes could signal more stamina or focus, but also higher ability. We did not measure frustration directly, as we are not aware of a standard measure. However, we measured subjects' tendency to fall prey to the sunk-cost fallacy, which we think provides indirect support for the role of frustration.

An interesting feature is that the resulting temptation to switch too soon can be offset by a sunk-cost bias. Someone who suffers from the sunk cost fallacy may decide not to act on experienced frustration because by switching the exerted effort on the current task would have been in vain. Of course, a rational decision maker should not disregard any progress that has already been made. But a person who is sensitive to sunk cost can be inclined to attach too much value to the effort that was already exerted on a task. An implication would then be that people who do not disregard sunk costs may fare better in our task when they are faced with multiple options. In many situations, a sensitivity to sunk costs is costly (see Thaler, 1980; Arkes and Blumer, 1985; Friedman et al., 2007). In our case, however, people who are sensitive to sunk costs may be less willing to switch to the alternative task, and hence do better.

We indeed find some suggestive evidence supporting the view that a high sunk cost sensitivity (SCS) can be helpful. Fig. 7 compares earnings of those with high sunk costs sensitivity (SCS) to those with low SCS, based on a median split of SCS.[14] In Hard Options, participants with high SCS earn on average 70 percent more than those with low SCS (€ 8.49 vs €

[14] About 9.7% of subjects are at the median. As a robustness check, we repeated all our analysis related to sunk costs while excluding the subjects at the median. The results are largely the same as those described in the main text.

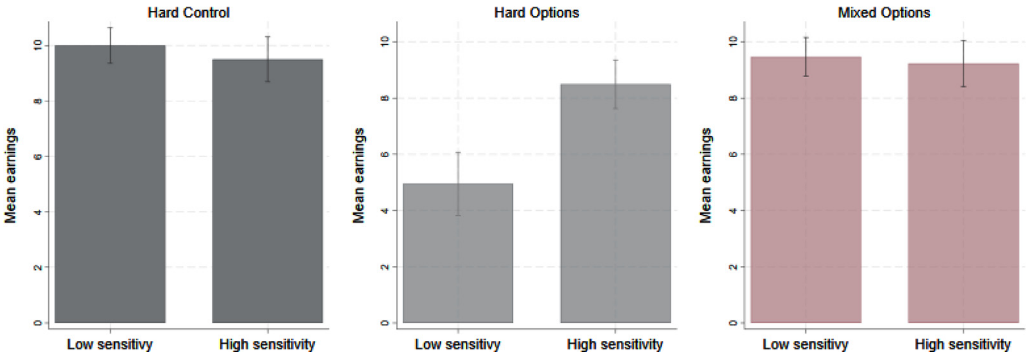

Fig. 7. Earnings by sunk costs sensitivity (based on a median split). Error bars indiciate +/- 1 s.e.

4.95, $p = .019$, Wilcoxon rank-sum test). This is not because these people groups differ inherently in their ability: in Hard Control there is no difference in earnings depending on SCS (€ 10.00 vs € 9.50, $p = .912$).[15,16] Participants with high SCS also switch fewer times compared to those with low SCS (6.0 versus 10.1 times), a difference which is marginally significant ($p = .068$, Mann-Whitney test). A regression analysis indicates that the difference in switching partially drives the effect on the earnings; after controlling for the number of switches, the SCS coefficient becomes smaller and insignificant (see Appendix A, Table A2 for details).[17] The result does not carry over to the Mixed Options treatment: earnings are € 9.47 (low SCS) versus € 9.23 (high SCS) and the difference is not significant ($p = .859$). This makes sense, because in contrast to Hard Options, switching in Mixed Options is much more likely to be beneficial given that one of the options is much easier.

To summarize, a lack of stamina seems to be a major driver of the difference in performance. Participants that are not sensitive to sunk costs often switch and work on the alternative set, which hinders their performance and decreases their earnings. We find much less support in our data for the other potential mechanisms.[18]

5. Behavior of managers

Our results suggest that in the presence of alternatives, agents could benefit from limiting themselves to concentrating on a single task. Some agents may not realize this; others may realize this but nevertheless get tempted to explore other options when the task gets challenging. Managers could therefore improve performance by restricting the worker's set of options.

In this section, we report the results of an incentivized online survey among people with management experience.[19] These managers were informed about our experiment and the incentives faced by the participants in it (see Appendix D for the instructions). We also explained that some participants could only work on one set of pictures, while others could switch back and forth between two different sets. The managers were told that they would be paired with one of those workers. They could choose to be paired with a worker from our control group who could only work on a single task, or with a worker from the Hard Options treatment who could switch between tasks.

On top of a participation fee of £1.00, participants earned a bonus of £0.50 if their paired worker completed the task and another £0.10 for every minute that the worker had still left upon completing the task. We implemented two conditions: One in which managers had to pay £0.25 if they wanted to provide the worker with more options and one in which no additional payment was required for providing more options.

We find that 31 out of 60 (52 percent) managers chose to provide the worker with more options when this was not costly. In other words, 52 percent of managers chose the treatment with lower performance. This resulted in a bonus that was on average 30 percent lower than that of managers who only provided the worker with a single task. When given an

[15] Those who fail to complete the task report a lower sunk cost sensitivity (2.83 versus 3.68 for those who do not fail). The difference is (marginally) insignificant ($p = .11$).

[16] We also created two composite measures out of the four survey question that relate to stamina (focus, challenge seeking, sunk cost sensitivity, and retakes). Our first composite measure simply averages the score over the four questions. The second composite measure is derived from a principal component analysis (based on the eigenvector of the first component). Both in Hard Control and in Hard Options, there is no significant relationship between earnings and either one of these composite measures. The pairwise correlations between the survey questions are also low, suggesting that they are measuring different things.

