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Free to Choose: Testing the Pure Motivation Effect of Autonomous Choice

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Abstract

We conduct an experimental test of the long-standing conjecture that autonomy increases motivation and job performance. Subjects face a menu consisting of two projects: one risky and one safe. The probability that the risky project succeeds depends on the subject's effort. In one treatment, subjects *choose* a project from the menu; in the other treatment, they are *assigned* a project from the menu. Using a difference-in-difference approach that controls for selection effects, we show that autonomy (the right to choose a project) has a significant *pure motivation effect* on effort. The effect is consistent with aversion to anticipated regret, but not with standard expected-utility maximization. Futher, as predicted by regret theory, effort on the (chosen) risky project is increasing in the return to the (unchosen) safe project, and the pure motivation effect is greater, the riskier is the risky project. Finally, we find a significant negative relationship between the strength of the pure motivation effect and the subjects' expected earnings.

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1 Introduction

If workers have heterogeneous preferences, then giving them the right to choose which project to work on will generate a good match between workers and projects. This benefit of decentralization, which we will refer to as the *selection effect*, is perfectly consistent with standard economic theory. However, the gains from decentralization may go beyond the selection effect. Psychologists and organization theorists argue that autonomy generates a psychological state of personal responsibility which increases motivation and job performance. A worker will therefore try harder to ensure that a project succeeds if the project was chosen by him, rather than having been assigned to him. This *pure motivation effect* implies that, controlling for project attributes and material incentives, autonomy will have a positive effect on effort. For example, DeCharms (1968) argued that the key to motivation is to perceive oneself as being the cause of one's own actions. The link between autonomy and motivation is also a cornerstone of Deci and Ryan's *self-determination theory*.[1] This link is postulated to be a psychological effect which is not caused by a concern about material incentives (promotion or salary increase) and so goes beyond standard economic theory.[2]

Our experiment is designed to identify the pure motivation effect, while controlling for the selection effect. It has two parts: the Menu part and the Isolation part. In the Menu part, the subject encounters a pre-set menu (i.e., a set of feasible projects), consisting of a safe project and a risky project.

[1]Spector's (1986) meta analysis of empirical studies suggested that a high degree of autonomy is typically associated with high job performance, but this does not imply a causal effect (Renn and Vandenberg, 1995). Ryan and Deci's (2000) well-known experiments did establish a causal effect: subjects who could choose a puzzle to work on (the autonomy condition) were more motivated to solve the puzzle than subjects who were assigned a puzzle. However, as autonomy might lead to a better match between subject and task (the selection effect), they did not identify a pure motivation effect.

[2]Standard economic theory can explain why an agent might work hard to signal that he is competent, in order to obtain a future reward such as a better job or a pay increase. But the pure motivation effect discussed by psychologists and organization theorists is due to an altered psychological state which is independent of any such material incentives.

The subject can increase the chance of success of the risky project by providing costly effort. He is either asked to choose a project from the menu – the "Chosen" treatment – or a project from the menu is randomly assigned to him – the "Assigned" treatment. The Isolation part has only one treatment, where a project is presented in isolation (there is no menu); this generates a benchmark effort level for each risky project. To control for behavioral tendencies associated with selection from a menu, for instance those caused by risk attitudes or miscalibrated beliefs, we estimate difference-in-differences in effort choices. That is, we consider whether effort in the Chosen treatment exceeds the benchmark effort more than effort in the Assigned treatment exceeds the benchmark effort. Potentially confounding variables are differenced out.[3]

In our between-subject design, each subject faces each menu at most once. This avoids the drawbacks of the natural alternative to our approach – a within-subject design – where the subject would encounter the same menu twice: first being allowed to choose a project from the menu, and then being assigned the same project from the same menu. The hypothesis would be that he works harder in the former situation. However, such a design might be both too artificial and too transparent; the subject might be alerted to the purpose of the experiment, and the sense of being manipulated could influence his behavior.

A theoretical foundation for the pure motivation effect is provided by *regret theory* (Bell, 1982; Loomes and Sugden, 1982).[4] If the agent freely chooses the risky project, and the project fails, then he will regret not having chosen the safe project. To avoid this negative feeling, he works extra hard

[3]See Chetty, Looney and Kroft (2009) or Hennig-Schmidt, Sadrieh and Rockenbach (2010) for implementation of similar designs in field and lab settings.

[4]Early experimental support for regret theory was found in lottery choice data (e.g., Loomes *et al.*, 1991; Zeelenberg *et al.*, 1996; Zeelenberg, 1999). For a critique, see Starmer and Sugden (1993) or Humphrey (1995). More recently Bleichrodt et al. (2010), Camille et al. (2006) and Frydman and Camerer (2016) have offered neuroimaging evidence. For economic applications, see, for example, Filiz-Ozbay and Ozbay (2007), Engelbrecht-Wiggans and Katok (2008) or Shefrin and Statman (1984).

to avoid a failure: a pure motivation effect. This effect is expected to be stronger, the bigger is the scope for regret, i.e., the more costly (or more likely) is failure relative to the forgone safe return.

Specifically, regret theory predicts that the pure motivation effect is increasing in the value of the safe option. In our experiment, the safe project yields \$$s$ for sure. The risky project yields \$0 in case of failure and \$$V$ in case of success, where $V > s$. The bigger is s, the more consequential is the choice of the risky project; the bigger is the regret if it fails, and the more effort will be provided to prevent regretting the choice. Regret theory also predicts that the pure motivation effect is stronger when the risky project is a highly risky "\$-bet" with a small probability of success and a large V (as opposed to a low risk/low return "p-bet"). These predictions agree with the intuition that there is more "real" autonomy when the choice menu is diverse (i.e., contains options that differ significantly from each other), so that the choice is experienced as consequential and meaningful.

Overall, our results support these predictions. We find evidence of a pure motivation effect, but only when the choice is between a very risky (but potentially very profitable) project and a high-value safe option. The effect is substantial and highly statistically significant; the strongest pure motivation effect we record (when project choice is most consequential) amounts to about 31% of the chosen effort. Overall, the effort on the risky project depends positively on the *forgone* return, s, and this pattern is stronger in menus where the risky project is highly risky. Thus, our results are quite consistent with the idea that the pure motivation effect is driven by aversion to anticipated regret.

2 Related Literature

Sen (1999) argued that autonomy may have positive intrinsic value, and recent experiments have provided support for this. Fehr, Herz and Wilkening (2013) and Bartling, Fehr and Herz (2014) found that decision rights have an intrinsic value in principal-agent settings. Neri and Rommeswinkel (2016) attribute the value of the decision rights primarily to the individual aversion to being interfered with by others. Fehr, Herz and Wilkening's (2013) experiment is particularly relevant to us. In their set-up, the principal first decides to either keep the decision rights or delegate to the agent, then both make effort decisions. They find that the person with decision rights tend to supply more effort. They do not control for selection effects – principals who delegate may be systematically different from those who do not. Moreover, it is a strategic game where decisions affect the payoffs of both parties. The delegation decision may influence the play of the game in various ways, such as signaling the principal's beliefs or intentions, creating a motive for the agent to reciprocate a "nice" decision by working harder, etc.

Our experiment is designed to first identify a pure motivation effect, and second to test regret theory; there is no strategic interaction, and selection effects are controlled for. It is not designed to identify the intrinsic value of decision rights. Decision rights are exogenously determined; the subjects never choose whether to keep or give away decision rights. In the Chosen treatment the subject has decision-rights, and *must* choose a project – a choice he may later regret. In the Assigned treatment the subject has no decision-rights and *cannot* choose a project, so he cannot regret the project-choice (for further discussion, see the concluding section).

A growing experimental literature documents the relationship between (self-)selection into a role, task or institution, and subsequent performance. For example, Sutter, Haigner and Kocher (2010) found that contributions to a public good were higher when the group unanimously voted for a reward or a punishment institution than when the same institution was imposed on them exogenously. Similarly, in a real-effort experiment, Mellizo, Carpenter and Matthews (2014) found that workers who voted on their compensation scheme provided higher effort than when the scheme was assigned to them. Herbst, Konrad and Morath (2012) found that in a group contest setting, alliances that were created endogenously by the individual members outperformed those that were put together externally. Not all studies point in the same direction: Cooper and Sutter (2015) found that the increased internal conflict between team members eliminates any potential benefit from endogenous team formation. None of these studies attempt to identify a "pure" psychological effect of autonomy on performance, as opposed to a selection effect (e.g., the compensation scheme selected by the workers in a team may be correlated with their individual characteristics).

Dal Bo, Foster and Putterman's (2010) study of collective choice did control for selection. Groups voted on whether to endogenously modify the payoffs of a prisoner's dilemma and turn it into a stag-hunt game. After the vote, there was a probability that the computer would override the group's decision and instead exogenously assign a game to the group. Among subjects who voted to modify the payoffs, a significantly larger proportion (82%) chose the cooperative strategy ("stag") in the endogenously modified game than in the exogenously modified game (58%). This important finding indeed suggests that autonomy may have a beneficial effect on productivity. However, their experiment involved strategic considerations. A vote may signal beliefs or intentions, and this may influence future behavior, especially when there are multiple equilibria. In contrast, we study an individual choice problem, with no strategic interaction between subjects.

