Visual Convex Time Preferences

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Lab, Field and High Schools*

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Abstract

The original standard for measuring time preferences was Multiple Price List (MPL), where subjects are asked to choose between an amount of money in the present and a larger amount of money in the future. Convex Time Budget (CTB) was later introduced, allowing subjects to differentially allocate money between present and future. It improved precision of measurement but also increased the complexity of the task. In this paper we introduce the Visual Convex Time Preferences (VCTP), a new measure of time preferences synthesizing simplicity of MPL and precision of CTB. Results from the lab suggest that VCTP is robust and improves precision of time preferences measurement compared to the MPL. Same results are replicated in the field of Honduras, especially when the experiment is run with the help of enumerators. Experiments with teenagers show that younger population exhibit high level of inconsistency although older participants perform better.

Keywords: Time Preferences, MPL, Experiments.

JEL-codes: C91, C93, D15.

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1 MOTIVATION

"It should be noted that the seeds of wisdom that are to bear fruit in the intellect are sown less by critical studies and learned monographs than by insights, broad impressions and flashes of intuition."
Von Clausewitz, *On War* (1873)

Understanding the formation of time preferences and estimating them is of great importance for economists and policy makers since time preferences play a decisive role when economic agents decide how much to invest in savings, education or life insurance. Since several papers suggest that the more patient the individual, the better their decision-making in economic problems is, we can suppose that the ability to recognize optimal choices over time is linked with a better ability to understand the consequences of his own actions, resulting in better decision-making being made. Since the literature also suggests that time preferences are stable over time, we can consider them as a rough proxy of the decision-making ability of an individual. Therefore, possessing an instrument capable of rapidly and precisely estimate time preferences would be of great value, since it would help economists and policy-makers to predict the behavior of agents or identify individuals understanding the long-term consequences of their actions.

The economic literature linking patience to better decision-making is made of several papers. Ashraf, Karlan and Yin (2006) found that more patient women are more likely to open a bank account and increase their savings. Meier and Sprenger (2010) showed that impatience is correlated with more frequent credit card debt and higher level of borrowing. Burks, Carpenter, Goette and Rustichini (2009) linked higher cognitive skills with higher patience and better decision-making in economic problems. Meier and Sprenger (2013) showed that most patient individuals are also the ones likely to take financial literacy lessons. Aiming at a domain-general characteristic, one benefit of an efficient tool for measuring time preferences is their stability over time suggested by the literature. It means that one measurement could be sufficient to give a representation of time preferences. Meier and Sprenger (2015) showed that 60 to 70% of the variance in time preferences can be explained with individual fixed effect. Indeed, aggregate distribution of time preferences and present bias among population of subjects are indistinguishable across a two years delay between each part of the experiment. Chabris, Laibson, Morris, Schuldt and Taubinsky (2008) provided additional support for a domain-general characteristic by using the 27-choices task of Kirby, Petry and Bickel (1999) and finding that time preferences are a better predictor than individual characteristics (age, sex, education...) for an aggregated index of field behaviors. Reuben, Sapienza and Zingales (2010) gave additional support for this theory by demonstrating that people impatient with primary rewards also exhibit impatience with monetary rewards.

Neuroeconomics literature reinforces the idea of a domain-general characteristic for time preferences by documenting the link between patience and cortex areas. Knutson, Adams, Fong and Hommer (2001) showed that the Ventral Striatal Nucleus Accumbens is responsible for coding anticipation of reward and proposed that the Medial Nucleus Accumbens is responsible for coding the expected magnitude of the reward. Hariri, Brown, Williamson, Flory, De Wit and Manuck (2006) showed that higher activity in several subzone of the Ventral Striatum correlates with preference for immediate rewards. The bulk of the literature was related to the Prefrontal Cortex (PFC) with Miller and Cohen (2001) proposing that PFC integrates, interprets, maintains and updates diverse sensory inputs to guide performance in complex tasks, since activity of PFC neurons increases when later reward increases and midbrain dopamine neurons in the PFC detect later rewards and encode "prediction errors". McClure, Laibson, Loewenstein and Cohen (2004) gave evidences in support for this theory by using fMRI to demonstrate that two separate systems are involved in time preferences. Regions of the limbic system are heavily innervated by dopamine projections that have been shown to be responsive to reward expectations and are more active for immediately disponible rewards. Several regions in the PFC and the Inferoparietal cortex are associated with greater activity when subjects chose the larger and later reward in ambiguous trials. McClure, Ericson, Laibson, Loewenstein and Cohen (2007) extended these results to primary reward (orange juice, water) by finding that activated brain regions overlap with previous studies, except that different subcortical areas activate for present bias preferences. It suggests that subcortical areas are stimulus-specific but that time preferences are domain-general. In conclusion, the literature reinforces the idea of a domain-general characteristic for time preferences by demonstrating that cortex areas are responsible for them. Because of the consistency of time preferences showed by experimental literature, we can suppose that each individual has a brain calibrated toward specific time preferences, with contextual variations due to brain activity specific to local areas.

The recent state of the time preferences literature is an intense debate about whether Multiple Price List (MPL) or Convex Time Budget (CTB) is the best measurement tool. Coller and Williams (1999) proposed MPL as the first measurement tool for time preferences. Subjects have to choose between an amount of money in the present and an amount of money in the future, with the standard version proposing a fixed amount of money in the present and an increasing amount of money in the future. Subjects should initially take the money in the present, and the choice where they switch to future preferences gives an interval of potential values for the discount rate measuring their time preferences. Later, Andreoni & Sprenger (2012) attracted a great deal of attention by proposing CTB as a refinement of MPL. Historically, the literature dedicated to the measurement of individuals discount rates started with Thaler and Shefrin (1981) obtaining discount rates from 1% to more than 1000%. Comparable psychological experiment of Kirby and Marakovic (1996) or Kirby et al (1999) similarly found unrealistic Annual Interest Rate (AIR) between 1000% and several bil-

lions, questioning how to plausibly estimate individuals discount rates. Coller et al. (1999) proposed a 15-choices MPL task as a more controlled environment likely to elicit more realistic preferences[1]. They found estimates of discounted interest rates ranging between 15% and 22%, lower than previous studies and consistent with market borrowing rates. This study established MPL as the gold standard for measuring time preferences.

Harrison, Lau and Williams (2002) and Coller, Harrison and Rutström (2003) built on MPL and obtained estimates on a similar range, proving robustness of the tool. Harrison et al. (2002) estimated individual discount rates using a 20-choices MPL with a field survey population. They measured subjects preferences over four time intervals: 6 months, 12 months, 24 months and 36 months. A total of 109 subjects just responded to one time interval and 132 subjects to all time intervals. They obtained AIR between 2.5% and 50% as well as estimating overall discount rate at 28.1%, with estimates between 27.8 and 34.8%. Results were considerably lower than traditional literature estimates and between three and ten times higher than estimates from welfare analysis. Additionally, authors showed that discount rate is influenced by sociodemographic characteristics of subjects. Coller et al. (2003) investigated the effect of Front End Delay (FED) in a 15-choices MPL task with interest rates from 2% to 100%. FED is the time delay until the first date of payment. Subjects chose with FED of 0, 7 or 30 days (a FED of 0 day means that subjects are paid on that particular day). Additionally, subjects replied to one MPL task with time horizon randomly chosen between 1 and 60 days to obtain more precise estimates. Results demonstrated that subjects have a $10.28 premium with a FED of 0 day, while this premium does not exist with a FED of 7 or 30 days where discount rates are constant over time, suggesting hyperbolic discounting.

Andersen, Harrison, Lau and Rutström (2006) criticizes MPL by pointing three limitations: First, subjects only indicate at which interest rate they switch for the larger amount of money in the future. Therefore, it is only possible to estimate an interval for one subject's interest rate, which is not as precise as a "point" valuation. Second, subjects could make multiple switch between present and future. Instead of switching to the future at one choice and sticking to these preferences when future amount is larger, subjects may back-and-forth between present and future. Third, framing effects can occur because subjects can be attracted by the middle choice, irrespective of others proposed choices. Tackling the second point was impossible, but authors dealt with the third by designing an experiment suggesting that framing has no influence on results. They dealt with first point by using the iterative MPL (iMPL) of Andersen et al. (2006). When subjects switch to future preference, they play MPL again for interest rates between their last present choice and their first future choice. Results in both studies show that subjects preferences are more precisely identified

[1]MPL were previously used in other economic measurements, such as risk attitudes with real payoffs (Binswanger, 1980, 1981) or valuation of a commodity like in Kahneman, Knetsch and Thaler (1990)

with this mechanism, and authors also found results suggesting that symmetric framework (replies follow the same increasing rate) are better than asymmetric ones (replies follow an irregular increasing rate). The path for the next improvement in the literature of time preferences was opened.

Andreoni and Sprenger (2012) creates the Convex Time Budget (CTB). It is a refinement of MPL since subjects are now allowed to differentially allocate in present or future for each available unit of reward. In this experiment, subjects were given 100 tokens and chose to allocate each of them in the future at \$0.20 or in the present at a lower value between \$0.13 and \$0.19. Subjects were answering for three sooner payment dates and three payment delay lengths, making 45 budget choices in total. They also answered to Double Multiple Price List (DMPL), where MPL estimated the discounting and Hault-Laury the curvature of discounting. Using a Constant Relative Risk Aversion (CRRA) authors estimated a 30% annual discount rate, lower than MPL studies. They also found preferences closer to linear utility than with DMPL. Results suggest that CTB precisely estimate time preferences and that Hault-Laury task does not allow to precisely estimate curvature in discounting. Andreoni, Kuhn and Sprenger (2015) further investigated CTB and DMPL by comparing the predictive validity of both methods. They designed a simplified version of CTB where subjects answered for six interest rates, each with six possible choices. They found that both perform well when predicting their own results (DMPL predicts 89% and CTB 75% of their own results) but CTB outperform DMPL when predicting results of the other method (DMPL predicts 16% and CTB predicts 86% of the other task results), suggesting that CTB is better at measuring time preferences with a simplified version of the task.

