Gender Differences in Risk Preferences of Children and Adults

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In this paper the question of the sources of differences in risk aversion between men and women are investigated. There are two competing explanations of how risk preferences are formed. First is biological one, which implies that gender divergences in attitudes towards risk are predetermined. Second employs the socio-cultural issues of the raising up process, when girls are told to be quite and obedient, and boys are told to be brave and fearless. These stereotypes can clearly influence the risk-taking patterns of behaviour of children of different genders.

The research considers the zero hypothesis that differences in risk averseness of women and men appear innately. In order to test this, an experiment is conducted which investigates the risk patterns of small kids of age 3-7 and adults of age 18-23. According to preliminary results, small boys and girls are indistinguishable in their risk behaviour, while adult group illustrates that men are significantly more risky that women under conditions of financial motivation. Thus, the hypothesis of differences appearing innately may be rejected.

INTRODUCTION

According to the latest annual Global Gender Gap Report the difference in participation in economical and political spheres between men and women is equal to 40% and 80%, correspondingly. The recent trend is leading towards shortening of the gap; however, even those countries showing the smallest indicators (Scandinavian ones) still economically discriminate women by 25%.

In the report mentioned above, Russia is 29th out of 135 countries for the issue of gender equality. The assigned Gender Gap index for economic participation in Russia is equal to 0.737, which means that there is a 26.3% difference in the economic position of man and women. As for the wage gap, women earn about 65% of the earnings of men. This gap is absent for engineering professions.

Thus, it is obvious that nowadays there is a significant distinction between different genders in relation to economical status. For instance, this distinction becomes apparent in the wage differences, or in career barriers for women.

One of the reasons that may explain this situation is the difference in the economical behaviour of men and women. For instance, if women are more risk-averse, possess weaker, than men, leadership skills, and are less self-confident, then, firstly, they would tend to choose less risky professions, which are less compensated, and secondly, this behavioural pattern will influence the top-management's promotional decisions.

In this paper an intent attention will be paid to the question of gender differences in risk-aversion. The vast majority of existing papers on the mentioned topic conclude the higher risk-aversion of women (Eckel and Grossman, Holt and Laury, Powell and Ansic, Booth and Nolen, Schubert et el, etc). However, experimental research has shown that the degree of risk taken by individuals may be influenced by the context in which the decisions are made (Schubert et al, Powell and Ansic, Eckel and Grossman). In addition to this, there was discovered a gender difference in competition conditions (Gneezy et al, Niederle and Vesterlung, Booth and Nolen), a difference in degree of confidence in estimating self-abilities in risky issues (Barber and Odean) and behaviour in ambiguity context (Gysler et al).

One of the questions raised by these conclusions is what are the reasons for the existence of gender gap. There may be two explanations: one involves the influence of Nature, and

the other considers the Nurture issues. That is, the question is whether the difference in risk preferences of individuals is inherent, or it is acquired during the growing up process. For instance, when boys are raised up, they are told that they should be brave, strong and fearless, while girls are persuaded to be quite, obedient and accurate. This may directly influence on the formation of attitude towards risk.

The conducted research described in this paper tests the null hypothesis of whether or not the gender gap in risk-aversion is not innate. For the purpose of examining this question an experiment was designed, which captures the differences in risk-taking in two groups: one consisted of little boys and girls of age from 3 to 7 years old, and the other included students of different Russian universities of age 18-23. Thus, the patterns of risk behaviour for different gender and ages were investigated. The experimental hypothesis relies on assumption that if no difference will be detected between males and females in children group, while there will be a significant difference in adults group, then one of the possible conclusions may be drawn is that it is most likely that the divergence of risk preferences is not innate and formed during the growing up process.

In addition to the gender difference in risk attitudes (section 3 and section 5), the two other issues will be investigated: the level of aspirations (section 4) and the risk strategies of the participants (section 6). These questions arise due to certain peculiarities in the design of the experiment, which is described thoroughly in section 2.

1. LITERATURE OVERVIEW

1.1 Results of the experimental research for the gender difference of adults

The theoretical base of the individual's behaviour with respect to risky engagements is provided by the Cumulative Prospect Theory, proposed by Kahneman and Tversky (1992). According to their theory, the overall utility of a prospect is the aggregated utilities for all outcomes, multiplied by the decision weights, which are evaluated separately the loss and gain domains.

As for the experimental evidence on the gender difference in risk attitudes, the majority of them verify the hypothesis of higher risk-averseness of women compared to men.

For instance, according to the results of research conducted by Eckel and Grossman (2008), *women are less prone to risk regardless of the context they are taking their decisions in.* Eckel and Grossman considered the difference in expectations of women's and men's behaviour with respect to their inclination to risk (the common belief is that women are more risk averse). They also examined the individuals behaviour in a risky game in different contexts: financial (to account for this context, a game on investments is used for gains and losses) and abstract (for this context a standard lottery on gains and losses is implemented). The null hypothesis of no gender difference was rejected on a 0.1% level (chi-square contingency table: chi-square(4)=26,42; p-value<0,001; t-test for means: t=5,13; p-value<0,001). In addition to this, the hypothesis of the similarity of gamble choices was rejected (Epps-Singleton test: chi-square = 26,36; p-value<0,001).

The context issues were also considered in the papers of Powell and Ansic (1997), and Schubert, Brown, Gysler and Brachinger (1999). According to the first research, women demonstrate higher level of risk averseness regardless of the context; as for the second research, the differences in risk preferences appear in the abstract contexts only, whereas in the financial environments there are *no significant gender divergences* revealed.

Powel and Ansic conduct the experiments in the following contexts: insurance, as a familiar to the majority context; and foreign exchange market, implied as a less familiar to participants context. In the first case, a choice had to be made from five options, that differed by the size of initial contribution and following compensation: insurance from both a catastrophe and damage, insurance from either catastrophe or damage, no insurance at all or a random option hat chooses one of the previous four. The forex

market provided the participants with two options: they had to decide whether to enter the market or not, taking into account the information on the exchange rates and the value of cost of repeated entry. According to the conclusions of this research, *women more ofter choose to insure*, which indicates their higher loss aversion compared to men. In addition to this, the behavioural strategies of both genders on the forex markets differ – on average, women are spending less time in the market for all of the levels of enterance cost.

Schubert et al analyse the results of the following experimental games: investment, as a game on gains; insurance, as a game on loss; and an abstract game on both gains and losses. The researches do not find any significance gender divergence in risk behaviour, while in the abstract games women tend to be *more risk-averse* for games on *gains* and *less risk-averse* for games on *losses*.

In addition to the investigation of gender gap in risk-taking, Booth and Nolen (2009) also raised a question of the origins of such gap, which is close to the research performed by this paper. Booth and Nolen examined the differences of boys and girls of a school age. They compared the behaviour of kids visiting a mixed sex schools (where boys and girls studied together), and of kids from single sex schools, with only girls or only boys on board. Statistically significant difference was detected between the kids *from mixed sex schools*; while for the ones *studying with their own sex only, no difference in risk attitudes was revealed*. This research enables Booth and Nolen to make a conclusion that risk attitude depends on the environment in which the individual is placed in. Thus, the risk preferences are of Nurture, and not Nature, origins.