A design closer to ours is the independent work by Babcock, Bedard, Charness, Hartman and Royer (2015). They paid students to study at the university library. The subjects received \$2 per visit and a bonus of \$25 if their attendance reached or exceeded a target of 4 visits. In one treatment, each subject acted individually, i.e., they did not affect each others' earnings; in another treatment, each subject decided whether to act individually (the "individual option") or to condition his bonus payment on the target being reached jointly by himself and another subject (the "team option"). The finding was that subjects studied more when they chose to act individually (on average 2.33 library visits per subject) than when they did not have a choice (1.95 visits). This is a pure motivation effect in our sense. However, this interesting finding partly conflicts with our results. They used a single choice menu where the team option was clearly inferior (in terms of monetary payoffs) and was chosen by only 3% of the subjects.[5] In contrast, our results suggest that a significant pure motivation effect requires that the subject experiences his autonomy as consequential and meaningful. In particular, the pure motivation effect is increasing in the value of the forgone option, as predicted by the regret hypothesis. Sorting out these partly conflicting results on the pure motivation effect is an interesting topic for future research.

The rest of the paper is organized as follows. In Sections 3 and 4 we present our experimental design, derive some behavioral predictions and outline our empirical strategy and procedures. Section 5 presents the main results and some auxiliary observations. Section 6 concludes.

3 Experimental Design and Predictions

3.1 Projects

There are two kinds of projects, risky and safe. They generate income, referred to as "prizes." A safe project generates a prize s with certainty. A risky project can either succeed or fail; there is a prize V if it succeeds, and no prize if it fails. By providing costly effort, the subject, in the role of a worker, determines the probability that the risky project succeeds. Effort is denoted e and must belong to the set $\{1, 2, 3, ..., 15\}$. The worker's cost function is linear in effort, $c \times e$. The risky project succeeds with probability $1-(1-p)^e$, where p is a parameter. The expected monetary payoff is therefore

$$(1 - (1 - p)^e)\, V - ce. \tag{1}$$

This production process is explained to the subject in an intuitive way. The subject is told that he can increase the probability of success by trying

[5]If the team option had been more appealing it would presumably have been chosen more often, which would have introduced selection effects. It was only because the team option was clearly inferior that neither selection effects nor strategic issues played any role in their experiment.

the risky project (running a lottery) multiple times (at least once, and at most 15 times), at a flat fee c per try. His effort e is simply the chosen number of tries. Each trial succeeds with probability p; the risky project succeeds if *at least one* of the e tries succeeds. Thus, a risky project can be characterized by a pair (p, V), where p is the probability of success *if the project is tried only once*, and V is the prize in case of success. More tries will increase the probability of success, at a decreasing rate, but, importantly, the subject chooses e before any tries are resolved.[6] With probability $(1-p)^e$, all e tries fail and so the whole project fails. The risky project thus succeeds with probability $1-(1-p)^e$. The expected monetary payoff is given by (1).

This presentation was designed to be easy for the subjects to grasp. From personal experience, they should be familiar with the idea that more tries will increase the probability of success. For example, the more job applications a student sends out, the greater will be the chances of landing a job.

3.2 Isolation Part and Menu Part

We will contrast decentralized and centralized decision making. With decentralization, the agent *chooses* a project from a menu; with centralization, a project is *assigned* to him from the same menu. The pure motivation effect says that (controlling for project attributes) the agent is motivated to work harder in the former case. That is, increased autonomy will cause a subject to supply more effort on the same project. The selection effect instead implies that, under autonomy, different subjects will choose different projects. That is, increased autonomy will lead to a different matching of projects and agents. Our objective is to measure the pure motivation effect while controlling for the selection effect.

Our experiment has two parts, a Menu part and an Isolation part (in that

[6]The key point is that the subject chooses e before finding out if any try has succeeded. Thus, if the subject chooses five tries he must pay the cost of effort $5 \times c$ even if, say, the second try succeeds. This corresponds to sending out five job applications before knowing which, if any, will be successful.

order), separated by a survey. In each trial of the Menu part, the subject sees a menu consisting of two projects, one safe and one risky. One of the two projects will be either chosen by the subject or externally assigned to him by the computer. Effort is relevant only for the risky project; having a safe project on the menu helps the internal validity of the experiment.[7] Our treatment variation involves two experimental conditions for the Menu part. In the *Chosen treatment* the subject first selects a project from the menu. This corresponds to decentralized decision making. If he chooses the risky project, then he goes on to select the number of tries, e. If he chooses the safe project, then he has no further decision to make: the safe project automatically uses a single try and succeeds. In the *Assigned treatment* the subject is first presented with the menu, after which one of the two projects is randomly assigned to him by the computer. This corresponds to centralized decision making. If the assigned project was the risky one, he goes on to select the number of tries, e; if the project was safe, it automatically succeeds on a single try.

In each trial of the Isolation part, a project is presented in isolation: the subject sees only this one project and is asked to choose an effort level. This establishes a benchmark effort level which will depend on the subject's characteristics, such as risk-related preferences and beliefs, as well as properties of the project. Note that in real-world scenarios, regardless of whether the choice is centralized or decentralized, there would typically be a set of feasible projects to choose from (as in the Menu part). A situation where only one project is feasible (the Isolation part) may induce a different psychological state; it is a benchmark, but not a model of centralization.

[7] The implications of the regret hypothesis are most transparent when one of the feasible options is risk-free. The drawback is that we do not obtain any information about effort if the safe project is selected.

3.3 Regret Theory

Our theoretical benchmark is a simple model of risk-neutral and regret-averse individuals. Consider the Chosen treatment. The subject has a choice between two options: a safe return of s versus a risky project (p, V). The expected *monetary* payoff from the risky project is given by expression (1), where e is his chosen effort level. Now consider the possibility of regret. Suppose that if he chooses the risky project, and the risky project fails, the subject experiences a feeling of regret which is proportional to $s + ce$. That is, he regrets expending effort ce on a failed project, having foregone the sure payoff s. This is experienced with probability $(1-p)^e$. Anticipating the negative feeling of regret, the decision maker's expected payoff from the risky project is

$$U(e; p, V, s) = (1 - (1-p)^e)V - ce - r(1-p)^e(s + ce) \tag{2}$$

where $r \geq 0$ is a regret parameter. Setting $r = 0$ yields (1), which corresponds to the no-regret case. The partial derivative of (2) with respect to e is

$$U_e = -c - cr\,(1-p)^e - (V + r\,(s + ce))\,(1-p)^e \ln(1-p)\,. \tag{3}$$

If we neglect integer constraints and assume an interior solution, the optimal effort level is given by $U_e = 0$. The cross-partial derivatives are

$$U_{eV} = -\,(1-p)^e \ln(1-p) > 0$$

and

$$U_{es} = -r\,(1-p)^e \ln(1-p) > 0.$$

These inequalities imply that U has strictly increasing differences in both (e, V) and (e, s). Monotone comparative statics (Milgrom and Shannon, 1994, Edlin and Shannon, 1998) implies that the optimal effort level is strictly increasing in both the prize V of the risky project, and in the payoff s he could have obtained by choosing the safe project.[8] The latter is the key prediction of regret theory, so we state it as a proposition:

[8]The cross-partial U_{ep} cannot be signed without making assumptions on the remaining parameters. Thus, the effect of a change in p on effort is ambiguous.

Proposition 1 *In the Chosen treatment, $de/ds > 0$. That is, effort on the risky project will depend positively on the forgone income from the safe project.*

This proposition has two important corollaries.[9] The first corollary is the existence of a pure motivation effect. To see this, suppose the subject is assigned the risky project in the Assigned treatment. If it fails, he can regret having expended effort on it; but he cannot regret forgoing the safe payoff s, since this was not his choice. Thus, his feeling of regret should be proportional only to ce, not to $s + ce$. From the point of view of regret theory, failing in the Assigned treatment is like failing in a hypothetical (and trivial) Chosen treatment where the forgone option pays $s = 0$. But since in our Chosen treatments, the safe option always has a payoff $s > 0$, and $de/ds > 0$ by the proposition, regret theory predicts a strictly higher effort on the risky project in the Chosen treatment than in the Assigned treatment. The second corollary is that the pure motivation effect is increasing in s. That is, the more profitable is the forgone safe option, the more the subject will regret failing in the risky project (if chosen), and therefore the more effort will be expended.

As argued in the Introduction, for autonomy to play a role, the choice of project has to be meaningful, and for this, the menu needs to be sufficiently diverse. Consider then how the key implication of regret theory, $de/ds > 0$, depends on the diversity of the menu. In the Chosen treatment, the subject can choose a safe return of s or a risky project (p, V). If p is just slightly smaller than 1 and V is just slightly bigger than s, then the risky project is almost equivalent to the safe project: the diversity of the menu is very low. Let us make the menu more diverse by increasing V and reducing p in such a way that pV is held constant, $pV \equiv k$. Using the implicit function theorem,

[9] Notice that standard expected utility theory predicts $de/ds = 0$, since it does not contain any mechanism by which the properties of a forgone project can influence behavior in the chosen project.

we differentiate (3) to obtain the expression[10]

$$\frac{de}{ds} = \frac{-U_{es}}{U_{ee}} = \frac{-r}{2cr + (V + r(s + ce))\ln(1-p)} \tag{4}$$

Substituting $p = k/V$ into (4) we get

$$\frac{de}{ds} = \frac{-r}{2cr + (V + r(s + ce))\ln\left(1 - \frac{k}{V}\right)} \tag{5}$$

which is increasing in V.[11] That is, as the menu becomes more diverse, effort on the risky project becomes more sensitive to the safe payoff, and hence, the pure motivation effect is larger (cf. the first corollary to the proposition). Intuitively, when the menu is very diverse, the project choice is weighty and autonomy matters a lot.