CTB is more precise than MPL for measuring time preferences, however an heavy limitation of CTB is that it requires a laboratory with equipped computers and a consequent amount of time to obtain the measurement. Similarly, the iMPL increases the amount of time needed by doubling the task length. A valuable development for this literature would be to propose a task requiring the same amount of time than MPL while obtaining the improvement in precision given by CTB. We created a a new task combining MPL and CTB advantages for this purpose. It could be seen as a simple, shorter and visual version of the CTB task by Andreoni et al. (2015). The key methodological development of this task is the simplicity of the graphical representation and the goal of this paper will be to validate this tool in the laboratory, field and schools. Because this minimalism is reminiscent of MPL while subjects are still allowed to make continuous choices, it inspired us for naming our task the *Visual Convex Time Preferences* (VCTP).

The rest of the paper is organized as follows. Section 2 explains experimental design. Section 3 summarizes the main questions of this research. Section 4 shows results of the laboratory experiment, Section 5 results of the field experiment and Section 6 results of the high school experiment. Section 7 concludes.

2 EXPERIMENTAL DESIGN

The key feature of our design is the use of a graphical representation with ten coins instead of a list. The experiment was separated in two identical parts with one difference: in the part with the MPL mechanism, subjects are forced to allocate all the coins either in the present or in the future. In the part with the VCTP mechanism, there is an additional rule allowing subjects to allocate each ball in the present or in the future. Since the only difference between MPL and VCTP is that *subjects can use only one color in a MPL scenario*, comparing these parts allow to judge which mechanism is superior.

Graphical representation: In Andreoni et al. (2015) subjects have one hundred units and allocate each one to present or future for each decision. In our experiment we reduced the task to a ten choices space for concision. Figure 1 displays one choice space. The solid line circle represents one Euro in the present and the dotted circle represents the monetary bonus associated with waiting one week at the current interest rate. The cross is used by subjects to indicate their choice by coloring it with a two-color pencil. They color the cross in blue if they want the payment in the present, or in red if they want the payment in the future. Figure 2 displays the decision space[2]. Circles are disposed in three horizontal rows. The middle row is composed of four circles, the first and third rows are comprised of three circles positioned in the middle of the center line spaces. This disposal allows circles to form the most homogeneous disposition possible in order to avoid any potential effect coming from their disposal.

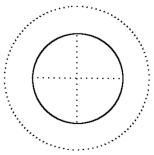


Figure 1: One choice space in the experiment

Number of scenarios: Subjects are invited to perform the decision task six times with increasing interest rate: 0%, 20%, 40%, 60%, 80% and 100%. We chose these values as a compromise between obtaining precise data and not requiring too much time or effort from subjects.

Time Frame: The early payment date is tomorrow. This Front-End Delay (FED) allows to avoid any bias associated with obtaining the reward immediately. The later payment date is in one week and one day. We chose a one week delay because it seemed a minimal amount of time to be perceived as a future payment for subjects, but not long enough to be perceived as the far future.

[2]Translation of the instructions in English: "Interest rate=60%. Tomorrow: 1€, In one week and one day: 1.60€".

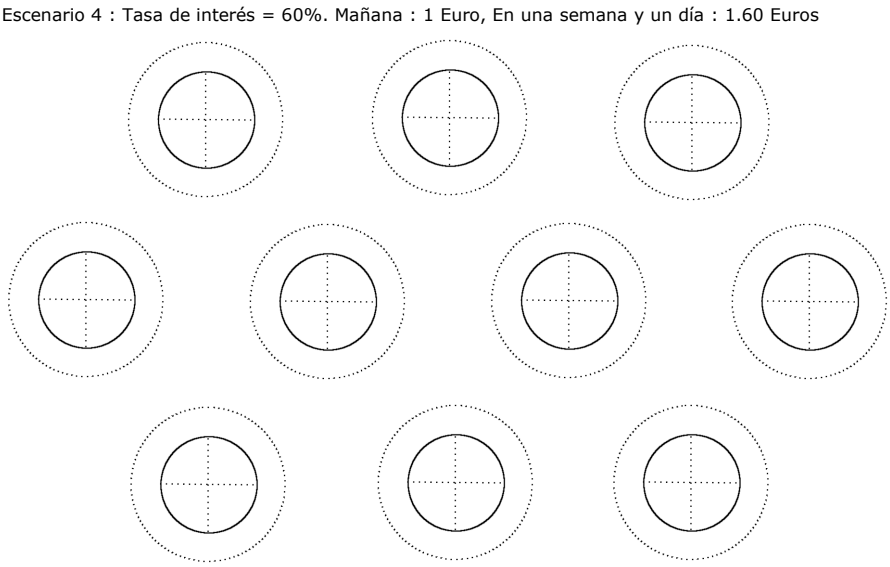


Figure 2: One decision task in the experiment

Measurements: We have three basic measurements to compare MPL and VCTP:

Time is the number of seconds taken by subjects to answer a part of the experiment. We registered the starting and finishing time for each part, allowing to compute the total experimental time.

Consistency identifies subjects correctly replying to the task. Subjects are consistent if their number of future choices always stays the same or increases when interest rate increases. It would not be logical that a subject allocates X€ in the present at one interest rate, then allocates more than X€ in the present at the next (and higher) interest rate. It would mean that the potential gain decreased while the interest rate increased, thus that staying with the previously chosen allocation would have resulted in a gain[3].

Precision refers to the number of Euros taken in the future at each interest rate during each task, resulting in twelve measurements giving time preferences of subjects. We call it *precision* because subjects are provided with an extensive set of possible allocations in VCTP that we will refer to as *interior solutions* from now on.

[3]This is not true if all balls are allocated to the present since the gain would be constant, but then you cannot increase the number of balls allocated to present.

3 QUESTIONS TO BE ADDRESSED

This research intends to analyse to which extent VCTP outperforms classical MPL. To this end, we cover three different environments: the laboratory, the field and high schools. First, it will allow us to compare three radically different population of subjects: western university students, rural inhabitants of developing countries and western teenagers. Second, it will give us the opportunity to address several questions by appropriately using each environment.

3.1 Questions for the Lab

The lab experiment is aimed to answer two separate questions. The first question refers to the importance of monetary incentives while the second focuses on the comparison of both mechanisms. The study was pre-registered in As-Predicted before being conducted. The documentation can be consulted at https://aspredicted.org/yd6pt.pdf

Q1: Do payment scheme influence results?

One of the critical issues in time preferences is the payment scheme, *id est* whether to pay subjects or let them make hypothetical choices. An issue with real payment is that there are huge monetary and logistic costs associated with paying subjects later[4], but conventional wisdom in Experimental Economics is that hypothetical payoffs not making subjects risk their own money do not make them put sufficient efforts in the task, eliciting random choices. However, evidence from several studies (such as Matusiewicz, Carter, Landes and Yi (2013) or Ubfal (2016), just to name a few) do not support the emergence of noisy behavior in absence of real payoffs for delay discounting estimations. Brañas-Garza, Jorrat, Espín and Sánchez (2020) run experiments in the lab, the field and online to test the effects of payment scheme on time and allocations in MPL. In their paper subjects are randomly assigned to three possible payment schemes: Hypothetical, Real and 1/10 (one subject out of ten will be paid with real € and others with hypothetical €). They also found no differences in results related to the payment method. We decided to follow the same strategy by randomly assigning subjects to *Hypothetical*, *One Tenth* or *Real* monetary incentives. Our first goal will be to test whether the lack of effect of payment methods is replicated in both MPL and VCTP.

Q2: Do MPL and VCTP provide similar outcomes?

The original idea of the CTB created by Andreoni et al. (2012) was to propose a more precise task than MPL. The VCTP task is the intermediate case between the binary MPL and the continuous CTB. The VCTP provides a more flexible version of the MPL. However, it is an open question whether subjects will take

[4]See Martín, Brañas-Garza, Espín, Gamella and Herrmann (2019) for a analysis of the problems related to paying subjects later.

advantage of the VCTP flexibility and provide more precise answers than MPL, or if they will continue taking corner choices. Our paper will investigate if MPL and VCTP differ in three different dimensions: (*i*) Whether subjects take more or the same time using VCTP than MPL; (*ii*) If subject find the task similar in term of complexity by counting the proportion of consistent subjects in both tasks; (*iii*) Whether subjects take advantage of the VCTP flexibility by using interior choices. To answer these questions we asked our subjects to perform the experimental task twice, once with the MPL rule and once with the VCTP rule in random order. Summarizing, VCTP outperforms MPL if we prove that it does not need more time or decrease consistency, but that subjects use the additional precision of interior solutions.

3.2 Questions for the Field

We run the field experiment in order to answer two different questions. The first question refers to the number of balls, investigating if the interval length makes any difference. Then, we wish to test whether using enumerators has an impact on outcomes. Finally, we wish to test Q2 in the field by comparing performances of VCTP and MPL there. The study was pre-registered in As-Predicted before being conducted and the documentation can be consulted at https://aspredicted.org/dx52q.pdf

Q3: Testing Q2 outside the lab (field)

Q2 explored whether VCTP outperforms MPL in terms of precision at the same cost (no more time needed by participants and no higher level of inconsistency). We will conduct the same analysis than Q2 in the field. We test whether subjects spend more time using VCTP. Recall that time in the field is expensive. We also test whether the proportion of consistent subjects is similar. Inconsistent choices are costly since datas are not considered valid and sample size decrease. We fear that participants from rural areas of developing countries would have higher level of inconsistency.

Q4: Does a shorter version (five balls) provide the same outcome?

Our original experimental design in the Lab used ten balls. But time is money outside of it. We need to test whether a shorter version, by definition less time-consuming, has a negative impact on results. That is, we need to verify that simplifying the experimental design is detrimental to the precision of results. To answer this question we implemented two treatments: the original *10-Balls* version and the shorter *5-Balls* version.

