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Comparing risk elicitation in lotteries with visual or contextual aids ☆

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ABSTRACT

Eliciting risk preferences usually involves tasks that subjects may find complex, such as calculations of expected values and assessment of probabilities in multiple price lists (MPL). There is a serious concern that the decisions of the subjects may be driven by miscalculations or miscalibration of probabilities, rather than by their risk preferences. In this paper, we test whether introducing aids to the usual lottery choices would help to reduce the error rate and possibly change risk aversion elicitation. The experiment was run with subjects from a rural area in Honduras. We compare the risk elicitation results of a multiple price list and two different treatments, one with visual aids (graphical representation of probabilities) and the other with contextual aids (bills to represent rewards and a distribution of ten beans between the two rewards to represent a lottery). Our results indicate that risk attitudes elicitation was affected with contextual aids, reducing risk aversion. For the treatment with visual aids we observe no effect.

1. Introduction

One of the critical issues in risk elicitation is the complexity of dealing with probabilities and the fact that individuals very often miscalibrate their chances (Camerer, Loewenstein, & Rabin, 2004; Dessalles, 2006). The traditional elicitation methods, such as Multiple Price Lists (MPL), where subjects face pairwise choices between lotteries within a choice list, allow the estimation of risk preference parameters in a model that makes particular functional form assumptions (Holt & Laury, 2002), but these methods based on MPL may be very demanding for some subjects. This complexity may translate into errors and inconsistencies, so that choices may not correspond to the subject's true attitude towards risk. For laboratory experiments with university students the complexity of choosing lotteries in an MPL framework may not be a serious concern, but in different populations the difficulty of the task may be too high for results to be reliable. For example, in Charness and Viceisza (2016) 75% of Senegalese farmers made inconsistent choices; Hirschauer, Musshoff, Maart-Noelck, and Gruener (2014) found 57% inconsistent answers amongst Kazakh farmers; and Jacobson and Petrie (2009) found a 55% inconsistency rate for adults in Ruanda. Inconsistencies have been found also in developed countries, Holt and Laury (2002) reported 13% of inconsistencies among students in the USA and Dave, Eckel, Johnson, and Rojas (2010) found 8.5% of inconsistent answers in a sample of Canadian citizens.

These differences in the rate of inconsistencies suggest that the ability to make correct probabilistic evaluations may depend on education. Fontanari, Gonzalez, Vallortigara, and Girotto (2014) have tested this hypothesis and they find that preliterate and prenumerate Mayan adults are able to solve a variety of probabilistic problems and their performance is equivalent to that of the western controls. For their experiment they used chips of several colors and shapes to represent probabilities so that the elicitation instrument would not interfere or be a barrier to the probabilistic assessment of the subjects. They conclude that the human mind possesses a basic probabilistic knowledge.

However, the previous results on the differences in inconsistent choices across populations suggest that the cognitive requirements of the usual elicitation instruments may be a barrier to the correct elicitation of risk preferences. In this paper we test whether the introduction of *(a)* visual aids or *(b)* contextual aids in the usual lottery choices, may reduce inconsistencies and/or change choices. Visual and contextual aids are designed to help subjects understand probabilities and lotteries in a more intuitive way and our hypothesis is that they should reduce inconsistencies and provide a more accurate measurement of risk attitudes. According to Alekseev, Charness, and Gneezy (2017), it is typically more difficult for most people to operate with abstract rather than concrete terms, especially when a task requires sophisticated

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reasoning. Thus, the influence of context may be determinant in reducing errors (inconsistencies) in measuring risk preferences (Meraner, Musshoff, & Finger, 2018).

Regarding the ability of subjects to accurately assess quantitative magnitudes from visual referents, Cleveland and McGill (1984) analyze how people extract quantitative information from graphs. One example of these visual representation is the dots method employed by Krupnick et al. (2002), that provides a graphic image to complement the direct fractional, numerical representation of probability. Visual ladders have been used in previous research on mortality risk by Gerking, De Haan, and Schulze (1988) and Gegax, Gerking, and Schulze (1991).

No single task representation for lotteries seems to be equally effective for all subjects and the existing literature points to important differences between experts and non-experts (Cleveland, Harris, & McGill, 1983 and Cleveland, Harris, & McGill, 1982). Harrison, Rutström, et al. (2008) summarize visual aids used to represent probabilities in risk elicitation. They find that a careful experimental design that includes these representations may generate some robustness and convergence in subjective and perceived probabilities, but there is no single task representation for lotteries that is optimal for all subjects.