[17] The relation between sunk cost and earnings is somewhat sensitive to how sunk cost sensitivity is specified. If in model (1) of Table A2 we regress earnings on a dummy variable that equals 1 if a person is sensitive to sunk cost at all (i.e., does not stop attending the course) and 0 otherwise, the coefficient is 3.851 with a p-value of 0.043. If we do not transform the sunk cost variable, the estimated coefficient is 0.696 with a $p-$value of 0.110.

[18] In their responses to the open question at the end, participants mostly comment on how they selected the initial set to work on, and not so much on the reason to switch.

[19] Participants were recruited on the online platform Prolific.ac.uk. We selected participants (ages 18–65) who self-reported to have supervisory duties at work, and describe their role at work as upper/middle/junior management. 52 percent of respondents is male, with a mean age of 37 years.

Table 3
The Choice to Provide Options.

	Provide options
Costly	-0.209**
	(0.093)
Middle management	0.107
	(0.114)
Upper management	0.130
	(0.126)
Age	-0.003
	(0.005)
Female	-0.083
	(0.094)
Constant	0.579***
	(0.207)
N	116
R-squared	0.057

Notes: Linear probability model. The baseline category is Junior management. Standard errors in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$

additional task was costly, the fraction of managers who chose to provide this extra option decreased to 20 out of 59 (34 percent).

The tendency to provide the worker with more options is not related to the manager's age, gender, or management position. A regression analysis reveals that the only significant coefficient is whether providing options was made costly (see Table 3).[20]

The respondents arguments for their choices are also instructive. Of the 68 respondents that did not provide options, 21 (31 percent) explicitly mention better focus or less distraction as the main reason. Another 7 (10 percent) mention that they wanted to prevent workers from wasting time on inspecting the different options. Of the 51 that did provide options, 12 (24 percent) do this to allow workers to select the option they find easiest. Another 10 (20 percent) believe that providing autonomy has positive motivational effects by itself.

The fraction of managers who provide options when this is costly is consistent with those managers expecting a strictly better performance from workers that had more options. However, it can also be driven by an experimenter demand effect. To address this, we ran an additional study in which we asked managers to predict performance. We instructed participants that they would be matched with a random worker, and that the worker generates profits for completing the task (500 points) and for completing it fast (100 points per minute still left). Managers were paid a fixed participation fee of £1.00 and a bonus of £1.00 if they predicted profits sufficiently accurately (within 200 points from the actual profits). In a between-subject design, we varied whether the matched worker was in the Hard Control treatment or in the Hard Options treatment, and we informed managers if their worker could work on only one or on two sets.

Managers' predictions are on average quite accurate when workers do not have options: Their mean prediction is 1584 (median 1500), against actual mean profits of 1598. Predictions do no differ significantly from actual profits ($p = .687$, signed-rank test, N=62). When workers have options, mean predicted profits are 1665 (median 1700), and are above actual mean profits (1243). The difference between predictions and profits is significant ($p = .009$, N=58). Managers therefore do not predict that profits are lower when workers are given options. If anything, on average they predict slightly higher profits when workers have more options compared to when workers have no options, but the difference is not significant (two-sided Mann-Whitney test, $p = .531$). In neither case did any manager predict that the worker would not complete the task within 25 minutes.

6. Conclusion

We compare the success of participants in solving a task when given only one option versus two options from which they have to solve one. The standard assumption that more options should weakly improve performance is not supported by the data.

When the additional option is approximately as hard as the original one, we find that adding an alternative harms performance. The additional alternative diminishes our participants' earnings by 35 percent. Even when the additional option is an easier task, we find that the presence of the additional task does not help participants to improve their overall performance.

Subjects may well switch too often because they expect that switching is beneficial. In this case, they could ex-ante be rational, even if ex-post they find out that their expectations are mistaken. This would be congruent with the results from the survey among managers, who also often believe that giving more options is good for performance. The evidence also points to a lack of stamina as a cause for excessive switching, as corroborated by the finding that subjects with a high sunk

[20] We have missing background information for 3 participants.

cost sensitivity perform better. Subjects can get frustrated when they reach the hard part of a project, and switch tasks as an easy way to get rid of frustration. This is not the case for subjects with a higher sensitivity to sunk costs. They are less likely to quit in the middle, and end up performing better. While the literature has focused on instances where people suffer from a sensitivity to sunk costs, our findings suggest that sunk costs can offset a temptation to give up too easily.

Of course, there may also be good reasons to not restrict employees. If managers care about the happiness of their employees, they may consider giving options and thereby sacrificing some profit to avoid frustration among their employees. Having more options available can also increase a feeling of autonomy, which may improve a worker's intrinsic motivation, a recurrent theme in self-determination theory (see e.g., Gagné and Deci, 2005; Falk and Kosfeld, 2006 and Belot and Schröder, 2016).

Declaration of competing interest

On behalf of all authors, I hereby declare that there are no conflicts of interest.

Data availability

The data will be publicly available at Figshare (DOI:10.21942/uva.21878949)

Appendix A. Supplementary Tables and Figures

Table A1
Failure Rates and Completion Times.

	(1)	(2)	(3)	(4)
	Fail to complete		Completion time (in seconds)	
Hard Options	0.204***	0.187***	62.202	74.169
	(0.068)	(0.069)	(70.840)	(72.544)
Mixed Options	0.043	0.053	-5.829	-10.151
	(0.046)	(0.047)	(61.380)	(62.823)
Male		-0.030		28.625
		(0.051)		(52.291)
Age (years)		0.013		-6.045
		(0.010)		(10.077)
Experienced		-0.021		-69.659*
		(0.032)		(37.123)
Constant	0.041	-0.221	785.447***	947.879***
	(0.029)	(0.203)	(45.054)	(234.600)
Observations	158	154	139	136
R-squared	0.069	0.082	0.009	0.036

Notes: OLS estimates. Baseline is Hard Control. Experienced indicates experience with similar tasks (4 point scale). Standard errors in parentheses. $***p < .01$, $^{**} p < .05$, $^{*} p < .1$

Table A2
The effect of sunk costs sensitivity (SCS) on earnings.