Q5: Is there any enumerator effect?

Experiments in the field are typically conducted by enumerators helping the responder. Lupu and Michelitch (2018) noted that using enumerators not only have a relevant impact on the casting, but enumerator effect could occur over

a large range of technicalities that still has to be more extensively understood. Relevant to our study is that attributes of enumerator influence replies to questions linked to the same attribute. It is also worth investigating if VCTP can be self-managed, meaning it can be ran independently as part of larger questionnaires. We investigate if enumerators have an effect by using two conditions: *i*) *Self-managed* where subjects perform the task without any help from the enumerator. *ii*) *Externally-Managed* where subjects perform the task with the help of the enumerator.

3.3 Questions for High Schools

We run the same experiment in several Andalusian high schools to test whether teenagers are able to perform both MPL and VCTP with minimum level of consistency. Our question of interest is the following:

Q6: Testing Q2 outside the lab (schools)

We repeat questions for the Lab by studying time, consistency and precision across students in grade 2, grade 3 and grade 4. Our study at high school is only exploratory and there are no additional treatments.

4 THE LABORATORY EXPERIMENT

The Lab experiment was conducted at the School of Economics and Business of the Universidad de Sevilla[5] in late May 2019. We had 151 subjects that were randomly allocated to treatments with $n_R = 50$ in the *Real* condition, $n_H = 52$ in the *Hypothetical* and $n_{1/10} = 49$ in the *One Tenth* treatment. We ran power calculations to estimate the number of observations to detect a minimum effect equal to this relativized size effects. We used the size effects found in Brañas et al. (2020) and relativized magnitudes according to our number of decisions. For power β=0.8, significance level α=0.1 and effect size r=0.69 we need 25 observations per treatment. Regardless of the treatment all subjects completed both tasks: VCTP and MPL. The order was randomised: 74 played the VCTP first and then the MPL, and 77 did the reverse order[6], so we have 74 observations for VCTP and 77 for MPL in the between-subjects analysis. We want to know whether payment scheme had an effect on allocations of subjects. Table 1 shows estimates of the impact of payment schemes on individual choices in VCTP played first and Table A1 displays same regressions for MPL played first. We ran each regression with and without controls (Age, Female, CRT). We consider 6*2 potential cases in each table and see that only one is weakly significant. Additional tables in Supplementary Information display same regressions for each task played second or regardless of order, only showing a weakly significant effect of One Tenth increasing allocations to future in VCTP regardless

[5]It is the largest public university in Southern Spain.

[6]The precise numbers are: VCTP first: real ($n = 24$), hypothetical ($n = 25$) and 1/10 ($n = 25$); MPL first: real ($n = 26$), hypothetical ($n = 27$) and 1/10 ($n = 24$).

Table 1: VCTP allocations to the future in first round

	All Subjects	All Subjects	VCTP Consistent	VCTP Consistent	Consistent	Consistent
Hypothetical	0.582	1.289*	0.861	1.473	0.905	1.512
	(1.07)	(2.16)	(1.31)	(2.00)	(1.35)	(2.01)
Onetenth	0.796	0.946	0.799	0.798	0.842	0.828
	(1.46)	(1.68)	(1.29)	(1.24)	(1.33)	(1.26)
Age		0.0819		0.167		0.171
		(0.81)		(1.18)		(1.19)
Female		1.481**		1.153		1.133
		(2.97)		(1.92)		(1.86)
CRT		-0.295		-0.381		-0.400
		(-0.46)		(-0.45)		(-0.47)
Constant	5.771***	3.137	5.926***	1.715	5.882***	1.610
	(14.82)	(1.39)	(12.76)	(0.56)	(12.22)	(0.51)
N	74	67	59	54	58	53
R^2	0.0310	0.1789	0.0380	0.1486	0.0404	0.1501

t statistics in parentheses

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

of order. We conclude there is *no impact of payment scheme on allocations to future*.

Result 1: Payment scheme does not influence elicited time preferences in both MPL and VCTP.

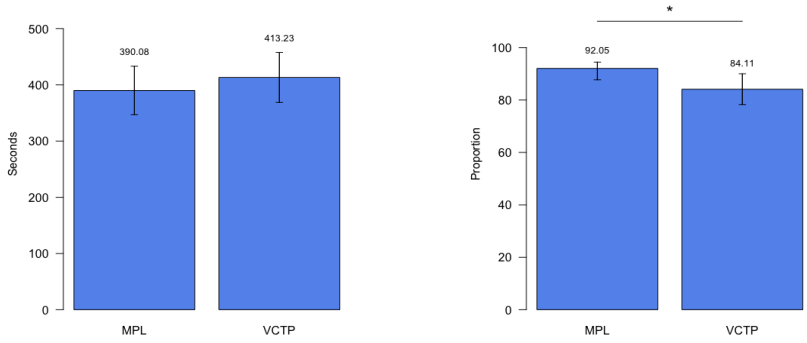
4.1 Is VCTP an improvement over MPL?

While the VCTP is an improvement in precision over MPL, it comes at the expense of increased complexity. VCTP could be considered as an improvement over MPL if the time needed to collect datas and the share of consistent subjects giving exploitable datas remain similar. We also need to verify that there is a significant improvement in precision of results.

Is time higher in VCTP ?

Figure 3a displays the average amount of time needed by subjects to perform a task when played first (between-subjects). The t-test of equality of means between MPL and VCTP time with H0: average time is equal between tasks (H1: MPL needs less time than VCTP) does not reject (t = -0.305, p = 0.760) that MPL and VCTP need similar amounts of time to be performed in the Lab. We conclude that time in MPL and VCTP is similar.

Result 2a: There is no difference in time between MPL and VCTP in the Lab.



(a) Time (b) Consistency

Figure 3: Time and Consistency by task in the Lab

Is consistency lower in VCTP?

Figure 3b displays consistency performing the task (between-subjects). The t-test of equality of means between MPL and VCTP consistency with H0: average consistency is equal between tasks (H1: MPL needs less time than VCTP) does not reject (t = -0.731, p = 0.465). We conclude that consistency in MPL and VCTP is similar.

Result 2b: There is no difference in consistency between MPL and VCTP in the Lab.

Are VCTP choices more precise?

We need to prove that the additional precision of VCTP is *meaningfully* used by subjects. Figure 4 displays multi-histograms of allocations to the future in MPL and VCTP by interest rate, allowing us to study the pattern of interior allocations. According to interest rates by increasing order[7], interior solutions are respectively used 11.92%,60.93%, 58.28%, 52.32%, 48.34% and 26.49% of the time in VCTP. Consistent with our expectations, we see a considerable use of interior allocations in all scenarios except for the salient extremes of 0% and 100% interest rate where subjects should take everything in the present or future, yet they still use interior allocations at these interest rates. To judge whether subjects meaningfully use the additional precision of VCTP, we take advantage of having MPL and VCTP choices for all subjects (n = 151). Figure 5 displays box plots showing allocations to the future in VCTP compared to allocations to the future in MPL represented by the red line. We think that subjects switching from present allocation to future allocation at interest rates 20%, 40% and 60% in MPL have precise time-preferences that they cannot express inside the rigid structure of MPL. Therefore, they should take advantage of the flexibility

[7] 0%, 20%, 40%, 60%, 80%, 100%.

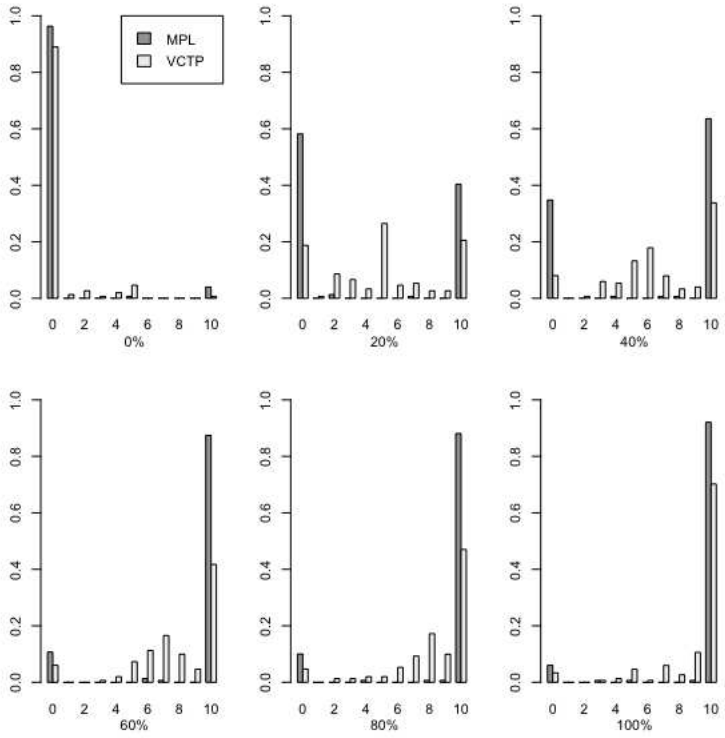


Figure 4: Multi-Histograms of allocations to future by task in the Lab

of VCTP to allocate closer to their preferences. Subjects switching at 20% in MPL should allocate more to the present with VCTP because they were previously forced to take everything in the future if favoring larger gains. Subjects switching at 40% in MPL should make slight adjustments toward present or future since this interest rate seems to be the closer to the indifference point of subjects. Subjects switching at 60% in MPL should allocate more to the future with VCTP because they were previously forced to take everything in the present if favoring immediate gains. We find the expected pattern of results with (a) Subjects switching at 20% in MPL have the same number of balls in the future as the 75th quartile (and almost the median) in VCTP (b) Subjects switching at 40% in MPL have the same number of balls in the future as the median allocation in VCTP, with the 25th quartile slightly below it and the 75th quartile slightly above it (c) Subjects switching at 60% in MPL have the same number of balls in the future as the 25th quartile in VCTP. We conclude that subjects make meaningful use of VCTP.

