"Impact of Risk and Utility Discounting Factors on Behavioral Economics Models in Addiction Groups"

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Summary

This paper examines the attitude towards risk and the benefit to be received in time in various experimental and control groups. Analysis of the literature shows that risk-related and myopic decisions are typical to addiction groups which in the context of various alternatives conduct risky and less risky benefit analysis, consider the volume of the to-be-received benefits, analyze immediate and later benefit according to discounting factor and take appropriate decisions. Two experiments have been conducted to determine these factors, which have shown that groups with addiction behavior are prone to risky behaviors, and they tend to discount their future benefits rather than the control group members. The main question of the research was to determine whether the decision on stopping taking drugs affected the discount factors of risk and the benefits to be received in time. The results showed that there is no significant difference in these factors with respect to the persons involved in the replacement therapy, on the one hand, and the drug users who have not applied for treatment, on the other hand, which means that the decision on discontinuing use of drugs does not change the attitude towards risky and myopic decisions. This leads us to introduce a variety of choices to the consumer market in implementation of result-oriented narcopolitics to create alternatives of such values that can outweight the benefit received as the result of using these substances.

Introduction

Behavioral addiction, drug dependence, gambling, are often considered as psychological or criminal problems such as illness or as a crime, but in economic terms this problem can be considered in the context of decision theory as choice between risky and for-sure benefits, current, immediate utility and tomorrow's discounted utility (DU). Decision-solving problem is characteristic for all areas of human life and can be used to explain different behaviors, including adaptive habits.

As a starting point we refer to the fact that any action of human beings (as a reward-hunter) is directed towards making the best choice between different alternatives. Consequently, choice between alternatives is related to risk analysis and immediate / tomorrow's utility measurement. We will consider the utility in general, which includes not only quantitative characteristics, but also the state of pleasure and satisfaction.

Generating utility (pleasure) is associated with a certain investment (refusal to receive today's utility, which is the initial investment expenditures), which has the corresponding returns in time as earned benefit. When making decisions, a person faces a dilemma – he/she evaluates what is the alternative value of the pleasure he/she has received. Such judgment is right when making decisions about use of alcohol, drugs and cigarettes. It is widely recognized that cigarettes are harmful to health. However, in most cases, a cigarette smoker does not panic that smoking causes lung cancer after regular exposure for 40 years, and for him it is far more important to get a guaranteed satisfaction with a cigarette smoke at the moment, which he/she receives by tradeoff of the current and future utility.

We believe that in developing a single addiction policy which will be directed towards dependence (addiction)- caused harm reduction, the natural factors of human behavior in the context of different alternatives of pleasure should be taken into consideration bearing in mind the risk and time factors. Approaches and methods, which are still used today towards individuals with behavioral addictions, do not take into account these principles and we can say that there is no addiction policy in Georgia today. There are different approaches to cigarettes, alcohol, gambling, marijuana and other drugs. This paper is aimed at finding out the risky and myopic decisions of individuals with behavioral addictions and introducing the obtained results in the addiction policy.

The **goal of the research** is to identify and measure the risk and time-consuming utility factors based on the study of scientific literature and observation of various behavioral and economic models among the drug users with behavioral addictions, as well as to determine whether the decision made for treatment or quitting the substance dependence by drug-dependent individuals affects the changes of such factors.

The answer to this question will allow us to consider the final aims of various approaches defined in the Addiction Policy; let's choose a better, more efficient model taking into consideration risk and time discounting factors; and predict the public benefits resulting from the implementation of such approaches. More specifically, the objective of the research topic is not the comparative analysis of various policies, but the impact of risk and discounted benefits on the decisions taken at the individual level and the results in future Addiction Policy.

The **research hypothesis** is that the decision taken for treatment by the substance (drug)-dependent persons and quitting the behavioral dependence neither affect the risk of these persons towards dependence, nor change their approach to tomorrow's utility discount and these factors remain substantially unchanged.

The similar factors of comparable groups of students and gamblers were simultaneously studied with the drug-dependent persons within the framework of the experiment. Analysis of economic models of risk and time consumption in test groups both proved our hypothesis and showed that these factors in the vulnerable groups (gamblers, pharmacists) are significantly different from the similar parameters of the student control groups. The determined risk factors have shown the preferences of test groups to risk behaviors more than it was expressed in the group of students. In addition, exponential and hyperbolic discounting factors in time detected vulnerable groups, which in its turn describes the quantitative characteristics of impatience and impulsive behaviors, confirmed the sharp predominant mood of the instant benefits, which in its turn, is differed from the similar data of the comparable groups of students towards the tomorrow's utility.