	(1)	(2)	(3)	(4)	(5)	(6)
	Earnings (in euros)					
SCS high[a]	3.543**	2.334				
	(1.414)	(1.457)				
SCS positive[a]			3.851**	2.343		
			(1.849)	(2.119)		
SCS (continuous)					0.696	0.377
					(0.427)	(0.438)
Number of switches		-0.292***		-0.317***		-0.324***
		(0.086)		(0.086)		(0.088)
Constant	4.950***	7.899***	3.812**	7.509***	4.777***	8.311***
	(1.118)	(1.491)	(1.682)	(2.273)	(1.694)	(2.104)
Observations	49	49	49	49	49	49
R-squared	0.117	0.245	0.064	0.222	0.047	0.212

Notes: OLS estimates for subjects in treatment Hard Options. Robust standard errors in parentheses. [a]) SCS high is a dummy variable that equals 1 if the subject is above median sensitive to sunk costs. SCS positive is a dummy variable that equals 1 if the person is sensitive to sunk costs (attends at least one more lesson). Switches is the number of times a subject switched to the other set of pictures. $^{***} p < .01$, $^{**} p < .05$, $^{*} p < .1$

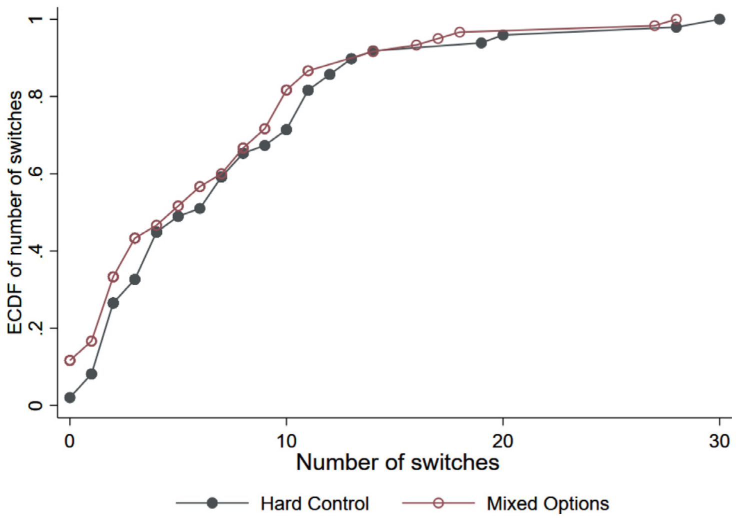

Fig. A1. CDFs of number of times that participants switched.

Appendix B. A Simple Model of Switching Behavior

In our experiment, we test our conjecture that having multiple options can hurt agents' performance. After finding support for this conjecture, we developed a theory that explains the finding and that sheds light on the circumstances in which the phenomenon may be expected to materialize. In this Section, we present this theory.

A manager hires a risk-neutral agent to work on a set of tasks for a maximum of $T < \infty$ periods. We model the problem in discrete time and assume that there are two tasks available, $k \in \{1, 2\}$. In each period $t = 0, 1, \ldots, T$, the agent chooses for each task an action $a_{t,k} \in \{0, 1\}$. Our interest is in the allocation of attention over time rather than multi-tasking. We therefore assume that the agent can work on at most one task in any given period: $a_{t,1} + a_{t,2} \leq 1$. Task k is idle whenever $a_{t,k} = 0$. If $a_{t,k} = 1$, then the agent incurs effort cost $c > 0$.[21]

The output of a task is $y \in \{0, 1\}$. To capture tasks that require some time before they can be completed, each task requires at least $n \geq 0$ periods of attention. After this initial phase, a task is completed ($y = 1$) with probability $a_{t,k}p_k$. This probability is independent across periods. The initial phase can be thought of as a part of the task on which it is easy to make progress, followed by a more difficult phase where making progress is stochastic. For simplicity, we assume that the agent can always resume a task where it was left off. Thus, if the agent completed the initial phase for task k, and returns to this task after working on the other task for a while, he does not have to redo the initial phase.

A task can be either easy ($p_k = p_h$) or hard ($p_k = p_l < p_h$). The task difficulty is not directly observable but the agent knows that with probability q the task is easy and that this is independent across tasks. This uncertainty about the task difficulty creates an incentive to switch and explore the other task. Each time the agent switches between tasks, he incurs a cost $\lambda > 0$.

The agent receives a fixed payment (s), a bonus for completing a task (b), and a bonus for completing it quickly (β). If the agent completes a task at time j, he earns $w = s + b + \beta(T - j)$. There is no additional payoff from completing a second task. The agent's outside option is zero. The agent's payoff from completing a task at time j is:

$$u = w - \sum_{t=0}^{T}\sum_{k=1}^{2} a_{t,k}c - \lambda n_{\lambda}, \tag{2}$$

where n_{λ} is the number of times that the agent switched between tasks. We assume that $qp_h + (1-q)p_l > (n+1)c/[b + \beta(T-n)]$, so that the agent always finds it profitable to start working on a task.

The manager can let the agent freely choose between tasks ("options") or restrict the agent to work on a single, randomly selected task ("single task"). Our main result is that giving options (weakly) increases the agent's expected earnings ($\hat{w}$) and performance (expected output, $\hat{y}$). Note first that a simple revealed preference argument shows that the agent's expected utility cannot be lower when he has more options. An agent that has both tasks available can always randomly select one of the tasks and work only on that task, guaranteeing the same expected utility as an agent who can only work on a single task. In our setup, a higher expected utility also translates into higher expected performance and earnings.

[21] Our model has similarities to multi-armed bandit models. A key difference is that in bandit models, agents receive stochastic payoffs from each arm and their objective is to find the arm that yields the highest expected payoff, whereas in our model the agent's objective is to find the arm that gives a payoff fastest.

