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ABSTRACT

The Relationship between Cognitive Ability and Risk Preferences in a Developing Nation: Findings from the Field

We find a strong relationship between risk-loving preferences and cognitive ability which becomes stronger as adherence to the generalized axiom of revealed preference (a proxy for rationality) increases. Our results are taken from a field study of individuals at the very bottom of the income distribution in a developing nation. Our results for some of the poorest in the world support recent findings drawn from subjects in wealthy Western nations, suggesting there may be a stable relationship between risk preferences and cognitive ability for the human population as a whole irrespective of socio-economic status.

JEL Classification: I11, I12, I18, C93, D03

Keywords: risk, cognitive ability, rationality, generalized axiom of revealed preference, field experiment, low incomes, developing nation

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1 Introduction

Recent work has made a strong case for the potential for cognitive ability to at least partly explain risk preferences (Amador-Hidalgo et al., 2021; Dohmen et al., 2018). But cognitive ability itself can be hard to define: it is a multidimensional and latent trait, and as such can be measured in many very different ways (Friedman et al., 2007; Stanovich and West, 1999; Toplak et al., 2014). Risk preferences are prone to different forms of measurement (Blais and Weber, 2006; Falk et al., 2016; Holt and Laury, 2002). Work in the laboratory and the field have pointed to the existence of a relationship between cognitive ability and risk preferences (Dohmen et al., 2018), but to date the focus has mainly been on advanced developed nations and there is as yet no accepted perfect way to capture cognitive ability even in a highly controlled laboratory environment.

We offer a first attempt to investigate the relationship across several novel dimensions. First we will offer results from a field study in a developing nation with a pool with unusually low incomes which provides a stark contrast with the typical developed world relatively affluent pool. Much has been made of the reliance upon so-called WEIRD (Western, Educated, Industrialized, Rich, and Democratic) populations in experimental work. For instance a recent psychology paper points out that in the top six journals published by the American Psychological Association, 96% of the samples studied were drawn from WEIRD countries (Puthillam, 2020). Our paper is part of a larger project designed to help understand the decision-making of those in a position of desperation with incomes towards the very bottom of the distribution. We provide demographic data (detailed in the methods section below) that indicates that our subjects are close to the minimum income in Iran, itself a middle income developing country. In the context of the notion of a WEIRD population our pool is non-WEIRD in *every single* dimension.

Second, as we will see the context is one in which risk preferences are unusually salient: our subjects are potential donors in the world's only regulated kidney market. While the decision to sell a kidney may be explained by these individuals' financial insecurity, this also provides a context characterised by high levels of uncertainty: our subjects are already thinking in terms of how to make decisions in a risky context.

Third, we will make use of the Critical Cost Efficiency Index (CCEI) which records the extent to which decision-making is consistent with the Generalized Axiom of Revealed Preference (Choi et al., 2014). This acts as a means to control for underlying rationality when investigating the relationship between risk preferences and cognitive ability. In other words we seek to understand the extent to which adherence to one of the most widely used measures of rational economic decision-making interacts with the relationship between cognitive ability and risk preferences. This frames our key structural regression, and provides some important insights.

While we focus on the original features of our work, our results have a high degree of consistency with existing work which allows us to also present our findings as a strong form of robustness

check: many studies have shown a relationship in the lab, we corroborate that in the field, and particularly for those in developing nations in a desperate situation. Our results suggest that for this distinctly non-WEIRD population there is a good correlation between risk attitudes and cognitive ability (higher cognitive ability is linked with risk-loving behavior) which works best when we control for underlying rationality as measured by the CCEI (Choi et al., 2014). We therefore consider our work to be novel but also highly supportive of existing work with other populations. This indicates that many of the key insights in the literature can be seen as generalizable to those with substantially lower incomes (or expected lifetime income) than a typical developed world population. We compare our results with two leading papers based on developed world data and come to the conclusion that the link between risk loving behavior and cognitive ability is stable even across extreme income divides.

We should note that while the bulk of the literature observes a relationship between cognitive ability and risk preference, there is some critical discussion around the relationship. (Andersson et al., 2016) argued that the observed negative correlation between cognitive ability and risk aversion might be due to the bias induced by random choices. They illustrate that errors in decision-making, which is linked to cognitive ability, can lead to overestimation/underestimation of risk aversion from observed choices depending on the specifics of the risk elicitation task. By conducting two risk elicitation tasks on a large sample drawn from the general Danish population, they are able to generate both a positive and a negative correlation between risk aversion and cognitive ability. In a more recent study (Amador-Hidalgo et al., 2021) finds no correlation between individuals' cognitive abilities and their risk-taking behavior in a representative sample of first year Business Economics students in Spain. They, however, find a relationship between inconsistency, measured as a binary variable that captures whether individuals make inconsistent choices such as multiple switching or choosing dominated choice in a in a standard 10-item risk aversion task following Holt and Laury (2002), and risk-taking behavior. Their findings show inconsistency is associated with more risk-aversion ($\rho = 0.13$) and less loss-aversion with ($\rho = 0.07$). One advantage of our own study is that by avoiding the use of Holt-Laury-style measures of risk we avoid the confounding of risk preference with the ability to carry out probability calculations which can be prone to significant errors (Amador-Hidalgo et al., 2021) which is especially relevant when attempting to investigate a relationship with cognitive ability. A second advantage is that we make use of the CCEI which gives us a separate channel through which to investigate the role of rational decision-making.

In what follows we first outline our method, which includes the experimental and logistical details of our field study. We then present our results by first highlighting the core relationship between risk preferences and cognitive ability, then going on to present structural modeling which also allows us to compare our findings to other structural studies. We conclude with some final observations.

2 Methods

Our main method was the use of an experimental design combined with a series of survey questions all undertaken in the field in Iran. Our design was registered in August 2017 at the start point of the field study (Moghaddasi Kelishomi and Sgroi, 2017) which ran until May 2019, with further telephone interviews and follow-up sessions continuing until February 2021.