4 Procedures

Each project was presented to the subject as a box containing 20 balls. For a risky project, some of the balls would be red (representing success), others would be blue.[12] The subject chose the number of tries, i.e., the number of random draws (with replacement) from the box. He immediately incurred the cost of effort, which was 5 times the chosen number of tries (i.e., we

[10]This expression is positive by the proposition. To verify it, note that $U_{es} > 0$, and $U_{ee} < 0$ by the necessary second-order condition.

[11]This follows from

$$\begin{aligned}
&\frac{\partial}{\partial V}\left((V + r(s + ce))\ln\left(1 - \frac{k}{V}\right)\right) \\
&= \ln(1-p) + \frac{p}{1-p}\left(1 + \frac{r(s + ce)}{V}\right) \\
&> \frac{p}{1-p}\frac{r(s + ce)}{V} > 0,
\end{aligned}$$

where we used the fact that $\ln(1-p) > -p/(1-p)$.

[12]For a picture of the interface, please see the instructions in the Appendix.

set $c = 5$). On each try, one ball from the box was randomly highlighted.[13] If the ball was red then the project was deemed successful and the subject received the prize written on the face of the ball. If it was blue, then if the subject had more tries available another ball was drawn; if all tries had been exhausted the project was deemed a failure which paid zero. For a safe project, all 20 balls would be be identical and yield the prize s; one ball would be automatically chosen on behalf of the subject.

Both the Menu and the Isolation parts involved a sequence of twelve projects. In each round the subject started with an endowment of $75 = 5 \times 15$ which eliminated the need for a bankruptcy rule.

To simplify the presentation, from now on we will write a risky project in the form $r = (\rho, V)$, where $\rho = 20 \times p$ is the number of red (success) balls in the box. Thus, for example, the project $(5, 100)$ corresponds to a box with 5 red balls, i.e., the project succeeds with probability $p = 5/20 = 0.25$ on a single trial, and it pays $V = 100$ in case of success.

The experiment included four risky projects: $(7, 90)$, $(5, 100)$, $(3, 130)$ and $(2, 160)$. The probability and prize parameters were chosen to make the projects comparable in terms of expected payoff, keeping the salience of incentives similar across projects and menus. Using the terminology of Grether and Plott (1979), it is helpful to refer to $(7, 90)$ and $(5, 100)$ as the p-bets and to $(3, 130)$ and $(2, 160)$ as the \$-bets. The p-bets had higher success probabilities (more red balls) but lower prizes. However, it is important to notice that even the p-bets would be likely to fail with too few draws. The optimal number of tries for a standard CRRA utility function with a $r = 0.8$ would be somewhere between 5 and 10 for all four projects.

In the Menu part, each of the four risky projects was paired with one of three different safe projects that increased in value (in terms of s) as shown in the top panel of Table (1). Specifically, for each of the four risky projects,

[13]The random draw was simulated with a simple computer animation in which the balls in the box started flashing one by one in sequence form the top to the bottom in 1/3 of a second intervals. At some randomly determined termination time the flashing stopped and the last highlighted ball became the outcome of the draw.

the highest value of s gave about the same expected utility for the safe and risky projects (i.e., rounded to the nearest nice integer) when evaluated using CRRA with $r = 0.3$, which is about the midpoint of Holt and Laury's (2000) "slightly risk averse" category (see Table 3 in Holt and Laury, 2000).[14] Similarly, the middle value of s was set to equalize the expected utilities for $r = 0.8$ (about the midpoint of the "very risk averse" category) and the lowest value equalized the expected utilities for $r = 2$ (well inside the "stay in bed" category).

Table 1: Projects and menus

Menu part: $(20 \times p, V; s)$

Mn.	1	2	3	4	5	6
	(2,160; 50)	(2,160; 30)	(2,160; 0)	(3,130; 55)	(3,130; 45)	(3,130; 15)
Mn.	**7**	**8**	**9**	**10**	**11**	**12**
	(5,100; 55)	(5,100; 50)	(5,100; 40)	(7,90; 60)	(7,90; 55)	(7,90; 45)

Isolation part: $(20 \times p, V)$

Prj.	1	2	3	4	5	6
	(2,160)	(3,130)	(4,120)	(4,110)	(5,100)	(6,100)
Prj.	**7**	**8**	**9**	**10**	**11**	**12**
	(6,95)	(7,90)	(8,90)	(9,85)	(9,80)	(10,80)

The four risky projects that were used in the Menu part were also included

[14]For the risky project the EU was

$$(1-(1-p)^{e^*})\frac{(75+V-5e^*)^{1-r}}{1-r}+(1-p)^{e^*}\frac{(75-5e^*)^{1-r}}{1-r},$$

where e^* is the optimal effort choice; for the safe project the EU was

$$\frac{(75+s-5)^{1-r}}{1-r}.$$

in the Isolation part. To make the two parts consistent in terms of the number of experimental tasks, we included eight additional projects that differed in values of the parameters p and V, i.e., as shown in the bottom panel of Table (1). These projects incidentally give us exogenous variation on parameters p and V that can be used to check whether subjects properly responded to incentives. The ordering of menus (in the Menu part) and projects (in the Isolation part) was randomized.

The Menu part, which was key to identifying the autonomy effect, came before the Isolation part. To reduce the risk that experience with projects from the Menu part might contaminate the behavior in the Isolation part, we inserted a survey between the two choice-relevant parts. The survey took approximately 15 minutes to complete. The survey questions were short, easy to answer, and were unrelated to the objective of the experiment.

Whenever a project (or a menu of projects) was displayed on the computer screen, to enhance the subject's attention and awareness he was asked to enter the following information (for each project): the number of red balls in the box, the prize if the project succeeded (which was written on each red ball), and the cost of a single try (which was always 5). If this was entered correctly, the information was displayed below the project for quick reference. Only after that was the subject prompted to choose effort. To reduce a possible outcome dependence between individual rounds, the evaluation of projects was postponed until the very end.

Before the experiment started, we made sure the subjects fully understood the task. They were first given a few minutes to study the instructions on their own. Then, the experimenter read the instructions aloud for everyone to hear. This was followed by a review, organized as a series of questions regarding the choices, incentives, and the structure of the experiment. Each question was first read aloud, and after a short pause (a few seconds) the correct answer was provided. The subjects then turned to their computer terminals and answered four comprehension questions on the computer screen. Everyone was required to answer the questions correctly before moving on.

Subsequently, subjects entered a practice stage in which they became familiar with the computer interface and experienced the whole process of effort choice and project evaluation in six practice rounds with two different projects. The project was $(10, 50)$ in the first three practice rounds and $(1, 200)$ in the next three rounds; in effect, these were boundary cases for all the projects in the actual experiment. In each practice round, the subject chose the number of tries and then watched the project being evaluated in real time. Practice rounds were not paid.

After all parts of the experiment were completed, subjects filled out a short questionnaire. Then, two rounds were randomly selected and evaluated for payment. All subjects saw their projects evaluated on their computer screens. The experiment lasted about 75 minutes. The average earning was 21 dollars and 20 cents.

5 Results

Before presenting our main results, we consider a few diagnostic checks on data from the Isolation part. Recall that this part did not involve any treatment variation.

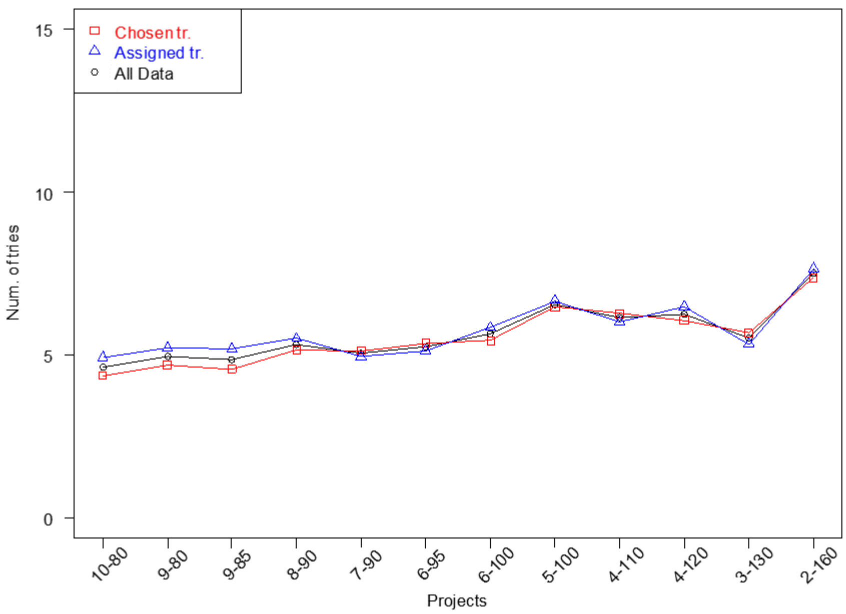
5.1 Isolation Part: Diagnostic Checks

Figure (1) shows the mean effort choices for the twelve risky projects in the Isolation part. The projects are ordered in the order of increasing prize (and decreasing chance of success on a single try).