Previous literature has addressed the question of the influence of risk measurement instruments (Csermely & Rabas, 2016; Drichoutis & Lusk, 2016; Espinosa & Ezquerra, 2022). Among other dimensions, instruments may differ according to the complexity of the elicitation method and this complexity may be related to the framing of the task. For example, simple elicitation methods such as the Balloon Analogue Risk task, tend to be easier for participants to understand Charness, Gneezy, and Imas (2013). Dave et al. (2010) compare two elicitation methods with different degree of difficulty and find that with more complex instruments subjects exhibit noisier behavior.

Experimental studies have found a negative relationship between cognitive abilities and risk aversion. Andersson, Holm, Tyran, and Wengström (2016, 2020) and Amador-Hidalgo, Brañas-Garza, Espín, García-Muñoz, and Hernández-Román (2021) explore whether the negative correlation is due to preferences or noisy decision making in tasks to elicit risk attitudes.[1] They conclude that when computations are hard, random decision making by subjects with lower cognitive ability may lead to an overestimation of risk aversion for these individuals. Therefore, we should expect that an elicitation procedure that improves the understanding of the task, by decreasing the cognitive requirements, would lead to a lower elicited risk aversion. Indeed, in our experiment we find that for the treatment with contextual aids, with lower cognitive demand, the elicited risk aversion is lower.

For our experiment, we have chosen a subject pool in a rural developing-country, not used to dealing explicitly with probabilities, so that the effect of visual aids and contextual aids could be more apparent. Previous work on contextual framing has tried to introduce "realism" into the decision problem faced by subjects. For example, Rommel, Hermann, Müller, and Mußhoff (2017, 2019) run an experiment with German farmers and framed the MPL as a decision between two wheat varieties that differed in the variation of their gross margins contingent on uncertain weather events. Hill and Viceisza (2012) elicited Ethiopian farmers' risk preferences framing the MPL as a decision to purchase fertilizer under yield variations from stochastic weather conditions.[2] In our field experiment we did not try to frame the decision as a real one, but explained the lotteries using contextual *aids* (bills for the payoffs and beans to explain probabilities). With this approach we tried to improve the subjects' understanding of the task while avoiding the interference of a framing which may affect the subjects' objectives in a way we cannot control.[3]

The question is whether using traditional MPLs may generate different outcomes than using other instruments with the same lottery choices but adding visual or contextual aids. In a between-subjects design, we test whether the estimated risk aversion coefficient, the number of inconsistent decisions and the subjects' time response differ across treatments.

We find that a graphical representation of probabilities (visual aids) did not have any effect. However, contextual aids (bills to represent rewards and a distribution of ten beans between the two rewards to represent a lottery) decreased inconsistencies and affected the risk attitudes elicitation when compared to a traditional MPL where subjects face 5 pairwise choices between lotteries within a choice list.

The paper is organized as follows. Section 2 describes the experimental design and main hypotheses. Section 3 presents the results concerning differences between the treatments and Section 4 concludes with a discussion of the results and directions for future research.

2. Methods

2.1. Experimental design and hypotheses

The experiment was carried out in conjunction with data collection for a larger World Bank project implemented also in Nigeria, aiming to test how an educational intervention may influence literacy rates of children and parental attitudes towards education. It was run between May 1st and 14th of 2019, in eleven school districts in Santa Rosa de Copán (Honduras), where 360 households were randomly selected to be interviewed. The eligibility criteria for households was having at least one child between 6 and 9 years old registered at one of 11 different public schools.

The experiment was conducted by 12 field enumerators who were trained in a three-day workshop. All the enumerators (1 man and 11 women) were over 20 years old and had university studies. They received a list of households they had to visit, and the type of paper-based questionnaire they had to apply to each household. In the experiment, instructions were read and explained by the enumerator.

The random allocation of treatments was performed prior to the visit and the interviewers did not have any influence on such selection. To ensure the enumerators were applying the corresponding questionnaire to the households, a field coordinator supervised the correct use of the lists created by the researchers. All questionnaires and instructions were originally written in English. Prior to the experiment, we run a pilot of the risk preference questionnaire with around 20 subjects to ensure the translation into Spanish was appropriate to the context. Enumerators conducted all face-to-face interviews in the households of the participants and only one experimental subject was interviewed per household.[4]

In the risk elicitation literature there is a variety of MPL mechanisms. Holt and Laury (2002) proposed a mechanism where subjects make choices in 10 pairs of lotteries that vary in risk and return. Binswanger (1980) asked subjects to make binary choices between eight pairs of 50/50 gambles where gains in expected value corresponded to an increase in risk; the task included two dominated lotteries, and among the rest, expected payment had a nonlinear (convex) relationship to risk. Eckel and Grossman (2008) designed a simple task where

[1] See also Benjamin, Brown, and Shapiro (2013), Taylor (2013) and Dohmen, Falk, Huffman, and Sunde (2018).