The influence of the environment also was studied in the papers of Gneezy, Lenard and List (2009), and Niederle and Vesterlund (2008). However, they investigated the issue in terms of the different aspect – the attitudes of men and women to competition. According to the former research, *women are less likely to behave competitively, than men, in patriarchal societies*, while *in the matriarchal ones the tendency is the reverse*. According to the latter research, woman's behaviour depends on the context in which she takes the decisions. They have discovered that *women tend to risk more if they compete with each other only* (that is, there are no men participating in the competition). Additionally, women achieve less in case they participate in competition where individuals of both sexes are represented.

The research performed Gneezy, Lenard and List is based on the behaviour of different genders in two types of society: patriarchal Maasai from Tanzania, and matriarchal Khasi from India. The following patterns were observed: *in the patriarchal society women's behaviour is two times less competive*, than men's behaviour; at the same time, *in matriachal society women choose competitive behaviour more often* than men do. Thus, Gneezy et al conclude that the behaviour of men and women strongly depends on the environment they are surrounded by, which can serve as an argument for the initial natural equality of women and men with regard to competitive behaviour.

In the research of Niederle and Vesterlund, *women avoid the competitive behaviour two times more often*, that men, and show a worse result when they compete with men than when the competition is between women only. In addition to this, Niederle and Vesterlund observed a possibility of influence on the behaviour of individuals via usage of affirmative policy. In the case when it is known that the number of men and women will be equal in the competition, women are more likely to agree to participate in it.

As for the effect of the size of payoff, the experiment conducted by Holt and Laury (2002) has revealed a *gender difference for the gambles with low-payoffs*, which is significant on a 5% level. They provided the participants with ten pairs of lotteries with different payoffs, but same probabilities of gain, which were changing from the first to the last pair, making the expected value of the gain higher for the first type of lottery in the first five pairs, and then making the second lottery provide a higher expected gain. The interesting issue concerning this experiment is that the *gender divergence in risk attitude disappears in the gambles for high payoffs*. Thus, according to these results a conclusion can be driven that the risk averseness differences appear only for low stakes.

Lastly, Barber and Odean (2001) in their research have observed a *difference in self-confidence levels* of the investors of different sexes and its influence on the overall gains and losses. Their research has shown that single men participate in trading 68% more often, than single women do; the corresponding yearly income from trading is on 1.44% lower for the male investors (according to performed t-tests, this result is significant on a 1% level).

As for the evidence against the existence of gender difference in risk aversness, the research provided by Gysler et al shows that regardless of the context in which the risk desions are made, there is no significane divergence of females' and males' behaviour. However, the researchers observe the difference in the behaviour with respect to ambiguity risk taking: in this case, the level of competency has a different influence on choices of different sexes in ambiguity conditions. The higher is the level of competency and/or knowledge of the men, the less likely would he take the ambiguous decisions; for women an opposite situation is observed.

Table 1: Experimental results

	Method of investigation	**Context**	**Risk domian**	**Conclusion (the more risk-averse gender)**	**Significance**
Eckel, Grossman	Gamble (lottery)	Abstract	Gain only	Women	p-value<0,001
		Abstract and financial	Gains and losses	Women	p-value<0,001
Holt, Laury	Gamble (lottery)	Abstract	Gains and losses	Women , for low values of gains	p-value<0.05
Powell, Ansic	Insrance	Abstract and financial	Gain only	Women	p-value=0.043
	Inverstments	Abstract and financial	Losses only	Women	p-value=0,014
Booth, Nolen	Gamble (lottery)	Abstract and financial	Gains and losses	Women (from co-education schools)	p-value<0.01
Gysler et al	Gamble (lottery)	Abstract and financial	Gain only	No difference	p-value<0,001
Schubert et al	Gamble (lottery)	Abstract	Gain only	Women	-
		Abstract	Losses only	Men	-
	Investments and insurance	Financial	Gains and losses	No difference	-

Lastly, one of the interesting factors taken into account by the researches on the theme considered was the influence of professional environment and profession of the respondent. Atkinson, Baird and Frye (2003) observed the behaviour of mutual funds managers. According to their research, among individuals of this occupation there is a significant divergence of attitude towards risk, especially in the first year of individual as a specialist. As for the managerial professions in general, the Johnson and Powell (1994) provide evidence that *in managerial population the null hypothesis of no gender difference cannot be rejected*, while within non-managers a statistically significant divergence can be observed.

1.2 Results of the regression analysis

The researches conducted by Jianakoplos and Bernasek (1996), and Hartog, Ferrer-i-Camponell and Jonker (2002) also support the alternative hypothesis of the existence of the difference in risk aversion of females compared to males. The first research considered in addition to gender variable the influence of number of kids of the individual; the ratio of human capital to the financial capital of the individual; ethnicity; education; job; age. According to results of Jianakoplos et al model, *females are significantly less risk prone*, than men are; there was also observed a positive effect of number of kids on the level of risk aversion of individual. Lastly, the research revealed a higher risk loving behaviour of black women compared to behaviour of white women.

1.3 Results of the experimental research for children risk averseness and comparison to the adult's behaviour.

In the work of Harbaugh, Krause and Vestelund (2002), the age differences in attitudes towards risk were considered. They examined the behaviour of individuals of age from 5 to 64 years old. An experiment was conduted in the loss and gain domains, with tokens that could buy toys for children and cash for adults. As a result, they have reveled the difference in weighting functions of children and adults. According to Harbaugh et al, kids underestimate the events which have low probabilities (compared to adults' probability weighting function).

In the research conducted by Kearney and Drabman (1992), the effect of the success or failure of previous participants on the kids gambling choice was explored. The two

groups of children were modified: one was the peer group and the second was the control group. The first group before participating in risk-taking game observed children, who have already won a big prize (a large toy) – the other group observed the kids who did not win anything. As a result, the first group turned out to be more risky, than the second, which drives an implication of the importance of taking into account the formation of pre-gambling expectations.

1.4 Results of the experimental research for the gender difference of children

In a number of existing studies to date the relationship between the risk attitude and age is concerned. Additionally, a hypothesis of no influence of gender of a kid on his risk averseness is tested.

For instance, in the study of Slovic (1966) the *absence of differences in risk taking of girls and boys of age 6-10 years old was found*. At the same time, *this difference was significant for the group of kids older 10 years old* (the boys were less risk averse than the girls). He has conducted the following experiment: the children which participated on a fair had to pull sequentially a number of cards from a set. This set included cards that enabled to either win a certain (differing) number of M&Ms candies, or to loose all the cumulated candies up to point of the game when this card was drawn. Therefore, the higher was the gain of a child, the more risky was his decision to continue drawing the cards from the set, since one of them could lead to a loss.

One of the drawbacks of Slovic's research was the self-selection process of kids who played the game. Since the experiment was conducted on the fair, those children who decided to take part in the game could be in general more risk-loving than those who decided to avoid the game.

The results of Slovic's game were tested in the paper of Kopfstein (1973), who conducted an experiment with the scholars of 9-11 years old. In his research he also investigated the influence of the gender of the experimentalist on the level of risk averseness of children. According to the results of this experiment, there is *no significant difference observed within the kids of age 9-11*. However, there is a 5% significant influence of the gender of the experimentalist on the risk choices taken by girls. In case when the experimentalist was a men, girls were more risk-seeking than otherwise.

An interesting experiment was conducted by Arenson (1978): she offered the kids to choose one of the games out of the three. The games consist of a board with two, four and eight holes – and the task of the game is to put a stick in a hole; one of the holes pay a positive gains, and the others do not provide any gain. This experiment provided support for *no gender difference among children*.