Result 2c: Subjects use the additional precision of VCTP to allocate closer to their preferences.

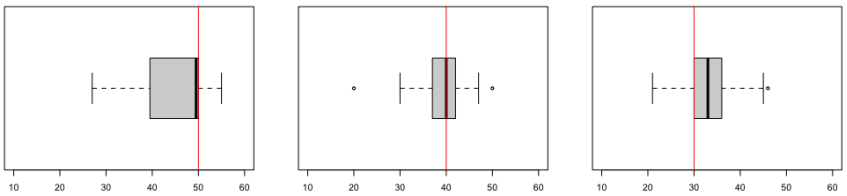


Figure 5: Allocations to the future in VCTP according to MPL switch

4.2 Parametric Estimation of VCTP datas

In order to evaluate whether or not our instrument provides meaningful and useful estimations of delay discounting, we need to estimate them using a parametric model. The goal of this paper is not to propose a new estimation model, but verify that the tool we propose is providing meaningful estimates of time preferences by comparing obtained estimations with the ones of Andreoni & Sprenger (2012, AS hereafter). We chose them because they are the most recent development of the field that we took inspiration from, and because they provided the most extensive study of delay discounting. Since our experiment is a simplification of their extensive one, our goal is to obtain comparable estimates in terms of value with sizable diversity. We adapted their time separable CRRA utility function discounted via the quasi-hyperbolic β-δ discounting to our environment by removing the present bias β from the original utility function, since we defined tomorrow and not today as our early period.

$$U(c_t, c_{t+k}) = \frac{1}{\alpha}(c_t - \omega_1)^\alpha + \delta^k \frac{1}{\alpha}(c_{t+k} - \omega_2)^\alpha, \tag{1}$$

With α the CRRA curvature parameter, δ the one period discount parameter, t the present period, $t{+}k$ the future period, c_t earnings in the present, c_{t+k} earnings in the future, ω_1 and ω_2 the Stone-Geary consumption minima or background consumption. We set $k = 1$ since our experiment has only two periods. Being m the experimental budget, subjects are constrained to the following budget:

$$(1 + r)c_t + c_{t+k} = m \tag{2}$$

Maximizing (1) subject to the future value budget (2) gives the tangency condition:

$$\frac{c_t - \omega_1}{c_{t+k} - \omega_2} = (\delta^k(1 + r))^{\frac{1}{\alpha - 1}} \tag{3}$$

Giving us the Stone-Geary linear demand for c_t:

$$c_t = \frac{1}{1 + (1 + r)(\delta^k(1 + r))^{\frac{1}{\alpha-1}}} \cdot \omega_1 + \frac{(\delta^k(1 + r))^{\frac{1}{\alpha-1}}}{1 + (1 + r)(\delta^k(1 + r))^{\frac{1}{\alpha-1}}} \cdot (m - \omega_2) \tag{4}$$

We make different assumptions concerning ω_1 and ω_2. We estimate them separately, set them at zero or specify equality between them. Additionally, we estimate the constant absolute risk aversion (CARA) utility with $u(c_t) = -exp(-\rho c_t)$ to check for robustness to alternate forms of utility. It can be easily estimated with two-limit maximum likelihood regression techniques because the CARA specification eliminates background parameters. But it does not allow direct comparisons with CRRA estimates and different background consumption assumptions. The tangency condition is:

$$c_t - c_{t+k} = \frac{ln(\delta)}{-\rho} \cdot k + \frac{1}{-\rho} \cdot ln(1+r). \tag{5}$$

And the solution function is:

$$c_t = \frac{ln(\delta)}{-\rho} \cdot \frac{k}{2+r} + \frac{1}{-\rho} \cdot \frac{ln(1+r)}{2+r} + \frac{m}{2+r} \tag{6}$$

Table 2 gives estimates using the different techniques and specifications, only presenting here pooled estimations for concision. *Weekly Time Discount* $\hat{\delta}$ refers to the estimated weekly discount rate, *CRRA Curvature Parameter* $\hat{\alpha}$ refers to the estimated CRRA curvature and *CARA Curvature Parameter* $\hat{\rho}$ refers to the estimated CARA parameter.

Table 2: Discounting and curvature parameter estimates

	NLS (1)	NLS (2)	NLS (3)	Tobit (4)	Tobit (5)	Tobit (6)
Weekly Time Discount $\hat{\delta}$	1.098	0.806	0.804	0.967	0.977	0.984
	(0.193)	(0.010)	(0.010)	(0.003)	(0.002)	(0.001)
CRRA Curvature Parameter $\hat{\alpha}$	0.7842	0.901	0.867	0.967		
	(0.086)	(0.008)	(0.006)	(0.003)		
CARA Curvature Parameter $\hat{\rho}$					0.023	0.016
					(0.002)	(0.001)
$\hat{\omega}_1$	1.123					
	(10.981)					
$\hat{\omega}_2$	-13.1864					
	(-)					
$\hat{\omega}_1 = \hat{\omega}_2$		0.603	0	0.01	-	-
		(0.218)	(-)	(-)	(-)	(-)
R^2 / LL	0.700	0.689	0.690	-2626.36	-2757.9	-2560.7
# Observations	1774	1774	1774	1774	1774	1774
# Uncensored				388	388	388
# Cluster	12	12	12	12	12	12

NLS and two-limit Tobit ML estimators. Column (1): CRRA regression of equation (3) with restriction $\omega_1 = \omega_2$. Column (2) and (3): CRRA regressions of equation (3) and (2), with restriction $\omega_1 = \omega_2 = 0$. Column (4) and (5): CARA regressions of equation (5) and (6).

We can see that the estimated values for $\hat{\alpha}$ and $\hat{\delta}$ in regressions (2), (3) and (4) of Table 2 are in the same range than AS estimations. Estimated $\hat{\alpha}$ are

around 0.900, slightly lower than AS estimations. With $\omega_1 = \omega_2$, daily discount rates $\hat{\delta}$ are estimated between 0.968 and 0.970 while AS annual discount rates correspond to daily discount rates between 0.994 and 0.997. We think this difference is a consequence of different experimental design. The rationality check scenario with 0% interest rate represents $\frac{1}{6}$ of our experiment and $\frac{1}{45}$ of AS experiment. Consequently, his impact on decreasing $\hat{\delta}$ is much larger in our design. Regressions (5) and (6) verify robustness of the tool by providing coherent $\hat{\delta}$ estimates. However, regression (1) provides implausible parameters. We attribute this result to the erroneous methodology of estimating ω_1 and ω_2 separately when previous results indicate that background consumption does not impact choices of subjects. Figure A1 and A2 display histograms of α and δ individuals value according to regression (2), since we judged this estimation the most plausible one. The interest reader can found the detail of individual estimations according to regression (2) in Supplementary Material[8]. Figure A3 further suggests that low background consumption estimate the most plausible parameters by showing aggregate estimates of α and δ for NLS and Tobit estimations according to different values of background consumption. Since we obtain coherent estimations in line with AS ones and develop their findings by suggesting that background consumption does not influence choices of subjects, we conclude that the parametric estimation validates the pertinence of our tool for estimating time preferences.

Result 2d: The estimated values for α and δ are slightly lower than in AS but remain coherent. Subjects do not consider background consumption in their choices.

5 THE FIELD EXPERIMENT

The Field experiment was conducted at Santa Rosa de Copán, Copán Region, Honduras. Running ex-ante pòwer analysis, using results obtained in the Lab experiment and Brañas-Garza et al (2020)[9], we determined that a sample of 360 subjects allows us to detect effects size of 0.38 standard deviation with power 0.8 and significance level 90%. A consultancy firm (PILARH) was hired to run the experiment as part of a larger project from the World Bank. We chose eight primary schools and randomly selected households from their listing to recruit our experimental population. The study was approved by the Ethics Committee of Middlesex University London and IRB Solutions (US). All participants signed an informed consent and were paid for real, thus we had no treatment related to payment scheme. Subjects received 25 Lempiras as show-up fee and earnings in the task vary from 50 to 100 Lempiras. Our interest was to test whether our task could be used in the context of rural inhabitants of developing countries, using poor and possibly illiterate farmers that should have difficulties

[8] Available on request.

[9] The literature lack evidences about the effect of different designs and administration methods

understanding the mechanism. We considered this experiment a robustness test for our mechanism that also provides the context for answering two additional questions. First, it allows us to study a potential *Number of Balls effect*, that is whether a different amount of balls produce different levels of continuity. We want to verify that we cannot simplify the 10-balls design with a 5-balls design because the loss in precision offset the reduced time. The overall pattern of results is therefore grosser, validating the 10-balls design as the appropriate degree of complexity. Second, it allows us to study the possibility of an *Enumerator effect*, that is whether letting subjects answer the task by themselves (Self-Managed) or helping them with an enumerator (Externally-Managed) produce different outcomes. Our interest is to verify that enumerators have a positive impact on results, since this is standard methodology to use them in the field. Subjects were randomly allocated to 2x2 treatments. From the randomisation we got $n_{5,S} = 68$, $n_{10,S} = 77$, $n_{5,E} = 91$ and $n_{10,E} = 92$ with S (E) referring to Self-Managed (Externally-managed) and 5(10) to the number of balls. As in the Lab experiment, all subjects completed both tasks (VCTP and MPL) regardless of the treatment. The order was randomised, with 157 subjects first playing MPL then VCTP and 171 subjects doing the experiment in reverse order[10]. We slightly modified our experimental design since we expected subjects to have difficulties understanding the representation of interest rates with circles (see Figure 2). Instead, we used the universally known symbol of piggy banks to represent interest rate level. Figure 6 shows an example of piggy bank for 60% interest rate and Figure A4 displays the complete decision task.