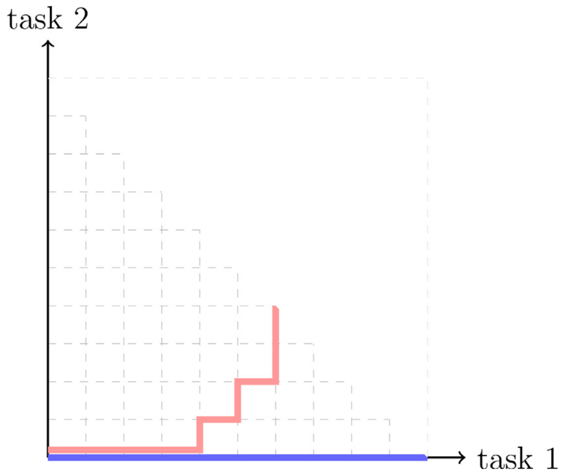

Fig. A2. Switching behavior when the agent starts with task 1. Figure drawn for $T = 10$, $p_h = 0.4$, $p_l = 0.1$, $q = 0.5$, $\lambda = 0$, $c = 0.08$, $n = 3$, $b = 1$, $\beta = 0.05$. Blue path: $\alpha = 0$. Red path: $\alpha = 0.025$.

To see why performance and earnings must increase when the agent switches, consider an agent who switches once (the argument generalizes to multiple switches). Suppose this changes expected output and cost by respectively Δy and Δc, and let $\Delta\beta$ be the expected change in the bonus β for completing the task quickly. The agent switches if:

$$b\Delta y + \Delta\beta \geq \Delta c + \lambda. \tag{3}$$

From the above inequality it appears that the agent may be willing to sacrifice earnings by switching to a task with lower expected cost. However, below we show that $\Delta c < 0$ implies an increase in expected performance and a decrease in completion time. Intuitively, lower expected effort cost implies that the agent expects to complete the task faster, increasing expected earnings. This is easy to see when $n = 0$. If no investment phase is required, lower expected cost immediately imply a more favorable posterior that the task is easy. It remains true for $n > 0$, where a more favorable posterior does not immediately imply higher earnings, as the task cannot be completed during the investment phase. If, on the other hand, the agent expects an increase in cost ($\Delta c > 0$), this implies a lower expected bonus for fast completion ($\Delta\beta < 0$). Thus, when $\Delta c > 0$, inequality (3) can only be satisfied if expected performance increases ($\Delta y > 0$), and the agent will not switch if this is not the case.

We restate the proposition from Section 2:

Proposition *Giving the agent options weakly increases expected performance ($\hat{y}$) and earnings ($\hat{w}$) compared to assigning a single, randomly chosen task. The increase in expected performance and earnings is strict if switching between tasks occurs with positive probability.*

Proof. See Appendix C. □

The above result holds for a rational agent with standard preferences and accurate beliefs. In practice, people exhibit behavioral biases. Here, we consider a bias that seems prevalent and particularly relevant in the current setting: *frustration cost*. Frustration arises because people tend to be 'cognitive misers' (Fiske and Shelley, 1984). They are inclined to search for the easy path to success and get frustrated if there is a lack of progress. We model this as a cost $\phi_{t,k}$ which the agent incurs if she keeps working on a task on which no progress was made in the previous period (not counting periods in the investment phase). At time t, we have

$$\phi_{t,k} = \begin{cases} 1 & \text{if } y_{t-1,k} = 0,\ a_{t,k} = a_{t-1,k} = 1 \text{ and } \sum_{t=0}^{t-1} a_{t,k} > n, \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

Note that under this specification, frustration cost die out while working on another task. At T, the agent's payoff is then:

$$U = w - \sum_{t=0}^{T}\sum_{k=1}^{2} a_{t,k}c - \lambda n_\lambda - \alpha \sum_{t=0}^{T}\sum_{k=1}^{2}\phi_{t,k}, \tag{5}$$

where $\alpha \geq 0$ reflects the weight of frustration cost in the agent's payoff. We keep on assuming that the agent is forward looking, and anticipates any frustration cost.

Proposition 2. *With frustration cost, having more options can result in lower performance and lower earnings.*

Frustration causes the agent to switch more often between tasks. This lack of stamina need not necessarily hurt performance. An agent who has $\alpha = 0$ can increase performance by switching more often, but switching cost prevents him from doing so. Frustration cost can then have a positive effect on performance. However, frustration cost can also result in excessive switching between tasks, thereby lowering performance. This does not happen when $n = 0$ (because in that case performance is maximized by always switching to the task with the highest probability of success), but can happen for $n > 0$.

Fig. A2 shows an example in which frustration cost hurts performance. It is assumed that the agent starts working on task 1. The thick lines show how the agent switches between tasks as long as the task has not yet been completed. For the chosen parameters, an agent without frustration cost ($\alpha = 0$, blue path) never switches. The probability of completing the task is then approx. 0.75, with expected earnings of 0.91. With positive frustration cost (red path), the agent switches to task 2 if the task has not been completed after 4 periods. After that the agent starts switching back and forth several times. The probability of completing a task is then 0.65 and expected earnings are 0.76, below that of an agent who cannot switch.

Appendix C. Proofs

We first show that proposition 1 holds for $\beta = 0$, i.e., without a bonus for fast completion. If switching increases expected cost, the agent only switches when the probability of success increases. If switching decreases expected cost, we show that the probability of success must increase.