Ginsburg and Miller (1982) in their research considered a wider age group of children – from 3 to 11 years old. They have observed the kids behaviour in a zoo, analyzing their willingness to feed a donkey, ride an elephant, climb a steep river bank. The research have revealed that *boys were higher risk prone than girls* in every activity mentioned, on a 1% level of significance.

Summing up, it can be seen that the evidence of risk attitudes among children is contradictory, with a number of researches that provide proof of existence of gender differences, and some investigations that reject it.

2. DESIGN OF THE EXPERIMENT

The main difficulty for the construction of experimental design was the age of the respondents. Since the youngest children in the sample were of age of 3 years old, the game had to be easy to comprehend and to play. Also, there had to be a small number of choices needed to be made due to the fact that for small children it is difficult to concentrate for a long time. Initially, two types of experiments were made: both of them represented the modifications of the well-known Holt and Laury lottery. The latter provides the player with ten pairs of two lotteries: both of them have the same probabilities to win a high and a low stake, which increase in a course of the game. The stakes are identical within single game, and differ across two lotteries (Appendix 3).

The modification for kids' experiment was the following: in order for children to make a choice and discriminate between the two games, the two sets of ten cards were provided. In the first modification, they differed for color: one was gold and the other was silver. However, it turned out that some children prefer the game with gold cards despite the gains and probabilities. The second game implied the two images from the coin – heads and tails. In this case some of the children preferred the game with heads on the cards just for the image. Thus, the conclusion was made that it is difficult to discriminate between the two games because children do not know yet the letters and the numbers, and as for images – they can have preferences and choose a game not for its gambling features, but for the image used to mark that game.

Therefore, a final design represented a single sequential game, which satisfied the aims of the research: it was easily perceived by children and allowed to control for the level of risk of the choices. In addition to this, the gamble allowed to investigate the patterns of the behavior concerning successes and failures of the trials.

The game that was presented to respondents was the following: they were faces with a piece of paper of standard size, with 8 parallel lines that split the lower right corner into 8 segments of different area and height; the further the sector was from the corner edge, the narrower was the sector (Appendix 1). The task for the players was to decide, which sector they would be aiming at, than close their eyes, put their hand with a pen up and with closed eyes try to hit the targeted sector. There were five trials in each of the game, so any five sectors in any sequence could be chosen. In case when the player hit the right target, he received a number of points corresponding to the sector – one point for the first

(widest) sector, 2 points for the second, etc, with maximum possible amount of points to be win in single trial equal to eight. Thus, the gains corresponding to each sector increased linearly. The total gain aggregated through the game was equal to the sum of the gains received in each trial.

As for the properties of this game, the level of risk taken was assumed to increase from the first to the last sector, since the area – and thus the probability to hit the target – declined from the first to the last sector.

Sector	**Probability** (calculated as *area of the sector/total area*)
1	0.12
2	0.09
3	0.08
4	0.07
5	0.06
6	0.05
7	0.03
8	0.02

As for the participants, there were two groups of them: children of age 3-6, and adults of age 18-22. The first group consisted of children from two Moscow kindergardens, while the second consisted of students from the Higher School of Economics, and the participants of the Winter School organized for HSE master's degree applicants. The incentives for the children group were homogeneous and real: for each if the points they were able to win in the experiment they received one balloon. For the adults group there were three types of incentives: HSE students group divided on two subgroups, one of which was provided with real incentives – money (10 rubles per point), the second one was provided with virtual incentives (they were playing purely for the excitement, and the virtual points were exchanged for nothing). The HSE master's degree applicants were provided with real incentives, which consisted of souvenirs with HSE symbolics (pens, notebooks, badges), and each combination of points gave a right to take a certain set of souvenirs.

Children payoffs		Adult payoffs (cash incentives)		Adult payoffs (souvenir incentives)	
Hit sector	Gain	Hit sector	Gain	Total points	Gain
1	1 balloon	1	10 rubles	0-5	calendar
2	2 balloons	2	20 rubles	6-10	badge
3	3 balloons	3	30 rubles	11-15	pen
4	4 balloons	4	40 rubles	16-20	notebook
5	5 balloons	5	50 rubles	21-25	badge+pen
6	6 balloons	6	60 rubles	26-30	badge+notebook
7	7 balloons	7	70 rubles	31-35	pen+notebook
8	8 balloons	8	80 rubles	36-40	badge+pen+notebook

The total number of participants was 158, with 51 children and 107 adults. Among children there were 26 girls and 25 boys; among adults there were 63 girls and 44 boys. There were three sessions for children group and four sessions for adults group.

The non-parametric tests indicate significant differences between the experiment subgroups in adult age category, despite the same design of the game used in every session. The possible explanation is that since the incentives were different for all three subgroups, the difference is quite expected one. The main implication of these results is the necessity to analyze the adults' subgroups not only aggregately, but separately as well.

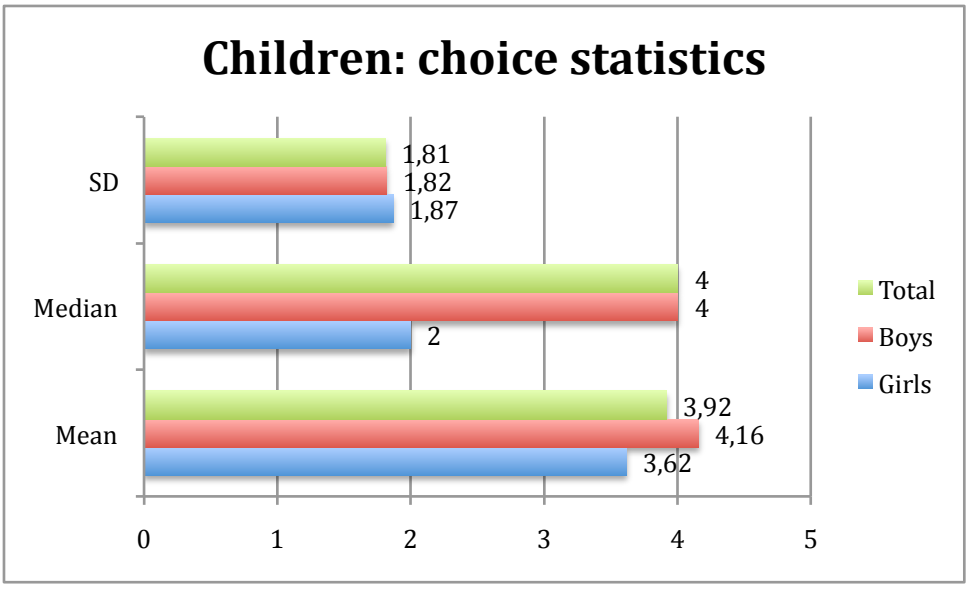
As for the children group, there is a sort of diversity with respect to the age of participants. In the analysis, all kinds of age categories would be examined and compared with each other in order to reveal any possible changes that evolve with age of a small child.