Let us first consider the data pooled across treatments (i.e., the line segments connected by circles in the Figure 1 above). A preliminary observation is that subjects respond differently to different projects. A Kruskal-Wallis test run on the twelve samples (one for each project) with pooled observations across treatments[15] is highly significant (the p-value $= 0.000$). To

[15] The Kruskal-Wallis test treats samples as being independent.

Figure 1: Isolation part: average effort



check if subjects properly respond to incentives, we run a linear regression of project effort on several variables, including the project parameters (the prize, the chance of winning on a single try and their interaction term) and the (Chosen) treatment dummy. The table below only shows the results for the three project relevant regressors.[16]

As predicted by theory, the coefficient on Prize is positive and significant. Theory makes no prediction for the coefficients on Probability or Prize×Probability and, as it turns out, neither is significantly different from

[16]One of the regressions also included demographic variables. The full output including all additional variables can be found in the Appendix, see Figure (9) regressions (1) & (2).

Table 2: OLS: effort on project-relevant variables

	Coeff.	St. err.	p-value
Prize	0.015^{**}	0.007	0.032
Probability	-0.531	3.21	0.869
Prize×Probability	-0.039	0.045	0.381

Note: The dependent variable is e_I – effort in the Isolation part; the regression is based on 1608 observations; errors were clustered by subject; standard errors are in the parenthesis. ***,** ,* indicate significance at 1%-, 5%-, 10% -level.

zero.[17]

The next question of interest is whether there is any difference in effort choices between the two treatments. This is important as we will be interpreting our main results under the assumption that choices in the Isolation part were unaffected by the treatment variation in the Menu part.[18] Figure 1 shows the averages broken down by treatments (i.e., the line segments connected by squares and triangles). Visually, there seems to be no difference. This is also confirmed by the regression estimate of the treatment coefficient in Table (9) in the Appendix. The coefficient is close to zero (-0.145) and not significant (p-value $= 0.75$).

5.2 The Total Autonomy Effect

The Menu part was subject to the treatment variation (Chosen vs. Assigned). We focus in this subsection on the total effect of autonomy on effort. In the next subsection, we identify the components of the total effect: the pure motivation effect and the selection effect.

Figure (2) presents a visual summary of mean effort levels for subjects who either selected (in the Chosen treatment) or were selected into (in the Assigned treatment) a risky project. On the left-hand side of the Figure we

[17] In all of our regressions we get the same results on project relevant variables.

[18] This is equivalent in spirit to the "common time trend" assumption that is needed for the difference-in-differences to yield unbiased estimates.

plot mean effort for the Isolation part;[19] on the right-hand side we plot the mean effort for the Menu part, where the data is pooled across all menus involving the same risky project.[20]

Figure 2: Average effort for selected subjects in the Menu part

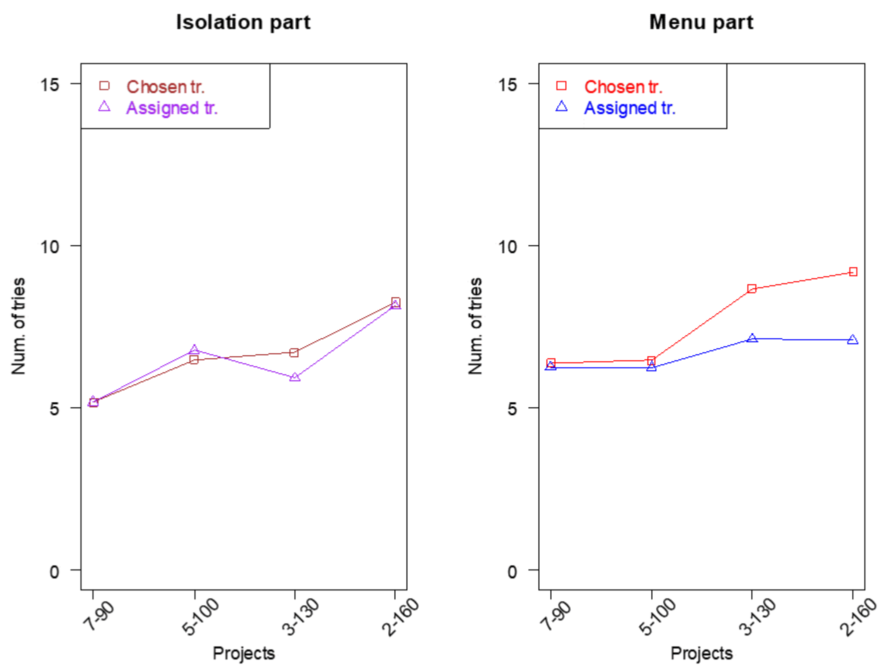


Figure (2) hints at a significant total autonomy effect for the \$-bets (3,130) or (2,160). There was no notable effect for the p-bets. Recall that, in

[19]These are weighted averages that account for how many times the subject chose the same risky project in the Menu part. For example, subject's Isolation part effort for project (2,160) e_I would be weighted by 1 if the same subject chose the project (2,160) in all three menus where this project was included. If the project was chosen only twice, then e_I would be weighted by 2/3; and 1/3 and 0 if (2,160) was chosen only once or never respectively.

[20]A detailed summary of average efforts broken down by individual menus can be found in Table (8) in the Appendix.

fact, regret theory predicts a smaller autonomy effect for less diverse menus. A menu consisting of a safe project and a p-bet is less diverse than a menu consisting of a safe project and a \$-bet.

Figure 3: Average effort: (Menu pt.)

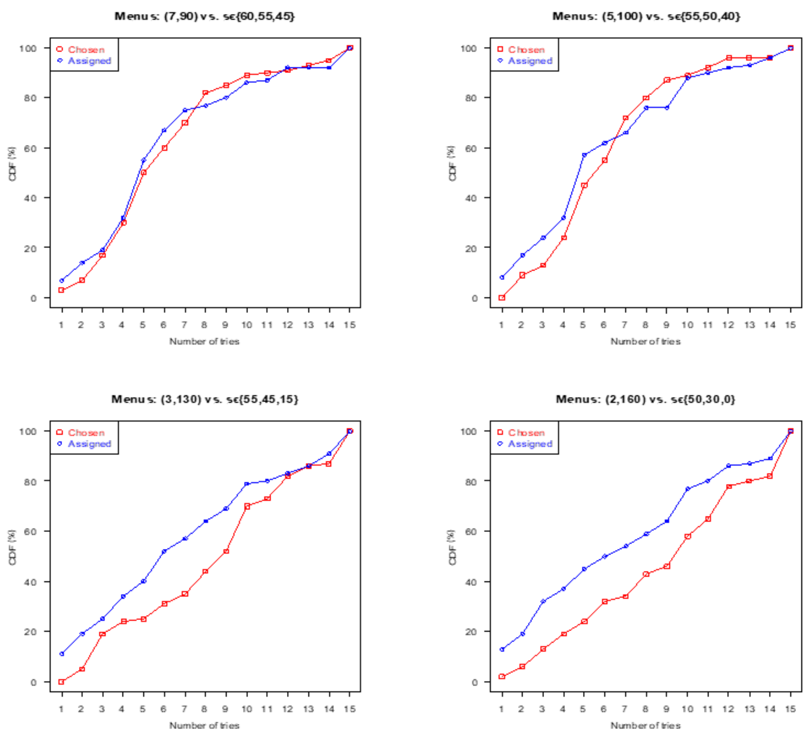


Figure (3) plots the distribution of effort in the four risky projects. In the top two panels, corresponding to the p-bets, the distributions are very close together and crossing. An Epps-Singleton (ES) test indicates[21] no difference between the distributions (the p-values are 0.7 and 0.13 respectively). In

[21] The ES test is more powerful than other nonprametric alternatives (e.g., Kolmogorov-Smirnov test). More importantly, unlike other tests, it is designed to handle discrete data of the kind we have here.

contrast, the lower two panels, corresponding to the \$-bets, suggest first order stochastic dominance (FSD): the distributions for the Assigned treatment (circles) lie above those for the Chosen treatment (squares). The ES test is significant here: p-value $= 0.015$ for menus involving the project $(3, 130)$ and p-value $= 0.006$ for menus involving $(2, 160)$.

Table (3) shows differences in average efforts for all twelve menus. The first two rows confirm that there are no qualitatively significant autonomy effects for the p-bets. The bottom two rows suggest that, as predicted by regret theory, the driving force behind the autonomy effect on \$-bets is the (counter-factual) safe return s. As s grows, the autonomy effect becomes more pronounced.[22] To test whether the treatment differences are significantly different form zero we run OLS regressions of effort on menu/treatment dummies. In each regression we rotate dummies so that each time the base corresponds to the Assigned treatment for the menu being tested. The treatment effect is the coefficient on the dummy for the Chosen treatment. The standard errors are clustered by subject. The test outcomes are indicated by asterisks on the values in the table.