[2] See Iyer, Hirsch, Meraner, and Finger (2019) for a review on farmer risk preference measurement across Europe.

[3] For example, Rommel et al. (2019) find that there may be interaction between monetary incentives and contextual framing in lottery tasks, and that monetary incentives may undermine the framing effects.

[4] The study was approved by University Loyola Andalucía Ethics Committee. All participants signed an informed consent form. The field study was pre-registered in AsPredicted before conducted. The documentation can be consulted here: https://aspredicted.org/6qh4a.pdf.

Table 1
Five pairwise choices MPL.

Choice	q	Lottery A	Lottery B
1st	0.1	0.1*L50 + 0.9*L40	0.1*L100 + 0.9*L1
2nd	0.4	0.4*L50 + 0.6*L40	0.4*L100 + 0.6*L1
3rd	0.5	0.5*L50 + 0.5*L40	0.5*L100 + 0.5*L1
4th	0.6	0.6*L50 + 0.4*L40	0.6*L100 + 0.4*L1
5th	0.9	0.9*L50 + 0.1*L40	0.9*L100 + 0.1*L1

subjects face five gambles and are asked to choose which of the five they wish to play; the gambles include one sure outcome with the remaining four increasing (linearly) in expected payoff and risk. We use a MPL similar to Holt and Laury (2002) but with 5 choices since the duration of the interview is a critical issue in the field. To avoid the "embedding bias" (Bosch-Domènech & Silvestre, 2013) that appears when either a group of first or last choices in a 10-choice MPL are removed, we select interleaved pairs; in particular $q = 0.1$, 0.4, 0.5, 0.6 and 0.9. Moreover, there is experimental evidence that subjects usually switch between options at these points (Amador-Hidalgo et al., 2021) and that the number of options offered in a MPL does not affect the results (Herranz-Zarzoso, Sabater-Grande, & Jaramillo-Gutiérrez, 2020).[5]

In our 5-item MPL (see Table 1), each subject is asked to choose between two lotteries A and B (in Appendix B we include the MPL as it was presented to the subjects). Both A and B offer a low and a high payment with probability q and (1-q). The set of choices is the following, with the amounts of money expressed in Lempiras (L), the local currency in Honduras:[6]

Observe that in the first choice the expected value of A is much higher than that of B (L41 vs L10.9) while this is reversed in decision 5 (L49 vs L90.1). In decisions 2, 3 and 4 the expected values of A and B are much closer (L44 vs L40.6; L45 vs L50.5; L46 vs L60.4, respectively). A risk neutral subject would select: A, A, B, B, B in decisions 1 to 5, respectively. A risk-loving subject would select less than two A's and a risk averse subject more than 2 A's (3, 4 or 5).

Subjects were paid for only one random choice out of the five made. In each treatment, subjects were randomly assigned to three groups. In the first group subjects would receive real payments, in the second we paid 1 out of 10 participants (BRIS, Between-subjects Random Incentive System) and in the third group payments were hypothetical. Before the task subjects were aware of their own incentive system. There were no significant differences in subjects' choices between the three incentive schemes and therefore we pool the data. This is consistent with previous experimental evidence. According to Camerer and Hogarth (1999) review, monetary rewards matter when there is effort or performance response to such incentives, while tasks related to trading in markets, bargaining in games and choosing risky gambles were not found to be sensitive to such incentives.[7]

Our experiment contains two treatments (the first with visual aids and the second with contextual aids) and the baseline treatment (the MPL with 5 decisions):

- Treatment PC: Implementing a binary lotteries method where subjects face 5 pairwise choices with a visual aid. For each of the five decisions, two pie charts are presented to the subject with the circles divided in two parts that contain the respective rewards for each lottery. The enumerator explains that the size of each part of the circle represents how large is the possibility of winning the amount written.
- Treatment BB: Implementing a binary lotteries method with 5 pairwise choices with a contextual aid mechanism. For each of the five decisions, the lotteries involved were explained as follows: the enumerator shows two images with copies of money bills representing the rewards of each lottery and distribute ten beans between the two images, to represent the chances of winning that amount. The interviewers explained that the more beans are placed on a certain quantity, the higher the possibility of winning that amount.

Each subject was randomly assigned to one of the three treatments: MPL denotes the multiple price list mechanism, PC the Pie chart mechanism and BB the beans and bills mechanism. In Appendix B we provide more information on these visual and contextual aids. For the measurement of the time spent on the tasks, and after having explained to the subjects the use of each mechanism, the enumerator recorded the time at the beginning of the task, and again after the task was completed.