2.1 Children: descriptive statistics

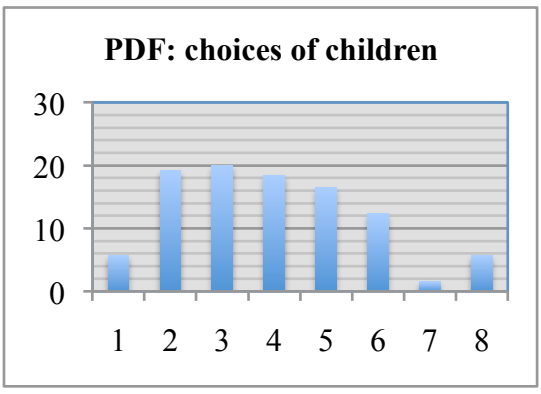
The experiment with children was held in two Moscow kindergardens; all sessions were completed within two years. There were two sessions in the first kindergarden with older kids (average age of 5.14 years), and one session in the other kindergarden (average age of 3.18 years).

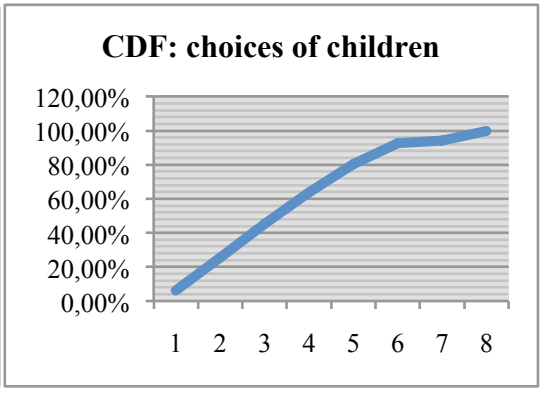
The experiment was conducted in one of the study rooms, provided by the kindergarden. Each child played under the supervision of the experimentalist (who explained the instructions to every child separately, appendix 2), which prevented the cheating possibility for the player to kike. The experimentalist and the child were one-on-one during the game in order to prevent any external influence on the choices of the participant from other children.

The distribution of boys and girls is almost even for the aggregated sample: 51% of girls to 49% of boys. The average choice of children was 4.86, with standard deviation of 1.42 and median of 5. As for the choice statistics, the following differences can be seen among different gender groups:



The general distribution of choices of the kids sample is skewed to the right, in the direction of area of less risky choices; the mode of the sectors chosen is “3”.



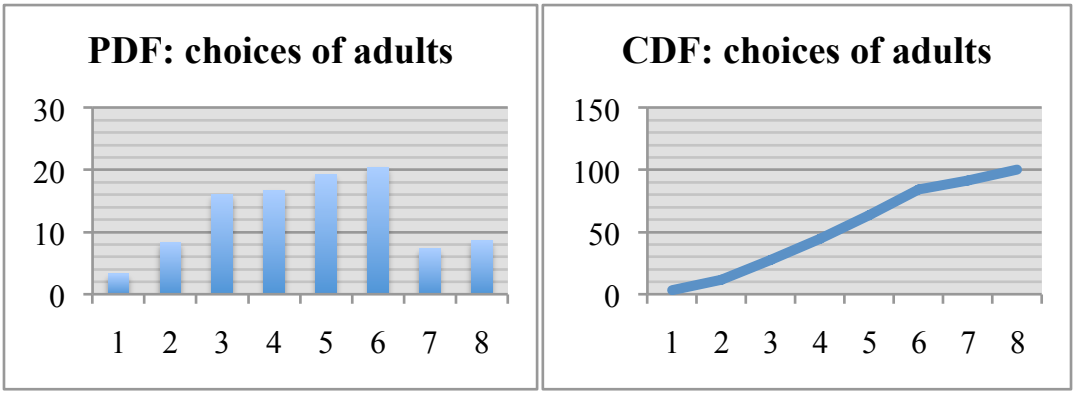


2.2 Adults: descriptive statistics

Since there were three groups of students distinguished by the type of incentive provided for the game, in addition to the aggregated analysis the separate analysis are conducted as well.

Adults	**First group**		**Second group**		**Third group**	
Gender	Males	Females	Males	Females	Males	Females
N	10	6	11	10	23	47

The general distribution of adults' choices is to some extent close to a bell-shaped distribution; the mode is at the choice "6".



First group: students of the Higher School of Economics with no material incentives

The experiment with no material gains was conducted in the classrooms of the University, with students sited in front of the desks (one student per desk, so that no distractive factors from other participants would be present), from 5 to 10 students per room per experimental sitting. The experimentalist read out loud the instructions (appendix 2). The participants started to play the game simultaneously, the two people supervised the process to prevent cheating.

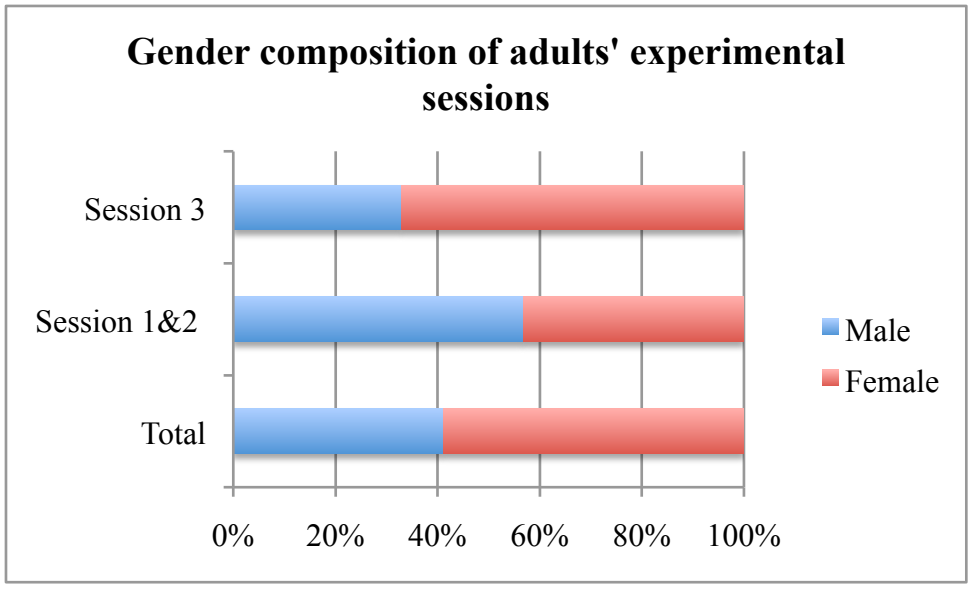
Second group: students of the Higher School of Economics with material gains (money – cash)

The experiment with HSE students with material incentives was conducted in the laboratory of experimental and behavioral economics. The process was similar to the one with the previous group.