2.1 Subject Pool

Our 215 subjects were potential donors in the Iranian kidney market and access was provided by the non-profit organization (NGO) "Association for Supporting Renal Patients". All of our participants took part in an experimental procedure located in the Iranian capital Tehran, including a set of 11 tasks. The core tasks are detailed in the Appendix, while the full survey is provided in (Moghaddasi Kelishomi and Sgroi, 2021). To give an idea of scale, in 2017 there were 931 kidney transplants from live donors in the whole of Iran (Kidney Foundation of Iran, 2018). There are 30 kidney transplants units in Iran with 12 units located in Tehran and the rest in other Iranian cities (IRNA, 2018). Our sample is therefore a non-trivial proportion of all live donors in Tehran and indeed even within Iran.

In many cases these were individuals with extremely low incomes who had chosen to enter the market in order to pay off debts or provide resources for their families. The minimum monthly wage in Iran was 11,860,273 Rials over the period of this study ILNA (2021). The average household income in our sample was 15,205,690 Rials. This is a remarkably small difference suggesting that our samples contains individuals close to what is considered minimum income in Iran. The average household income over the same time period in Iran was 37,298,889 Rials (SCI, 2021). In addition, 18.8% of people aged 18-35 were unemployed during the period of this study which is much less than our sample of similar age group (ILNA, 2020). In terms of wealth, only 5.5% of our participants own a house compared to 64% in the general population, and 72.5% live in a rental property compared to 26% in the general population in 2018. Only 8.7% of our participants owned a car compare to 53% in the general population (SCI, 2018). Within our sample 42.5% had only elementary and secondary education, 43.3% had a high school education, and 14.3% attended some form of tertiary education. The overall picture is of individuals who are in financial need, often unemployed but with a family to support and where the alternatives are grim. Our sample is therefore towards the very bottom of the income distribution in a low income developing nation. More demographic detail is provided in Table (A1) in the Appendix.

2.2 Experimental Design

The first part of the experiment was a questionnaire containing a series of basic demographic questions including gender and age. The second part switched attention to economic data including employment status, income, job details, property ownership, car ownership, family economic

status, and information relating to their participation in the organ market and any alternatives. This data was especially important in assessing the general income and wealth level of the participant pool. Demographic and socioeconomic details are provided in table A1 and provides some further supporting evidence for the socioeconomic status of our subject pool.

The next part of the experimental design consisted of a series of incentivized tasks designed to reveal behavioral characteristics. The first such task was a simple check on basic understanding and numeracy before the main tasks and includes simple questions such as: "what is 50% of 200,000 rials?" This was followed by a timed intelligence test which presents a simple example followed by a set of 15 Raven's graphical matrix questions which is a commonly used "IQ" test (the full set is presented in the Supplementary Materials). Participants were give 8 minutes in total (a countdown timer was clearly visible). The next task was our measure of rationality following directly from Choi et al. (2014) and measures consistency of individual choices with the Generalized Axiom of Revealed Preference (GARP). The participants were presented with a sequence of decision problems under risk, with each presented as a choice from a two-dimensional budget line. Exactly as in Choi et al. (2014) each choice of the allocation from the budget line represented an allocation of points between accounts A and B (corresponding to the horizontal and vertical axes) and the incentivized payoffs of a particular choice were determined by the allocation to the A and B accounts; the subject received the points allocated to one of the accounts A or B, determined at random.

2.3 Logistics

The average number of participants per session was 5.6 and refreshments were provided during the session. We examined a total of 215 participants throughout the study. 78 were first interviewed post-donation while the remaining 137 were interviewed pre-donation. Of the pre-donation group 91 were contacted a second time to confirm their final status in February 2021. 35 had donated by this point with the remaining 56 dropping out of the market (30 for medical reasons and 26 through choice).

Payments were split between a show-up fee and incentive payments. The show-up fee was set at 200,000 Rials which is the equivalent to $5.23 (converted via the market exchange rate) or $15.32 (in terms of purchasing power parity).[1] Incentive payments varied but typically were made in the range of 600,000–700,000 Rials or equivalently $15.69–$18.31 (market exchange rate) or $45.96–$53.62 (purchasing power parity). We adjusted the show up fee and incentive payments annually to account for inflation during the study using the official inflation rate from the Statistical Centre of Iran.

[1]Conversions were calculated using the market exchange rate of 38,210 IRR = 1 USD from `www.tgju.org` for the market rate. For purchasing power parity, the conversion was calculated using the purchasing power parity conversion factor, GDP (LCU per international $) for 2017, 13,061.3 = 1 USD from the World Banks' world development indicator.

2.4 Data from Existing Papers

Our study also takes advantage of the data collected by Choi et al. (2014) and Carvalho et al. (2016). On that basis we also describe some key features of their study here. Choi et al. (2014) recruited 1,182 participants at random from the entire CentERpanel sample. The CentERpanel is an online, weekly, and stratified survey of a sample of over 2,000 households and 5,000 individual members which is designed to be representative of the Dutch-speaking population in the Netherlands. They measure the decision-making quality in the experiment by evaluating the consistency of individual choices with the Generalized Axiom of Revealed Preference (GARP). By using the Afriat (1972) Critical Cost Efficiency Index (CCEI), they were able to measure the fraction by which all budget constraints must be shifted in order to remove all violations of GARP. The cognitive ability measure they used was Frederick's (2005) Cognitive Reflection Test. The data from Carvalho et al. (2016) was taken from their second study which was conducted with members of the GfK KnowledgePanel (KP), aged 18 and over, with an annual household income of $ 40,000 or less. This provides a population with a low relative income for an advanced developed nation (so lower than in Choi et al. (2014)) though high relative to our study. They collected data between November and December of 2014, using the same task as in Choi et al. (2014) to measure the willingness to take risk and the quality of decision-making. Ten percent of their 1,119 participants were randomly selected to be paid for the task. To measure cognitive function they used the numerical Stroop task.

3 Results

We regress a measure of risk-taking behavior on cognitive ability and decision-making quality using the data obtained from the experiments in Choi et al. (2014), Carvalho et al. (2016) and Moghaddasi Kelishomi and Sgroi (2021). This will allow us to demonstrate the robustness of the results across a diverse range of participants. We use the following measures:

Risk-taking: is defined by the average fraction of tokens allocated to the cheaper account in the portfolio choice experiment, used in all three studies, as in Choi et al. (2014). The intuition being the choice experiment is reasoned as follows. First, each account on the budget line, drawn from a symmetric distribution, is equally likely to be chosen, and the budget line is drawn from a symmetric distribution. Next note that a risk neutral subject will always allocate all points to the cheaper account. Hence, a less risk-averse subject will allocate a larger fraction of points to the cheaper account. A full description of the task can be found (as "task 6") in the Appendix.

