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Comprehension and Risk Elicitation in the Field

Evidence from Rural Senegal

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ABSTRACT

In the past decade, it has become increasingly common to use simple laboratory games and decision tasks as a device for measuring both the preferences and understanding of rural populations in the developing world. This is vitally important for policy implementation in a variety of areas. In this paper, we report the results observed using three distinct risk elicitation mechanisms, using samples drawn from the rural population in Senegal, West Africa. Whatever the intellectual merits of a particular elicitation strategy, there is little value in performing such tests if the respondents do not understand the questions involved. We test the understanding of and the level of meaningful responses to the typical Holt-Laury task, to a simple binary mechanism pioneered by Gneezy and Potters in 1997 and adapted by Charness and Gneezy in 2010, and to a nonincentivized willingness-to-risk scale à la Dohmen et al. We find a disturbingly low level of understanding with the Holt-Laury task and an unlikely-to-be-accurate pattern with the willingness-to-risk question. On the other hand, the simple binary mechanism produces results that closely match the patterns found in previous work, although the levels of risk-taking are lower than in previous studies. Our study is a cautionary note against utilizing either sophisticated risk-elicitation mechanisms at the possible cost of seriously diminished levels of comprehension or nonincentivized questions in the rural developing world.

Keywords: risk elicitation, laboratory experiments in the field, comprehension, rural Senegal

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1. INTRODUCTION

It has become increasingly common in recent years for development economists to utilize tools developed by experimental economists, in order to measure important traits, attitudes, and characteristics of rural populations in the developing world. Some examples include Ashraf (2009); Attanasio et al. (2011); Castillo and Carter (2011); Harrison, Humphrey, and Verschoor (2010); Hill, Maruyama, and Viceisza (2011); and Giné et al. (2010). The importance for policy recommendations and implementation of characterizing risk attitudes is well established. Welfare evaluation of any proposed policy with risky outcomes should take into account people's risk attitudes (see for example the discussion by Harrison 2011 and many of the references within).

A variety of techniques have evolved for testing risk preferences. These are typically incentivized, although nonincentivized questions have also been used successfully in recent years. The elicitation mechanisms range from the simple to the complex.[1] Some researchers favor the theoretical elegance of the more sophisticated approaches, while others favor the simpler mechanisms on the basis of the ease of comprehension and the greater probability of obtaining meaningful responses.

In our study, we implement three elicitation devices in rural Senegal. One device is the well-known method used in Holt and Laury (2002), where people make a series of 10 choices between two systematically varied alternatives. A second device is that created by Gneezy and Potters (1997) and refined by Charness and Gneezy (2010), where there is a simple choice of how much to invest in a risky asset with a positive expected profit. The third mechanism we use is a survey question of the (experimentally validated) type used in Dohmen et al. (2011). We are primarily interested in how well these approaches are understood by people in a rural, developing country setting. To do so, we analyze patterns in the responses made and compare these to the patterns observed in responses to the same questions in Western societies.

Our main results can be summarized as follows. (1) There is a great deal of inconsistency in the choices made by individuals responding to the Holt-Laury (HL) questionnaire; in fact, no more than 25 percent of the respondents made consistent and sensible (nondominated) responses; furthermore, the pattern of choices has little resemblance to the patterns typically observed. (2) The Gneezy-Potters-Charness (GPC) approach seems to have borne more fruit. While the degree of risk aversion is higher in the sample population (perhaps because the payments represent much more purchasing power in Senegal) than in the host of studies reported in Charness and Gneezy (forthcoming), the distribution of responses is reasonably similar and there is no obvious failure of comprehension. (3) While the Dohmen et al. (2011) willingness-to-take risk (WTR) question would seem to be quite easy to understand, the answers are a bit odd, as they do not match up well with the original data from Germany and, if one believes the Senegal data, women are much more likely to take on the highest degree of risk.

Using demographic measures and other covariates elicited by means of a post-survey, we also investigate the determinants of risky choices in the three tasks and the sources of consistency in the HL responses. With the HL questions, the response data suggest that women are less consistent even after controlling for several covariates such as schooling. We find no effect from covariates such as age, schooling, marital status, occupational choice, and trustworthiness on risk-taking in any of the tasks. While the gender effects are in the expected direction, they are statistically insignificant.

Our results bear some resemblance to those of Dave et al. (2010), who found (with Canadian subjects) that a coarser but simpler elicitation method gives less noisy results. However, they found no improvement in predictive accuracy, as measured by a choice rule involving estimated parameters, while our data suggest otherwise.

Overall, our results indicate that simpler is better and that incentives may matter when eliciting risk preferences in developing nations. Development economists wishing to gather data on risk

[1] Two of the most complex mechanisms are those put forward in Tanaka, Camerer, and Nguyen (2010) and Offerman et al. (2009).

preferences should take heed; furthermore, the spirit of our methodological results may also apply to the elicitation of other preferences in this environment.

The remainder is structured as follows. In Section 2, we describe the results from previous studies using the elicitation methods we implemented in Senegal, and we describe our implementation in considerable detail. Section 3 contains the experimental and survey results, and we conclude in Section 4.

2. EXPERIMENTAL DESIGN AND IMPLEMENTATION

There have been quite a few experimental studies on risk preferences, as this is one of the building blocks of economic theory and analysis. In this section, we only discuss the main articles that use the elicitation methods that we implement in our own study. For reviews of previous work, we refer the interested reader to Offerman et al. (2009) and Dave et al. (2010).

Holt and Laury (2002) ask participants to make 10 choices of either option A (the safe option) or option B (the risky option), one for each row. Table 2.1 shows the choices the participants faced in the low-payoff treatment. They also conducted treatments in which the payoffs are 20 times, 50 times, or 90 times the ones shown below.

Table 2.1—Holt-Laury lottery choices

Option A	Option B	Expected payoff difference
1/10 of $2.00, 9/10 $1.60	1/10 of $3.85, 9/10 of $0.19	$1.17
2/10 of $2.00, 8/10 $1.60	2/10 of $3.85, 8/10 of $0.19	$0.83
3/10 of $2.00, 7/10 $1.60	3/10 of $3.85, 7/10 of $0.19	$0.50
4/10 of $2.00, 6/10 $1.60	4/10 of $3.85, 6/10 of $0.19	$0.16
5/10 of $2.00, 5/10 $1.60	5/10 of $3.85, 5/10 of $0.19	-$0.18
6/10 of $2.00, 4/10 $1.60	6/10 of $3.85, 4/10 of $0.19	-$0.51
7/10 of $2.00, 3/10 $1.60	7/10 of $3.85, 3/10 of $0.19	-$0.85
8/10 of $2.00, 2/10 $1.60	8/10 of $3.85, 2/10 of $0.19	-$1.18
9/10 of $2.00, 1/10 $1.60	9/10 of $3.85, 1/10 of $0.19	-$1.52
10/10 of $2.00, 0/10 $1.60	10/10 of $3.85, 10/10 of $0.19	-$1.85

Source: Holt and Laury (2002).

It is clear that option B dominates option A in the last row. It would also require very strong risk-seeking preferences to choose option B in the first row. If a person chooses option A in the first row, there should be exactly one switch point. If we observe switching back and forth, this would seem to indicate either a lack of comprehension or frivolous responses. Most studies in the Western world have inconsistency rates between 10 and 15 percent (13 percent in Holt and Laury 2002, 11 percent in Stockman 2006, and 12 percent in Meier and Sprenger 2010). In settings more similar to ours the evidence seems to be mixed. Galarza (2009) finds an inconsistency rate of 52 percent in Peru while de Brauw and Eozonou (2011) find an inconsistency rate of 14 percent in Mozambique. Jacobson and Petrie (2009) use an instrument that is different from HL (but can also be used to assess inconsistencies) and find a rate of 52 percent in Rwanda.