To elicit risk preferences, we used a between-subject design where participants were randomly assigned to one of the 3 treatments (arms), each with probability $\frac{1}{3}$. The distribution of subjects resulting from the random assignment was as follows: MPL (116 subjects), PC (122) and BB (122).[8]

For each treatment, we estimate the risk aversion coefficient assuming a CRRA utility function (constant relative risk aversion):

$$u(x) = \frac{x^{1-r}}{1-r}$$

for $r > 0$, $r \neq 1$ and

$$u(x) = lnx$$

for $r = 1$, where x is the money earned and r is the relative risk aversion coefficient, the parameter to be estimated.

We use maximum likelihood (ML) structural estimation with the Luce error specification (Harrison, 2008; Harrison et al., 2008; Luce, 1959). In MPL lotteries it is often the case that subjects show inconsistencies by switching options multiple times (Charness et al., 2013). These observations are usually eliminated from the analysis, but with a ML structural estimation we are able to account for these "mistakes" by adding a stochastic component that models errors.[9] The CRRA coefficient is determined by individual and treatment characteristics.

In the ML regressions the dependent variable is r. The treatment effects will be identified by the coefficients of the treatment dummies, and this will allow us to test the following two hypotheses:

- Hypothesis 1. Visual aids (*treatment PC*) decrease the elicited risk aversion coefficient compared to the *baseline treatment MPL*.
- Hypothesis 2. Contextual aids (*treatment BB*) decrease the elicited risk aversion coefficient compared to the *baseline treatment MPL*.

[5] Nevertheless, compared to other papers using the Holt and Laury MPL, a simplified MPL may affect the number or percentage of inconsistent choices (Lévy-Garboua, Maafi, Masclet, & Terracol, 2012) so that our percentage of inconsistencies may not be directly comparable to theirs.

[6] L1 is approximately USD 0.041. The daily wage of unskilled workers in this rural community is about L150.

[7] See also (Wiseman & Levin, 1996), Jacobson and Petrie (2009), Bellemare and Shearer (2010), (Kühberger, Schulte-Mecklenbeck, & Perner, 2002) and Brañas-Garza, Estepa-Mohedano, Jorrat, Orozco, and Rascón-Ramírez (2021). However, other authors report significant effects. In a bi-dimensional multi-lottery choice task, Barreda-Tarrazona, Jaramillo-Gutiérrez, Navarro-Martínez, and Sabater-Grande (2011) find that hypothetical payments are associated to higher risk aversion. Holt and Laury (2002, 2005) find that increasing the size of real payoffs leads to more risk averse behavior than hypothetical payments. See also Etchart-Vincent and l'Haridon (2011), Charness and Viceisza (2016), Binswanger (1980) and Levitt and List (2007).

[8] The risk aversion elicitation task was part of an experiment with 4 tasks: coordination, expectations, risk aversion and time discount, in that order.

[9] See also Carbone and Hey (2000) and Loomes, Moffatt, and Sudgen (2002).

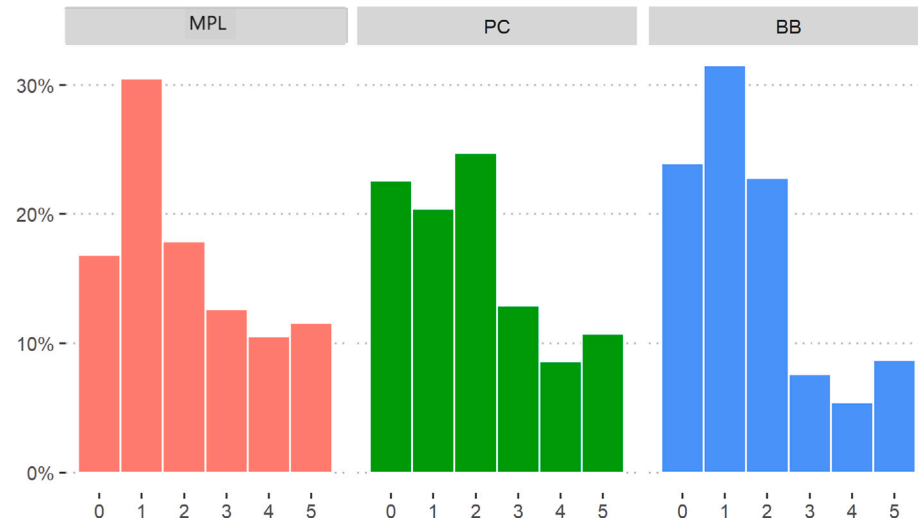

Fig. 1. Distribution of A-choices for each treatment. The number of A-choices ranges from 0 (always chooses lottery B) to 5 (always chooses lottery A).

Table 2
Subject pool in different treatments.