Cognitive ability: Choi et al. (2014) uses Frederick (2005)'s Cognitive Reflection Test (CRT). Carvalho et al. (2016) uses 48 numerical Stroop to measure participants cognitive ability. "Stroop correct" is the correct answer dummy in each trial and "Stroop time" is the log of response time in each trial (measured in milliseconds). The IQ test score in Moghaddasi Kelishomi and Sgroi (2021) is measured using Raven's progressive matrices test.

Decision-making quality: is defined by the consistency of choices in the portfolio task with the General Axiom of Revealed Preference (GARP). Following Choi et al. (2014) we measure the extent of GARP violation using Afriat's (1967) critical cost efficiency index (CCEI).

3.1 Risk Taking Behavior and Cognitive Ability

Summary statistics of the variables used in the analysis are reported in Table 1. The table reveals a similar distribution of the risk-taking and CCEI measures across the three different experiments: this provides an initial hint that the non-WEIRD characteristics of the population in Moghaddasi Kelishomi and Sgroi (2021) as compared to the populations in Choi et al. (2014), Carvalho et al. (2016) may not be as important as we might think.

Table 2 shows the pairwise correlations between the key variables across the three samples form Choi et al. (2014), Carvalho et al. (2016), and Moghaddasi Kelishomi and Sgroi (2021). The correlation coefficients confirm the positive association between cognitive ability and risk-taking behavior found in experimental studies across all three samples. The only exception is in the middle panel where the cognitive ability is measured by Stroop correct answers in Carvalho et al. (2016) which does not perform as well as the other measures of cognitive ability. For instance, the positive and highly significant coefficient between our measure of cognitive ability, the nonverbal IQ test (Raven's matrices), and risk-taking behavior is consistent with the findings in Burks et al. (2009) who use a similar measure for cognitive ability. The table also reveals a positive correlation between rationality, measured by the CCEI index, and risk-taking behavior. The table displays a positive and significant correlation between cognitive ability and decision-making quality. This is consistent with Amador-Hidalgo et al. (2021) who observe that individuals with higher cognitive ability are less likely to make inconsistent decisions. The overall correlation patterns are consistent across all three samples.

Tables 3 presents the OLS results from estimating the risk-taking variable on cognitive ability and decision-making quality in Choi et al. (2014), Carvalho et al. (2016), and Moghaddasi Kelishomi and Sgroi (2021). Column 1 includes only the cognitive ability variable in each experiment. The estimated coefficients confirm the positive association between cognitive ability and risk-taking behavior. We control for age and gender across all models. In column 2 we include only the decision-making quality which reveals a positive association with risk-taking behavior. Column 3 shows that the positive association between cognitive ability and risk-taking behavior remains significant after we control for the decision-making quality. In column 4 we add the interaction of the cognitive ability with their decision-making quality to verify whether the association between ability and risk attitude varies with individuals rationality. The results indicate that the association is indeed increasing in subjects decision-making quality measured by the CCEI index. The estimates are once again consistent across all three experiments. The coefficient signs suggest that the highest association between cognitive ability and risk attitude is observed for the most rational individuals (CCEI=1) and the associations weakens as individuals become less

consistent in decision-making[2].

In terms of real impact, the point estimates in column 3 of Table 3, the bottom panel for Moghaddasi Kelishomi and Sgroi (2021), for instance, indicate that a one standard deviation increase in IQ is associated with a 0.2 standard deviation increase in the average fraction of tokens allocated to the cheaper accounts, the risk-taking measure. Similarly, a one standard deviation increase in the CCEI score is associated with a 0.15 standard deviation increase in risk-taking.

3.2 Structural Equation Modeling

In order to evaluate the direct and indirect effect of cognitive ability on risk-taking behavior we use structural equation modeling (SEM) a la Amador-Hidalgo et al. (2021). This allows us to compare our results on the mediation directly with their findings. This exercise aims to show the extent to which the quality of decision-making mediates the relationship between cognitive ability and risk-taking behavior.

Figure 1 provides a schematic representation of the SEM model. We estimate the total, direct and indirect effect of cognitive ability mediated through the decision-making quality. The Maximum Likelihood estimates are reported in Table 4 for the SEM model. The first column shows the direct effects of cognitive ability and the quality of decision-making on risk-taking behavior as well as the direct association between cognitive ability and the quality of decision-making, the directions, and the SEM parameters c, b, and a described in Figure 1, respectively. All the direct effects except the effect of decision-making quality on risk-taking behavior in Carvalho et al. (2016) are statistically significant at the 1 or 5 percent significance level across all three experiments. Column 2 presents the indirect effect of cognitive ability through participant's decision-making quality. The effects are positive and statistically significant in Moghaddasi Kelishomi and Sgroi (2021) and Choi et al. (2014) and are of the expected sign though not significant in Carvalho et al. (2016). The total effect of cognitive ability on risk-taking behavior in column 3, as expected from the previous section, is positive and significant which is consistent with the findings in the literature.

The results in Table 4 indicate that the mediated effect of cognitive ability on risk-taking behavior is rather small which implies that there is a genuine relationship between individuals' cognitive ability and their risk attitudes which does not stem from the quality of their decision-making. This confirms the consensus in the literature. Contrary to Amador-Hidalgo et al. (2021) our measure of rationality does not hinge on probability calculation errors when facing lottery choices. As a reminder, the CCEI index measures individuals consistency in making economic decisions.