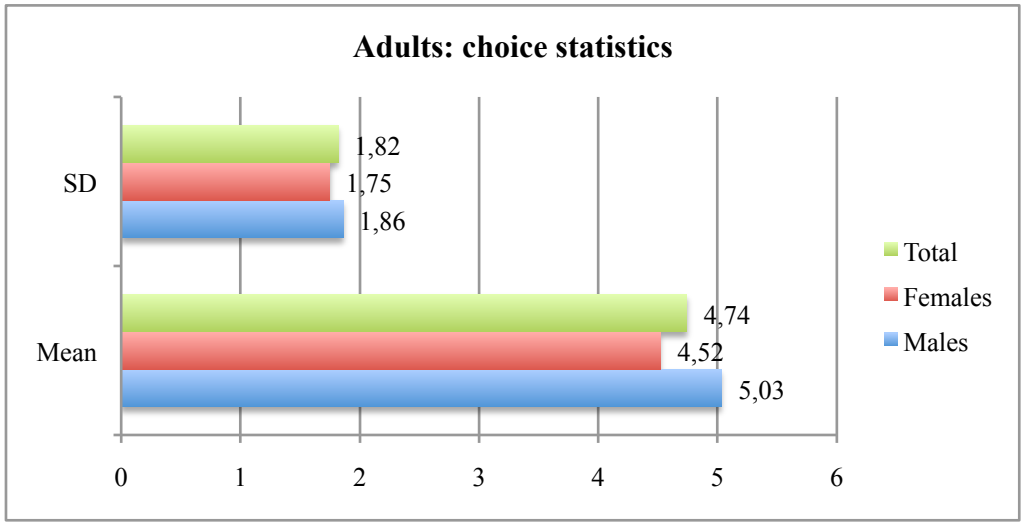
Third group: applicants for the Higher School of Economics Masters Programme (Winter School) with material incentives (souvenirs)

The experiment was constructed in one of the rooms of HSE Winter School accommodation place. There were 18-20 people per one experimental sitting, and 6 supervisors. The process conducted was similar to the one with the first group.

As for the descriptive statistics for the adult group: males and females in the aggregated sample were presented unevenly; with 41 percent of men to 59 percent of women. Session three was biased towards the female category.



On average, males have taken a riskier choice than females had had:



As for the statistics within each of the three samples, on average the choice of the sector for males is higher than that for females. This tendency is observed in all of the three samples except for the third one, with the HSE Winter School participants.

TABLE 1

		Number of participants	Mean	SD	Median
Adults (combined)	**Female**	**63**	**4.52**	**1.75**	**5**
	Male	**44**	**5.03**	**1.86**	**5**
Adults (first group)	**Female**	**6**	**5.77**	**1.35**	**6**
	Male	**10**	**6.11**	**1.73**	**6**
Adults (second group)	**Female**	**10**	**4.18**	**1.39**	**5**
	Male	**11**	**5.16**	**1.57**	**5**
Adults (third group)	**Female**	**47**	**4.32**	**1.78**	**4**
	Male	**23**	**4.22**	**1.68**	**4**

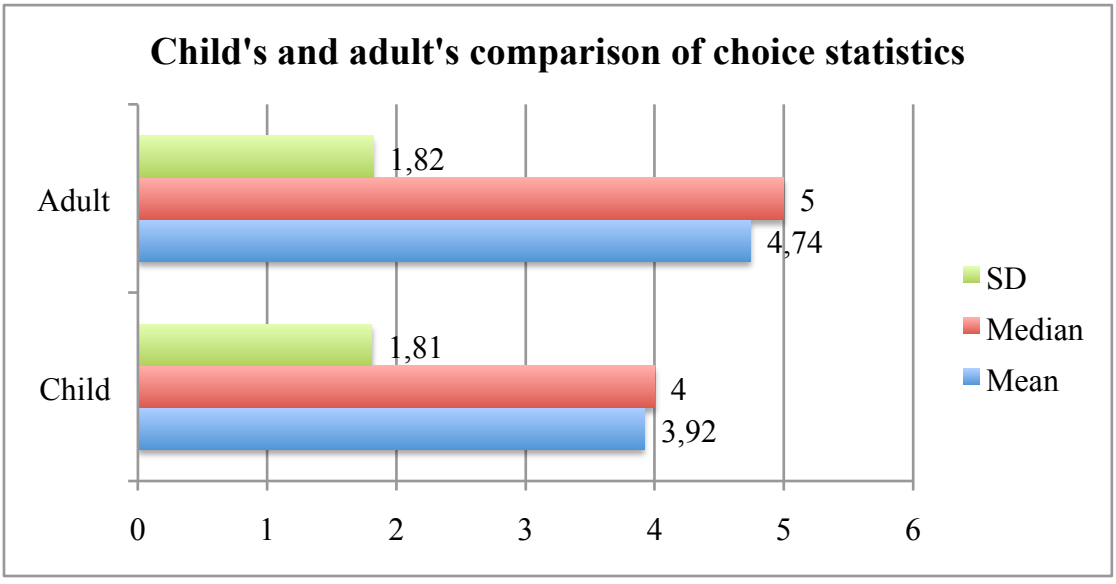
3. RISK PREFERENCES: GENERAL OVERVIEW

Since the distributions of the population are not known, to avoid the mistake of assuming a wrong distribution, non-parametric tests were used to reveal the differences in risk taking between genders among children and adults. In general, there is a significant gender difference for adults; as for the kids, the difference is significant only for the last trial. Below a more detailed analysis is provided.

3.1 Difference between children and adult group

In general, adults are less risk-averse than children, with a mean of 3.91 for kids and 4.74 for adults. Same trend can be observed while comparing the age differences within the same gender groups: there is a strong evidence that the samples come from distributions with differing populations, and the one of the older participants show higher levels of risk than the one for the younger ones.

The general tests on the difference of distribution of children and adults samples show significant divergence on a 1% level of significance (the non-parametric tests[1] reveal the difference on a 0.0001 level for the aggregated age groups).



[1] Kruskall-Wallis, Kolmogorov-Smirnov, Mann-Whitney

3.2 Gender difference between adults

As it was already mentioned, there were three groups discriminated by the incentives provided by the game. The analysis of the aggregated adult sample illustrates a significant difference between the levels of risk-aversion of females and males: according to non-parametric tests, males choose sectors that are on 0.47 greater than the ones that females choose. This result is significant on a 0.1% level for the Kruskal-Wallis and Kolmogorov-Smirnov tests on equality of distributions, and Mann-Whitney test on larger than females' males' sample observations. The results are provided in Table 2.

The same trend can be observed for the sample with material gain in form of cash. The evidence for the first sample with no material gains is controversial: it is significant on a 5% level for Kolmogorov-Smirnov test, but insignificant for Kruskall-Wallis and Mann-Whitney. The last group, consisting of Winter School participants with gains in form of HSE souvenirs, differs from the first two in the difference between female and male risk attitude. For this group, females tend to be less risk-averse, than males are (with the mean of 4.33 against the mean of 4.22), however, this tendency is insignificant on any reasonable level.

This result seems considerably contradictable to the hypothesis of gender differences in risk preferences of adults, and with the empirical results for the other two groups. However, the analysis of the properties of the third group sample presents an explanation of such a phenomenon. Students, which have participated in the HSE Winter School event, had scrupulously passed a strict screening process. In addition to this, only a few of participants came from Moscow; the others were residents of other cities and even countries (Kazakhstan, Uzbekistan etc). Thus, since the participants were the future enrollees of the Higher School of Economics, they were more or less ready to immigrate to Moscow in order to obtain a MSc degree there. Therefore, the possible reason for an unusually high level of risk of the female subgroup is the self-selection process: a person who is ready to emigrate from the home town for education purposes is likely to possess a higher level of risk baring.