	MPL (1)	*PC* (2)	*PC − MPL* (3)	$p_{(PC-MPL)}$ (4)	*BB* (5)	*BB − MPL* (6)	$p_{(BB-MPL)}$ (7)	*n* (8)
Men	0.181	0.139	−0.041	0.353	0.098	−0.082	0.066	50
Women	0.818	0.860	0.041	0.353	0.901	0.082	0.066	310
Educ	9.4	9.2	−0.221	0.700	8.7	−0.723	0.208	358
SES	2.189	2.098	−0.091	0.377	2.182	−0.007	0.945	360
Age	33.8	35.6	1.699	0.178	33.6	−0.231	0.854	359
Pay real	0.293	0.303	0.010	0.865	0.311	0.018	0.759	109
Pay Bris	0.353	0.344	−0.009	0.883	0.352	−0.001	0.987	126
Pay hypot.	0.353	0.352	−0.001	0.987	0.335	−0.017	0.779	125
Mayachorti	0.230	0.164	−0.068	0.174	0.164	−0.068	0.174	67
Lenca	0.086	0.087	0.004	0.908	0.048	−0.037	0.280	27
n	116	122			122			360

Note: *Educ* is the average number of years of schooling; *SES* is the socio economic status of the school district: 1 (high), 2 (medium), 3 (low); *Age* is the average age of participants; *p* is the *p*-value of the corresponding test of differences between means.

The sign of the effect is suggested by the literature, which has pointed out that a reduction of the task cognitive requirements may reduce elicited risk aversion (Amador-Hidalgo et al., 2021; Andersson et al., 2016, 2020).

We also look at the treatment effects on the number of inconsistent choices and the time spent in making the decision:

- Hypothesis 3. Visual aids (*treatment PC*) reduce the number of inconsistent choices compared to the *baseline treatment MPL*.
- Hypothesis 4. Contextual aids (*treatment BB*) reduce the number of inconsistent choices compared to the *baseline treatment MPL*.
- Hypothesis 5. Compared to the *baseline treatment MPL*, subjects will require less or the same time at most under the treatment with visual aids (*treatment PC*).
- Hypothesis 6. Compared to the *baseline treatment MPL*, subjects will require less or the same time at most under the treatment with contextual aids (*treatment BB*).

2.2. Subject pool

We present some descriptive statistics of the subject pool. Table 2 contains for each treatment the proportion of male and female subjects (in percentage), the average number of years of schooling (Educ), average age of the subjects measured in number of years (Age) and the socio economic status of the school district (SES), which can take value 1 (high), 2 (medium) or 3 (low). Finally, proportion of Mayachorti and Lenca (both ethnic groups) subjects across treatments is provided.

Subjects were randomly assigned to the treatments and the sub samples are balanced across treatments in socio-demographic characteristics and ethnic composition. The table also includes the proportion of subjects for each payment method in each treatment. Columns (3) and (6) show differences in means between each treatment and the baseline. Columns (4) and (7) show the *p-values* of those differences.

3. Results

3.1. Description of the data

Table 3 provides information on the average number of A-choices in different subsamples and for each treatment, for consistent subjects ($n = 280$; 95 in MPL, 93 in PC and 92 in BB). Risk neutrality would correspond to 2 A-choices and the mean of the different treatments is not far from that reference point. For the baseline MPL and treatment PC we cannot reject that the mean is 2. However, for treatment BB the mean is statistically different (see the p-values in Table 3).

Fig. 1 presents the distribution of choices for each treatment (only for consistent subjects). Note that the density of risk averse choices (3, 4 and 5 A-choices) is lower in treatment BB than in MPL or PC. A Wilcoxon signed rank test suggests differences between the distribution of choices in treatments MPL and BB ($z = 1.660; p = 0.097$), while the differences between PC and MPL are not significant ($z = 0.264; p = 0.791$).

This preliminary look at the data suggests that the contextual aid may have affected behavior. In the next subsection we present a regression analysis that allows to control for several covariates and therefore test for treatment effects rigorously.

Table 3
A-choices by treatment, consistent subjects.

	MPL	*PC*	*PC − MPL*	*BB*	*BB − MPL*	*n*
All	2.04	1.97	−0.074	1.65	−0.389	280
Men	1.93	2.38	0.456	1.18	−0.746	38
Women	2.06	1.89	−0.161	1.71	−0.345	242
Highedu	2.31	2.19	−0.124	1.9	−0.408	124
Old	1.68	2.08	0.401	1.69	0.018	66
n	95	93		92		280
H_o: mean = 2						
p value	0.399	0.423		0.014		

Note: *Highedu* stands for the subsample of subjects with more than 10 years of schooling; *Old* the subsample of subjects more than 40 years old. The p-values correspond to the test whether the mean of A-choices is 2 (risk neutrality) for each treatment. *n* includes only consistent subjects.