[2]We test jointly whether the coefficients on cognitive ability and the interaction term between cognitive ability and decision-making quality are equal to 0, $(\beta_{CA}, \beta_{CA*CCEI}) = 0$ and also test the joint significance of the cognitive ability effect and the interaction term, $(\beta_{CA} + \beta_{CA*CCEI}) = 0$. The effects are jointly significant with p-values of $(p = 0.049)$ and $(p = 0.017)$ in the first test and the second test, respectively, in Choi et al. (2014), $(p = 0.021)$ and $(p = 0.48)$ in Carvalho et al. (2016) with Stroop(time) as a measure of cognitive ability, and $(p = 0.035)$ and $(p = 0.021)$ in Moghaddasi Kelishomi and Sgroi (2021)

4 Conclusion

Much has been made of the relationship between risk preferences and cognitive ability, but this has been largely restricted to so-called WEIRD populations, and also subject to problems especially linked to the measurement of risk or cognition. Our work draws on findings related to a population that is distinctly non-WEIRD, and in fact contains individuals at extremely low levels of income, towards the very bottom of the distribution in a developing nation. This is in stark contrast to the leading papers in the area Choi et al. (2014) and Carvalho et al. (2016) who do draw from WEIRD populations, though the pool in Carvalho et al. (2016) are from significantly lower socio-economic backgrounds than in Choi et al. (2014) on average. Despite the substantial difference in background (our pool is non-Western, not highly educated, not industrialized, not rich and not from a conventional liberal democracy) our findings are remarkably consistent with the results in Choi et al. (2014) and Carvalho et al. (2016). Our results also provide more evidence for a relationship between risk-loving preferences and cognitive ability, especially when we control for adherence to the generalized axiom of revealed preference (or "GARP", a widely adopted measure of rationality). In essence, we show that in a population as far removed from WEIRD as feasible, the relationship between risk preferences and cognitive ability still holds. Our setting is highly salient (with our pool under high degrees of financial pressure but also in the middle of a major life-changing decision under uncertainty) and takes place in a field setting. In many ways our work suggests that, while it is important to verify supposedly generic findings outside the typical rarefied experimental setting, there is nevertheless hope that many established findings are general. Finally, as an aside we also note that there is remarkably little difference in general cognitive ability and rationality (adherence to GARP) between our pool and those in distinctly WEIRD settings which provides a contrast from other recent work that suggests that those who are very poor might suffer lower cognitive function though our context is very different (Mani et al., 2013).

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Tables & Figures

Table 1: Summary Statistics

	mean	# Obs.	S.D.	min	max
	Choi et al. (2014)				
CRT	1.334	1014	1.096	0	3
Risk-taking	0.602	1014	0.102	0.351	1
CCEI	0.881	1014	0.140	0.177	1
	Carvalho et al. (2016)				
Stroop(correct)	0.888	575	0.315	0	1
Stroop(time)	7.540	575	0.518	0	8.517
Risk-taking	0.601	575	0.121	0.340	0.998
CCEI	0.843	575	0.159	0.282	1
	Moghaddasi Kelishomi and Sgroi (2021)				
IQ	3.214	215	2.710	0	13
Risk-taking	0.650	215	0.092	0.402	0.960
CCEI	.847	215	0.160	0.222	1

Note: Risk-taking in the experiments is measured by the average fraction of tokens allocated to the cheaper account as in Choi et al. (2014). IQ in Moghaddasi Kelishomi and Sgroi (2021) is measured using Raven's progressive matrices test. CRT in Choi et al. (2014) is the Cognitive Reflection Test. Carvalho et al. (2016) uses 48 numerical Stroop to measure participants cognitive ability. Stroop correct is the correct answer dummy in each trial and Stroop time is the log of response time in each trial (measured in milliseconds). The panel for Carvalho et al. (2016) uses the data from the before payday sample (n=575).

Table 2: Correlation Between Behaviours

	(1)	(2)	(3)	(4)
	Choi et al. (2014)			
CCEI	1.000			
Risk-taking	0.113***	1.000		
CRT	0.188***	0.097***	1.000	
	Carvalho et al. (2016)			
CCEI	1.000			
Risk-taking	0.034***	1.000		
Stroop(correct)	0.169***	0.0057	1.000	
Stroop(time)	-0.087***	-0.045***	0.025***	1.000
	Moghaddasi Kelishomi and Sgroi (2021)			
CCEI	1.000			
Risk-taking	0.195***	1.000		
IQ	0.246***	0.223***	1.000	

Notes: Risk-taking in the experiments is measured by the average fraction of tokens allocated to the cheaper account as in Choi et al. (2014). IQ in Moghaddasi Kelishomi and Sgroi (2021) is measured using Raven's progressive matrices test, CRT in Choi et al. (2014) is the Cognitive Reflection Test. Carvalho et al. (2016) uses 48 numerical Stroop to measure participants cognitive ability. Stroop correct is the correct answer dummy in each trial and Stroop time is the log of response time in each trial (measured in milliseconds). The panel for Carvalho et al. (2016) uses the data from the before payday sample, n=575 (results for the after payday sample are very similar). $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Table 3: Risk Attitude and Cognitive Function

	(1)	(2)	(3)	(4)
	Choi et al. (2014)			
CRT	0.007**		0.006*	-0.036**
	(0.003)		(0.003)	(0.017)
CCEI		0.062***	0.046**	-0.007
		(0.019)	(0.21)	(0.030)
CRT*CCEI				0.047**
				(0.021)
N	1014	1182	1014	1014
adj. R^2	0.025	0.0232	0.028	0.031
	Carvalho et al. (2016)			
	Stroop (correct) as cognitive ability			
Stroop(correct)	0.002		0.000	-0.014
	(0.009)		(0.008)	(0.052)
CCEI		0.026	0.026	0.009
		(0.031)	(0.032)	(0.067)
correct*CCEI				0.019
				(0.066)
	Stroop (time) as cognitive ability			
Stroop(time)	-0.015**		-0.014**	-0.034
	(0.007)		(0.007)	(0.026)
CCEI		0.026	0.023	-0.168
		(0.031)	(0.031)	(0.275)
time*CCEI				0.025
				(0.036)
N	27565	27600	27565	27565
adj. R^2	0.001	-0.001	0.002	0.002
	Moghaddasi Kelishomi and Sgroi (2021)			
iq	0.008***		0.007**	-0.001
	(0.003)		(0.003)	(0.017)
CCEI		0.112***	0.084**	0.062
		(0.037)	(0.040)	(0.057)
iq*CCEI				0.008
				(0.018)
N	213	213	213	213
adj. R^2	0.040	0.025	0.056	0.053