Research novelty: Based on the results of the experiment, the answer to the main research question regarding the decision of drug users to start treatment and quit drug use does not change the risk and time-consuming factors of these individuals, and causes us to prove that treatment is not a precondition to stop drug use. The risk factors for these people's risk and time-discounting factors remain unchanged, which, in the case of appropriate encouraging environmental conditions, will still disclose the preferred mood towards risky and time-consuming benefits and will continue to use drug use after treatment.

Due to the fact that treatment intervention does not substantially change the attitude of people to risky behaviors, on the one hand, and repressive policy is not an effective tool for achieving harm reduction goals, on the other hand, which has been confirmed by many different researches, including with our participation. Our recommendation is to consider the economic nature of the decision model when developing the Addiction Policy, as well as alternative prices and utilities related to human decisions. Consequently, it is important to develop an Addiction Policy based on alternatives that will be focused on long-term perspectives and will be based on the benefits received from various activities..

The **practical significance of the research** is that drugs, substance-dependance, gambling, should not be regarded as mental or criminal problems. The dependence, i.e. addiction should be considered as making a decision about the most utility-changing choice among other alternatives by an individual. Approval of our opinion makes it possible to think about more effective, stable result-based long-term policy oriented on solving the problem, which aims at offering a wide variety of social and personal benefits, instead of responding to the "problem" using the methods with the same risky and less beneficial factors, as the people who carry this problem.

In other words, this paper, based on the analysis of the scientific literature and the conducted studies, shows that drug users punishment/ detention policy in

Georgia has a slight impact on other drug-related circumstances and ineffective spending of limited resources of the law enforcement system, on the one hand, while on the other hand, the treatment policy also does not give the desired result, which will be reflected in a reduction in the number of drug dependent persons after treatment. Consequently, it is necessary to implement effective addiction policy built on effective alternatives.

Paper structure:

The paper consists of 154 pages and includes abstract, introduction, analysis of the current situation, review of literature, description of research methodology, analysis of results and discussion.

The introduction consists of seven pages reviewing urgency of the problem, the goal and the practical value of the research. There is also a brief overview of research method and scientific innovation.

Chapter I - drug use in Georgia from 90s to now, providing for nine pages of analysis of important moments of the Georgian drug policy, demand/supply responses on external mainsprings, as well as explanations of the general tendency on the drug market and summary of the surveys conducted in the Georgian drug policy.

Chapter II - Review of Literature, 59 pages describing human motives through pursuit of pleasure towards getting benefits starting from the ancient times to the existential philosophy. Different models of decision-making in the context of risk and indefinite conditions have been analyzed and the crime economics have been considered in terms of addiction. The nature of the elasticity of the demand for various addiction substances has been described and discount models of decisions taken in time have been reviewed.

Chapter III provides for the description of the survey, ten pages. In this chapter we summarize the researches on the issue, analyze them and present the methodology chosen for our research purposes.

Chapter IV provides for the analysis of the obtained results, 40 pages, and the data obtained as the result of the experiment and analysis thereof, using statistical tools, evaluation of risks towards behavioral addiction and an economic model of risk dependence, as well as tomorrow's utility measurement according to the beta-delta hyperbolic function.

Chapter V provides for the discussion; nine pages describing the main conceptual issues of future addiction policy presented on the results obtained.

The Conclusions provides for the main findings presented on two pages coupled with the relevant recommendations.

The Reference contains a list of 124 sources of literature used in research.

Research description

In order to identify risk preferences, utility in time and behavioral addictions for identification of their connections, we have chosen target groups to which the same research methodology has been applied. Several target groups were selected:

Group I - students (n = 35), which we, based on the results of the survey, divided into two risk-seeking and risk-averse behavioral subgroups (marijuana, drug use/non-use, game in the betting house);

Group II – the so called gamblers (n = 15), persons engaged in gambling games;

Group III - drug users (n = 15) who are involved in methadone replacement therapy courses in order to reduce dependence.