Table 2 : Experimental results

	Sample	Statistics	P-value
Mann-Whitney	Combined	-3.256	0.0011
	1st	-1.561	0.0986
	2nd	-3.096	0.0020
	3rd	0.543	0.5871
Kolmogorov-Smirnov	Combined	0.1407	0.005
	1st	0.2583	0.023
	2nd	0.2618	0.036
	3rd	0.0683	0.833

Holt and Laury lottery, general risk evaluation and the experiment results verification

In addition to the specified game, the participants of HSE Winter School have filled the questionnairies with adjusted Holt and Laury lotteries. The latter consisted of ten pairs of two lotteries – A and B, such that A is less risky than B. The expected gains of the lottery increased from the first to the tenth pair, firstly being higher in the lottery A, and converging to the same value for the fifth pair; after that, the gains of the lotteries start to diverge again, with lottery B providing higher expected gain than lottery A. The gain was measured in rubles; however, individuals did not gamble on real stakes, they had to make the choice as if they were going to be paid the resulting prize. In each of the ten pairs of lotteries individual had to choose, which one – A or B – he would like to play (Appendix 3). The experiment design implies that the latter the individual switches, the higher is his risk-aversion. The resulting correlation between the two measures of risk-averseness was negative, accounting for -0.072. This sign of the result corresponds to the one that was expected.

Additionally, the participants of Winter School also answered a question concerning their self-evaluation of riskiness. The formulation was the following: «Some people never risk, while others risk all the time. Where on a scale from 1 to 10 would you put yourself?» The received estimate correlates with the average level of risk chosen in a sector game by 0.15 in general, with 6% level of significance (p-value=0.534). The low value of correlation can be explained by the difference in financial risk, which participants are taking while playing the game with segments, and the general level of risk, which insorporates such types as health risk, driving risk, job risk etc.

3.3 Gender difference between children

In general, the sectors that girls have chosen illustrate the insignificant difference with the sectors that boys choose, with boys' average choice of sector on 0.3 higher, than the girls' one. The deviation of choices is higher for the boys (Table 3.3.1).

Table 3.3.1: comparison of boys and girls

	Sample	Statistics	P-value
Mann-Whitney	**Children**	**-2.038**	**0.0416**
Kolmogorov-Smirnov	**Children**	**0.1191**	**0.267**
Kruskal-Wallis	**Children**	**4.152**	**0.0416**

The further analysis of the risk preferences of children shows insignificant difference in risk taking for the first four trials on any reasonable level of significance. However, a significant gender difference is revealed on a last trial of the game (Table 3.3.2). This suggests for the investigation of the last-choice effect.

Table 3.3.2: comparison of boys and girls within trials

1-4 trials

	Sample	Statistics	P-value
Mann-Whitney	**Children**	**-0.423**	**0.6725**
Kolmogorov-Smirnov	**Children**	**0.1033**	**0.576**
Kruskal-Wallis	**Children**	**0.179**	**0.6725**

5th trial

	Sample	Statistics	P-value
Mann-Whitney	**Children**	**-2.870**	**0.0041**
Kolmogorov-Smirnov	**Children**	**0.3526**	**0.048**
Kruskal-Wallis	**Children**	**8.007**	**0.0047**

The adult sample does not indicate any difference of the last trial compared to the first four trials. Therefore, this effect can be observed only in kids group.

The main implication of this result is that while little boys' risky behaviour does not differ from the little girls' risky behaviour in all of the trials except for the last one. This may serve as an argument in support of the null hypothesis of no gender difference among children. However, the interesting issue that has to be considered in further research is the reason for the existence of the last trial effect. Additionally, due to a certain divergence of the evidence on kids behaviour, there arises a need for a further verification of the stated null hypothesis. This would be done in section 5.

4. LEVEL OF ASPIRATIONS

One of the issues that has to be taken into account is that the provided design of the experiment allows not only to investigate the participants' attitude towards risk, but also take into account the level of aspirations. This phenomenon was firstly introduced by Lewin. By this term he implied the level of subjective probability of individual to complete a certain task successfully. Therefore, since the design of the experimental game involved a certain assessment of the one's abilities, it is important to take into account the possible effect of either high or low aspirations of the participants on their choices. In addition to this, it is an interesting issue how females and males differ in their level of aspirations. According to the research conducted by Barber and Odean, men tend to be more self-confident, thus, a positive difference between men's and women's aspirations level is expected.

As a measure of aspirations level, the difference between the first and the last trial is used. By aspirations the self-appraisal of abilities is meant. Therefore, when the individual makes his first choice, it is influenced not only by his desire to obtain a certain gain (including the risk considerations), but also on self-esteem of his abilities to hit a certain sector (his accuracy, for instance). At the same time, the last choice – in the fifth trial – is made on the basis of certain experience and adjusted evaluation of one's accuracy. Thus, the difference between the first and the last choice can indicate the pre-game level of aspirations. In addition to general analysis, the aspirations level of individual was compared to his aggregated number of successes through the game.

In general, both genders increased their level of risk from first to fifth trial: 2.76 and 1.07 for children males and females, and 1.17 and 1.36 for adult males and females correspondingly.

This difference was significant for children, but insignificant for the adult group. As for the influence of number of successes (a sum of number of successes for the game of each participant) on aspirations level, the correlation between these two variables is positive in most cases and equal to 0.42 for adult males, 0.12 for adult females, 0.13 for child males and, finally, -0.14 for child females. However, this value is only significant for the adult males group (on a 0.5% level of significance with a p-value of 0.0041).

5. RISK PREFERENCES: REGRESSION MODEL

On the basis of the prior investigation of the data, the two models for the estimation of variables influencing the risky choice of the participant will be considered:

ln (P(choice)=8) / P(choice=3) = b_1 + b_2 * gender + b_3 * trial + b_4 * aspirations +b_5 * success

This model includes the four basic variables: the number of trial, which is expected to have a positive influence on the choice since the increasing trend through the game was captured for all four control categories (adult males, adult females, child males and child females); aspirations level, which is constructed as a difference between the last and the first trial; success, which referes to the outcome of each trial (whether the indicated sector was hit or not); and, lastly, the control variable gender, the dummy variable taking a value of «1» for male participants and «0» for female participants.

The model were estimated via the multinomial logistic regression, which enable to capture the fixed effects in the panel data. In the model specified, the coefficients refer to the log odds of individual choosing the most risky – eighth – sector versus the third sector. The latter was chosen as a base sector since the cumulated area of the first three sectors is equal to the cumulated area of the latter five sectors, threrefore representing a middle line in the game field.

The results of the model are the following: the variables *gender*, *trial* and *aspirations* have significant positive effect on adults' choice on a 5% level of significance. According to the coefficients derived, adult males lead to a rise on 1.34 of the relative log odds of taking a riskier choice. Also, the higher is the trial, the higher are the odds of choosing the eighth sector – on 0.41 per a unit increase in trial. Lastly, the aspirations level influence was estimated as having a positive effect of 0.36 on the log odds of the riskiness of the choice.

As for the children group, the only significant variable was the level of *aspirations*; all the other variables appear to be insignificant on a 5% level, including the gender indicator. Influence of aspirations level on the choice of a child was just about the one in the adults' sample – 0.35.

6. DIFFERENCES IN RISK STRATEGIES

In order to capture the effect of the previous to a trial successful or unsuccessful event on the individual's choice, the two new variables are constructed: *choicels*, corresponding to the choice made by individual in previous trial which resulted successfully (the candidate hitted the chosen sector); and *choicelf*, corresponding to the choice made by individual in previous trial, that resulted unsuccessfully (the individual failed to hit the chosen sector). Technically, these variables were constructed in the following manner: a variable *choice_lagged* was considered, which corresponded to the choice of the participant with lag 1 (taking values from 1 to 8). *Choicels* was obtained by multipying *choice_lagged* by the dummy representing the lagged success; *choicelf* was obtained by multiplying *choice_lagged* by the dummy for lagged failure.