The original HL results indicate that the median and modal number of safe choices is 5.0 in the low-payoff condition. Higher payoffs lead to more risk-averse behavior; the median and modal number of safe choices in the 20x treatment is 6.0. In the 50x and 90x treatments with real payoffs, the medians are respectively 7.0 and 7.5, and the modes are 7.0 and 9.0.[2] Only 8 percent of the choices in the low-payoff treatment and 6 percent of those in the 20x real-payoff treatment indicate risk-seeking behavior.

Gneezy and Potters (1997) use a simple investment task. Each person is endowed with 100 units. Any number of these could be invested in a risky asset that has a one-third chance of success, and a payoff of 3.5 times the investment is successful; whatever is not invested is kept. Charness and Gneezy (2010) adapt this task to avoid probability-weighting issues (the inverse S-shaped curve; see Wu and

[2] Given the high per-capita cost of the 20x, 50x, and 90x treatments, they also asked for hypothetical choices; these choices showed considerably less risk aversion than those with real payoffs.

Gonzalez 1996), by making the chance of success one-half and the success payoff 2.5 the investment made. Under either payoff calibration, any risk-neutral or risk-seeking person should invest all 100 units.

This mechanism typically gives a nice range of values, and it is possible to directly compute the constant relative risk aversion (CRRA) coefficient from the investment choice (one can only determine a range with the HL mechanism). Furthermore, it seems rather easy to understand. One disadvantage is that one cannot distinguish between risk-neutral and risk-seeking preferences, but risk-seeking preferences appear to be rare. Charness and Gneezy (2010) elicit the risk preferences of students at the University of California, Santa Barbara (UCSB) with financial incentives. Table 1 of their paper shows that the average investment for 136 males and 64 females was 75.82 percent and 60.25 percent, respectively, giving an overall average of 70.84.

A number of other studies have used this investment mechanism (the paper was in existence for many years before publication). A summary of the results is provided in Table 2.2 (reproduced from Table 4 of Charness and Gneezy forthcoming and adding the Charness and Villeval 2009 data in the last row).

Table 2.2—Investment choices in other studies

Study	Participants	Periods	Avg. Male Investment (N)	Avg. Female Investment (N)
Langer and Weber (2004)	Finance students, Mannheim	30	64.62 (93)	58.70 (14)
Haigh and List (2005)	Professional traders, CBOT	9	58.30 (50)	55.59 (8)
Fellner and Sutter (2004)	Undergrads, Jena	18	57.44 (39)	49.04 (79)
Bellemare et al. (2005)	Undergrads, Tilburg	9	45.48 (95)	42.73 (40)
Charness and Genicot (2009)	Undergrads, UCLA	1	59.22 (41)	52.23 (53)
Dreber and Hoffman (2007)	Students, Stockholm	1	69.60 (92)	50.00 (55)
Gneezy, Leonard, and List (2009)	Villagers in Tanzania and India	1	50.00 (157)	50.06 (157)
Ertac and Gurdal (2010) [a]	Undergrads, Turkey	1	72.32 (79)	54.29 (49)
Gong and Yang (forthcoming)	Matrilineal villagers in China	1	53.9 (31)	32.5 (36)
Gong and Yang (forthcoming)	Patrilineal villagers in China	1	37.3 (37)	4.3 (28)
Charness and Villeval (2009)	Workers at French firms	1	62.73 (33)	53.2 (29)

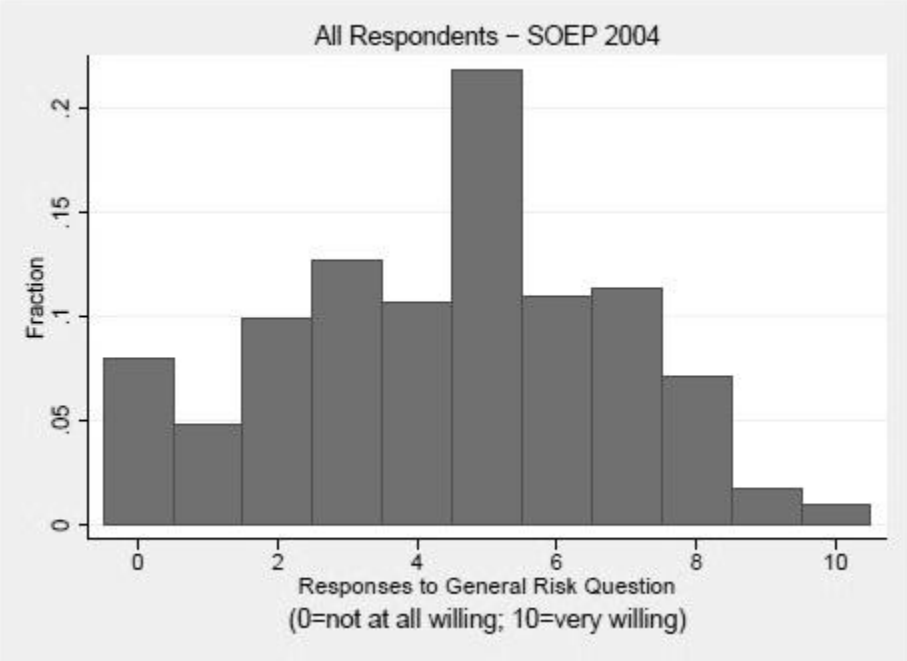
Source: Charness and Viceisza (2011).
Note: [a] We include only the individual risk decisions where there is a positive expected return from investing in the risky asset. A similar gender difference applies in the other cases.

We see that there is a good deal of variation in the investment rate, with villagers more risk-averse than people in Western societies. The overall investment levels range from 44.67 to 65.42 among student populations and from 23.08 to 50.03 among villagers. In general, the local purchasing power of the stakes involved is higher for the villagers, perhaps explaining the greater degree of risk aversion (as HL find with higher stakes).

Dohmen et al. (2011) utilize the general risk question in the German Socio-Economic Panel (SOEP), which simply requests that respondents give an assessment of their general willingness to take risks. The precise wording (in the English translation from the German; see Dohmen et al. 2011 for the original German) is "How do you see yourself: are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a box on the scale, where the value 0 means: "not at all willing to take risks" and the value 10 means: "very willing to take risks". This approach differs from the others in at least two important ways: (1) there are no financial incentives provided, and (2) this question is not specific to financial risk-taking, which may well be better suited to the purposes of development economists. It is clear that there are many forms of risk-taking (for example, physical risk,

financial risk, emotional risk), so that this question may pick up traits orthogonal to the issue of concern; however, they also find that this measure matches up well with the results of an experimental validation. In any event, Figure 2.1 below (from their Figure 1) shows a good spread of risk attitudes in their data, with a strong peak at 5 (the average value in the range).

Figure 2.1—Nonincentivized survey risk attitudes in Dohmen et al. (2011)



Source: Dohmen et al. (2011).
Note: SOEP is German Socio-Economic Panel.