Case (i) *the agent never gives up before* T. Assume w.l.o.g. that the agent starts working on task 1, and consider a strategy where the agent switches only once. Switching is strictly dominated when there are at most n periods left (no success is possible on a task in the first n periods). Suppose therefore that the agent switches when there are still $k \geq n+1$ periods left. If at that point q_1 is the posterior that task 1 is easy, the expected probability of completing task 1 (and thus earning a bonus) when the agent keeps working on task 1 until the end is given by:

$$\hat{y}_1 = 1 - q_1(1-p_H)^k - (1-q_1)(1-p_L)^k. \tag{6}$$

The expected cost of continuing on task 1 are given by:

$$\begin{aligned}\hat{c}_1 = {} & c + q_1[(1-p_H) + (1-p_H)^2 + \ldots + (1-p_H)^{k-1}]c \\ & +(1-q_1)[(1-p_L) + (1-p_L)^2 + \ldots + (1-p_L)^{k-1}]c.\end{aligned} \tag{7}$$

In the upcoming period cost are certain. There is a probability of $q_1(1-p_H) + (1-q_1)(1-p_L)$ that the agent is not successful in the upcoming period and ends up working at least one more period, and so on.

The expressions for task 2 are very similar, except that during the first n periods there is no chance of success and the posterior of the task being easy is still given by the prior $q_2 = q > q_1$. The expected completion rate and cost are given by:

$$\hat{y}_2 = 1 - q_2(1-p_H)^{k-n} - (1-q_2)(1-p_L)^{k-n}, \tag{8}$$

$$\begin{aligned}\hat{c}_2 = {} & (n+1)c + q_2[(1-p_H) + (1-p_H)^2 + \ldots + (1-p_H)^{k-1-n}]c \\ & +(1-q_2)[(1-p_L) + (1-p_L)^2 + \ldots + (1-p_L)^{k-1-n}]c.\end{aligned} \tag{9}$$

Define $\Delta y(q_1, q_2) \equiv \hat{y}_2 - \hat{y}_1$ and $\Delta c(q_1, q_2) \equiv \hat{c}_2 - \hat{c}_1$. We have:

$$\begin{aligned}\Delta y(q_1, q_2) = {} & (q_2 - q_1)[(1-p_L)^{k-n} - (1-p_H)^{k-n}] - q_1(1-p_H)^{k-n}(1-(1-p_H)^n) \\ & -(1-q_1)(1-p_L)^{k-n}(1-(1-p_L)^n),\end{aligned} \tag{10}$$

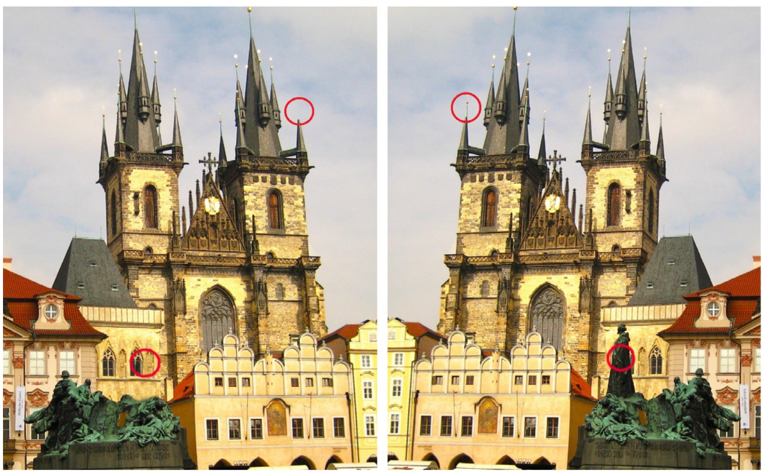

Fig. A3

$$\Delta c(q_1,q_2) = nc + (q_2-q_1)\left[\frac{1-p_H-(1-p_H)^{k-n}}{p_H} - \frac{1-p_L-(1-p_L)^{k-n}}{p_L}\right]c$$
$$-q_1[(1-p_H)^{k-n}+\ldots+(1-p_H)^{k-1}]c-(1-q_1)[(1-p_L)^{k-n}+\ldots+(1-p_L)^{k-1}]c. \quad (11)$$

Note that $\Delta y(q_1,q_2)$ is increasing in q_2 and $\Delta c(q_1,q_2)$ is decreasing in q_2. For any given q_1, let q_2^* be such that $\Delta c(q_1,q_2^*(q_1))\equiv 0$. Using (11), this implies:

$$q_2^*-q_1 = -\frac{n-\sum_{j=k-n}^{k-1}[q_1(1-p_H)^j+(1-q_1)(1-p_L)^j]}{\left(\frac{1-p_H-(1-p_H)^{k-n}}{p_H}-\frac{1-p_L-(1-p_L)^{k-n}}{p_L}\right)}. \quad (12)$$

We next verify that at $\Delta y(q_1,q_2^*(q_1))>0$. Plugging (12) into (10) and rearranging shows that this is true if:

$$\frac{(1-p_L)^{k-n}-(1-p_H)^{k-n}}{\left(\frac{1-p_L-(1-p_L)^{k-n}}{p_L}-\frac{1-p_H-(1-p_H)^{k-n}}{p_H}\right)} \geq \frac{q_1(1-p_H)^{k-n}(1-(1-p_H)^n)+(1-q_1)(1-p_L)^{k-n}(1-(1-p_L)^n)}{n-\sum_{j=k-n}^{k-1}[q_1(1-p_H)^j+(1-q_1)(1-p_L)^j]} \quad (13)$$

The LHS of (13) is constant in q_1. The numerator of the RHS is decreasing in q_1, and the denominator increasing, so the RHS is decreasing in q_1. Thus, if (13) holds at $q_1=0$ then it always holds. It holds at $q_1=0$ if:

$$\frac{(1-p_L)^{k-n}-(1-p_H)^{k-n}}{\left(\frac{1-p_L-(1-p_L)^{k-n}}{p_L}-\frac{1-p_H-(1-p_H)^{k-n}}{p_H}\right)} \geq \frac{(1-p_L)^{k-n}(1-(1-p_L)^n)}{n-\sum_{j=k-n}^{k-1}[(1-p_L)^j}. \quad (14)$$