Figure 6: Piggy bank example with 60% interest rate

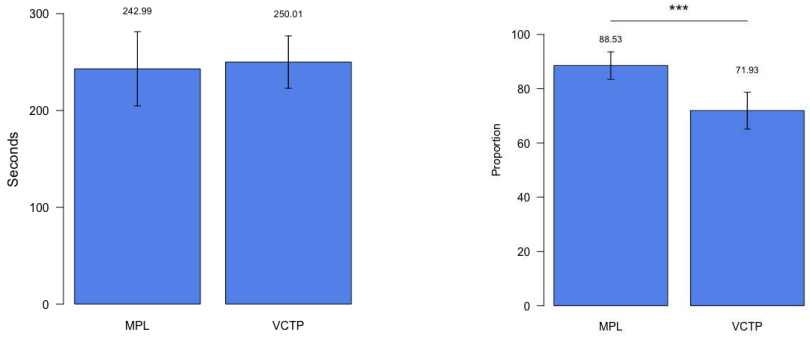
5.1 Replication of Laboratory Results

Before showing results to the main questions (complexity and enumerator effect), we repeat the analysis we did for the lab in order to see whether results 2a, 2b and 2c hold in the field. We use the entire dataset, hence the analysis does not differentiate by number of balls or management type.

Figure 7a displays the average amount of time needed for each task [11]. On average, subjects need 242.9 seconds to perform MPL and 250 seconds to perform VCTP with t-test not rejecting equality of task time ($t = -0.296$, $p = 0.767$). Figure A5 in Appendix shows this result holds regardless of the number of balls.

[10]The precise numbers by order, number of balls and management type are: MPL first: $n_{5,S} = 35$, $n_{10,S} = 33$, $n_{5,E} = 47$ and $n_{10,E} = 42$ and VCTP first: $n_{5,S} = 33$, $n_{10,S} = 44$, $n_{5,E} = 44$ and $n_{10,E} = 50$

[11]When played first, like all results in this section



(a) Time (b) Consistency

Figure 7: Time and Consistency by task in the Field

We conclude that MPL and VCTP require similar amounts of time in the field.

Result 3a: Time is similar between tasks in the field.

Figure 7b displays the average consistency for each task. We can see that 88.53% subjects are consistent in MPL and 71.93% subjects are consistent in VCTP, with t-test rejecting equality of consistency between tasks ($t = 3.818$, $p < 0.001$). Figure A6 decomposes consistency in each task by number of balls, showing that MPL is more consistent than VCTP regardless of number of balls but t-tests only reject equality of means for the 5-balls tasks at 1%. Although MPL is superior to VCTP, we note that VCTP consistency remains satisfyingly higher than 70%.

Result 3b: MPL is more consistent than VCTP in the field.

We want to test whether interior solutions are used in the Field. Figure 8 displays the multi-histograms of allocations according to task and interest rate for consistent subjects.[12] It shows that both tasks follow similar trend and that interior solutions are not used very often.

Result 3c: Consistent subjects make little use of interior solutions.

5.2 Effects of Number of Balls and Management Type

Because of the population of subjects and task difficulty, we expected that some subjects would not be able to perform the task without the help of an enumerator. We have 18 subjects fully reporting NA in the task, with 15 of them self-administered and 3 of them externally-administered, respectively rep-

[12]Figure A7 displays the same multi-histograms than Figure 8 but for all subjects.

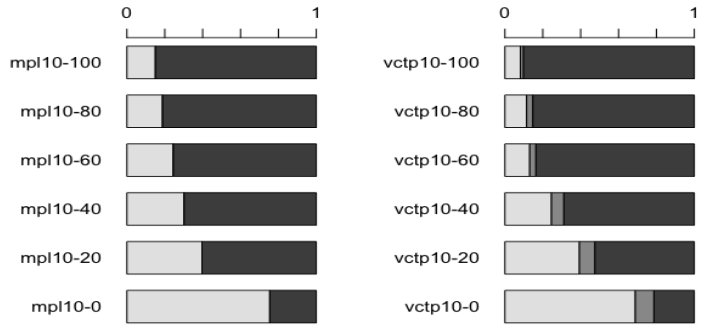


Figure 8: Frequency of allocations type by interest rate, task and number of balls

resenting 8.6% of self-administered subjects and 1.6% of externally-administered subjects. Among them, 13 are unable to read and 5 do not want to perform the task, with all subjects lost due to illiteracy being in the self-administered condition. It suggests that enumerators avoid losing 7.5% of the sample because of illiteracy.

Result 4a: Enumerators increase sample size.

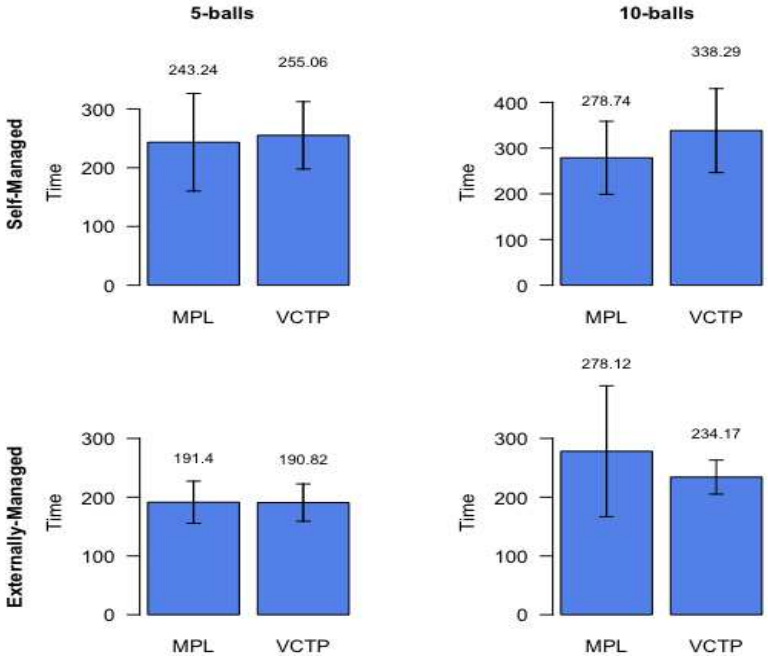
Figure 9a shows Time in the tasks by number of balls and management type. We see that time in MPL and VCTP are similar for given number of balls and management type with t-tests not rejecting equality of time between tasks. We conclude that VCTP is not more time consuming than MPL in the field for a given number of balls and management type.

Result 4b: Time is similar between tasks in the field regardless of the number of balls and management type.

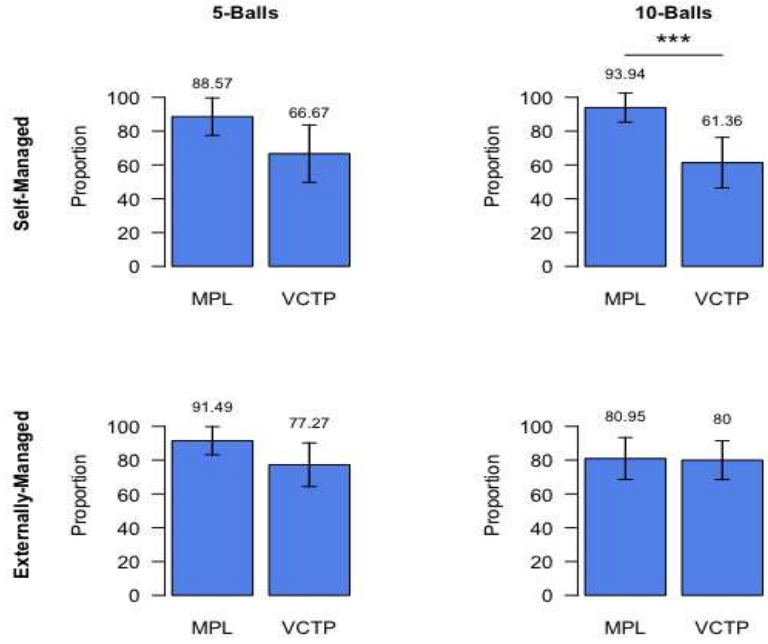
Figure 9b displays consistency for each task according to number of balls and management type. We see that consistency in VCTP is lower than in MPL for all management type and number of balls[13] except for 10-balls externally-managed where consistency is similar between tasks, suggesting that enumerators increase consistency in VCTP. In order to identify any effect of management on consistency, we look at Figure A8 displaying consistency for management type according to task and number of balls. It shows that consistency is higher with an enumerator in all conditions[14]. Figure A9 shows that when 10-balls MPL is

[13] 21.9% in 5-balls self-managed, 32.6% in 10-balls self-managed (significant at 1%) and 14.2% in 5-balls externally-managed.

[14] 2.9% in MPL 5-balls, 10.6% in VCTP 5-balls and 18.6% in VCTP 10-balls (significant at 5%).



(a) Time



(b) Consistency

Figure 9: Time and Consistency by Number of Balls and Type of Management in the Field

played second consistency in externally-managed is higher by 17.5% and significant at 5%. We conclude that enumerators seem to increase consistency in the field, especially with the complex 10-balls VCTP.

Result 4c: Enumerators increase consistency in the field, especially for 10-balls VCTP.

We now investigate any potential effect of number of balls or management type on precision. Figure 10 displays the cumulative multi-histograms of allocations type in each task and interest rate, according to number of balls and management type for consistent subjects. We see that subjects use interior allocations more at low interest rates in 10-balls externally-managed[15].

Result 4d: 10-balls and enumerators seem to increase precision.

We conclude that enumerators improve the size and quality of results, and that the 10-balls version is a better experimental design because it provides more precision but not more errors than the 5-balls version. Overall, results from the Field suggest that the externally-managed 10-balls VCTP task can measure time-preferences in rural context.