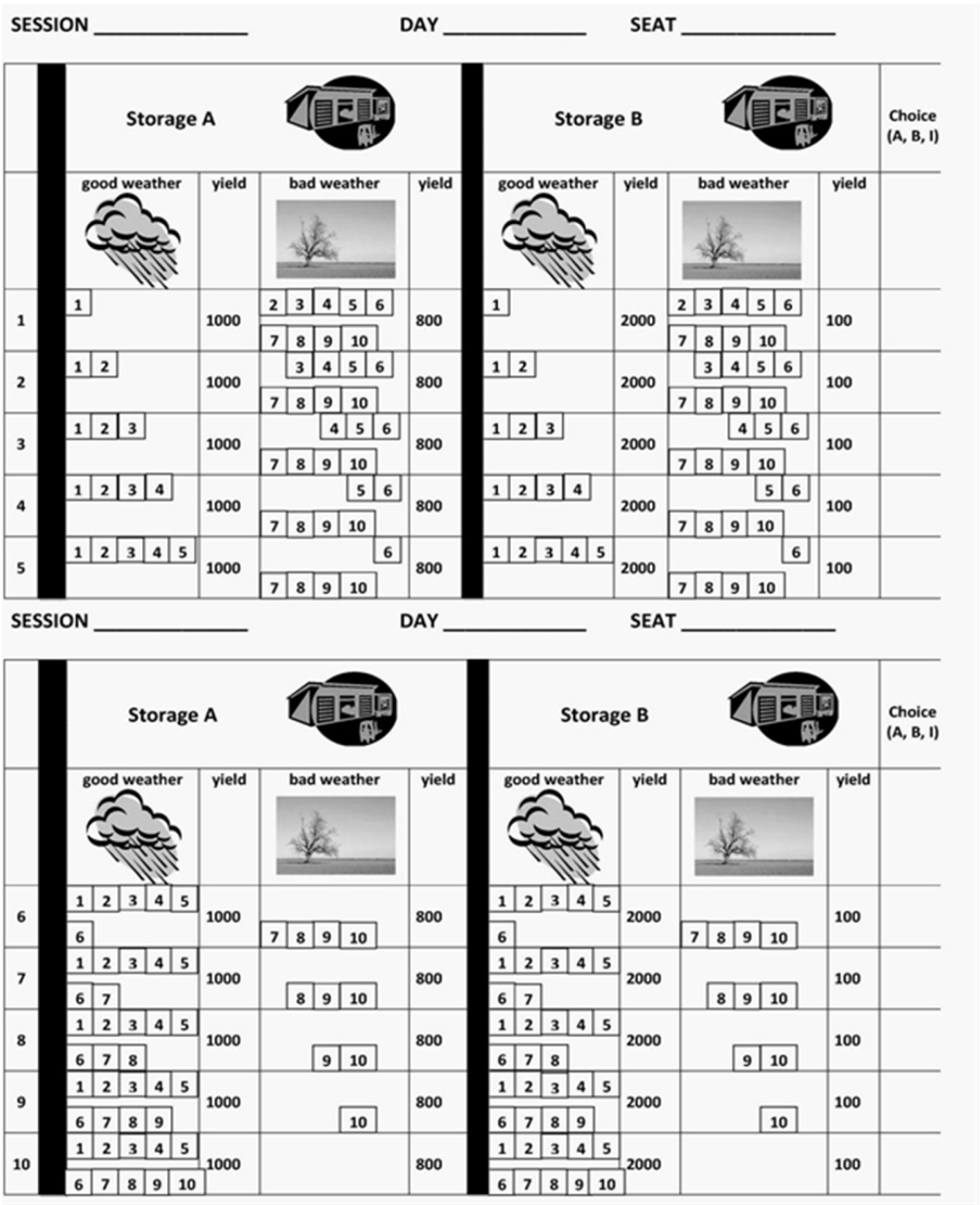
Our experiments were conducted in rural Senegal (in the regions of Thies and Diourbel) in December 2010. Since the experiments were conducted as part of a larger project on linking farmers to markets, we had access to a sample of umbrella organizations that are part of the federation of nongovernmental organizations of Senegal (FONGS), which represents farmer groups at the national level. The participants were members of village-level farmer groups and were recruited by means of such groups, which in turn are part of the aforementioned umbrellas. We conducted four sessions across two days. On one day, two sessions— one HL and one GPC—were held with different members of one farmer group in a village in Diourbel and on the next day, two sessions (again, one HL and one GPC) were held with different members of a different farmer group in a village in Thies. In all sessions, we elicited the WTR question as part of a presurvey, with the option to revise the response after the other task was completed. A typical session lasted between 2.5 and 3.0 hours. The average payoffs were FCFA 5,070.79 (approximately US$11), which compares to an average daily wage of approximately FCFA 2,527.95 for a comparable but larger sample of households (N = 260) drawn as part of the larger aforementioned project. There were 45 participants in the HL sessions and 46 participants in the GPC sessions. Since all of them responded to the WTR question, these data comprised 91 observations.

Implementing such experiments in the field is always a challenging matter. We provide highly detailed information about the implementation process in Appendix A, but three main aspects of our experiment protocol are noteworthy. (1) The experiments were conducted by a main experimenter in English and translated live into Wolof (the main national language of Senegal) by a translator. (2) We framed the HL and GPC experiments in terms of *seeds* since most subjects in rural areas can relate to concepts of risk in agricultural terms. (3) For the WTR question, it turned out that the term *risk* was

somewhat undefined in terms of the national language. Ultimately, in consultation with the translator, the experimenters agreed on describing risk as a situation that could lead to a good event (high payoff/gain) some of time and a bad event (low payoff/loss) some of the time. It may well be that this added noise to the WTR data. To the extent that it may have, others seeking to use this instrument in a developing country context should keep this in mind when risk is not necessarily well defined.

In our version of the HL formulation, a nonrisky seed gave a payoff of FCFA 1,000 (800) in rainy (dry) weather, while a risky seed gave a payoff of FCFA 2,000 (100) in rainy (dry) weather; the probabilities were systematically varied. A screenshot is shown in Figure 2.2:

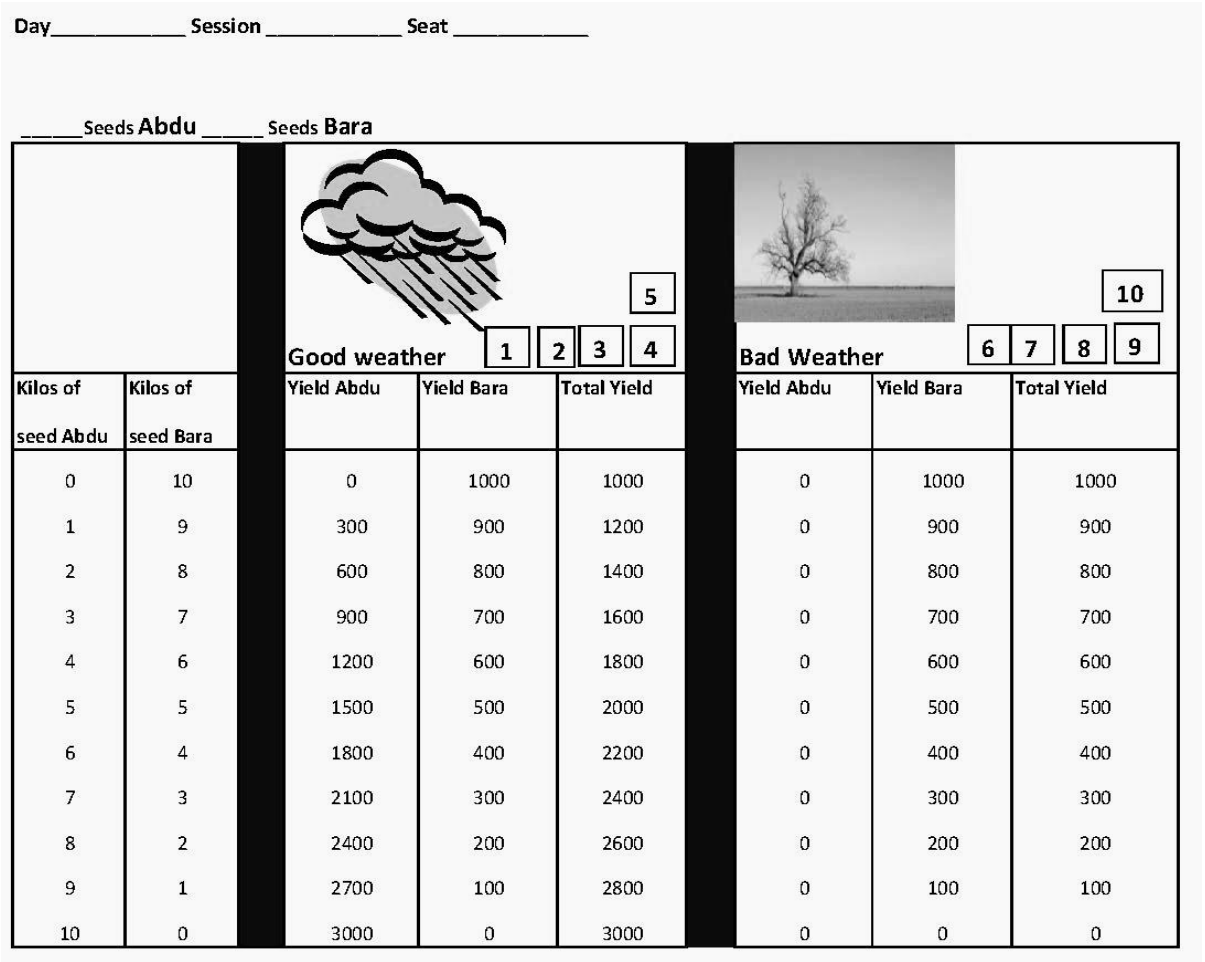
Figure 2.2—Holt-Laury task screen shot



Source : Charness and Viceisza (2011).

In our version of the GPC task, nonrisky seeds pay FCFA 100 per kilo regardless of the weather. Risky seeds paid FCFA 300 per kilo if the weather was good (rainy) and zero FCFAs if the weather was bad (dry). So, one receives 1,000 units if one purchases only nonrisky seeds and corresponding amounts for purchases of other numbers of risky seeds in the event of either rainy or dry weather (each 50 percent likely). We made an adaptation to the Charness and Gneezy (2010) payoff structure, making the successful payoff thrice the investment, as we felt that respondents would be less likely to be confused. We framed the decision in terms of how many *risky seeds* one wished to purchase. A screenshot is shown in Figure 2.3.

Figure 2.3—Gneezy-Potters-Charness task screen shot



Kilos of seed Abdu	Kilos of seed Bara	Yield Abdu	Yield Bara	Total Yield	Yield Abdu	Yield Bara	Total Yield
0	10	0	1000	1000	0	1000	1000
1	9	300	900	1200	0	900	900
2	8	600	800	1400	0	800	800
3	7	900	700	1600	0	700	700
4	6	1200	600	1800	0	600	600
5	5	1500	500	2000	0	500	500
6	4	1800	400	2200	0	400	400
7	3	2100	300	2400	0	300	300
8	2	2400	200	2600	0	200	200
9	1	2700	100	2800	0	100	100
10	0	3000	0	3000	0	0	0

Source: Charness and Viceisza (2011).

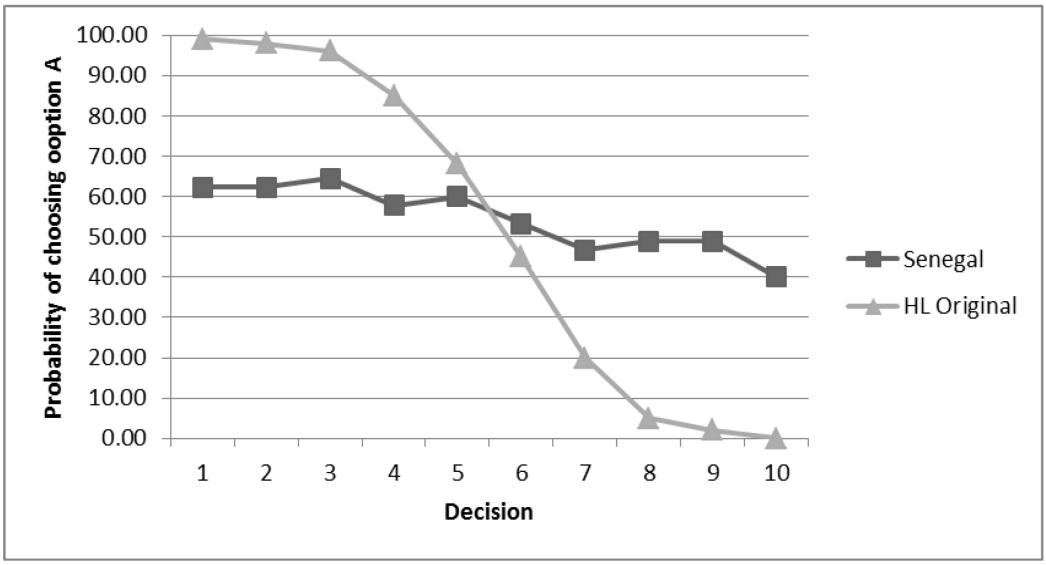
3. EXPERIMENTAL RESULTS

Holt-Laury Task

Figure 3.1 compares the original HL low-real-payoff data with the Senegal data. The horizontal axis displays the decision (that is, 1 through 10) and the vertical axis displays the probability with which option A is chosen (across all respondents). In our data, the median and modal number of safe choices is 5.0. This is the same as the numbers in the original HL data for the low-payoff treatment and of course smaller than the numbers in the higher-real-payoff treatments.

However, it is clear that the patterns differ between the original HL data and our data, as the shape of the distribution is dramatically different. If the Senegal participants on aggregate understand the task, the curve should look as it does in HL. This is not the case however. Most notably, the Senegal curve is not decreasing everywhere. Furthermore, even in the last decision (where option B pays a greater amount with certainty), 40 percent of the subjects still choose option A. This is troubling. In fact, there is a great deal of within-subject inconsistency in the Senegal data.

Figure 3.1—Senegal versus original HL data (probability of choosing option A)



Source: Charness and Viceisza (2011).

In order to analyze this inconsistency, we classify people into the following types (1 through 4). The first two together are classified as *consistent* in our analysis, the third type makes a seriously dominated choice, and the fourth type switches two or more times.

1. Respondents who first chose option A and at some point switched to option B. We see these subjects as those who truly understood.
2. Respondents who always chose option B. We see these subjects as consistent, and in principle we cannot rule out the possibility that they misunderstood.
3. Respondents who always chose option A. While we see these subjects as consistent, we also think they did not quite understand, since they should have switched to option B in decision 10. So, we classify them as *inconsistent* in subsequent analysis.
4. Respondents who switch at least twice.