3.2. Regression analysis

In this subsection we present our main results on the treatment effects. First, we look at how risk attitude elicitation is affected by the treatment; more precisely, we look at the treatment effects in the estimation of the risk aversion coefficient by maximum likelihood. Then, we look at the effect of the treatment on the number of inconsistent choices and the time of response.

First, we present the treatment effects on the estimated risk aversion coefficient in Table 4.

We present four models in Table 4. In all the models but the second one, we include the treatments and their interactions with gender to check whether there is a differential effect for males and females. In models (2), (3) and (4) we include demographic covariates. In the last model we introduce socio economic status (SES) fixed effects. In our sample all subjects have children attending different public schools and the SES dummies collect school district disparities in socio economic features. Socio-demographic variables are not significant except for the ethnic minority maya chorti, that shows higher risk aversion. In all the models but (2), the treatment with contextual aids (money bills and beans) is significant and the risk aversion coefficient is lower.

Visual and contextual aids are intended to improve subjects' understanding of the task and therefore elicit more accurate measures of risk attitudes. Treatments PC and BB should therefore imply a lower number of inconsistent choices. If we look at treatment effects on the number of inconsistent choices, we can see in Table 5 that money bills and beans aid (BB) contributes to the reduction in the number of inconsistent choices made by the subjects, as expected. However, for the female subjects this is not the case since the interaction effect is significant and has a positive sign. The visual aids treatment (PC) has no impact on the number of inconsistent choices. Apparently, this visual aids treatment did not improve the subjects' understanding of the task.

We conclude that from the two treatments intended to improve the understanding of the task, PC and BB, only one was effective, the contextual aid. In the BB treatment the rewards of each lottery were represented through copies of bills and the probabilities were illustrated by distributing ten beans between the two amounts of money. In our experiment this representation of lotteries decreased the number of inconsistent choices (Table 5) and the elicited risk aversion coefficient (Table 4). Therefore, we cannot reject hypotheses 2 and 4.

The reduction in the elicited risk aversion coefficient in treatment BB can be interpreted using the results of Amador-Hidalgo et al. (2021). They find that low cognitive ability subjects face a higher computational complexity (and choose randomly) in Holt and Laury (2002) task after some point, precisely when consistent individuals start choosing the risky option more often. This explains why inconsistencies are associated with more A-choices. Thus, improving the understanding of the task may be equivalent to an increase in subjects' cognitive ability, causing a lower elicited risk aversion.

In the treatment PC, the lotteries were illustrated with a circle divided in two parts. The area of each part was proportional to the probability and in each part the size of the reward was printed. This seems to have been less effective and we reject hypotheses 1 and 3.

When we include the payment method as a regressor to check whether it has any influence on the results, it is not significant for the number of inconsistent choices (see Table 7 in the appendix).

Table 6 presents the treatment effects on the time required to do the task. The results in models (2), (3) and (4) are not significant, none of the two treatments requires additional or less time to do the task, compared to the baseline treatment. In view of these results, we cannot reject hypotheses 5 and 6. In model (1) treatment BB reduces the time required to complete the task but the effect is of small size (Cohen's d is 0.34).

Table 4
Treatment effects on the risk aversion coefficient (*r*).

Indep Variables	(1)	(2)	(3)	(4)
treatBB	−0.652*** [1.780]	−0.180 [0,374]	−0.673** [1.890]	−0.702** [2.052]
	(0.001)	(0.242)	(0.025)	(0.031)
treatPC	0.343 [0.740]	0.005 [0.009]	0.353 [0.766]	0.387 [0.852]
	0.131	(0.972)	(0.271)	(0.245)
Age		0.004	0.002	0.002
		(0.520)	(0.717)	(0.748)
Education		0.008	0.008	−0.001
		(0.678)	(0.662)	(0.954)
Female		−0.026	−0.011	−0.015
		(0.900)	(0.960)	(0.943)
Mayachorti		0.339***	0.353***	0.342***
		(0.003)	(0.000)	(0.001)
TreatBB x fem	0.489*		0.541	0.573
	(0.093)		(0.159)	(0.171)
TreatPC x fem	−0.413		−0.403	−0.440
	(0.186)		(0.353)	(0.319)
Constant	−0.431***	−0.680	−0.642	−0.371
	(0.002)	(0.115)	(0.103)	(0.354)
Observations	1,795	1,780	1,780	1,780
Subjects	359	356	356	356
SESs FE	No	No	No	Yes
AIC	2148.28	2129.90	2128.55	2125.39

Notes: p-values in parentheses. *Cohen's d* value in brackets. Boot clustered by enumerators in all models.
***p< 0.01.
**p< 0.05.
*p< 0.1.