6 THE HIGH SCHOOL EXPERIMENT

The high school experiment was conducted online using LimeSurvey with high schools students. We also adapted the task by using piggy banks since we did not expect teenagers to understand the concept of interest rate. We recruited 380 subjects (50.60% females) from four schools in Southern Spain[16]. The participants were randomly assigned to either MPL or VCTP, but not both. The experiment was incentivized by randomly choosing one student to be paid for every class, and the money was transferred by banks. The average gain for those selected was 10.95€. Students were distributed by grades as follow: Grade 2 ($n = 108$, average age=13.55), Grade 3 ($n = 107$, av.age=14.69), Grade 4 ($n = 94$, av. age=15.65) and Others[17] ($n = 71$). Only keeping subjects between thirteen and sixteen years old, we are left with $n = 301$ subjects. Additionally, some of these subjects gave up the experiment before finishing, leaving us with 234 over 301 subjects (77.74%) with complete data. In order to save space, we only present the main results regarding time, consistency and allocations to future in each task.

[15] Percentage of interior solutions by interest rate: 12.8%(0%), 10.2%(20%), 7.7%(40%), 2.6%(60%), 5.1%(80%) and 2.6%(100%)

[16] IES Astaroth, Cádiz; IES Beatriz de Suabia, Sevilla; IES Jorge Juan, Cádiz; IES La Soledad, Córdoba.

[17] Grade>4, Technical Training or Not Specified

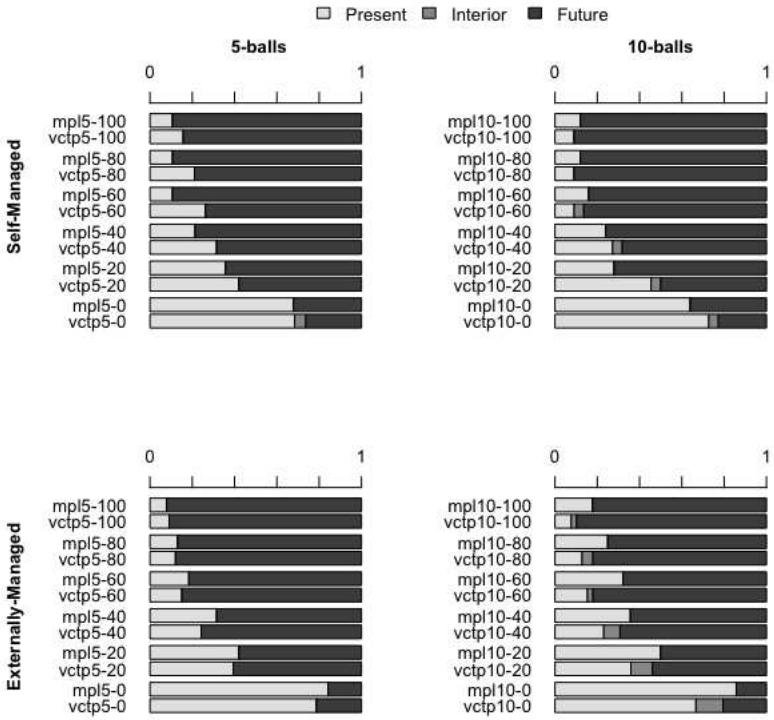
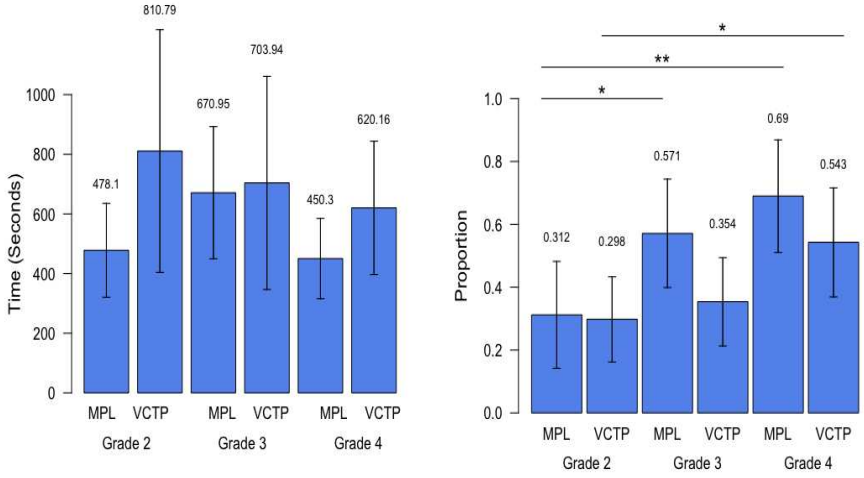


Figure 10: Frequency of allocations type by interest rate, task, management type and number of balls in the field

6.1 Time

Figure 11a displays the average amount of time needed to complete each task by grade. We consider both consistent and inconsistent subjects for now. It suggests that teenagers need more time than adults to perform the task, and that VCTP needs more time than MPL. The larger amount of time needed by Grade 2 subjects suggests that this age is a threshold for the understanding of the task. We also remark that time needed to perform the task decrease with grade, suggesting an improvement in the ability of subjects to understand the task. Additionally, we selected consistent subjects from Grade 3 and Grade 4 ($n = 76$) and found that they needed similar amount of time to complete MPL and VCTP ($t = -0.859$, $p = 0.393$), also suggesting that older subjects have better understanding of the task.

Result 5a: Teenagers need more time than adults to solve the task. Teenagers need more time to solve VCTP than MPL, especially younger subjects.



(a) Time

(b) Consistency

Figure 11: Time and Consistency by task and grade

6.2 Consistency

Figure 11b displays consistency by Task and Grade. We can see that consistency is low overall, but significantly increases with grade in both MPL and VCTP. We see that consistency increase by 25.9% between Grade 2 and Grade 3 in MPL with 5% consistency ($t = -2.178$, $p = 0.033$), increase by 37.8% between Grade 2 and Grade 4 in MPL with 1% consistency ($t = -3.124$, $p = 0.003$) and increase by 24.5% between Grade 2 and Grade 4 in VCTP with 5% consistency ($t = -2.251$, $p = 0.027$). Roughly 30% of Grade 2 subjects are able to complete the task consistently and our highest consistency is 69% with MPL in Grade 4. We also see that consistency is lower in VCTP than in MPL regardless of grade but this difference is not significant.

Result 5b: Teenagers are less consistent than adults but improve with grade. Teenagers are less consistent in VCTP than MPL.

6.3 Future Allocations

Figure 12 displays the average amount of allocations to the future in each task and grade for consistent subjects ($n = 100$). It shows that on average subjects allocate more to the future in VCTP than MPL, but this difference does not reach significance. We also see that Grade 3 subjects allocate more to the future in the MPL task than Grade 2 and Grade 4 subjects. This difference is significant at 5% for both Grade 2 ($t = -2.448$, $p = 0.029$) and Grade 4 ($t = 2.655$, $p = 0.012$).

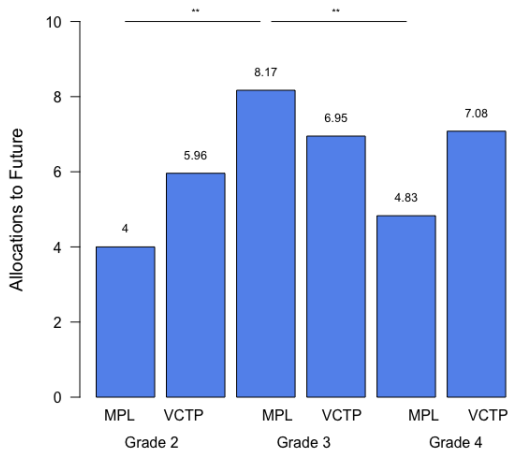


Figure 12: Average Allocations to Future by Task and Grade

We interpret the unusually low amount of allocations to the future in MPL for Grade 2 and Grade 4 as potentially reflecting difficulties to refrain impatience in teenagers, thus taking everything in the present if they are not allowed to mix. Additional validity to this interpretation is given by the increasing allocations to the future in VCTP according to grade, since it might reflect an increase in the ability to control immediate impulse stemming from the maturing of subjects.

Result 5c: Teenagers allocate more to the future with VCTP than MPL. Teenagers allocations to the future in VCTP seem to increase with age.

We conclude that teenagers face difficulties when answering MPL and even more answering VCTP. This pattern is especially prevalent for Grade 2 and decrease with age, suggesting that VCTP needs two adaptations, one for teenagers and one for children. Results also indicate that Grade 4 subjects are more consistent in VCTP and use it properly by saving more. We observe the same trend in a parallel research (see Alfonso, Brañas-Garza, Prissé and Vazquez (2020)) where teenagers solved MPL for risk preferences and the CRT: Grade 2 teenagers exhibit huge levels of inconsistency while Grade 4 perform fairly well.

7 DISCUSSION

Our paper aimed at developing a new tool for measuring time preferences. We developed a simplified version of the CTB with a visual aspect since we wanted to create a time-measurement task bypassing educational level differences. We kept the core idea of both allocating to present and future in CTB, while minimizing the amount of tokens to allocate and the number of trials to perform of MPL. We named our task the Visual Convex Time Preferences. We first evaluated VCTP in the Lab, with results indicating that subjects have similar time and consistency in VCTP than MPL. Subjects use the additional precision of VCTP and we estimated plausible weekly discount rates and curvature parameters using Andreoni-Sprenger methodology. We also obtained a smaller and larger panel of daily interest rates because a minimalist experiment make each choice significant and capture more diversity of estimated interest rates. Then, we brought the task to Honduras to validate our design with poor rural farmers in the Field, also testing whether the experimental design could be simplified to five balls and whether subjects could perform the task without enumerators. We partially replicated results from the Lab, identifying that 10-balls is a better experimental design than 5-balls because subjects switch earlier to the future and make more frequent use of interior allocations than 5-balls. We also showed that enumerators improve the quality of results by helping subjects correctly use interior solutions and increase sample size, since letting subjects managing themselves lead to losing 10% of the sample because of illiteracy. Finally, we brought our experiment to high schools to study if teenagers are able to perform a task designed for adults. Results suggest that high school students have difficulties completing both MPL and VCTP in terms of time and consistency, however older students perform better and closer to adults. The pattern of allocations to the future by consistent subjects suggest that VCTP help teenagers allocating to the future. We conclude that VCTP demonstrated his potential to measure time preferences in each environment we tested it. A potential development of our task is to launch a visual version on electronic tablets. This development is interesting because an electronic application would be more accessible, faster to perform and could be adapted to younger teenagers and children by designing it like a game.