Notes: The dependent variable, risk-taking in the experiments is measured by the average fraction of tokens allocated to the cheaper account as in Choi et al. (2014). IQ in Moghaddasi Kelishomi and Sgroi (2021) is measured using Raven's progressive matrices test, CRT in Choi et al. (2014) is the Cognitive Reflection Test. Carvalho et al. (2016) uses 48 numerical Stroop to measure participants cognitive ability. Stroop correct is the correct answer dummy in each trial and Stroop time is the log of response time in each trial (measured in milliseconds). The panel for Carvalho et al. (2016) uses the data from the before payday sample, n=575 (results for the after payday sample are very similar). Robust standard errors are reported in parentheses. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

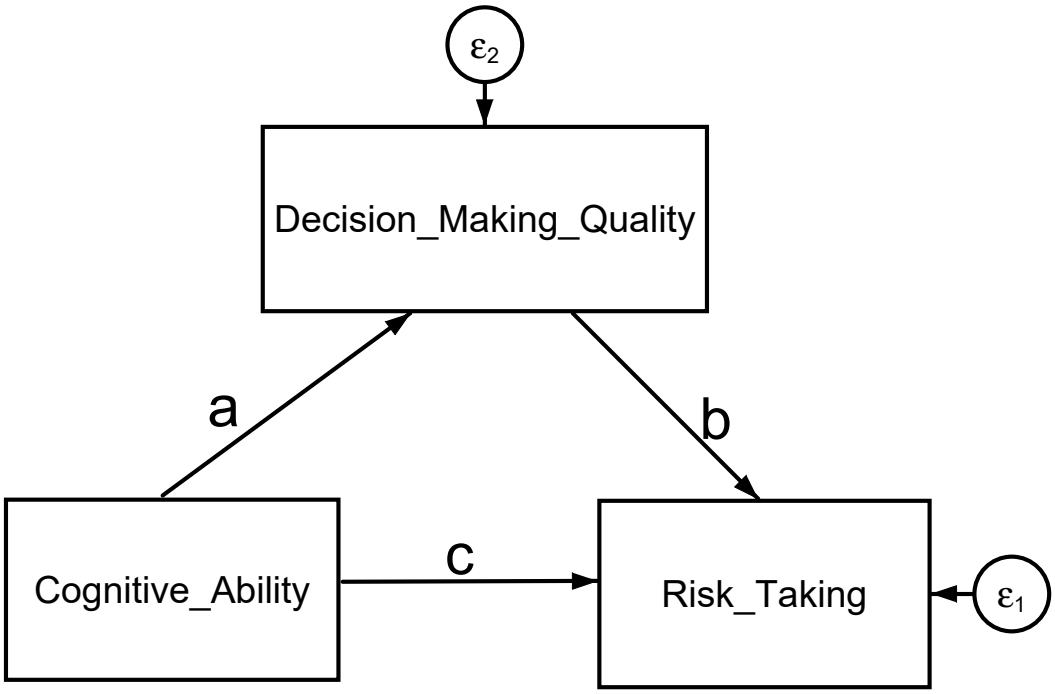


Figure 1: Structural equation model

Table 4: The Impact of Cognitive Ability of Risk Taking Behavior via Decision Making Quality

	Direct effects inside (.)	Indirect effects a*b	Total effects c+a*b
	Choi et al. (2014)		
Risk-taking as a function of			
CRT	0.008***(c)	0.0015***	0.009***
	(0.003)	(0.006)	(0.004)
CCEI	0.063***(b)		
	(0.003)		
Dep var: CCEI			
CRT	0.024***(a)		
	(0.000)		
	Carvalho et al. (2016)		
Risk-taking as a function of			
Stroop(time)	-0.014**(c)	-0.0009	-0.015**
	(0.032)	(0.50)	(0.022)
CCEI	0.023(b)		
	(0.47)		
Dep var: CCEI			
Stroop(time)	-0.0376***(a)		
	(0.003)		
	Moghaddasi Kelishomi and Sgroi (2021)		
Risk-taking as a function of			
IQ	0.006**(c)	0.0013**	0.008***
	(0.017)	(0.036)	(0.003)
CCEI	0.084**(b)		
	(0.030)		
Dep var: CCEI			
IQ	0.015***(a)		
	(0.000)		

Notes: Risk-taking in the experiments is measured by the average fraction of tokens allocated to the cheaper account as in Choi et al. (2014). IQ in Moghaddasi Kelishomi and Sgroi (2021) is measured using Raven's progressive matrices test. CRT in Moghaddasi Kelishomi and Sgroi (2021) is the Cognitive Reflection Test. Carvalho et al. (2016) uses 48 numerical Stroop to measure participants cognitive ability. Stroop correct is the correct answer dummy in each trial and Stroop time is the log of response time in each trial (measured in milliseconds). The panel for Carvalho et al. (2016) uses the data from the before payday sample. We use robust standard errors and p-values are reported in the parenthesis. Results remain very similar after controlling for the age and gender. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Appendix

Additional Tables

Table A1: Demographics & Socioeconomic Information

	Percentage*
Female	18.6
Age	
21-32	54.9
32+	45.1
Education	
Low	42.4
Medium	43.3
High	14.3
Employment	
Employed	49.5
Mean Monthly income	14,356,570
Household Composition	
Married	79.1
Number of children	2
Home ownership	
Owner	5.5
Renting	72.5
Living with parents	22
Observations	215

Note: * All figures are listed as percentages except for mean monthly income which is given in Rials and average number of children which reports the mean number. For education "low" indicates elementary and secondary school (8 years of education), "medium" indicates high school, and "high" indicates Tertiary education in Iran.

Experimental Script

The experimental script is divided into 3 parts.

Part 1 reproduces the information form initially a version translated into English together with the original version in Persian.

Part 2 reproduces the consent form translated into English.

Part 3 provides the full experimental script including the full content of all 11 tasks translated into English.

Part 1: Information Form (translated into English)

Information for participants

The project

The project is being run by the Economics department of the University of Warwick. We plan to carry out a series of experimental sessions with a number of subjects which will involve completing a series of simple questionnaires and tasks. The results of these sessions will hopefully lead to the production of one or more academic research papers.