Rewriting gives:

$$\sum_{j=k-n}^{k-1}\Bigg[((1-p_L)^{k-n}-(1-p_H)^{k-n})(1-(1-p_L)^j)$$
$$-p_L(1-p_L)^j\left(\frac{1-p_L-(1-p_L)^{k-n}}{p_L}-\frac{1-p_H-(1-p_H)^{k-n}}{p_H}\right)\Bigg]\geq 0. \quad (15)$$

Note that for $j=k-n$,

$$((1-p_L)^{k-n}-(1-p_H)^{k-n})(1-(1-p_L)^j)\geq p_L(1-p_L)^j\left(\frac{1-p_L-(1-p_L)^{k-n}}{p_L}-\frac{1-p_H-(1-p_H)^{k-n}}{p_H}\right) \quad (16)$$

is equivalent to

$$\frac{p_L(1-p_L)^{k-n}}{1-(1-p_L)^{k-n}} \geq \frac{p_H(1-p_H)^{k-n}}{1-(1-p_H)^{k-n}} \quad (17)$$

The last inequality is satisfied since the function $g(z)=z(1-z)^k/[1-(1-z)^k]$ is decreasing in z. It is then easy to show that the expression in brackets is positive for each $j\geq k-n$, so the sum of all the terms in (15) is also positive. Thus, we have established that when the two tasks have the same expected cost, then task 2 must have a higher completion probability. It also follows from the properties of $\Delta c(\cdot)$ and $\Delta y(\cdot)$ that task 2 has a higher completion probability whenever task 2 has lower expected cost.

Case (*ii*) *The agent gives up before* T. Suppose that the agent would give up working on task 1 in period $m<T$ if he would not be able to switch.

If he then switches at m, then the probability of completing a task must clearly increase: without switching he would give up and he only starts on a new task if the probability of completing it is positive.

Suppose he switches before m, with k periods left, and let $m>T/2$ (so that he will never give up on task 2, once started). As $m>n$ (there is no point in starting a task if you give up before the probability of success becomes positive), the number of periods in which there is a positive chance on success on task 2 ($k-n$) exceeds that of task 1 ($k-m$). Since he only switches when the posterior $q_2>q_1$, this immediately implies that this increases the probability of completing a task.

If $m<T/2$, the worker would ultimately also give up on task 2 before time runs out. The above analysis still applies by redefining the end period (substituting $2m$ for T).

If the agent's strategy is to switch more than once, the above proof applies to the time between the first and second switch (by substituting the period of the second switch for T). Any subsequent switch immediately implies higher earnings; the agent never switches if the posterior of the task that he switches to is lower, and there is no longer an investment phase. The agent never returns to a task after giving up on it.

Next, we show that the proposition continues to hold for $\beta>0$. The time-bonus for completing it fast is given by $\beta(T-j)$, where j is the period of completion. The expected time-bonus $\hat{\beta}_1$ of continuing on task 1 when there are still k periods left is given by:

$$\hat{\beta}_1 = q_1[(k-1)p_H + (k-2)(1-p_H)p_H + \ldots + (1-p_H)^{k-2}p_H]\beta$$
$$+(1-q_1)[(k-1)p_L + (k-2)(1-p_L)p_L + \ldots + (1-p_L)^{k-2}p_L]\beta \quad (18)$$

This can be rewritten as:

$$\hat{\beta}_1 = (k-1)\beta - q_1\frac{1-p_H-(1-p_H)^k}{p_H}\beta - (1-q_1)\frac{1-p_L-(1-p_L)^k}{p_L}\beta. \quad (19)$$

Similarly, for task 2 this is given by:

$$\hat{\beta}_2 = (k-1-n)\beta - q_2\frac{1-p_H-(1-p_H)^{k-n}}{p_H}\beta - (1-q_2)\frac{1-p_L-(1-p_L)^{k-n}}{p_L}\beta. \quad (20)$$

It is easy to show that

$$\hat{\beta}_2 - \hat{\beta}_1 \propto -\Delta c(q_1, q_2)$$

.

This means that $\Delta c(q_1, q_2) < 0$ implies that both the probability of success and the expected time bonus increase. If $\Delta c(q_1, q_2) > 0$, the agent only switches if this is compensated by higher expected earnings. Since $\Delta c(q_1, q_2) > 0$ implies a lower expected time bonus, expected earnings can only be higher if the probability of success increases.

Appendix D. Instructions

Instructions of the main experiment

[page 1, All treatments] Welcome

Welcome to this experiment!

Please read the instructions carefully and remain silent throughout the experiment. Any use of electronic devices such as your phone is not permitted.

Please note that at the end of the instructions you will have to wait for other participants to finish reading the instructions.

In this experiment, the amount of money you can earn depends only on your own actions. You will not be paired with other participants, and the actions of other participants will not affect your earnings.

[page 2, All treatments] Description of the task - Part 1

Spot the differences. You will see two pictures. The picture on the right is the mirror image of the picture on the left, except for some small differences. Your task is to spot the differences between the pictures. Below is an example with two differences.

Marking differences. To mark a difference, just click on either one of the two pictures. A red circle will appear on each picture. Made a mistake? Just click again and the mark disappears.

How to mark correctly. To ensure that marked differences are correctly identified by the program, **make sure to place the marks in the center of the differences.** For instance, in the example below, there is a statue in the right picture that is missing in the left picture. You should mark this difference by clicking near the center of the statue (since the whole statue is missing), as indicated by the red circle in the example. Further, notice that one of the decorative spires is missing on one of the towers. Since only this detail is missing, you should mark **only** this detail and not the whole tower. [page 3, Control treatment] **Description of the task - Part 2**

10 differences. Your goal is to find 10 differences between the pictures.

You have 25 minutes to spot 10 differences correctly. A timer indicates how much time has passed. There is also a counter indicating the number of marks you have already placed. This counter does not tell you if the mark is correct or not.

Located 10 differences? Once you located and marked 10 differences, you can press the “Check Solution” button at the bottom (below the pictures). The program will then tell you if you successfully located 10 differences. If you did, you have completed the task (a ’success’ window will appear).