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A APPENDIX

A.1 Questionnaire

Subjects filled a questionnaire at the end of the experiment.

Q1: What was your favourite part ? Part 1 ☐ Part 2 ☐

Q2: What was the easier part ? Part 1 ☐ Part 2 ☐

Q3: In the first/second part, we allowed you to chose a quantity of money, as well in the present as in the future. Did you feel forced to chose both because we allowed you to ? Yes ☐ No ☐

Q4: Do the decisions that you chose really represent what you want ? Yes ☐ No ☐

Q5: Are the instructions clear ? Yes ☐ No ☐
How can we improve them ?

Q6: Was it too long or repetitive ? Yes ☐ No ☐

Q7: Do circles representing the interest rate for waiting helped you understand it ? Yes ☐ No ☐

A.2 Sociodemographics

Subjects filled a questionnaire on Internet before the experiment to obtain their Sociodemographics characteristics.

Q1: Age : 18 ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ 25 ☐ 26 ☐ 27 ☐ 28-30 ☐ 30-35 ☐ 35-50 ☐ 50-60 ☐ More than 60 ☐

Q2: Mail :

Q3: Are you a women ? Yes ☐ No ☐

Q4: Highest grade in which you registered ? Grade 1 ☐ Grade 2 ☐ Grade 3 ☐ Grade 4 ☐ University Master ☐

Q5: What curriculum / Master are you studying ?

Q6: Tick the box in the scale corresponding to the following statement : "I do not care about how much money I get, what preoccupy me is that others got less than me ?" 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐

Q7: Tick the box in the scale corresponding to the following statement : "I do not care about how much money I get, what preoccupy me is that others got more than me ?" 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐

The three following questions were the Cognitive Reflection Test (CRT).

Q8: A football stadium double the number of supporters at each game. If they need to play 48 games to fill the stadium, how much game do they need to fill half of the stadium ?

Q9: If 5 machines manufacture 5 goods in 5 minutes, how much minutes are needed for 100 machines to manufacture 100 goods ?

Q10: A ball and a baseball bat cost 1.10 Euros. The ball cost 1 Euro more than the baseball bat. How much does the ball cost ?

Q11: Choose the session you prefer between the ones available:
☐ 22 April 2019, session 13.30, aula 01
☐ 22 April 2019, session 13.30, aula 03
☐ 23 April 2019, session 13.30, aula 01
☐ 23 April 2019, session 13.30, aula 03

Q12: If you finally do not want to participate, close the window and do not send the formulary.

A.3 Additional Tables

Table A1: MPL allocations to the future in first round

	All Subjects	All Subjects	MPL Consistent	MPL Consistent	Consistent	Consistent
Hypothetical	-0.774	-0.366	-1.325	-0.832	-1.133	-0.622
	(-1.22)	(-0.50)	(-1.97)	(-1.06)	(-1.64)	(-0.78)
Onetenth	-0.182	-0.0603	-0.674	-0.462	-0.280	-0.0614
	(-0.28)	(-0.09)	(-0.98)	(-0.67)	(-0.39)	(-0.09)
Age		0.0656		0.0355		0.0398
		(0.97)		(0.51)		(0.58)
Female		1.309*		1.230*		1.094
		(2.39)		(2.13)		(1.84)
Crt		-0.632		-0.890		-1.001
		(-0.73)		(-1.00)		(-1.09)
Constant	6.731***	4.732**	7.222***	5.910**	7.105***	5.745**
	(14.87)	(2.88)	(14.43)	(3.36)	(13.76)	(3.21)
N	77	66	71	60	64	54
R^2	0.0215	0.1329	0.0541	0.1517	0.0473	0.1505