Additionally to the two variables representing the previous successful and unsuccessful decisions, the *trial* variable was included into regression in order to account for the effect of time variations.

Thus, the final model for strategy differences evaluation is the following:

$$\mathbf{choice_i = a_i + b_{1i} * choicelf + b_{2i} * choicels + b_{3i} * trial + u_i}$$

The data on risk attitudes can be treated as panel, since it includes observations of individuals' choices for five periods – five trials of the game. Thus, in order to estimate this relationship, the fixed effects model was used. The random effects model was preferred to a fixed effects one, since it is implied that there are some particular properties of individuals which influence their choice pattern, are not correlated with each other and are unique to individual. Therefore, this individual properties should be controlled, which can be performed by the fixed effects model. This intuition is supported by Hausman test (on a 0.01% level of significance, with chi-square = 65.22, p-value = 0.00000).

The only drawback of this model is its inability to capture gender differences, which is a crucial part of the investigation. However, this problem is resolved by two methods: the first one, to run two separate regressions for males and females, and then compare the results. The second one is to construct a new variable, which would capture the frequency of different choice strategies for every individual, and then evaluate the possible gender divergences via non-parametric tests.

The results of the fixed effects model are presented in Appendix 4. The significance of the model is high for all of the groups except for child females (on a 1% level of significance). Summing up, the previous success influence makes the adult participants to increase their risks, however, this effect is only significant for the male respondents and equal to 0.187. As for the children group, the data does not support any influence of previous hit on the subsequent ones.

Also, the regression shows systematic influence of the trial – in other words, the influence of the time variable – on the participants' choices. This influence predicts a positive trend, that is, the respondents in general tend to increase their level of risk through the course of the game.

The model was tested on the cross-sectional dependence via the Pasaran CD test. No contemporaneous correlation was found as a result (with test-statistic of -0.463, p-value=0.6433). Therefore, a conclusion can be made that residuals are not correlated across individuals.

In addition to regression, a variable choice_diff was constructed, referring to the difference in choices made between the two sequential trials:

$$\mathbf{choice\_diff_i = choice_i - choice_{i-1}}$$

The parametric tests (including the Kolmogorov-Smirnov, the Kruskal-Wallis and the Mann-Whitney tests) reveal the significant gender difference on a 5% level for the strategy of adults in second trial after previous success, and reveal no significant difference in other cases (both for children and for adults). Both genders are likely to increase the risk (choose a sector that provides higher benefits) after the successful trial; however, the extent of an increase is higher for male that for the female. The strategy for the previous failure is the same for both genders is to lower the risk; females tend to decrease the value of chosen sector to a greater extent than males, however, this difference is insignificant on any reasonable level.

As for the children group, there is no difference in reaction towards previous successes and failures on any reasonable levels of significance in any trial.

Lastly, the difference in the following statistics were compared:

(1) the average number of increase in risk after success in previous trial
(2) the average number of increase in risk after failure in previous trial
(3) the average number of unchanged risk after success in previous trial
(4) the average number of unchanged risk after failure in previous trial
(5) the average number of decrease in risk after success in previous trial
(6) the average number of decrease in risk after failure in previous trial

The analysis revealed that adult females tend to increase risk after failure more often, than adult males. This difference is significant on a 5% level[2]. Additionally, there is significance difference in the amount of remaining on the same level of risk after success (for females higher than for males). No significant difference was revealed among kids.

Previous trial	Change in sector	Adults		Children	
		Males	Females	Males	Females
Previous success	Increase risk	1.51	1.36	1.45	0.96
	Same risk	1.02	0.46	0.22	0.37
	Decrease risk	0.46	0.40	0.64	0.54
Previous failure	Increase risk	0.4	0.71	1.28	1.12
	Same risk	1.02	0.79	0.48	0.44
	Decrease risk	0.65	0.76	0.57	0.96

[2] according to Mann-Whitney, Kruskall-Wallis and Kolmogorov-Smirnov tests

CONCLUSION

The main purpose of the research performed in this paper was to reveal the possible reasons of gender differences in risk aversion. This question was considered under the null hypothesis of no gender difference among children, and the non-zero gender gap in risk-averseness among adults (which would provide a possible implication for the Nurture explanation of the gender gap in risk attitudes).

The analysis of descriptive statistics provide a general result that the zero hypothesis of no difference between female's and male's attitudes towards risk can not be rejected for children but is rejected for the adults' aggregated sample. However, the consideration of the three samples of adults differing for the game incentives separately proposes a controversial result. For instance, the experiment conducted via the HSE Winter School Event indicated no significant gender diversion; while the experiment conducted in laboratory shows that this difference is significant. One of the possible explanations for the absense of gender gap within the Winter School participants can be the non-randomness of the sample: since invitation on this event was made on a competitive basis, its participants could differ from population (were more ambitious, talanted etc.), which influenced the final result.

The regression results provide a more lucid implication: there is no difference in risk taking behaviour within children, while for the adults this difference is significant. These results on the gender effect are controlled for the level of aspiraitions, which can influence the choices of individuals and thus have to be taken into account in order to avoid the possible biases. The level of aspirations appear to be significant in both age groups and show a positive influence on the risk taken by individuals.

Summing up, the results of the research performed provide evidence in support of the absence of innate differences in risk behaviour, since the gender gap in risk preferences that were captured within the adults' group is not found within the children's group. As for extension of this investigation, a further analysis on the differences in formation of weighting probabilities funcion can be considered.