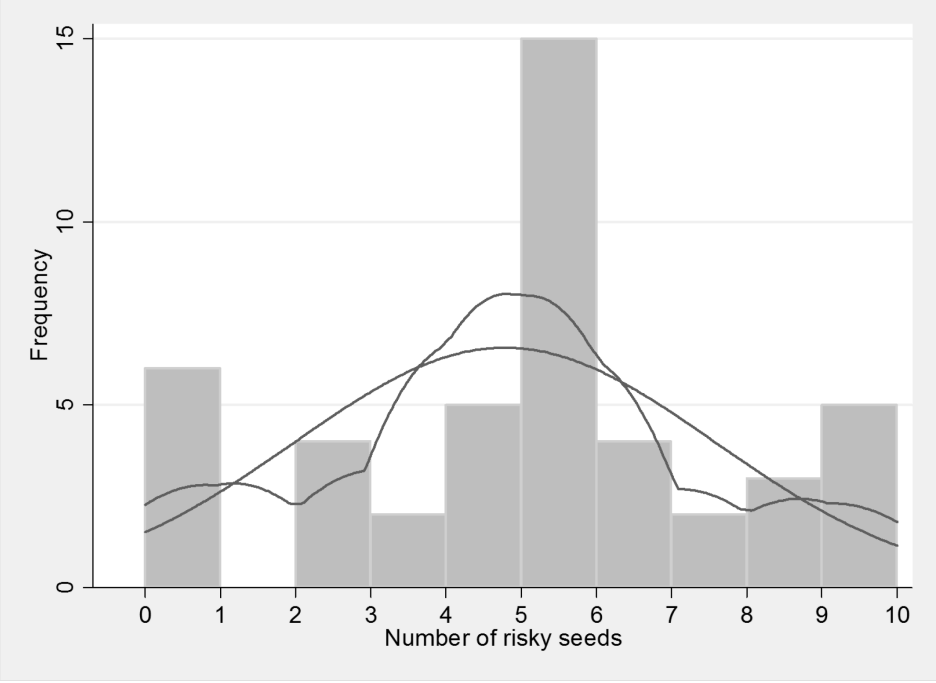
Under this classification scheme (and if we disregard the possibility of mechanical entry errors), 11 of 45 participants (24.4 percent) appear to have possibly understood the task, while another 11 participants always chose A. Finally, more than half of the participants (51.1 percent) switched columns at least twice. There is also a reasonable inference that people of type 2 did not really understand the task, since it takes a very pronounced risk-seeking preference to choose option B in the first row, since the expected payoff from option A is 820 and the expected payoff from option B is 290. Thus, in some sense, at most only the type 1 individuals (5 of 45 people) understood the task. This is obviously not a very high level of comprehension At most, 48.9 percent of the participants understood the task.

Overall, our impression is that our formulation of the HL task was not well understood by the participants. While it may be that there is a better way to present this task to people in this type of environment, it appears that using a relatively sophisticated mechanism does not mesh well with this rural environment.

Gneezy-Potters-Charness Task

Figure 3.2 shows the distribution of risky *seeds* chosen in the GPC task conducted in Senegal. The average number of risky seeds chosen in Senegal is 4.78, or 47.8 percent. Recall that in past studies the range among villagers for this elicitation mechanism was roughly 25–50 percent, so this is actually in the upper part of this range.

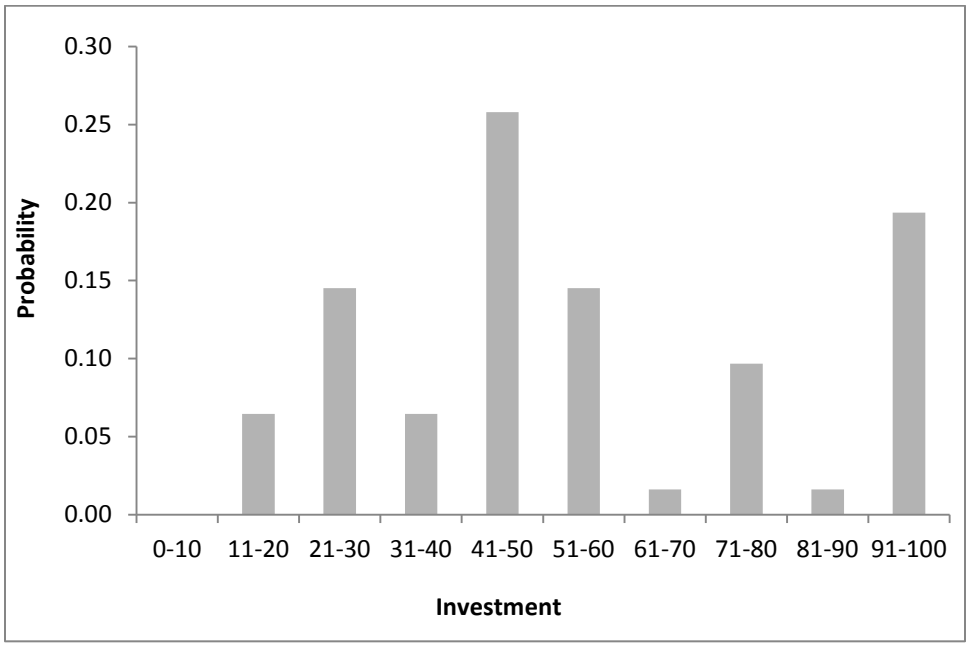
Figure 3.2—Histogram of Senegal GPC data (normal and kernel densities overlaid)



Source: Charness and Viceisza (2011).

It is immediately obvious that there is a big spike at 5 risky seeds, as nearly one-third (15 of 46) purchased this number of seeds. Overall, the fitted kernel density looks fairly close to a normal distribution. As a comparison, Figure 3.3 shows the distribution for the data from Charness and Villeval (2009) for employees of two French firms. We consider this comparison to be less confounded since the participants in the French study were working adults, more like the Senegalese participants.

Figure 3.3—Histogram of Charness and Villeval data (2009)



Source: Charness and Villeval (2009).

Here again we see a spike at 41–50 (almost all at 50). The main difference between the two data sets is that the spike at 91–100 (almost all at 100) in the French employee population was 19.4 percent, while 11.1 percent of the Senegal participants chose 10 risky seeds. We suspect that in part this reflects the much higher relative income in Senegal (French employees received perhaps an hour's wage for the hour of their participation). In any case, the Kolmogorov-Smirnov test of cumulative distributions gives $\chi^2_2 = 2.71$, $p = 0.258$, so that there is no significant difference between the two distributions.

We cannot know the *true* risk preference of the respondents in this study, so we cannot really state with any certainty that this mechanism elicits accurate responses. However, there is nothing in the data to indicate that people failed to understand the task here. It is difficult to know why our operationalization of the HL task appears to confuse participants relative to operationalization of the GPC task. The graphical representations are very similar. One speculation is that our participants have a much more difficult time with varying probabilities than with varying payoffs. Perhaps there is a sense in which people only understand a constant 50 percent probability better than the range of probabilities in the HL task. In any case, our interpretation is that the participants in our study gave more meaningful responses in the GPC task than in the HL task.