t statistics in parentheses

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

A.4 Additional figures

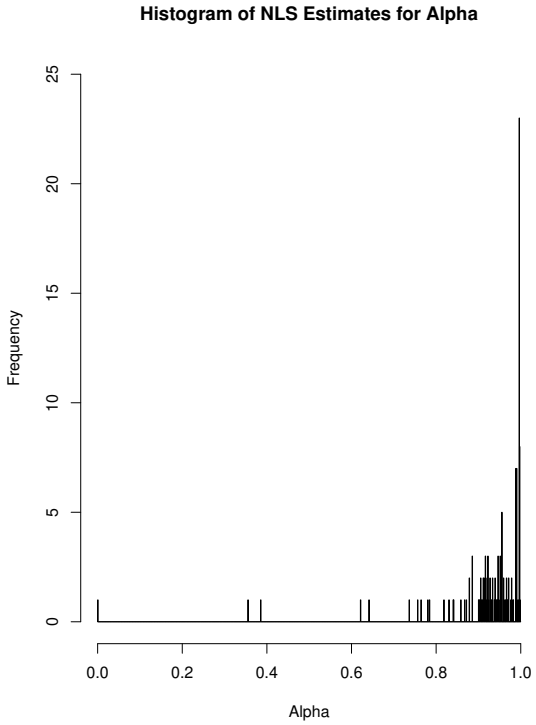

Figure A1: Histograms of estimated values for alpha of individuals

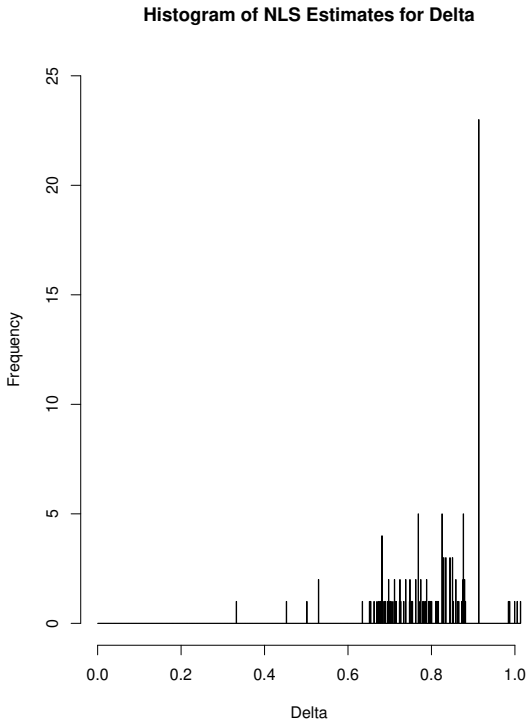

Figure A2: Histograms of estimated values for delta of individuals

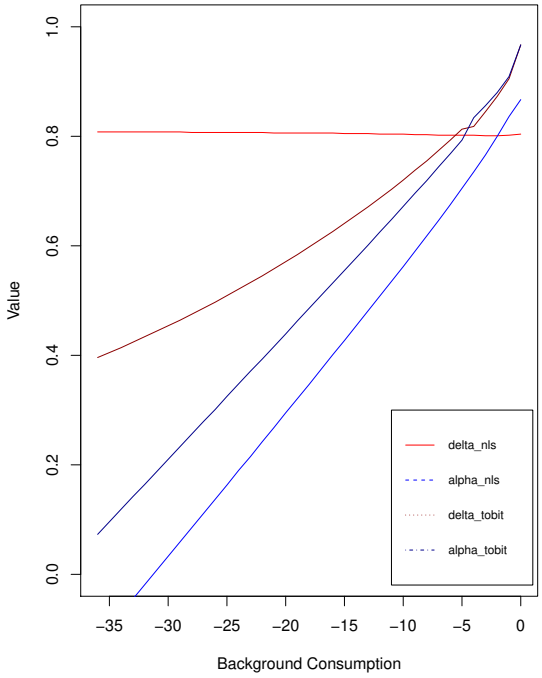

Figure A3: Histograms of estimated values for delta of individuals

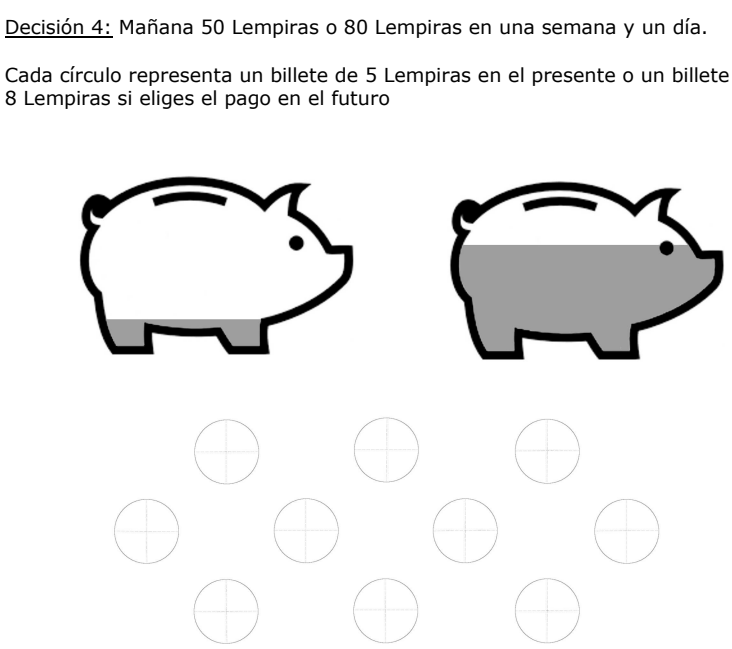

Figure A4: Example of a decision task in Honduras

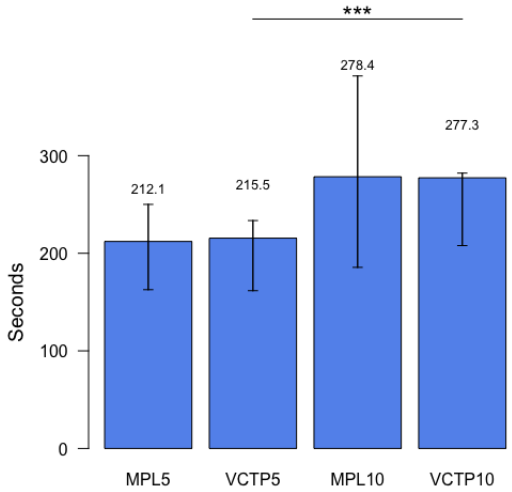

Figure A5: Time for task in the field according to number of balls

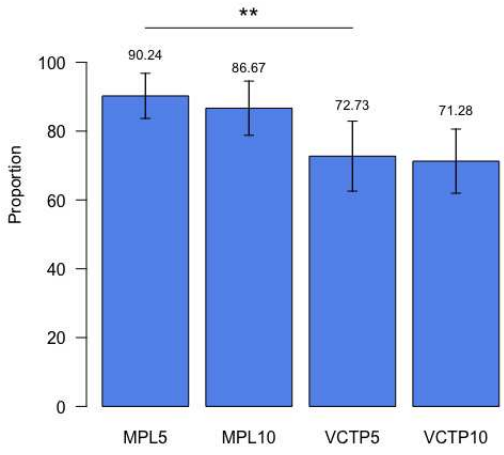

Figure A6: Consistency for task in the field according to number of balls

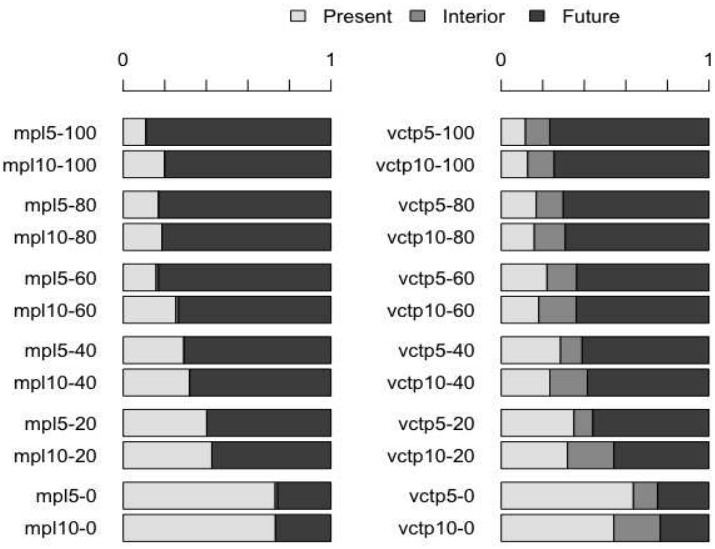

Figure A7: Frequency of allocations type by interest rate, number of balls and consistency for all subjects in VCTP

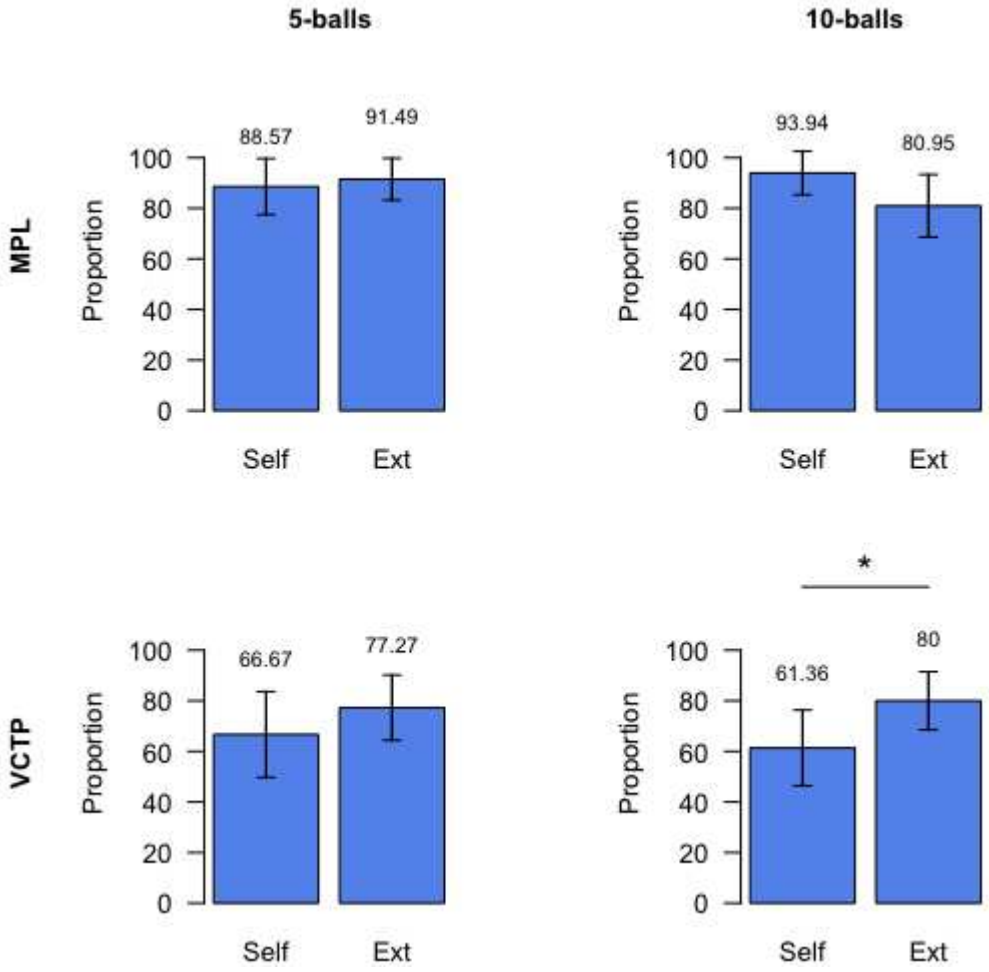

Figure A8: Consistency by type of management in the field according to task and number of balls

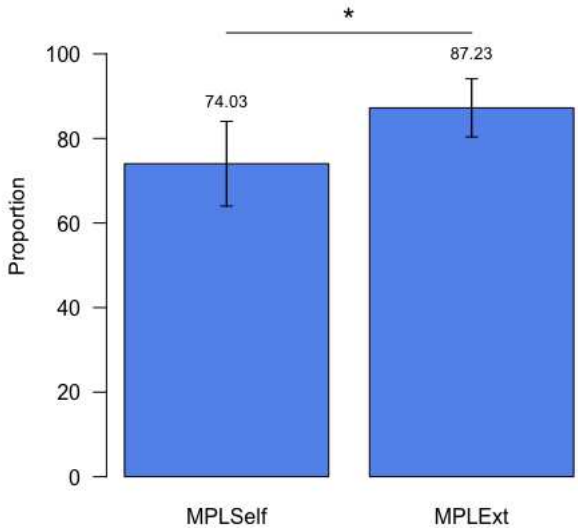

Figure A9: Consistency in the field for MPL 10-Balls played second by type of management

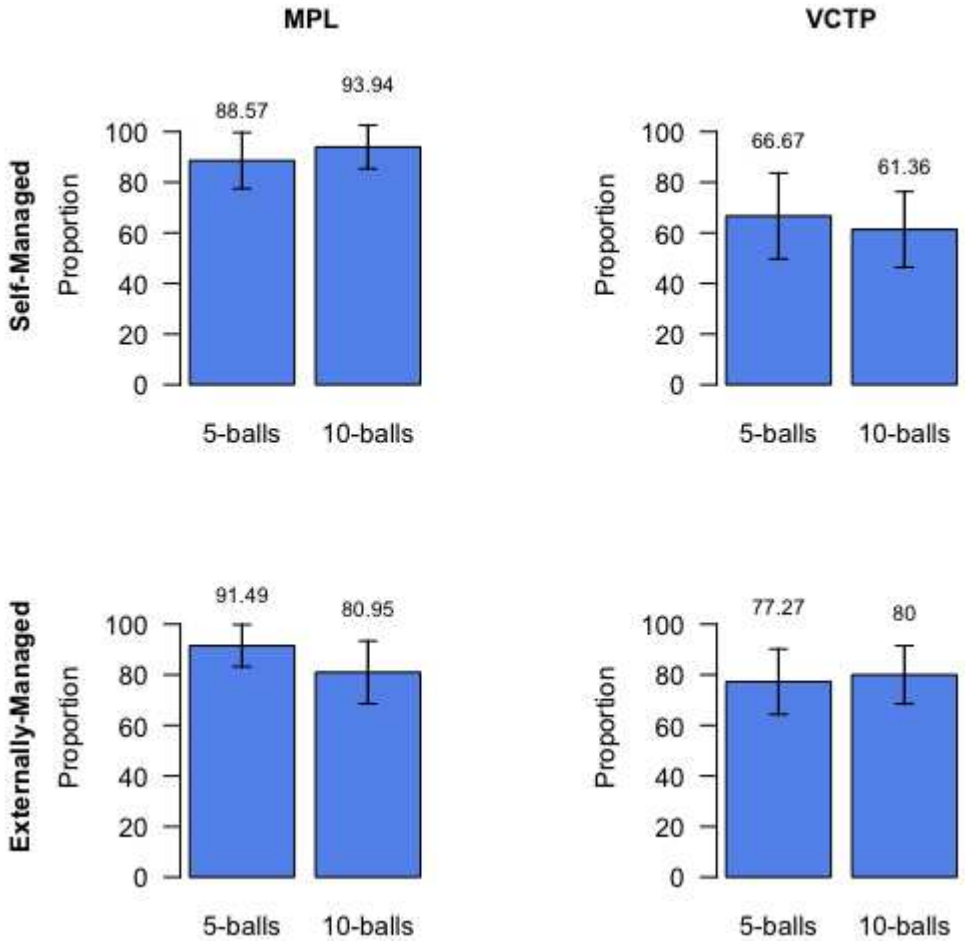

Figure A10: Consistency by type of management in the field according to task and number of balls