Your participation

If you agree to participate in the project, we will ask you to attend a session in which you may be asked to complete a number of questionnaires and attempt a number of tasks. You will be paid both a show-up fee and a supplement based on your performance in the tasks you undertake.

The entire process will be entirely anonymous from the very start - your answers and performance will be linked to an ID number and not your true name (for example you may be "subject ID06". There will be no way of linking your true identity to any of the data we have collected.

The anonymous data generated in the session will be used as the basis for at least one academic paper, and possibly more. Since the data is anonymous from the moment the study starts it will be impossible for anyone to link you to the data that is used so your name or identity will never appear in any work related to this research.

You will be asked to sign a consent form if you agree to take part in the study and a receipt at the point when you are paid. Both of these documents will be kept in a secure location for 10 years following the end of the study and then destroyed.

Participation in the project is entirely voluntary and you have the right to withdraw at any point without giving any reason. However, if you do end your participation early you may receive a reduced payment since the payment is in part performance-related.

Potential benefits

You will receive a show-up fee and an additional fee dependent upon your performance in the tasks during the session. More details about the nature of the payment will be made available during the session when you are provided with further instructions. To give an example, similar sessions in the past have typically resulted in payments in the range of 300,000-750,000 Rials for the session and you will always receive the show-up fee of 200,000 Rials irrespective of your performance during the session.

Complaints

It is up to you whether or not you take part in this interview. Nothing negative will happen if you decide not to take part. Your views are important to us and we hope you will agree to take part. Should you have any complaints relating this study conducted by a University of Warwick, please contact the Deputy Registrar: Jo Horsburgh (J.Horsburgh@warwick.ac.uk) Deputy Registrar, Deputy Registrar's Office, University of Warwick Coventry, CV4 8UW. PA– Natasha Lynch (Tel: +44 24 765 22706; n.lynch@warwick.ac.uk)

Please also see: www2.warwick.ac.uk/services/rss/researchgovernance/complaint_procedure

Information Form in Persian

اطلاعاتی برای مشارکت‌کنندگان در طرح

طرح

این طرح تحقیقاتی توسط دانشکده اقتصاد دانشگاه واریک (University of Warwick) اجرا می‌شود. هدف ما برگزاری تعدادی جلسه شامل پر کردن پرسشنامه‌ها و تستهای ساده با اهدا کنندگان کلیه می‌باشد.. نتایج این جلسات در نهایت منجر به تولید یک یا چند مقاله پژوهشی-دانشگاهی خواهد شد.

مشارکت شما

در صورت موافقت شما با همکاری در این پروژه‌ی تحقیقاتی، ما از شما خواهیم خواست که با در ادامه تعدادی پرسشنامه را پر کرده و چند تست ساده را بگذرانید. ابتدا صرفا جهت شرکت در جلسه مبلغی به شما پرداخت خواهد شد. همچنین با توجه به عملکرد شما در پاسخ دادن به تستها نیز مبالغ دیگری، جدای از مبلغ اولیه، به شما پرداخت خواهد شد.

تمامی مراحل انجام پروژه از ابتدا تا انتها بصورت ناشناس انجام خواهد شد، یعنی در همه مراحل جوابها و عملکرد شما نه با نام شما بلکه با یک شماره خاص مرتبط خواهد شد (مثلا مشارکت کننده شماره ۶). در نهایت اسم شما به هیچ عنوان در داده‌هایی که ما جمع‌آوری خواهیم کرد بکار برده نخواهد شد.

داده‌های جمع‌آوری شده بصورت ناشناس برای نوشتن یک و یا چند مقاله علمی مورد استفاده قرار خواهد گرفت. از آنجا که این داده‌ها از ابتدا بصورت ناشناس جمع‌آوری می‌گردد، به هیچ عنوان کسی نخواهد توانست که این داده‌ها را مرتبط با نام و هویت شما بکند؛ بنابرین اسم و هویت شما در هیچ یک از تحقیقاتی که از داده‌های جمع‌آوری شده ما استفاده می‌کنند، نخواهد آمد.

اگر شما موافق مشارکت در این مطالعه باشید، از شما درخواست خواهد شد که فرم رضایت و همچنین رسید پرداخت، بعد از پرداخت پول، را امضا کنید. هر دو این اسناد به مدت ۱۰ سال بعد از اتمام این پروژه در یک مکان امن نگهداری شده و آنگاه از بین خواهند رفت. مشارکت در این پروژه کاملا داوطلبانه می‌باشد و شما مختارید که در هر مرحله‌ای از اجرای آن، بدون اعلام دلیل، انصراف دهید. هر چند، از آنجایی که مقداری از مبلغ پرداختی مرتبط با عملکرد شما در پاسخ دادن به تستها می‌باشد، در صورتی که مشارکت شما نیمه تمام باقی بماند، مبلغ پرداختی به شما کمتر خواهد بود.

منافع بالقوه برای شما

شما بخاطر مشارکت در طرح یک مبلغ اولیه دریافت خواهید کرد. بعلاوه یک مبلغ اضافه که بستگی به عملکردتان در انجام تستها در طول جلسه دارد. جزییات بیشتر مرتبط با نحوه‌ی پرداختها در طول جلسه به اطلاع شما خواهد رسید. بعنوان مثال، در جلسات مشابه قبلی، مبالغی بین ۳۵ هزار تومان تا ۷۰ هزار تومان برای یک جلسه پرداخت شده است و شما جدای از عملکردتان در جلسه، صرفا برای مشارکت در مطالعه مبلغ ۲۰ هزار تومان دریافت خواهید کرد.

شکایات

مشارکت در این طرح کاملا در اختیار شماست. عدم تمایل شما به مشارکت هیچ بار منفی برای شما نخواهد داشت. نظر شما برای ما محترم خواهد بود، هر چند امیدواریم که در این طرح مشارکت کنید. لطفا در صورت داشتن هر شکایتی مرتبط با اجرای این مطالعه توسط دانشگاه واریک، با ایمیل زیر تماس بگیرید:

Jo Horsburgh (J.Horsburgh@warwick.ac.uk)

Deputy Registrar, Deputy Registrar's Office, University of Warwick

Coventry, CV4 8UW

PA – Natasha Lynch (Tel: +44 24 765 22706; n.lynch@warwick.ac.uk)

لطفا همچنین به لینک زیر مراجعه کنید:
www2.warwick.ac.uk/services/rss/researchgovernance/complaints_procedure/

Part 2: Consent Form

I confirm that I have read and understood the information sheet dated [DATE] which I may keep for my records.