Dohmen et al. Task

Figure 3.4 shows the distribution of subjects' levels of willingness to take risk on a scale of 1 to 10.[3] Dohmen et al. (2011) argue that this measure generates the best all-around predictor of risky behavior. Using their original data, we can compare this distribution to the original (see Figure 2.1 for the original distribution reported in their paper). The histograms are similar in some ways but have two exceptions: the peak at 5 is smaller in the Senegal data and there is a very high peak at 10 in the Senegal data,

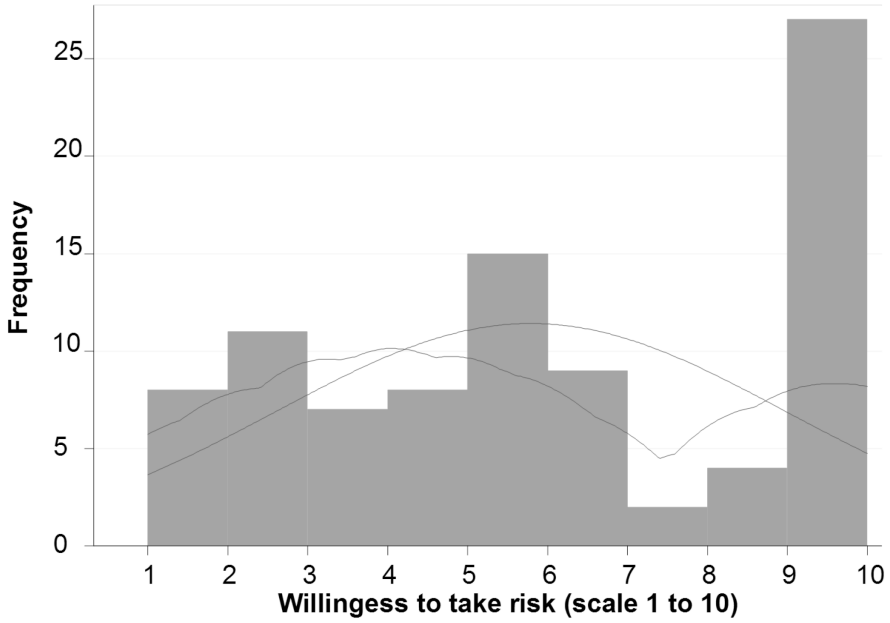
[3] We report the first WTR responses, as they are not contaminated by the intervening task and data from the HL and GPC treatments can be safely pooled. In any event, there is little difference between the first and second WTR measures. Eighty-two people (90.1 percent) did not change their report, 7 people (7.7 percent) decreased their WTR, and 2 people (2.2 percent) increased their WTR.

with 27.4 percent of the observations. This is dramatically different than the roughly 1 percent in the Dohmen et al. data (based on their Figure 1). While we do not have the full data from Dohmen et al., a Kolmogorov-Smirnov cumulative distribution test across the Senegal and their data gives $\chi^2_2 = 25.46$, $p = 0.000$ on the assumption that there are 22,000 respondents in the latter study, with a 1 percent rate for 10. Even if we reduce the number of observations to 220 and assume a rate of 2 percent, the Kolmogorov-Smirnov test gives $\chi^2_2 = 16.74$, $p = 0.000$.

We can look more deeply into those who reported 10 on this question. It turns out that 68 percent are women, so that 17 of 49 women (34.7 percent) choose the highest category. Given that women have been found to be at least financially more risk averse (see, for example, Charness and Gneezy forthcoming, for strong evidence), this seems decidedly odd. For a comparison, only 3 of 29 female employees (10.3 percent) in Charness and Villeval (2009) chose to invest in the top range. The test of proportions gives $Z = 2.380$, $p = 0.017$ (two-tailed test) for the difference in rates.[4]

Overall, we find that the Senegal results are significantly different from those of Dohmen et al. Furthermore, the fact that so many females in the Senegal study chose risky options strongly suggests either a lack of comprehension or frivolous responses, since extreme risk-taking behavior has been rare in previous studies.

Figure 3.4—Histogram of Senegal WTR data (scale 1–10, normal and kernel densities overlaid)



Source: Charness and Viceisza (2011).

[4] There is no significant difference in male rates (the test of proportions gives Z = 0.55); in fact, this goes in the opposite direction, with 8 of 42 males (19.0 percent) in the Senegal data and 8 of 33 males (24.2 percent) in Charness and Villeval (2009) who invested in the top range.

Additional Checks

While our main tests rely on differences in responses across samples drawn in Senegal and samples drawn in Western societies, it might be argued that subjects in the GPC task are different from subjects in the HL task (for example, in terms of schooling), and that it is these differences that drive the responses. So, we collected certain characteristics by means of a postsurvey in order to assess whether the average subject in the HL task is significantly different from the average subject in the GPC task. Since the data were collected *after* the experiments, we are cautious in choosing which variables we use to perform such an assessment since certain variables are more likely to be affected by decisions in the task.

The main variables collected through the survey were gender (1 = female), age (years), education (years of schooling), marital status (1 = married), number of children, whether the subject is a leader in his/her farmer group (1 = yes), whether the subject has farming as his/her main activity (1 = yes), whether the subject has trading as his/her main activity (1 = yes), frequency with which the subject feels liquidity constrained, trust (see Appendix A for further details on how this was elicited), patience elicited on a scale from 1 to 10 (much like WTR), and the number of cigarettes smoked per day.

We test for balance across those observables that are most likely to be *exogenous*, that is, gender, age, schooling, marital status, number of children, whether the subject is a leader, whether farming is his/her main activity, whether trading is his/her main activity and the number of cigarettes smoked per day. We find no significant observable differences suggesting that the average subject is similar across the HL and GPC tasks.

To further explore similarities/differences across the risk elicitation instruments within our study as compared to previous studies, we also ask whether some of these covariates systematically predict risky behavior across the instruments. In order to perform this analysis with the HL data without having to discard the *inconsistent* data points, we use the number of times a subject chose the less risky lottery (option A) as the dependent variable. For GPC and WTR, we use the previously reported outcome measures, the number of risky seeds and the number on a scale of 1 to 10, as dependent variables. For the HL task we also explore the determinants of consistency using a similar regression. In this case, the dependent variable takes the value 1 if the subject is of type 1 or 2 and zero otherwise.

Since gender is an important covariate included in this analysis, we also ask whether the average female subject is significantly different from the average male subject when the data are pooled across tasks. We find that women have more children ($p = 0.000$), trust more ($p = 0.005$), smoke fewer cigarettes ($p = 0.015$), have less schooling ($p = 0.000$), are more likely to be married ($p = 0.006$), and are more likely to be engaged in trading as their main activity ($p = 0.000$). Accordingly, we control for these covariates in our regressions.

Table 3.1 summarizes the determinants of consistency in the HL task as well as the determinants of risky behavior in all three instruments. Consider first the determinants of consistency for the HL task. Males are significantly more consistent (type 1 or type 2) than females in the data from this sample, even after controlling for those covariates that are significantly different across males and females. The analysis also suggests that those who smoke more cigarettes are more likely to make inconsistent choices. Perhaps oddly, schooling has no significant effect on consistency (in fact, in any regression). This may be due to insufficient variation.

Next, consider the determinants of risk attitudes in the HL task. While the sign of the gender dummy is in the right direction, suggesting that women choose the less risky option more frequently, the effect is insignificant. Also, those who are consistent in the HL task choose the less risky option less frequently.