Group IV - drug users (n = 15) with intensive narcotics use history treating themselves as drug addicts and who has never applied for treatment or replacement therapy;

Participants were awarded with cash prizes - GEL 5 for students; one of Tbilisi gambling house users selected for participation in Group II, and were awarded GEL 10 for participation in the experiments; as for the subsequent groups of persons involved in the methadone program, who agreed to take part in the experiment, we asked them if they invited any additional person who would satisfy the requirements of Group IV (an intensive user who did not apply for replacement or treatment therapy) would receive GEL 10 and the money generated in a lottery game. We also promised members of Group IV to participate in the same cash prize

In order to elicit risk preferences in the first experiment, Holt and Laury low- and high-payoffs lottery method was used. Since we were limited in the budget, the prize money was awarded to the participants only by low-payoff lottery results.

10 lotteries were presented to the participants. Each lottery consists of two options - A and B. In each lottery participants selected either A or B option. So they got 10 choices. Participants were rewarded with a cash prize lottery in order to stimulate the behavior that is close to reality. Before start of the game, the participants knew that only one choice should have been selected from 10 choices by random selection resulting from a throw of a 10-sided die to make real money. Later, after throw of a 10-sided die, the lottery would be played.

The computer screen shows ten decisions. Each decision is a paired choice between "Option A" and "Option B." You will make ten choices and record them using your mouse, but only one of them will be used in the end to determine your earnings.

Lottery #1:

Option A - 1/10 chance to win GEL 2 and 9/10 chances to win GEL 1.6
Option B - 1/10 chance to win GEL 3.85 and 9/10 chances to win 10 tetri

After the participants have made their choices, the instructor throws a ten-sided dice when selecting one lottery and determining the option. The faces are numbered from 1 to 10, where 1 serves a 10% chance, 2 - 20% chance, and so on. The last number was a 100% chance. The participant received the sum equal to the probability corresponding to the thrown dice.

Overall, 184.3 GEL was paid as earnings, which was GEL 2.8 GEL per participant on average.

The essence of this experiment was to determine the attitude of the players to the risk of their choice. If we look at the latter pairs and the differences between the winnings (EV (choice A) - EV (choice B), the rational and risk-neutral subject will choose option A in row 1 to 4 because EV(A)>EV(B), and then switch over and choose option B in row 5 to 10 as EV(B)>EV(A). It is also noteworthy that someone who switches earlier (in the first pair) to option B is classified as risk-seeking and the more risk-averse individual will switch later as she needs a higher expected value to choose the more variable option (Option A).

Consequently, selection of Option A in more than 4 rows indicates on the attitude required for the risk, and selection of Option B in more than 4 rows - indicates to the risk-seeking.

The next hypothetical part of the risk experiment consisted of similar questions from the first part, in contrast, that the amounts were increased and the award was not distributed.

10 pairs of lottery presented to the participants are now comprised of the following options A and B:

Lottery #11:

Option A - 1/10 chance to win GEL 244 and 9/10 chances to win GEL 195
Option B - 1/10 chance of winning GEL 470 and 9/10 chances to win GEL 12

In this experiment our goal was to determine if the player's risk preference is heterogeneous in terms of increased bet. Here, as in the previous experiment, the rational and the risk-neutral subject is between row 4 and row 5 of the lottery.

It is noteworthy that this approach to risk attitudes has its disadvantages, namely, to create an exact reflection of the reality that would make it possible for the participants to choose from the loss position. More specifically, in our experiment, and not only in ours, but also in all well-known laboratory experiments dedicated to measuring risk factors, individuals have to make choices between profitable options, according to the possible loss of profit standpoint, while in actual life have a sense of loss and it is likely that their behavior towards the losing position and the risk preference may be heterogeneous. However, within the scope of this experiment, it is almost impossible to convince the participants to play for their own with loss/profit expectations in laboratory conditions.

As for measuring the risk factor, we use the following utility function:

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

where r is the relative risk aversion, and the lottery outcome x is more than zero (as reported in the article of Holt and Laury, however, other exposure indicators are also used to express the risk factor). The risk ratio of the participant is measures in a point (in the choice) when he switches from option A to B. So, while option A stays the same, he thinks that the expected payoff os higher the relevant option B. Switching from A to B option is a key sequence where the participant expresses its own mood of risk.