I agree to take part in the above study and am willing to take part in the session dated [DATE] which may involve undertaking a number of tasks and/or completing a number of questionnaires.

I understand that the data generated during the session will be entirely anonymous so my name and identity will not be linked to the data that is generated.

I understand that my anonymous data may also be used for future research.

I understand that my participation is voluntary and that I am free to withdraw at any time.

Name of person taking consent:

Date:

Please complete the part below

Name of participant:

Signature:

Part 3: Main Tasks

Task 1

This section consists of 9 questions. Please answer all the questions to the best of your ability.

1.1- Are you male or female? (m/f) 1-Male 2-Female

1.2- What is your age? (years,months) (yymm)

1.3- How many siblings do you have?

1.4- What is your religion? 1- Islam-Shiite 2-Islam-Sunni 3-Islam 4-Christian 5-None 6-Others

1.5- Do you pray or fast during Ramadan? 1- Always 2- Sometimes 3-Never

1.6- Are you married? (y/n) 1-Yes 2- No 3- Divorced

1.7-Do you have children? (y/n) 1-Yes 2- No

1.8- What is your highest level of education?

(1) Elementary school (2) Secondary school (3) High school (4) Diploma (5) Upper diploma (6) Bachelor and higher (7) Illiterate

1.9- Have you ever donated blood before? 1-Yes 2- No

Task 2

Please answer the following questions to the best of your ability.

2.1- Have you ever been employed? 1-Yes (Go to 2.2) 2-No (Go to 2.9)

2.2- Are you currently employed? 1- Yes (Go to 2.3) 2-No (Go to 2.5)

If you are employed:

2.3 What is your current monthly salary?

2.4 What is your job title?

Go to 2.7

If you are unemployed:

2.5 What was your last monthly salary?

2.6 What was your job title?

2.7 Do you own a house or rent a place: 1- Own 2- Rent 3-Live with parents

2.8-Do you own a car? 1-Yes 2-No

If you are married:

2.9- Is your wife/husband employed? 1-Yes 2- No

2.10- What is their monthly salary?

2.11- Are you happy to sign the organ donation for at the end of this session? 1- Yes, 2-No

Task 3

3.1- What other alternatives you considered to selling your kidney?

1-Bank loan 2- Borrowing from family and friends 3- Sell my assets (house, car, jewellery, etc) 4- No alternative

3.2- Do you think you will ever fully recover? 1- Yes, 2-No, 3- I don't know

3.3- What is your blood type?

A+ A- B+ B- O+ O- AB+ AB-

3.4- Do you have any health insurance? 1- Social Security 2- Health Insurance 3- Iranian Health Insurance 4- Not insured

Task 4

Please do your best to answer the following questions – you will be paid 10000 Rials per correct answer. You may use a pencil and paper to help answer the questions but no calculators. There is also an example provided:

Example: You know that your chance to win 5000 RLS in a gamble is 10%. If you repeated this many times what would you make on average in each gamble.

Answer: 500 RLS.

4.1- What's 50% of 200,000 Rials?

4.2- You know that your chance to win 5000 Rials in a gamble is 30%. If you repeated this many times what would you make on average in each gamble?

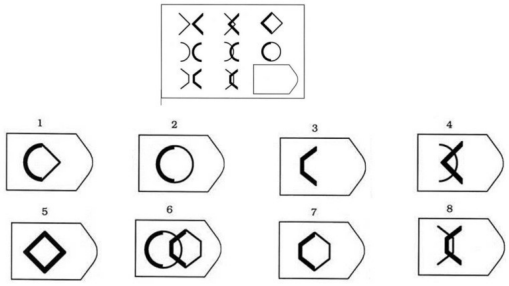
4.3- The original price of a coat is 200000 RLS and you pay 150000 RLS for it. Calculate the percentage discount?

4.4- Job 1 pays 5 million Rials per month. Job 2 pays 2 million per month plus 15% commission. How much would you need to sell to get paid the same as job 1?

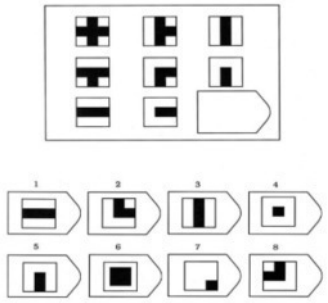
Task 5

You have 8 minutes to answer all 15 questions.

Example: The correct answer in the following example is 7.



Example



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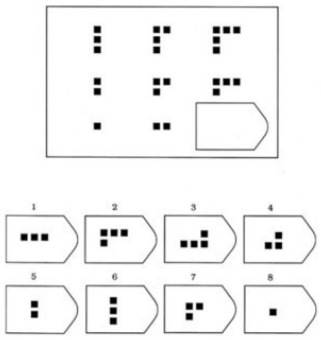

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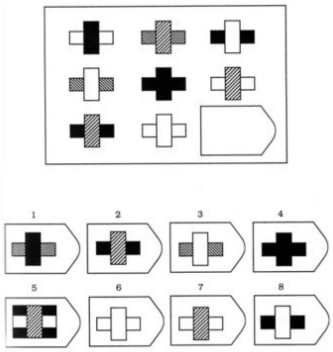

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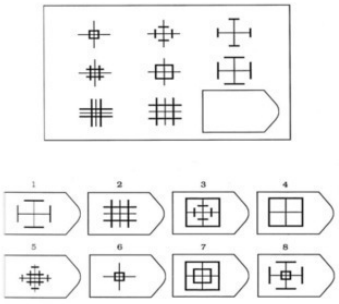

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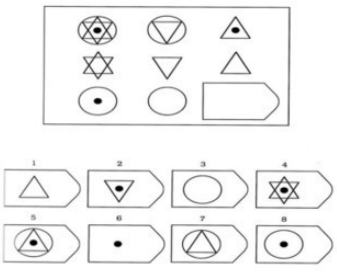