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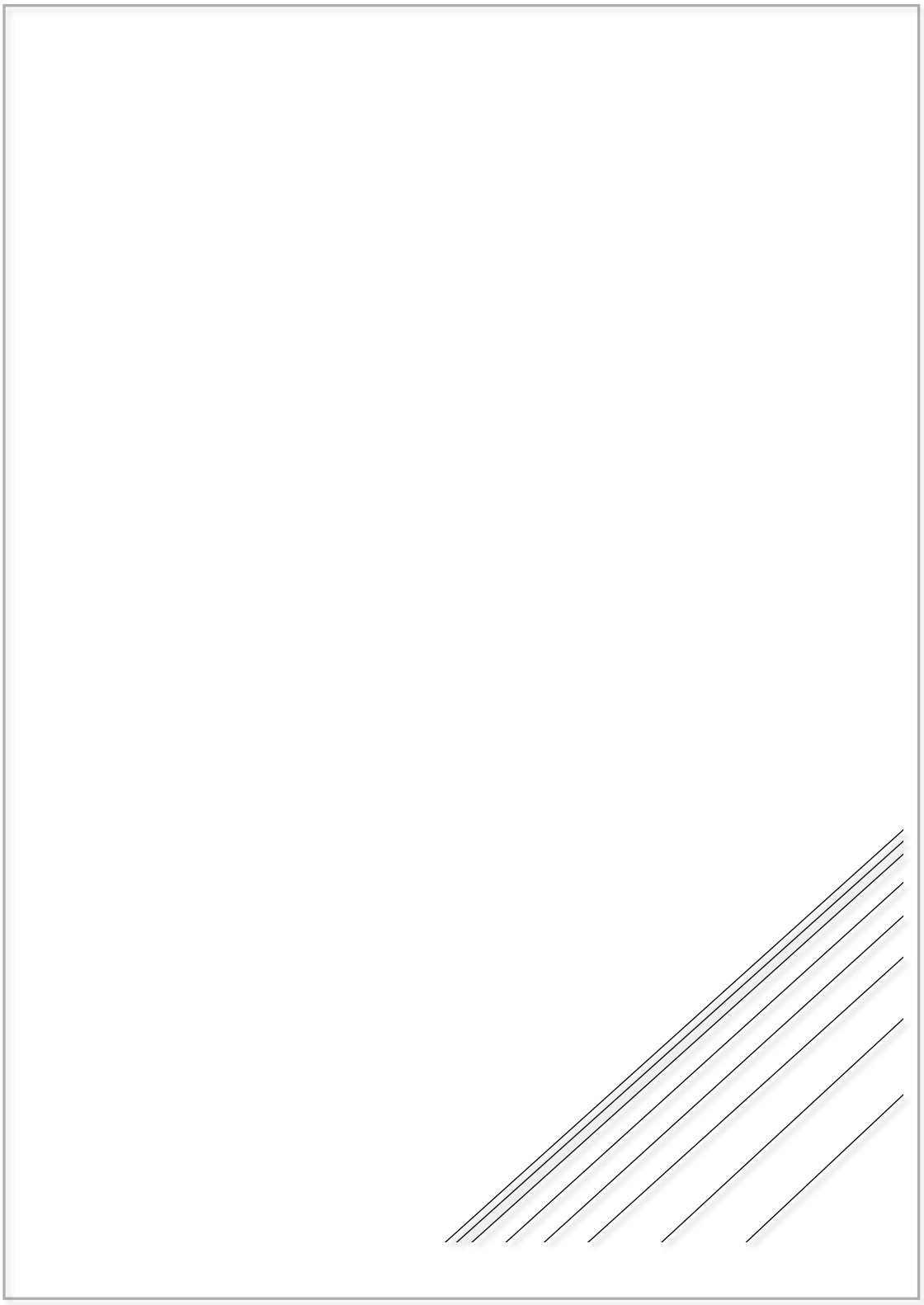
Appendix 1. Game field



Appendix 2. Instructions

For the children group:

Мы с тобой сыграем в следующую игру: вот листок, на котором восемь полосок разной ширины, чем дальше полоска от угла, тем она уже (ребенку показывается игровой лист, см. Приложение 1). Задание такое: ты должен(на) поставить точку в одну из этих полос, затем закрыть глаза, поднять руку с ручкой над листом и попробовать попасть как можно близко к этой точке (после этих слов экспериментатор показывает ребенку на пробном игровом листе, как нужно играть). Самое главное – попасть в полоску, в которую ты поставил(а) точку – в этом случае ты получаешь приз, воздушные шарики (ребенку показывается пакет с разноцветными воздушными шариками). Всего у тебя будет пять попыток – ты можешь пять раз ставить точку в разные полоски, и пять раз пытаться попасть с закрытыми глазами в поставленную точку. Количество шариков, которые ты выиграешь, будет зависить от ширины полоски, которую ты выберешь. Чем уже полоска, в которую ты поставишь точку – тем больше выигрыш. Например, если попадешь в первую полоску, ты получишь 1 шарик, во вторую – два шарика, ..., и, наконец, в самую узкую - восьмую – восемь шариков (при перечислении выигрышей на игровом листе показывается соотвествующие сегменты). Тебе все понятно в условии игры? Если что-нибудь непонятно, я объясню еще раз.

For the adult group:

Игра заключается в следующем: на этом листе нарисованы 8 секторов разной ширины, чем дальше сектор от угла, тем он уже (показывается игровой лист, Приложение 1). Задание следующее: ты должен(на) поставить точку в один из секторов, затем закрыть глаза, и, подняв руку над листом, попробовать попасть как можно ближе к поставленной точке (после этих слов экспериментатор показывает на пробном игровом листе, как нужно играть). . Самое главное - попасть в тот же сектор, в который была поставлена точка-цель – в этом случае ты набираешь баллы, причем количество набранных баллов зависит от ширины сектор, который ты выбираешь – чем уже, тем больше баллов. Так, если ты попадешь в первый сектор, ты наберешь один балл, во второй – два балла, и так далее (при перечислении выигрышей на игровом листе показывается соотвествующие сегменты). Последний

сектор дает девять баллов. Тебе понятны условия игры? Если что-нибудь непонятно, я объясню еще раз.

Appendix 3. Adjusted Holt and Laury lotteries for Winter School participants

	Вариант А			Вариант Б		
	Вероятность выигрыша в 600 рублей	Вероятность выигрыша в 480 рублей	Ваш выбор:	Вероятность выигрыша в 1155 рублей	Вероятность выигрыша в 30 рублей	Ваш выбор:
1	1/10	9/10		1/10		9/10
2	2/10	8/10		2/10		8/10
3	3/10	7/10		3/10		7/10
4	4/10	6/10		4/10		6/10
5	5/10	5/10		5/10		5/10
6	6/10	4/10		6/10		4/10
7	7/10	3/10		7/10		3/10
8	8/10	2/10		8/10		2/10
9	9/10	1/10		9/10		1/10
10	10/10	0		10/10		0

	Lottery A			Lottery B		
	Probability to win 600 rubles	Probability to win 480 rubles	Your choice:	Probability to win 1155 rubles	Probability to win 30 rubles	Your choice:
1	1/10	9/10		1/10		9/10
2	2/10	8/10		2/10		8/10
3	3/10	7/10		3/10		7/10
4	4/10	6/10		4/10		6/10
5	5/10	5/10		5/10		5/10
6	6/10	4/10		6/10		4/10
7	7/10	3/10		7/10		3/10
8	8/10	2/10		8/10		2/10
9	9/10	1/10		9/10		1/10
10	10/10	0		10/10		0

Appendix 4. Risk preferences: regression model

Choice	Adults		Children	
Base cat.	3	5	3	5
const	-4.594***	-3.815***	-4.157**	-1.96
	(0.919)	(0.893)	(1.896)	(1.784)
gender	1.343**	1.314**	0.549	0.604
	(0.673)	(0.621)	(0.688)	(0.631)
aspirations	0.357**	0.281***	0.346**	0.334**
	(0.123)	(0.105)	(0.157)	(0.163)
success (-1)	0.406	-0.299	-0.629	-0.539
	(0.519)	(0.489)	(0.863)	(0.729)
trial	0.640***	0.463	0.548	-0.091
	(0.135)	(0.118)	(0.378)	(0.337)

*Note: ** - 5% level significance; *** - 1% level significance; standard errors are shown in parenthesis*

Appendix 5. Risk strategies: fixed effects model results

Choice	Adults		Children	
	Males	Females	Males	Females
const	3.74***	3.71***	2.929***	3.558***
	(0.400)	(0.347)	(0.528)	(0.603)
trial	0.186***	0.142**	0.605***	0.157
	(0.082)	(0.063)	(0.139)	(0.141)
choicels	0.187**	0.095	-0.158	-0.149
	(0.054)	(0.076)	(0.129)	(01463)
choicelf	0.067	0.100	-0.142	-0.037
	(0.078)	(0.154)	(0.112)	(0.112)
F-test	8.98	3.12	6.58	0.81
p-value	0.00000	0.00000	0.0005	0.4926

*Note: ** - 5% level significance; *** - 1% level significance; standard errors are shown in parenthesis*