Table 3: Total autonomy effect ($\bar{e}_{r,M,Ch} - \bar{e}_{r,M,A}$)

$p, V \setminus s$	0	15	30	40	45	50	55	60
7, 90					-0.06 (.85)		0.11 (.9)	0.08 (.63)
5, 100				0.51 (.88)		-0.36 (.02)	0.5 (.87)	
3, 130		1.38 (1.05)			1.7* (1.03)		1.6 (1.06)	
2, 160	1.13 (.96)		2.77** (1.08)			3.0 *** (1.07)		

In summary, there are no significant autonomy effects for the p-bet projects $(7, 90)$ and $(5, 100)$. For the \$-bet projects $(3, 130)$ and $(2, 160)$, there are

[22] A Wilcoxon pairwise test applied to average efforts across menus rejects the equality of medians between the two treatments (p-value $= 0.004$).

significant effects, but only when paired with highly profitable safe options. Even for the riskiest \$-bet $(2, 160)$, there is a significant autonomy effect only when $s = 30$ or $s = 50$.

Result 1: (Total autonomy effect)

(i) Overall, autonomy of choice generates a positive effect on effort.

(ii) The autonomy effect is qualitatively and statistically significant only when the menu pairs a high-risk high-return project (a \$-bet) with a very profitable (high s) safe project.

5.3 Identifying the Pure Motivation Effect

Result 1 suggests that choosing a project can have a significant impact on the subsequent performance, at least when the choice is highly conseqeuential (\$-bet vs. high-s safe option). However, is effort higher in the Chosen treatment because subjects self-select into tasks that they prefer (a selection effect); or is it a purely psychological phenomenon (a pure motivation effect)?[23]

We isolate the pure motivation effect by first differencing efforts between the two parts of the experiment and then differencing between the treatments. Let $P \in \{M, I\}$ denote the part, where M is the Menu part and I the Isolation part. Let $T \in \{Ch, A\}$ denote the treatment, where Ch is the Chosen treatment and A the Assigned treatment. A menu consisting of a risky project r and a safe option with return s will be written (r, s).

Let $e(i, r, I, T)$ be subject i's choice of effort in project r in the Isolation part of treatment $T \in \{A, Ch\}$. Let $\bar{e}(r, I, T)$ denote the average of

[23]For example, highly risk averse subjects may be less likely to choose the risky project (e.g., Holt and Laury, 2002), but if assigned a risky project they may choose a high effort level to insure against failure. Self-selection into the risky project may be also influenced by heterogeneous beliefs, or psychological biases, such as overconfidence (e.g., Benoît and Dubra, 2011; Burks *et al.*, 2013; Ben David *et al.* 2007), concern for personal image (Bénabou and Tirole, 2002, 2006), updating of (optimistic) subjective priors (van den Steen, 2004), anticipatory utility from positive expectations (Brunnermeier and Parker, 2005), or the illusion of control (Langer, 1975).

$e(i, r, I, T)$, taken over all subjects in our treatments.[24] Let $R((r, s), M, T)$ be the set of subjects such that, when facing menu (r, s) in the Menu part of treatment T, they either chose (for $T = Ch$) or were assigned (for $T = A$) project r. Let $N((r, s), M, T)$ be the number of subjects in $R((r, s), M, T)$. For $i \in R((r, s), M, T)$, let $e(i, (r, s), M, T)$ be subject i's effort in project r when r was chosen or assigned from menu (r, s) in the Menu part of treatment T. Let $\bar{e}((r, s), M, T)$ denote the average effort among those subjects who faced this particular risky project in the Menu part of treatment T. That is,

$$\bar{e}((r, s), M, T) = \frac{1}{N((r, s), M, T)} \sum_{i \in R((r,s),M,T)} e(i, (r, s), M, T)$$

First-differencing between the two parts M and I within treatment T yields $\Delta((r, s), T) = \bar{e}((r, s), M, T) - \bar{e}(r, I, T)$. Thus, $\Delta((r, s), A)$ estimates the increase in effort when a project is *assigned* from a menu, compared to the benchmark with no menu. Similarly, $\Delta((r, s), Ch)$ estimates the increase in effort when a project is *chosen* from a menu, compared to the benchmark.

Our estimate of the pure motivation effect for menu (r, s) is $\Delta(r, s) = \Delta((r, s), Ch) - \Delta((r, s), A)$. Note that this can be written as

$$\Delta(r, s) = \bar{e}((r, s), M, Ch) - \bar{e}((r, s), M, A) - (\bar{e}(r, I, Ch) - \bar{e}(r, I, A))$$

where the first term on the right-hand side is the total autonomy effect and the second term the selection effect. By differencing in this way, the selection effects are filtered out.

In Figure (4) we plot distributions of $\Delta((r, s), T)$ for each of the four types of menus corresponding to one of the risky projects. The pure motivation effect should appear in the data as the first order stochastic dominance relationship between the two distributions. There is a clear FSD relationship in the bottom-right panel corresponding to the project $(2, 160)$. The ES test convincingly rejects the equality of distributions on 1% level (p-value

[24] Note that every subject faced all risky projects in the Isolation part of each treatment.

= 0.000). The bottom-left panel (corresponding to the project $(3, 130)$) also shows some hint of FSD relationship, but there the ES test does not come out significant (p-value = 0.14). The two menus that involve p-bets (in the top two panels) show no sign of FSD relationship.[25] This is consistent with the findings of the previous section regarding the total autonomy effect.

Table (4) gives a more detailed look at the pure effect by listing the average values of Δ's for each of the twelve menus. As in the previous section, the values are increasing as we move from the less diverse to the more diverse menus, i.e., in the down-right direction.[26] To test whether Δ's are different from zero we run OLS regressions analogous to those in the previous section, except with Δ as the dependent variable. The only significant treatment effect is on the menus involving the riskiest \$-bet $(2, 160)$ and the two most profitable safe projects with $s = 30$ and $s = 50$. Comparing the values in these two cells of tables (4) and (3), we note that in both cases the pure motivation effect accounts for a large portion of the total autonomy effect (85% and 84%). The remaining portion is attributed to the selection effect.

Table 4: Pure effect: $(\Delta_{Ch} - \Delta_A)$

$p, V \setminus s$	0	15	30	40	45	50	55	60
7, 90					0.06 (.71)		0.08 (.89)	0.08 (.52)
5, 100				−0.31 (.85)		0.84 (1.2)	1.02 (.76)	
3, 130		0.15 (.95)			0.98 (.82)		1.08 (.91)	
2, 160	1.44 (.97)		2.32** (1.11)			2.53** (1.07)		

[25]For the top-left panel the ES p-value = 0.13 and for the top-right panel it is 0.002. In the latter case the significant p-value reflects differences in higher moments, such as, dispersion. The ES test is sensitive to any variation in the shapes of the distributions. The alternative hypothesis is that one distribution stochastically dominates the other. We do not have any ex-ante predictions for higher order stochastic differences between distributions.

[26]Wilcoxon pairwise test applied to average deltas across menus rejects the equality of medians between the two treatments (p-value = 0.004).

Table 5: Selection effect ($\bar{e}_{r,I,Ch} - \bar{e}_{r,I,A}$)

$\frac{p,}{V} \setminus s$	0	15	30	40	45	50	55	60
7.90					-0.12 (.56)		0.03 (.49)	0.0 (.6)
5, 100				0.82 (.91)		-1.2 (1.25)	-0.52 (.9)	
3, 130		1.23 (.92)			0.72 (1.05)		0.52 (1.14)	
2, 160	-0.32 (1.04)		0.45 (1.22)			0.47 (1.18)		

Note: individual efforts are weighted by how many times the subject chose or was assigned to a risky project.

The selection effect for each menu is summarized in Table (5). When the riskiest $-bet is paired with the two most profitable safe projects (the two rightmost entries in the bottom row), there is about 15-16% of extra effort in the Chosen treatment that can be attributed to subject selection based on idiosyncratic tastes or beliefs. Thus, the selection effect turns out not to play a major role in our experiment. This is consistent with findings of Dal Bo, Foster and Putterman (2010) who also find a rather low selection rate in their data (less than 10%).[27]

Result 2: (The pure motivation effect)

(i) Overall, autonomy of choice has a pure motivation effect on effort.

(ii) The pure motivation effect is qualitatively and statistically significant only when the menu pairs a high-risk high-return project with a very profitable safe project.

(iii) The pure motivation effect can be substantial, increasing effort by as much as 31%.

(iv) The pure motivation effect accounts for about 85% of the total autonomy effect.

[27] In our case, the selection effect is not significantly different from zero for any of the twelve menus.

Recall that regret theory makes a striking prediction: the pure motivation effect should depend positively on s, the forgone income from the safe project. A glance at Table (4) reveals that the various Δ's indeed increase as we move along the last two rows in left-to-right direction. In order to test the null hypothesis that effort on the risky project is independent of s (as predicted by standard expected utility maximization), we perform a permutation resampling test on the menus involving project $(2, 160)$ (which is where we found a significant pure motivation effect).