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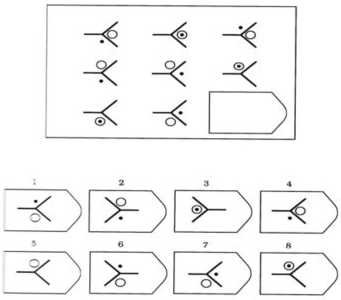

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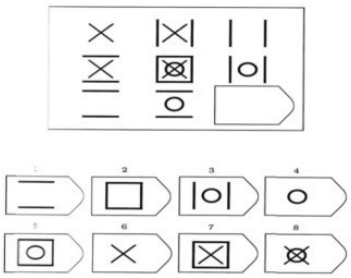

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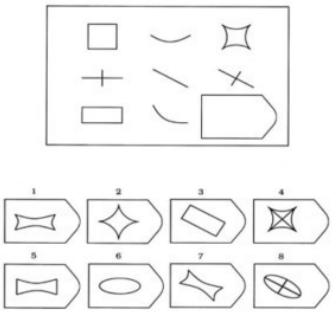

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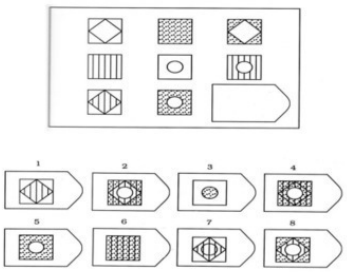

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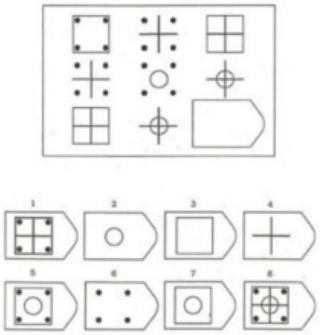

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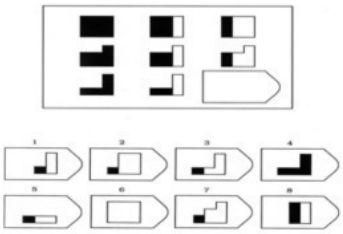

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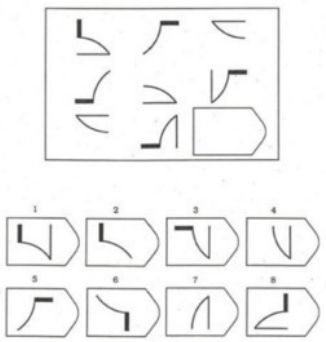

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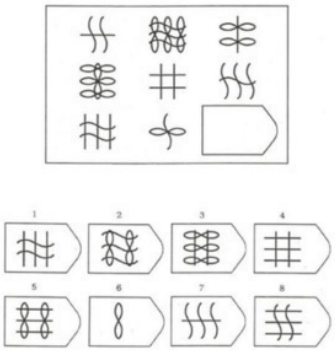
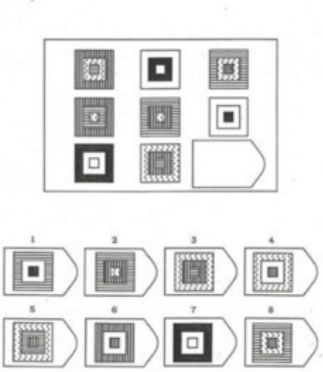


5.13



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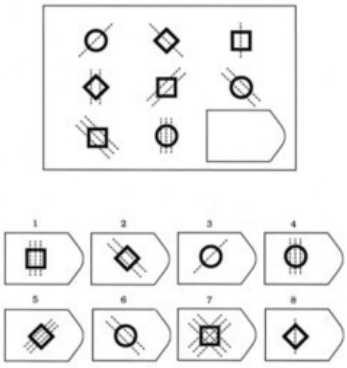
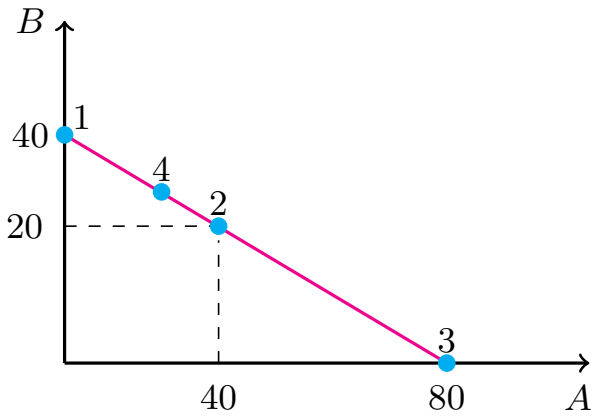


5.15

Task 6

In this section, 25 charts are shown. In each chart, your task is to distribute points between two accounts A, the horizontal axis, and B, the vertical axis. Note that every 4 points is equivalent to 10,000 Rials. In each round, after you allocate your points, the computer will randomly select one account. Each of the two accounts A and B have the same chance of being selected. Your earnings in this round then is equal to the points you have allocated to the selected account. You will be paid in cash at the end of the session. An example of the charts that you will be shown is given below:



You may choose any point on the red line, for example, points 1, 2, 3, 4 or any other points you wish. By choosing a point on the line, the points that are allocated to each account A and B are determined. For example, if you choose point 2 on the line, you allocate 40 points to account A and 20 points to account b. The probability that each of the accounts A and B is selected is the same and is 50 percent. Hence, by choosing point 2, there is a 50 percent chance that you earn 40 points (equivalent to 100,000 Rials) and 50 percent chance that you earn 20 points (50,000 Rials). If you choose point 3, then there is a 50 percent chance that you earn 80 points (200,000 Rials) and 50 percent chance that you earn 0 points (0 rials). The points are calculated at the end of the session and you will be paid what you earn. After calculating the points, a new chart will be shown. Each chart is randomly selected and is independent of your choice in the previous chart. Your task in each chart is the same as described above. A total of 25 charts like the example above will be shown. How your reward is calculated: After round 25 and the end of this activity, a chart is randomly selected by the computer from the 25 charts shown to you. The computer will randomly selects a number between 1 and 25. This number is the number of the chart from which your points will be calculated and you will be paid from. In order to practice, you will first be shown 2 practice charts. You can click the start button once you are sure you do not have any problem with this section to display the main charts.

End of session

Thanks for your participation.