Similar to the HL data, both the GPC and WTR data suggest that the sign of the gender dummy is in the *expected* direction. However, the effect is not significant. In the GPC specification, those who smoke more cigarettes also seem less likely to take risks. This seems to indicate that this variable is not picking up an external propensity to engage in *risky* behavior but something else. In the WTR specification, those who smoke more cigarettes are more willing to task risk. In contrast to the previous finding, the direction of this effect suggests that it could be capturing a *risky behavior* or a *wealth effect*.

Table 3.1—Determinants of subject consistency (HL task) and risk attitudes (all tasks)

	(1)	(2)	(3)	(4)
Variable	**HL consistency**	**HL risk**	**GPC risk**	**WTR**
Gender	-0.453**	0.529	-2.022	-0.741
	(0.22)	(1.54)	(2.34)	(1.16)
Age	0.000	0.027	0.045	-0.052
	(0.01)	(0.03)	(0.08)	(0.04)
Married	0.109	1.562	0.929	1.283
	(0.26)	(1.78)	(1.15)	(1.12)
Children	0.029	-0.238	-0.236	-0.005
	(0.03)	(0.23)	(0.20)	(0.14)
Schooling	0.009	-0.087	0.053	-0.035
	(0.03)	(0.16)	(0.17)	(0.10)
Trader	-0.054	1.069	1.12	0.263
	(0.14)	(1.03)	(1.32)	(0.79)
Trust	0.008	0.144	0.111	0.003
	(0.03)	(0.20)	(0.30)	(0.18)
Cigarettes	-0.058**	0.297	-0.330*	0.408***
	(0.03)	(0.22)	(0.19)	(0.14)
HL consistency		-3.474**		
		(1.42)		
Constant	0.325	2.412	4.041	6.553***
	(0.31)	(1.97)	(3.10)	(2.00)
Observations	45	45	46	91
R-squared	0.238	0.483	0.139	0.292
Adjusted R-squared	0.042	0.332	-0.076	0.194

Source: Charness and Viceisza (2011).

Notes: All estimations are done via OLS and are robust to probit/logit where relevant.

Dependent variables: column (1): variable takes the value 1 if the subject is of type 1 or 2 and zero otherwise; column (2): number of times a subject chose option A in the HL task; column (3): number of risky seeds chosen in the GPC task; column (4): number chosen on WTR scale (1–10).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Session/village dummies included in all specifications.

4. DISCUSSION

We test three different risk-preference elicitation mechansims in rural Senegal. Our primary interest is pragmatic: whatever the relative intellectual merits of these approaches, do we get meaningful responses in this environment with each of these? If one is interested in policy implementation in developing nations and knowledge of risk preferences is useful, it is vital to implement a mechanism that is easily understood and gives nonspurious responses.

Our findings are rather straightforward. The Holt and Laury (2002) mechanism is a mainstay of risk elicitation in experimental economics. However, it does not appear that this mechanism induces sensible or realistic choices. The majority of the respondents show inconsistency in their choice behavior, and regression analysis shows that female participants are more prone to this inconsistency even after controlling for several covariates. Of the remaining respondents, many make choices that are clearly dominated or show a consistency that demands an extreme degree of risk-seeking preferences. Thus, a researcher might wish to be cautious about using a relatively sophisticated mechanism in a rural, third-world environment.

The simpler mechanism involving equally likely alternatives and a fixed rate of return led to results that were fairly similar to results among adult employees (more comparable to our participant pool than students) at a French firm. In any case, none of the Senegal data from this mechanism look particularly suspect. This is the case even though the GPC mechanism has been put into a *price-list* format not too dissimilar from that of HL; we conjecture that this difference corresponds to people having considerably more difficulties with varying probabilities than with varying amounts of income.

Finally, the simplest device of just asking people for their assessment of how prepared they are to take risks delivers some results that are at odds with the patterns found in other studies of risk elicitation. This could be because formulating the notion of *risk* is complex in this environment. Not only are there far more claims of risk tolerance made in the Senegal data than in the German survey data, but it is women who are much more likely to show high risk tolerance. This latter observation does not mesh well with the strong evidence that women are more financially risk-averse than men; perhaps this general question picks up attitudes orthogonal to financial risk. In addition, it is entirely natural to wonder whether the lack of any sort of incentives played a role in the nonstandard results.

We do not presume to know the *true* risk preferences of the people in rural Senegal. Nevertheless, we do feel it is pragmatic to learn what sorts of responses one receives from different sorts of risk-elicitation mechanisms, since knowing the underlying risk preferences in the population is critical for designing effective programs. Our study is an early attempt to gather data on this practical and important methodological question.

APPENDIX A: IMPLEMENTATION DETAILS

Outline

The typical session comprised:

1. Survey 1
2. An introduction of the experimenter, translator, assistant(s), IFPRI, and the project
3. Instructions on the game (more below)
4. The game (sessions 1 and 3 were HL and sessions 2 and 4 were GPC)
5. An opportunity to revise certain responses to survey 1
6. The lottery
    a. For HL, this comprised three draws:
        i. The first draw was to determine the row for which the subjects would get paid. In other words, this determined the distribution of the weather.
        ii. The second draw was to determine whether those who chose indifference would be treated as "magasin/storage A" or "magasin/storage B".
        iii. The third draw was to determine the weather, that is, whether it was good or bad.
    b. For GPC, this comprised one draw that determined the weather.
7. Survey 2 (demographic survey)
8. Payment

Layout

1. The experiments were conducted in classrooms in the local schools. Boxes were used as dividers to give privacy.
2. The typical layout of the room was as follows:

FRONT OF ROOM (experimenter, translator, and white board)			
Seat 1	Seat 7	Seat 13	Seat 19
Seat 2	Seat 8	Seat 14	Seat 20
Seat 3	Seat 9	Seat 15	Seat 21
Seat 4	Seat 10	Seat 16	Seat 22
Seat 5	Seat 11	Seat 17	Seat 23
Seat 6	Seat 12	Seat 18	Seat 24
BACK OF ROOM (assistant experimenter/cashier)			

Survey 1

1. This survey was administered prior to anything else, that is, as soon as subjects walked into the laboratory.
2. The survey comprised the following questions:
    a. On the following scale of 1 to 10, please indicate how willing you are to take risks.
    b. In your day-to-day life, what do you consider to be a risky decision? Please describe using one or more examples.
    c. How much is 15% of 2,000 FCFA? If you don't know, put an **X**.

Introduction

1. The experimenter introduced himself, the translator and the two assistants. Typically, the main assistant experimenter was not introduced till the end.
2. The experimenter introduced IFPRI and the larger project, typically as follows:
    a. IFPRI is an institute in the United States.
    b. We are conducting a research project on farmer groups, their activities and so on.
    c. We have been holding discussions with farmers across many parts of Senegal. In particular, we have talked to farmers in Diourbel/Thies, but we have not been here before.
    d. For the upcoming task, we will pay you for the decisions that you make. We pay you for two purposes:
        i. Because you came here today and are spending your time with us. This is time in which you could be doing something else, so we pay you for that reason.
        ii. Also, we would like you to take this decision seriously, as you do any other decision in real life.