Table 5
Treatment effects on the number of inconsistent choices.

Indep Variables	(1)	(2)	(3)	(4)
treatBB	−0.090	0.061	−0.245** [0.571]	−0.247** [0.575]
	(0.376)	(0.113)	(0.027)	(0.028)
treatPC	0.054	0.056	−0.070	−0.076
	(0.582)	(0.147)	(0.635)	(0.603)
Age		−0.003	−0.003	−0.003
		(0.450)	(0.483)	(0.449)
Education		−0.004	−0.004	−0.005
		(0.273)	(0.231)	(0.187)
Female		−0.049	−0.186	−0.190*
		(0.509)	(0.117)	(0.099)
Mayachorti		0.019	0.025	0.022
		(0.801)	(0.720)	(0.748)
TreatBB x fem	0.173		0.351***	0.353***
	(0.132)		(0.006)	(0.006)
TreatPC x fem	0.003		0.154	0.157
	(0.976)		(0.321)	(0.306)
Constant	0.181***	0.358**	0.464**	0.502***
	(0.000)	(0.033)	(0.018)	(0.010)
Observations	359	356	356	356
SESs FE	No	No	No	Yes
AIC	395.81	391.86	391.24	394.21

Notes: p-values in parentheses. *Cohen's d* value in brackets. Boot clustered by enumerators in all models.
***p< 0.01.
**p< 0.05.
*p< 0.1.

Table 6
Treatment effects on the time required to do the task.

Indep Variables	(1)	(2)	(3)	(4)
treatBB	−52.316** [0.336]	−8.833	−112.135	−116.834
	(0.023)	(0.696)	(0.185)	(0.182)
treatPC	−5.747	−8.596	−86.788	−83.129
	(0.882)	(0.743)	(0.430)	(0.438)
Age		2.181*	2.416**	2.391*
		(0.051)	(0.049)	(0.064)
Education		2.127	1.953	0.661
		(0.394)	(0.431)	(0.717)
Female		−8.327	−70.483	−71.169
		(0.819)	(0.453)	(0.450)
Mayachorti		10.822	13.181	11.322
		(0.684)	(0.606)	(0.658)
TreatBB x fem	43.806		120.793	125.772
	(0.152)		(0.140)	(0.38)
TreatPC x fem	−1.815		94.153	90.515
	(0.945)		(0.368)	(0.372)
Constant	191.98***	102.599**	146.422**	187.015*
	(0.000)	(0.015)	(0.040)	(0.055)
Observations	352	349	349	349
SES FE	No	No	No	Yes
AIC	4520.11	4480.99	4479.48	4478.02

Notes: p-values in parentheses. *Cohen's d* value in brackets. Boot clustered by enumerators in all models.
***p< 0.01.
**p< 0.05.
*p< 0.1.

4. Discussion

Risk elicitation methods such as MPL involve dealing with probabilities and for some subject pools they may be very demanding in terms of cognitive abilities. In this paper we test whether visual or contextual aids may reduce the cognitive demands of MPL, reduce inconsistencies and result in a more accurate risk attitude elicitation. We incorporate visual and contextual aids to a 5 pairwise choices MPL, to test whether these treatments improve the subjects' understanding of the task, decrease the number of inconsistencies, reduce the decision time, and affect the elicited measure of risk aversion.

For the treatment with visual aids our results do not show any significant effect. These aids did not affect the number of inconsistencies, the risk aversion coefficient nor the response time. However, the treatment with contextual framing aids did have an effect. In this treatment, subjects see a lottery as two amounts of money (represented by copies of bills) and the probabilities are represented by distributing ten beans between the two possible rewards. This intuitive representation of lotteries (treatment BB) was able to reduce the number of inconsistent choices, mainly in the subsample of males, and at the same time, generated a lower elicited risk aversion.

A better understanding of the task could be related to a higher or lower decision time. Subjects who understand the task may take more time to weight their chances and the rewards, but it may also be the case that a better understanding allows them to decide faster. Subjects with a poor understanding may either decide at random quickly (yielding more inconsistencies) or spend more time trying to understand. Concerning the decision time in our experiment, in the treatment with contextual aids subjects spent less time working on the task than in the baseline, suggesting that a better understanding allows the subjects to decide more swiftly, although this effect becomes not significant when controlling for personal characteristics. The decision time was unaffected by the treatment with visual aids.