Let $\Delta(i,(r,s),T) = e(i,(r,s),M,T) - e(i,r,I,T)$. For a given risky project r and treatment T, let $\Sigma(r,T)$ be collection of all $\Delta(i,(r,s),T)$, as (i,s) ranges over all subjects and safe projects in the experiment. That is,

$$\Sigma(r,T) = \cup_s \cup_i \Delta(i,(r,s),T).$$

Under H_0, the Δ's in $\Sigma_{(r,s),T}$ are drawn from the same distribution which is independent of s. We permute the (i,s) indexes in $\Sigma(r,T)$ 100,000 times, each time calculating Δ for each of the three bins corresponding to low, medium, and high value of s. Next, we record the proportion of cases for which the differences in Δ's between the low and medium bin and between the medium and high bin are greater than the differences we observe in the data.[28] We find that under H_0 the likelihood of obtaining increasing differences that are more extreme than what we see in the data is less than 1% – i.e., the p-value = 0.003.[29]

Result 3: (Shadow of the foregone option)

When the pure effect is observed, it is increasing in the value of the forgone safe alternative s.

[28]The actual differences between the high and medium bin and the medium and low bin are: $2.53 - 2.32 = 0.21$ and $2.32 - 1.44 = 0.88$.

[29]If we run the same test for the total effect reported in Table (3), we obtain p-value = 0.002.

5.4 Additional Observations

In this section we comment on a few additional interesting patterns in the data.

Expected Profits

Regret aversion distorts the incentive to maximize material payoffs. Subjects are therefore expected to record lower earnings in the Chosen treatment than in the Assigned treatment. Moreover, this difference should be proportional to the size of the measured pure motivation effect. To examine this, we calculated the expected earnings in the Menu part, given the effort chosen in the risky project. That is, for project (p, V) we calculated

$$(1 - p/20)^e V - 5e.$$

The results are shown in Table (6). In each cell, the top two numbers refer to expected earnings for the Chosen and the Assigned treatments; the bottom number is their difference.

We see a familiar pattern. There are no obvious treatment differences in the top two rows (corresponding to the p-bets). The differences become increasingly negative and larger in magnitude as we move along the table in the down-right direction.[30] Statistically significant differences occur, as expected, when project $(2, 160)$ is matched with the two most profitable safe options, s =30 and s =50.

Demographic data

In the post-experiment questionnaire we collected information on demographic variables, including age, gender, major, number of semesters completed and number of months of work experience. Because the experiment was designed to be between rather than within subjects, we did not estimate

[30] Earnings in the two treatments do not come from the same distribution. This is confirmed by the Wilcoxon matched pairs test (the p-value = 0.000).

Table 6: Average expected profitst in the Menu pt.

$^{p,}_{V} \setminus s$	0	15	30	40	45	50	55	60
$7, 90$					57.3 53.5 3.8		51.9 53.8 −1.9	60.7 58.7 2
$5, 100$				67.4 66.9 0.5		67.8 65.5 2.3	65.7 66.1 −0.4	
$3, 130$		86.4 90.1 −3.7			87.9 93.9 −6		84.6 91.8 −7.2	
$2, 160$	118.5 122.7 −4.2		112 123.6 −11.6**			107.8 120.9 −13.1***		

Note: each entry is a triple where the top number refers to the expected profit in the Chosen tr. (top), Assigned tr. (middle) and their difference (bottom).

the pure motivation effect on an individual level. But we can get some idea about the role of demographic variables by estimating the overall average treatment effect[31] with the difference-in-differences regressions, see regressions (3) and (4) in the Table (9) in the Appendix. In each case, the effort is regressed on the treatment (Chosen) and menu (Menu part) dummies and their interaction term, i.e.,

$$e = \beta_0 + \beta_{Ch} \times \text{Chosen} + \beta_M \times \text{Menu} + \beta_{M,Ch} \times \text{Menu} \times \text{Chosen} + \varepsilon.$$

Regression (3) corresponds exactly to this specification. Regression (4) also includes demographic variables.[32] The overall average treatment effect is the coefficient on the interaction term, $\beta_{M,Ch}$. The coefficient is positive and significant in both regressions. This is in line with our previous results. None of the demographic variables in regression (4) is significant.

[31] Not conditioning on individual menus.

[32] Age was excluded due to the fact that it had a rather low variation in our sample and a high correlation with the number of semesters completed ($\rho = 0.67$). Including it in the regressions, however, did not change results.

To examine the role of gender, we run a triple difference estimation (see e.g., Gruber, 1994; Chetty, Looney and Kroft, 2009)

$$\begin{aligned}
e = {} & \beta_0 + \beta_{Ch} \times \text{Chosen} + \beta_M \times \text{Menu} + \beta_F \times \text{Female} + \\
& \beta_{M,Ch} \times \text{Menu*Chosen} + \beta_{F,Ch} \times \text{Female*Chosen} + \\
& \beta_{F,M} \times \text{Female*Menu} + \beta_{F,M,Ch} \times \text{Female*Menu*Chosen} + \varepsilon.
\end{aligned}$$

The relevant coefficient is the one on the triple interaction term, $\beta_{F,M,Ch}$. Table (10) in the Appendix presents the results. It can be seen from the table that gender does not significantly contribute to the treatment effect. Other demographic variables (such as major, number of semesters completed, or work experience) that were added as additional regressors are also not significant.

Project choices

In Table (8) in the Appendix, the third row of the top panel gives percentages of subjects who chose the risky project in the Menu part. As expected, there is a decreasing trend for each risky project as the safe alternative increases in value. A surprising observation is that in the Chosen treatment, 23 subjects (33.3% of the total) chose the dominated $s = 0$ option over the risky project $(2, 160)$.[33] Perhaps they were near indifferent, perceiving the probability of success on a single try as negligible, and in the safe project they did not have to go through the trouble of choosing e. Or perhaps they failed to realize that the safe project was dominated. In any case, they would definitely be expected to choose the safe project also in the remaining two menus that paired $(2, 160)$ with a better safe option $s > 0$. Among the 23 subjects, 4 (or 17%) chose $(2, 160)$ over the $s = 30$ safe option, and 6 (or 26%) choise it over the $s = 50$ safe option. One subject chose $(2, 160)$ in both cases, so there where 9 $(= 4+6-1)$ subjects who did not behave as expected.

[33] For the safe option, a single try ($e = 1$) was automatically imposed, which cost 5. Choosing $e = 1$ in $(2, 160)$ also cost 5, but then there is a possibility of winning 160. Therefore, choosing $(2, 160)$ and then $e = 1$ dominates the $s = 0$ option.

Perhaps this was due to confusion, although in the post-experiment questionnaire we did not find any evidence of this. As a precautionary measure, we excluded the 9 subjects from the analysis and reran all of our analysis with the restricted data set. All results remain qualitatively unchanged.

6 Concluding Discussion

Psychologists and organization theorists have argued that autonomy leads to higher job performance. In real social situations, this effect could be due to many factors, such as a signalling motive. If an individual is considered responsible for a task, other individuals will tend to credit him if the task succeeds (and blame him if it fails). This will stimulate him to work harder to ensure success, in order to signal his ability and value to the organization. Moreover, there is the selection effect: a college student may study harder if he can freely choose his major than if his parents choose it for him, because he himself will choose a major he likes better. Rather than trying to evaluate the importance of these many complex factors, our experiment establishes a benchmark in the simplest possible environment – a one-person decision problem – with the full experimental control and with meaningful economic trade-offs. In our experiment there is no interaction across subjects, so the treatment effect may be considered a "lower bound" for what the effect of autonomy on effort would be in actual social situations.

We find evidence of a "pure motivation effect": holding worker and project characteristics constant, the worker will tend to supply more effort if the project was chosen by him rather than assigned to him. This effect is consistent with regret aversion. The very concept of "regret" is closely linked to counterfactual reasoning and the feeling of personal responsibility (Mellers *et al.*, 1999) – people experience regret when they think the outcome would have been better had they chosen differently. Personal responsibility matters: choosing a task is different from being assigned a task, because the act of choosing can cause regret. If a college student's parents chose his major then he will work less hard, *in the same classes*, than if he had chosen his major himself, because his parents share responsibility for the outcome.

Furthermore, we find evidence in favor of a basic comparative statics prediction: the pure motivation effect is greater, the greater is the scope for regret. The pure motivation effect is significant only when the menu pairs a high-risk high-return project with a very profitable safe project. In this situation, the project choice is highly consequential, the scope for regretting the choice is large, and so the pure motivation effect is strong. It is noticeable that regret theory predicts that effort in the *chosen* project depends on the characteristics of the *forgone* project. The student who gave up a lucrative career for higher education will work harder than someone who had no such good outside option. This effect is present in our data (the pure motivation effect is increasing in s).