Instructions and Game

1. Game 1 (HL)
    a. The experimenter handed out the sheet of paper for the HL game.
    b. The experimenter first asked subjects what they thought the pictures on the form represented.
        i. This served as an icebreaker. It basically enabled subjects to start thinking about the material and the decisions they would be presented with during the session.
        ii. In some cases the storage was seen as a school and the good weather was perceived as clouds, but typically subjects soon realized that the task would have something to do with storage and good/bad weather.
    c. After this mini brainstorming, the experimenter explained the following steps:
        i. The brainstorming has shown that the task today has to do with storage and the weather.
        ii. Specifically, suppose there are two types of storage rooms (A/Abdu and B/Bara) that contain two different types of fertilizer/angrais (A/Abdu and B/Bara). We are going to ask you which of these two fertilizers you prefer.
        iii. How are these two fertilizers different? Let's focus on the first row of the first page.
            1) Fertilizer A in magasin Abdu
                a) The fertilizer in magasin Abdu gives FCFA 1,000 as income from production in times of bad weather and FCFA 800 in times of good weather.
                    i. Explain payoff and how it is associated with good/bad weather.
                    ii. Quiz people on how much the payoff is in times of good/bad weather.

2) Fertilizer B in magasin Bara
    a) Now, let's look at the fertilizer in magasin Bara. What is different about it? Well, this fertilizer gives FCFA 2,000 as income from production in times of good weather but FCFA 100 in times of bad weather.
    b) So, the difference between the two fertilizers is that the one in magasin Bara pays MORE in times of good weather but LESS in times of bad weather.
        i. Similar to above, explanation and quiz.
3) Recap: So, we've seen that there are two types of fertilizer, the one in magasin Abdu and the one in magasin Bara. We also know that they're affected by the weather.
4) *What do we know about the weather?*
    a) As in real life, sometimes the weather is good and sometimes the weather is bad.
    b) These 10 numbers (1, 2, 3,…, 10) represent 10 years of bad weather.
    c) In the first row, 1 out of 10 years the weather is good and 9 out of 10 years the weather is bad.
        i. The number 1 represents the year that the weather is good.
        ii. The numbers 2, 3,…, 10 represent the years that the weather is bad.
        iii. The numbers in the columns of good/bad weather represent the years that weather can be good/bad.
        iv. So, note that the weather is the same for magasin Abdu and magasin Bara. *What is different is the income from production you get depending on weather being good or bad.*
    d) Questions/quiz for understanding
        i. How many years can the weather be good in row 1?
        ii. How many years can it be bad?
        iii. What is the income from production if the weather is bad?
        iv. Depends on whether you buy Abdu or Bara.
        v. Suppose you buy Abdu and the weather is good, what is your income from production? How about Bara?
        vi. How about if the weather is bad?

d. This explains row 1. How are the other rows different from row 1?
    i. Notice that when we go from row 1 to row 2, the only aspect that changes is the number of years that weather can be good/bad. That is, the income from production does NOT change. However, in row 2 the number of years that weather can be good is 2 and the number of years that the weather can be bad is 8.
        1) Typically, the experimenter showed the years with the numbers 1, 2 in the left hand and 3, 4,…, 10 in the right hand.
    ii. Now, what happens if we go from row 2 to row 3? Now, weather can be good 3 out of 10 years and bad 7 out of 10 years.

iii. This process was continued up to row 10.

1) At this stage, subjects typically smiled indicating their understanding that in row 10 the weather was always good.

e. So, we are going to ask you to make a decision for each of the rows: Abdu or Bara. If you do not know which one to choose, you can choose I for "indifferent."

f. Is this clear?

i. At this point, a row was selected to quiz subjects again. Questions were asked with regard to the probabilities and earnings.

ii. Then, subjects were informed that only one row would be selected for payment. The exact procedures for selecting the row and drawing/simulating the weather were typically explained when the lottery was drawn in order to avoid too much information prior to decisions being made.

iii. Then, decisions were made.

2. Game 2 (GPC)

a. The game sheets (appendix) were handed out. Subjects were prompted on the images at the top as an icebreaker exercise. In both sessions they recognized them correctly as the two types of weather.

b. The experimenter asked the subjects to imagine that they are grain farmers and they are to be given 10 kilos of seeds to plant for the new season. They are told that they can take two types of seeds–from Abdu or from Bara. At this point the experimenter emphasized that they must take a total of 10. He did this by giving them examples of the possible combinations of the seeds that they could take.

i. Imagine that you are a grain farmer and you are given 10 kilos of seeds for free for the coming season. You can choose between two different types of seeds to take. You can either take the seeds of Abdu or of Bara. It is important that you realize you can take as many kilos of Abdu and Bara seeds as you want as long as at the end you are taking 10 kilos in total—no more and no less. On your answer sheet you will see a place for you to write how many Abdu seeds and Bara seeds you will take.

c. Next the experimenter explained how the seeds are different. Abdu seed is of higher quality than Bara seed but is more vulnerable to the weather. That is, when there is good weather the Abdu seed produces a harvest that sells for FCFA 300. When the weather is bad the harvest is so bad that it cannot be sold, eaten, or fed to the animals. On the other hand, the Bara seed does not respond to the weather and always gives FCFA 100 francs per kilo.

d. Next the experimenter proceeded to go through the columns for the Abdu seed and explain how different quantities of Abdu seed affect one's income from the harvest given good weather. What was emphasized through examples was that 300 times the number of kilos of the seeds determines the income, which is then provided for the subjects in the column 'xalis…. Abdu' on the side with good weather. This was done to the point where the experimenter felt comfortable with their understanding of the derivation of their income. Next the experimenter explained the bad weather columns for the Abdu seed, which was provided in the column 'xalis … Abdu on' the side with bad weather. This was always zero. Again examples were given until the experimenter felt comfortable with their understanding.

e. The same procedure followed for the Bara seed: first with the good weather 'xalis… Bara' column and then with the bad weather 'xalis…Bara' column. It was emphasized that there was no difference between the columns.

f. The experimenter explained the total income for any given type of weather–by adding the columns of ‘xalis… Abdu’ and ‘xalis… Bara’. It was explained that this number was indicated in the column ‘li ngay … xalis’.

g. The experimenter asked subjects specific questions such as:

   i. *If the weather is good and one had 5 kilos of bara seeds how many Abdu seeds does one have? How much money does one make from these Bara seeds? … from these Abdu seeds? In total? Then he repeated for other combinations… (1 and 9, 3 and 7… etc. – each time varying the weather)*

   ii. *Whenever one subject seemed to dominate by answering correctly in succession, the experimenter asked the translator to explain to him that we would like to hear from other people as well. These examples were repeated until the experimenter felt confident about the understanding of the subjects.*

h. The experimenter explained how weather was unknown at the time of the decision, how this was realistic, and how it was to be determined, from a box, with equal probability of the two types of weather. That is, the weather was to be determined from a box where drawing cards with numbers 1–5 would correspond to good weather, while drawing numbers 6–10 would correspond to bad weather. These numbers were the same as the ones used for the HL task.

i. Decisions were then made.

Lottery

The lotteries were conducted according to the procedures described previously. Typically, we let one of the subjects draw. Papers with numbers 1 through 10 were drawn from a bag.

Survey 2 (Demographics)

1. This survey was administered after the main task and comprised the following questions:
   a. Education level
   b. Marital status
   c. Number of children
   d. Primary occupation
   e. How often do you find yourself short of cash?
   f. How much do you agree with the statement “Most people can be trusted”? (1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Neither Agree or Disagree, 5=Slightly Agree, 6=Agree, 7=Strongly Agree)
   g. How many cigarettes do you smoke per day?
   h. On a scale of 1 to 10, how patient do you consider yourself?

Payment

After all these steps were done, subjects were called by their seat number—one by one—to get paid in private by the assistant experimenter. They were also paid a fixed fee for showing up.

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