Made any mistakes? If you made some mistakes, you can continue working on the task. The program will not tell you how many mistakes you made or where you made any mistake(s).

[page 3, Options treatment] **Description of the task - Part 2**

Two sets of pictures. In the experiment, you will get **two** sets of pictures. Your goal is to find 10 differences for **one** of the two sets. You can choose to work on any of the two sets, as well as alternate between them. [Only in treatment Hard Options: The two sets of pictures are of comparable difficulty. Nevertheless, it is possible that some people find the first set easier than the second set, while others find the second set easier than the first set.]

10 differences in one of the sets. You only need to find 10 differences for **one of the sets**. You cannot combine found differences on the two sets of pictures. For instance, if you found 7 differences in one of the sets and 3 differences in the other set, you have **not** completed the task. All 10 differences must be from the same set.

You have 25 minutes to spot 10 differences correctly. A timer indicates how much time has passed. There is also a counter indicating the number of marks you have already placed for each of the sets of pictures. This counter does not tell you if the mark is correct or not.

Located 10 differences? Once you located and marked 10 differences on **one** of the picture sets, you can press the "Check Solution for Set #" button below the correspondent set of pictures. The program will then tell you if you successfully located 10 differences on this set. If you did, you have completed the task (a 'success' window will appear).

Made any mistakes? If you made some mistakes, you can continue working on the task. The program will not tell you how many mistakes you made or where exactly you made any mistake(s).

[page 4, Control treatment] **Your Rewards**

Your earnings will be denoted in points, which will later be converted to euros. Every point will be worth 1 euro cent. So 100 points are worth 1 euro.

Participation fee You are guaranteed to earn at least 600 points (€ 6). Other rewards come on top of these minimum earnings.

Reward for spotting 10 differences. You earn 300 points (€ 3) if you spot 10 differences correctly.

Reward for fast completion. You earn 1 point for every second you have still left at the moment that you spotted 10 differences.

Example 1. Suppose you spot 10 differences in 15 minutes. You would then have 10 of the 25 minutes left (so 600 seconds). You would receive 600 points for completing the task and another 300 points because you still had 600 seconds left. In total, you would receive 600+300+600=1500 points (€ 15).

Example 2. Suppose you run out of time without spotting 10 differences. In that case, you will receive the guaranteed minimum earnings of 600 points (€ 6) but no other rewards.

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[page 4, Options treatment] **Your Rewards**

Your earnings will be denoted in points, which will later be converted to euros. Every point will be worth 1 euro cent. So 100 points are worth 1 euro.

Participation fee You are guaranteed to earn at least 600 points (€ 6). Other rewards come on top of these minimum earnings.

Reward for spotting 10 differences. You earn 300 points (€ 3) if you spot 10 differences correctly on one of the sets of pictures. The number of correctly spotted differences on the other (incomplete) set of pictures does not affect your earnings.

Reward for fast completion. You earn 1 point for every second you have still left at the moment that you spotted 10 differences on one of the sets.

Example 1. Suppose you spot 10 differences on one of the sets of pictures in 15 minutes. You would then have 10 of the 25 minutes left (so 600 seconds). You would receive 300 points for completing the task and another 600 points because you still had 600 seconds left. In total, you would receive 600+300+600=1500 points (€ 15).

Example 2. Suppose you run out of time without spotting 10 differences. In that case, you will receive the guaranteed minimum earnings of 600 points (€ 6) but no other rewards.

[page 4, Control treatment] **Summary**

1. Your goal is to find 10 differences between the pictures.
2. Click on the differences that you find to mark them and press the 'Check results' button when you find 10 of them.
3. Remember to click in the **center of the difference**. The program would only identify precise marks.
7. Click on an existent mark again to remove it. A counter at the bottom-right corner indicates how many marks you have already placed.
8. You have 25 minutes to complete the task.
9. You get **300** points for completing the task and **1** point for every second you have still left of the 25 minutes at the moment that you spotted 10 differences.
10. On top of that you receive **600** points of participation fee, and each of your points will be converted into **1 euro cent** at the end of the experiment.

You can review all instructions again by clicking 'Review Instructions'. When you are ready to start, press Start to begin the task.

[page 4, Options treatment] **Summary**

1. Your goal is to find 10 differences between the pictures.
2. You will see **two** sets of pictures comparable in difficulty, and you only need to find 10 differences on **one** of them.
3. You can work on any of the two sets, as well as alternate between them, as long as you can find 10 differences on one of them in the end.
4. To navigate between the two sets of pictures, scroll up and down on the task page.
5. Click on the differences that you find to mark them and press the 'Check Solution for Set #' button when you find 10 differences on one of the sets.
6. Remember to click in the **center of the difference**. The program would only identify precise marks.
7. Click on an existent mark again to remove it. A counter at the bottom-right corner indicates how many marks you have already placed on the current set.
8. You have 25 minutes to complete the task.
9. You get **300** points for completing the task and **1** point for every second you have still left of the 25 minutes at the moment that you spotted 10 differences on one of the sets.

10. On top of that you receive **600** points of participation fee, and each of your points will be converted into **1 euro cent** at the end of the experiment.

You can review all instructions again by clicking 'Review Instructions'. When you are ready to start, press Start to begin the task.

Instructions of the survey with managers providing options

[page 1, Managers]

General Information

Please read the following instructions carefully before you start.

You will be asked to make one decision. After that, there will be a short survey and you will be paid according to the instructions below. Please do not rush, the estimated completion time of 8 minutes is more than enough.

You receive £1.0 for your participation in this study. On top of that, you can earn a bonus.

The research is carried out by researchers from the University of Amsterdam (The Netherlands). All data will be kept confidential by the researchers. By participating, you consent to the publication of study results as long as the information about your decisions remains anonymous.