We have studied the effect of autonomy on motivation, not the intrinsic value of autonomy. In general, since regret is a *negative* feeling, regret theory would assign a negative intrinsic value to autonomy. Of course, autonomy also has an instrumental value (the selection effect): with the right to decide which project to work on, the subject can guarantee that it is the project he prefers. "Negative intrinsic value" means that if *the same* project is assigned to him, he is better off, because the responsibility for a failure would not rest on his shoulders.[34] Of course, there may also be psyhological reasons why someone may value "being his own boss", as suggested by Sen (1999). To be more precise, the payoff under autonomy may be $m+b-r$, where m is material payoff, $b > 0$ is Sen's (1999) intrinsic value of autonomy, and $r > 0$ is the cost of regret. The "net psychological gain" from decentralization would then be $b - r$. The regret factor becomes more important, the more uncertain is the

[34] We are assuming decision rights are exogenously allocated. Fehr, Herz and Wilkening (2013) argue that, if giving up decision rights is an *option* for the principal, then regret theory may explain why decision rights seem intrinsically valuable: the principal fears that he may regret the decision to give up decision rights, if the final outcome is undesirable. Regret theory would still, however, impute a negative intrinsic value to autonomy in the sense of "the right to decide who has the decision rights"; without this kind of autonomy, the principal could enjoy the benefits of decentralization with any fear of regret.

outcome. (If the outcomes are not stochastic, r vanishes.) Our experiment was not designed to measure b, so a comparison of the psychological costs and benefits of decentralization are left to future work.

Regret theory does suggest that in highly uncertain environments decentralization may cause a loss in employee welfare, which must be traded off against the productivity gains (the pure motivation effect) and the improved resource allocation (the selection effect). But it is not clear how to address this issue experimentally. In our experiment, subjects were on average financially better off (i.e., the material benefit m was higher) in the Assigned treatment than in the Chosen treatment. In addition, there is potentially a cost of regret $r > 0$ in the latter case. So we may suspect that our subjects liked the Assigned treatment better (unless Sen's b term was very high). Yet, suppose we try to verify this experimentally by giving subjects the right to choose which treatment to participate in. A subject might then fear that he will regret choosing the Assigned treatment (as suggested by Fehr, Herz and Wilkening, 2013), and therefore choose the Chosen treatment, but still secretly wish he had been assigned to the Assigned treatment. Giving him the right to choose a treatment gave him *de facto* autonomy, and we would still not know whether he likes this autonomy or not. Perhaps neuroeconomics could uncover true preferences (i.e., estimate b and r) without asking subjects to make choices (imposing autonomy).

Finally, we may discuss other possible explanations for why effort might depend on the "pure act of choice". The first possibility is overconfidence (Owens, Grossman and Fackler, 2014) or the "illusion of control" (Langer, 1975): for whatever reason, subjects think they are more likely to make the right choice than other people would be. This would allow the "pure act of choosing" to influence effort, but the direction could be positive or negative. If a subject thinks that the very fact that he chose a project makes it very likely to succeed, then he may put very little effort into it – the essence of overconfidence. Moreover, the overconfidence / illusion of control hypothesis could not tell us why or how effort would depend on the characteristics of a forgone project. In contrast, regret theory makes quite definite predictions on these matters, and these are largely supported by our data.

A second possible explanation is reference dependence theory (Koszegy and Rabin, 2006). This theory allows the possibility of multiple "personal equilibria", where the agent's effort choice is consistent with his beliefs. Perhaps in the Chosen treatment a high-effort personal equilibrium is selected, while in the Assigned treatment a low-effort equilibrium is selected. However, this selection principle seems ad hoc. Even if one could justify it, it could not rationalize other patterns in the data, such as the pure motivation effect increasing in the value of the safe option.

A third possible explanation is self-signalling theory (Bodner and Prelec, 2003, and Bénabou and Tirole, 2006). This theory posits a doer-self who takes actions, and an observer-self who learns about the doer. But it is not clear what the observer would want to learn in our experimental set-up: the doer's risk aversion, or perhaps his ability to make "good choices" and become successful? Since the appropriate formulation is not clear, we do not pursue this theory further. But if, for some reason, the observer rewards choices in proportion to the difference between the actual and the forgone payoff, the doer might behave as if he were regret averse.

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7 Appendix: additional tables

Table 7: Average effort in Isolation pt.

p, V	10, 80	9, 80	9, 85	8, 90	7, 90	6, 95	6, 100	5, 100	4, 110	4, 120	3, 130	2, 160
All	4.64	4.96	4.87	5.33	5.04	5.25	5.64	6.57	6.15	6.27	5.51	7.51
Ch	4.38	4.7	4.57	5.16	5.13	5.36	5.45	6.48	6.28	6.05	5.68	7.38
A	4.92	5.23	5.2	5.51	4.95	5.12	5.85	6.66	6.02	6.49	5.34	7.65
Df	-.54	-.53	-.63	-.35	.18	.24	-.4	-.18	.26	-.43	.34	-.27

Note: All – all data; Ch – Chosen treatment; A – Assigned treatment; Df – difference between Chosen and Assigned tr.

Table 8: Average effort for selected subjects in the Menu part

Chosen treatment

p, V; s	7, 90; 45	7, 90; 55	7, 90; 60	5, 100; 40	5, 100; 50	5, 100; 55	3, 130; 15	3, 130; 45	3, 130; 55	2, 160; 0	2, 160; 30	2, 160; 50
M	6.24	6.97	5.63	6.41	6.24	6.72	8.67	8.38	9.05	8.15	9.58	10.43
I^{sl}	5.11	5.31	5.0	6.5	6.48	6.45	6.6	6.92	6.68	7.91	8.58	8.5
$\%^{sl}$	54	57	35	46	30	32	70	35	28	67	35	43

Assigned treatment

p, V; s	7, 90; 45	7, 90; 55	7, 90; 60	5, 100; 40	5, 100; 50	5, 100; 55	3, 130; 15	3, 130; 45	3, 130; 55	2, 160; 0	2, 160; 30	2, 160; 50
M	6.31	6.86	5.63	5.89	6.6	6.23	7.29	6.68	7.45	7.03	6.81	7.43
I^{sl}	5.23	5.28	5.0	5.68	7.68	6.97	5.37	6.2	6.16	8.23	8.14	8.03
$\%^{sl}$	60	55	37	43	38	60	53	61	48	60	57	54

Note: M – Menu part; I^{sl} – choices in the Isolation part only for subjects who selected the risky project in the Menu part (weighted by the frequency of choice); $\%^{sl}$ – proportion of subjects choosing the risky project in the Menu part.

Figure 4: Average effort differences (Menu pt. - Isolation pt.)

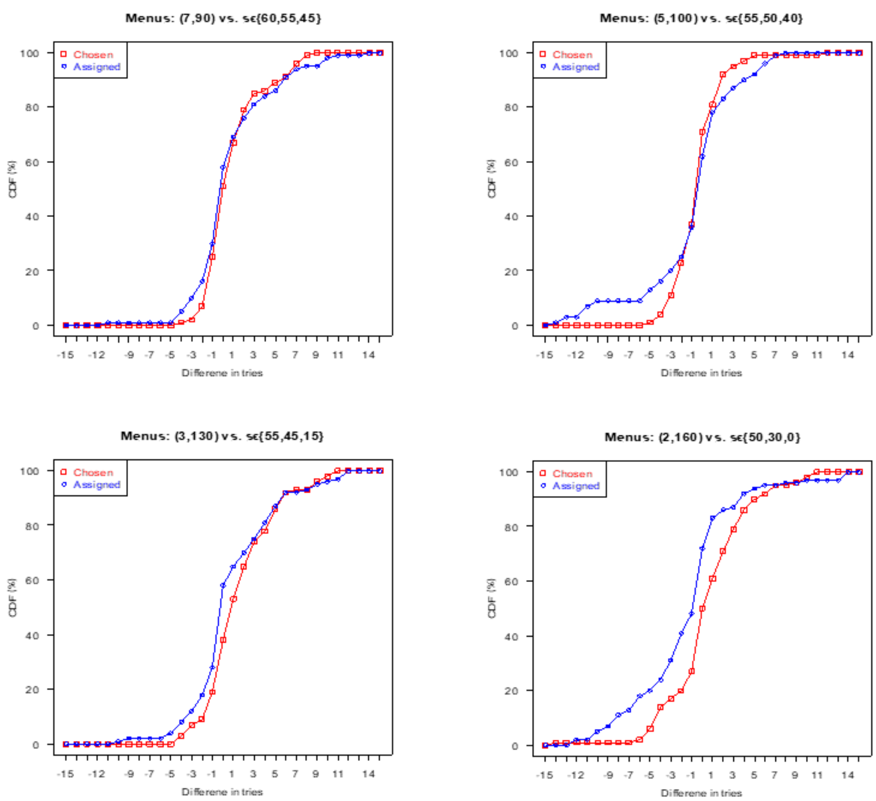


Table 9: OLS regressions

	(1)	(2)	(3)	(4)
Data restriction	Isol. pt.	Isol. pt.	None	None
Const	5.454***	4.73***	4.82***	4.351***
	(1.084)	(1.175)	(1.01)	(1.215)
Prize	0.015**	0.015**	0.018***	0.018***
	(0.007)	(0.007)	(0.006)	(0.006)
Prob	−0.531	−0.531	−1.964	−1.945
	(3.21)	(3.21)	(3)	(3)
Prize*Prob	−0.039	−0.039	−0.011	−0.011
	(0.045)	(0.045)	(0.044)	(0.044)
Chosen	−0.145	−0.21	−0.194	−0.122
	(0.456)	(0.45)	(0.432)	(0.447)
Menu		-	0.377	0.356
			(0.296)	(0.289)
Menu*Chosen.		-	1.24***	1.235***
			(0.413)	(0.409)
Female		0.409		0.271
		(0.459)		(0.464)
Mj. science		0.394		0.353
		(0.527)		(0.524)
Mj. econ/bus		0.653		0.628
		(0.564)		(0.571)
No. semesters		0.019		−0.035
		(0.102)		(0.108)
Months worked		0.003		0.009
		(0.012)		(0.013)
Observations	1608	1608	2393	2393
R^2	0.042	0.045	0.08	0.085

Note: dependent variable is effort; standard errors were clustered by subject and are included in the parentheses; ***,** ,* significant at 1%-, 5%-, 10% -level; regressions (1) and (2) include all subjects; the dependent variable is the effort choice (the number of tries) in the Isolation part only; regressions (3) and (4) use all data without restrictions.