Since the treatment with contextual aids reduces inconsistencies, we conclude that the risk aversion measurement is more accurate under this treatment than in the baseline. This conclusion is also supported by previous research on the negative relationship between cognitive abilities and risk aversion. If the treatment with contextual aids provides more clarity, and subjects consider the task less complex than the baseline MPL, this may be equivalent to subjects having more cognitive ability, therefore making fewer errors (less inconsistencies) and showing less risk aversion (Amador-Hidalgo et al., 2021). Our results may be particularly relevant for risk elicitation experiments in developing countries, where the percentage of inconsistencies is usually high.

Data availability

Data will be made available on request.

Appendix A. Instructions given by enumerators

The following instructions were read aloud in Spanish to all the subjects under the three treatments.

H. Risk Aversion *(Real payment)*
Let us play a game. You will choose between two imaginary situations: in both of them either you are lucky and you get some money or you are unlucky and you get less money.
The chances of getting the higher amount are changing from scenario to scenario.
Look at this card (ENUMERATOR – Show card with options). There are 5 scenarios and for each, I will ask if you prefer A or B. Payouts are real and you will receive a payment for your answers. Please take it seriously because the payments are real. You will be paid for only one random choice out of the five made.
IMPORTANT: For each scenario, the chances of earning the high amount of money are the same in A and B. Also note that chances increase (for the high prize) from H1 to H2, from H2 to H3, etc...

Appendix B. Treatments

Treatment MPL. Fig. 2 shows the 5 pairwise choices MPL.

Treatment BB. In Fig. 3 we present our contextual aid instrument. It shows an example of what is shown to subjects in decision 3, when the chances of winning two amounts in both lotteries are the same (five beans over each amount of money).

Treatment PC. In Fig. 4 the pie charts visual aid is presented as it was shown to subjects.

	Which of these two options do you prefer?	
H1	A. In the first option, if you are lucky and you win, you get L50, and if you are unlucky, you will get L40. You have 1 chance out of 10 of winning and getting L50 and 9 chances out of 10 of getting L40. B. In the second option, if you get lucky you get L100, and if you get unlucky, you get L1. You have 1 chance out of 10 of getting L100 and 9 chances out of 10 of getting L1.	1 = option A 2 = option B
H2	A. You have 4 chances out of 10 of getting L50 and 6 chances out of 10 of getting L40. B. You have 4 chances out of 10 of getting L100 and 6 chances out of 10 of getting L1.	1 = option A 2 = option B
H3	A. You have 5 chances out of 10 of getting L50 and 5 chances out of 10 of getting L40. B. You have 5 chances out of 10 of getting L100 and 5 chances out of 10 of getting L1.	1 = option A 2 = option B
H4	A. You have 6 chances out of 10 of getting L50 and 4 chances out of 10 of getting L40. B. You have 6 chances out of 10 of getting L100 and 4 chances out of 10 of getting L1.	1 = option A 2 = option B
H5	A. You have 9 chances out of 10 of getting L50 and 1 chance out of 10 of getting L40. B. You have 9 chances out of 10 of getting L100 and 1 chance out of 10 of getting L1.	1 = option A 2 = option B

Fig. 2. Multiple Price List, treatment MPL.

Fig. 3. Beans and bills, treatment BB.

Fig. 4. Pie Chart showing the probabilities and earnings, treatment PC.

Table 7
Treatment effects on the number of inconsistent choices, including payment method as regressor.

Indep Variables	(1)	(2)	(3)	(4)
treatBB	−0.090	0.060	−0.250**	−0.252**
	(0.376)	(0.133)	(0.030)	(0.030)
treatPC	0.054	0.053	−0.077	−0.082
	(0.582)	(0.171)	(0.599)	(0.571)
Age		−0.003	−0.002	−0.003
		(0.458)	(0.535)	(0.498)
Education		−0.005	−0.004	−0.005
		(0.263)	(0.248)	(0.196)
Female		−0.052	−0.190	−0.194*
		(0.473)	(0.107)	(0.091)
Mayachorti		0.016	0.024	0.022
		(0.831)	(0.727)	(0.754)
Payment method		−0.020	−0.024	−0.022
		(0.260)	(0.224)	(0.241)
TreatBB x fem	0.173		0.356***	0.357***
	(0.132)		(0.007)	(0.008)
TreatPC x fem	0.003		0.161	0.164
	(0.976)		(0.292)	(0.281)
Constant	0.181***	0.422**	0.505**	0.540***
	(0.000)	(0.010)	(0.009)	(0.006)
Observations	359	356	356	356
SESs FE	No	No	No	Yes

Notes: p-values in parentheses. *Cohen's d* value in brackets. Boot clustered by enumerators in all models.
***$p< 0.01$.
**$p< 0.05$.
*$p< 0.1$.

Appendix C. Payment method and inconsistencies

See Table 7.

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