[page 2, Managers] **Instructions**

You will be paired with another real person, whom we will call the 'worker'. The worker has to try to complete a task of spotting 10 differences between a pair of almost identical pictures. The worker has a maximum of 25 minutes for finding the 10 differences, and is rewarded for doing this fast.

We have created two pairs of pictures. You can see them below. The two pairs are of equal difficulty, although some people might find one pair easier and other people the other pair. You can see them below.

[pictures]

Your earnings are determined as follows. You are guaranteed to receive your participation fee of 1.0. On top of that, you earn a bonus of 0.5 if your worker completes the task within 25 minutes and another 0.1 for every minute that the worker has still left (out of the 25 minutes) upon completing the task.

For example, if your worker completes the task in 16 minutes, you earn additional 0.5 for completion and 0.9 for the 9 minutes left before the 25 minute deadline.

[page 3, Managers] **Instructions 2**

Your task is to choose between the following two options:

Option 1. You provide the worker with **one pair** of pictures to work on. If you choose this option, then one of the pairs will be randomly chosen and the worker can only work on that pair.

Option 2. You provide the worker with the option to work on **either** pair of pictures. If you choose this option, the worker still needs to complete only one pair of pictures, but can decide on which of the two pairs to work and can freely switch back and forth between the two at any time.

[treatment costly options] If you choose option 2, you have to pay a price of 0.25 which will be subtracted from your participation fee of 1.

Matching you with a real worker. As said, you will be matched with a real person. In a previous study, we already hired workers to work on the task. Some of them were given one pair of pictures to work with, and some of them were provided with both pairs of pictures. Depending on your choice, we will match you with a worker that could work on one or both pairs.

You can review all instructions again by clicking 'Review Instructions'. When you are ready to make your decision, press Ready.

Instructions of the survey with managers making predictions

[page 1, Managers predictions]

Thank you for participating! Please read the following instructions carefully before you start.

You will be asked to make one prediction. After that, there will be a short survey.

Please do not rush, the estimated completion time of 8 minutes is more than enough.

You will receive £1 for your participation in this study. On top of that, you can earn a bonus.

[page 2, Managers predictions]

You will be matched with another real person, whom we will call the 'worker'. The worker was asked to try to complete a task of spotting 10 differences between a pair of almost identical pictures. The worker had a maximum of 25 minutes for finding the 10 differences, and was rewarded for being fast.

We created two pairs of pictures. You can see them below. The two pairs are of equal difficulty, although some people might find one pair easier and other people might find the other pair easier.

[pictures]

[page 3, Managers predictions]

The workers were recruited among students at the University of Amsterdam. That part of the study has already been completed.

[treatment no options:]

Each worker saw **one set of pictures.** We randomly selected which one of the two sets of pictures they saw.

Workers were paid a bonus for completing a set of pictures and for solving it fast.

To get the reward, the worker needed to solve the selected set of pictures within 25 minutes.The reward was higher if the worker completed the task faster.

[treatment options:]

Each worker saw **both sets of pictures**, and could freely choose which set of pictures to work on. Workers could go back and forth between the two sets during the 25 minutes.

Workers were paid a bonus for completing a set of pictures and for solving it fast.

To get the reward, the worker needed to solve just one set of pictures within 25 minutes. The reward was higher if the worker completed the task faster.

[all treatments:] You will be matched with a randomly selected worker among the workers we recruited.

[page 4, Managers predictions]

Imagine that the worker generates profits based on how long it took them to complete the task.If they complete the task within 25 minutes, the profits are 500 points. The profits increase by 100 points for every minute that the worker had still left (out of the 25 minutes) upon completing the task.

You can use the slider below to see the profits for all cases.

[slider field, they could move the slider between 0 and 25 minutes and see the corresponding profits]

Profits can be between 0 points (if the worker did not complete the task within 25 minutes) and 2900 points (if the worker completed the task within 1 minute).

Your task is to predict what were the profits of the worker you are matched with.

You will earn a bonus if your prediction is sufficiently accurate. In particular, you will earn a bonus of 1.00 if your prediction is not more than 200 points different from the actual profits generated by your worker.

[Prediction field where they can enter predicted profits]

Appendix E. Questionnaire

What is your age?

What is your gender?

At which faculty are you a student?

What is your nationality?

Have you ever participated in laboratory experiments? [0=No/1=Yes, but only a few times/2=Yes, many times]

How experienced are you at solving similar visual tasks [0=Not experienced/1=Little experience/2=Moderate experience/3=Well experienced or Solve regularly]

How did you choose between the two sets of pictures? What made you switch between them if you did?

Do you have any remarks/comments about this experiment?

During the lectures, how often do you use your phone, talk to your neighbors or engage in other study-unrelated activities? (1=never, 2=at a few lectures during a semester, 3=at around 20–30 percent of the lectures, 4=at more than half of the lectures, 5=multiple times during most lectures)

How often did you not pass for the courses that you took in the past? [1="Never"/2="1-2 in 10 courses"/3="3-4 in 10 courses"/4="5-7 in 10 courses"/5="More than 7 in 10 courses"]

Suppose you paid 30 euros for 5 cello lessons. After the first lesson you realize that you really don't like it. What do you do? You cannot get the money back. [1=Stop going to the lessons/2=Attend 1 more lesson/3=Attend 2 more lessons/4=Attend 3 more lessons/5=Attend all 4 remaining lessons]

Suppose you have to complete a homework assignment for some course. You can choose between four options for this assignment. You expect that each of those assignment options would take you approximately the same time to complete. Which of the four options would you choose? [1="solve 20 very straightforward problems"/2="11 average problems"/3="5 quite tricky problems"/4="One extremely tricky problem"][22]

For research purposes, I allow to use my student number to link the results of this experiment to my study results under the condition that they will not be linked to my name. [Yes/No]

Please enter your Student Id (if you chose "Yes")

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[22] In Mixed Options and Easy Control this question was replaced with the 8-item grit scale taken from Duckworth and Quinn (2009).

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