Table 10: OLS regression

Const	4.419***
	(1.24)
Prize	0.018***
	(0.006)
Prob	−1.96
	(2.99)
Prize*Prob	−0.01
	(0.044)
Chosen	−0.426
	(0.598)
Menu	0.392
	(0.364)
Menu*Chosen	1.539***
	(0.539)
Female	0.103
	(0.648)
Female*Chosen	0.548
	(0.86)
Female*Menu	−0.05
	(0.537)
Female*Menu*Chosen	−0.601
	(0.794)
Mj. science	0.349
	(0.523)
Mj. econ/bus	0.612
	(0.579)
No. semesters	−0.032
	(0.109)
Months worked	0.009
	(0.013)
Observations	2393
R^2	0.086

Note: dependent variable is effort; standard errors were clustered by subject and are included in the parentheses; ***,** ,* significant at 1%-, 5%-, 10% -level;

INSTRUCTIONS

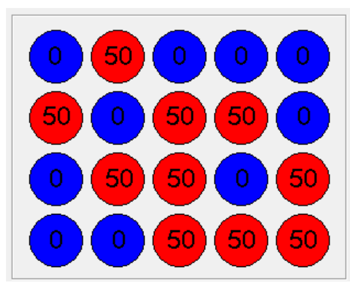
Now that the session has begun, we ask that you do not talk with each other for the duration of the experiment. If you have a question after we finish reading the instructions, please raise your hand and the experimenter will approach you and answer your question in private.

You will receive $5 USD for participating in this experiment. You may also earn additional payment, based on choices made by you and others as well as random outcomes as described in detail below. All earnings in this experiment are in Experimental Currency Units (ECUs). At the end of the experiment, these will be translated into US dollars at an exchange rate: $1 = 4 ECUs. Your earnings will be paid to you in cash individually and privately.

Throughout this experiment you will make decisions in several rounds but only two of those rounds will be selected for payment at the end of the experiment. These paid rounds will be chosen randomly. Because no one knows (until the end of the experiment) which two rounds will be paid, your best bet is to treat each decision as if that was the decision eventually chosen for payment.

The project

There is a project that can either succeed or fail. The project is represented by a box with 20 balls in it.



Some of the balls are red and the rest are blue. The project succeeds if a red ball is selected from the box.

You will decide how many times you want to try to make the project succeed.

Each try will cost you 5 ECU. On each try the computer will randomly select one of the balls from the box.

- If the selected ball is red, the project succeeds. The prize for success is written on the face of the ball.

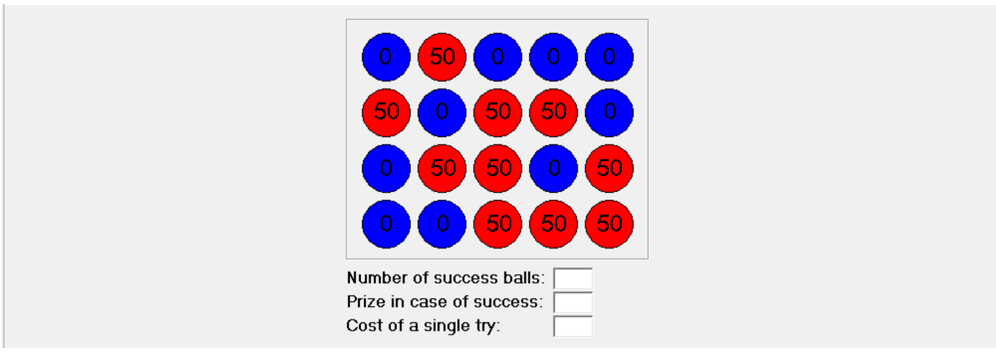
- If the selected ball is blue, then the project has not succeeded on this try. If you have purchased more tries and haven't exhausted them all, then you will automatically proceed to another try: a new ball will be randomly selected from the box.

If blue ball was selected on every one of your tries, then the project fails. The prize for failure is $0.

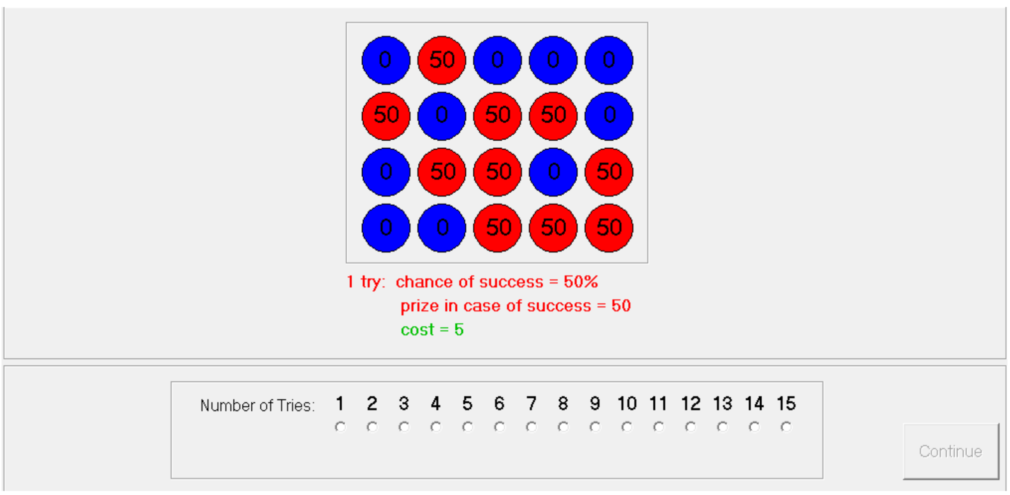
Sequence of actions

1. The software will first display the screen with the project. In the fields provided below the box, you will be asked to type in the basic information about the project:

(i) number of success balls that you see in the box,
(ii) the prize in case of success, which is written on the face of the red balls and
(iii) the cost of a single try, which equals 5.



2. Next, you will choose the number of tries and pay the corresponding cost: 5 x (number of tries).



3. After you've made your decision you will move to another round where you will encounter another project.

You will only find out if the project succeeds or fails if this is the decision that is selected for payment. This will be decided at the end of the experiment.

Structure of the experiment

The software will open up with a page containing several comprehension questions. These will test your understanding of the experiment. You will have to answer all questions correctly in order to be allowed to continue. Please make sure that you are clear on all of the details of this experiment.

Next you will enter the PRACTICE PHASE. This phase is intended to familiarize you with the software environment. You will complete 3 practice rounds with one project and another 3 practice rounds with a different project. After each round the project will be evaluated. In the actual experiment, however, the project will not be evaluated after each round. Rather, only that project which will be chosen for payment at the end of the experiment will be evaluated and paid.

After the PRACTICE PHASE the experiment begins. It is divided into three parts:

PART I: has 12 rounds. In each round **[you will be asked to choose from] {you will be randomly assigned one of}** two projects. One project is risky. It contains both red balls and blue balls. This project can fail if blue ball is selected on every one of your tries. The other project is safe. It contains only red balls. This project is guaranteed to succeed on the very first try.

If you **[choose] {are assigned}** the risky project, then you will also select number of tries for that project. If the project succeeds you will get the prize; if it fails you get zero for that particular round. If you **[choose] {are assigned}** the safe project, then you will automatically buy 1 try. This try will succeed and you will get the prize for that particular round.

SURVEY: In this part, you will answer 44 short questions.

PART II: has 12 rounds. In each round you will face a different project and for each project you will chose a number of tries. If the project succeeds you will get the prize. If it fails you get zero for that particular round.

After completing all parts of the experiment you will fill out a brief questionnaire.

How are your earnings determined?

Following the questionnaire we will determine your earnings for the experiment. One project from PART I and one project from PART II will be randomly selected and evaluated for payment. This will be done in the following way. In front of the room there are two decks of cards. Each deck contains 12 cards with numerical labels from 1 to 12 referring to individual rounds on the reverse side. One card from each deck will be drawn, each time by a different randomly chosen participant, and the number on each card will indicate the number of the paid round in the corresponding part of the experiment.

Your payment for each paid round is determined as follows:

75 + (prize if project succeeds or 0 if it fails) - 5*(number of tries)

Payment for the experiment: the amount of US dollars you will take home with you is

($5 fee for showing up)
+
$(amount of ECU for paid round from PART I + amount of ECU for paid round from PART II) / 15

Please make sure you have understood everything in these instructions. If you have any question please raise your hand.