So, a risk-neutral subject who chooses option A in row 1 to 4 and then switches over and chooses option B, the following equation is used to measure the risk ratio:

$$0.4\frac{2^{1-r}}{1-r}+0.6\frac{1.6^{1-r}}{1-r}>0.4\frac{3.85^{1-r}}{1-r}+0.6\frac{0.1^{1-r}}{1-r}$$

where the risk-neutral subject's risk ratio (($-0.1425<r<0.147$) is measured that means that in the fourth lottery pair the $EU(A_4)>EU(B_4)$. Accordingly, the risk coefficients are measured for all pairs. Coefficients are shown in Table # 1.

Table 1.

In the second experiment of hyperbolic discounting and delta impatience and beta impairment factors, we used a test that included choice between smaller / immediate and larger / tomorrow's hypothetical utilities.

Two pairs of utilities were used as awards: the choice between 20 GEL and 50 GEL and the choice between 500 GEL and 1250 GEL. Each pair included questions according to different periods of payment. The experiment was to find out not just the attitude of people towards immediate and tomorrow's utilities, but their preference to study a two-range conditions - in one case the choice regarding the utility to be received in immediate and tomorrow's periods, and the other in case, between the utilities to be received in 6 month-after and 6-months subsequent periods. For example, if one question was as follows:

Please choose - 20 GEL today or 50 GEL in another month

The other question retained the same period of time – i.e. the difference between the immediate and the tomorrow's utilities remains the same (according to this example, this period is four weeks, i.e. a month), but the utility acceptance terms changed, for example:

Please choose - 20 GEL after 6 months or 50 GEL after 7 months

Asking questions is such a way was needed because the delta factor is enough to tradeoff the two utilities distance from each other by date - for example, we ask an individual to make a choice between 20 GEL and 50 GEL a month later. If the choice is made on the first alternative, i.e. at 20 GEL today, we reduce the date of the payment or raise the amount of payments a week later and we do it until the individual becomes indifferent in time towards the to-be-received utility. As a result, if we know that the individual is indifferent between the today's 20 GEL and 50 GEL to be paid a month later, then its discount delta factor is based on the comparative advantage of 20/50 (if we assume that the distance between these two dates is one period).

As for the beta factor measurement, it was necessary to inform you about the size of a small but immediate utility (reward). That is why it is necessary to bring the second-order dominance (two-time range). The difference in the two-time range was the date of receiving immediate utilities. In the first time, it was today, and the second-order dominance is was a day 6 months later. The likelihood is the period between the two durations of the time - 1 week, 2 weeks, 1 month, etc.

Table 2.

The questions were distributed by the following principle (see Table # 2): first, alternatives were selected in the first-order dominance (the first time range), and in the second-order dominance (the second time period). Similarly, the choice was made in the first and the second time for large amounts.

The utility was assessed with a margin where a single alternative utility was $U^0(u)$, from t=0 time point:

$$U^0(u) = u_0 + \beta\delta u_1 + \beta\delta^2 u_2 + \beta\delta^3 u_3 + \cdots$$
$$= u_0 + \sum_{i=1}^{\infty} \beta\delta^i u_i$$

The difference in comparison with the exponential discounting function is that all utilities other than u_0 are multiplied by β factor ($0 < \beta \leq 1$). Note that while δ increases with high quality (δ, δ^2, δ^3 ...) for future rewards (δ - discounting coefficient, the discount rate quality corresponds to time periods), β remains unchanged. This method of discounting is called hyperbolic discounting. The coefficient β is the designer who adjusts the solution for the benefit of a smaller and immediate reward in exchange for larger and tomorrow's utility. This model is called a beta delta model. When $\beta = 1$, then the behavior of the human being exactly corresponds to the behavior of the person described in the exponential model. In this case, the individual is consistently in his choice - if he prefers a future reward compared to today's utility, he will have the same preference from any starting point for the immediate and future rewards. However, when $\beta < 1$, there is more to increase the quality of discounting of future rewards. In this case, the inconsistency appears in the decisions, and time approaching comes with the advantage of the immediate utility.

As soon as experiment participants become indifferent, equation was made as the result of comparing utilities of alternate options which allowed us to determine beta and delta factor. For example, let's consider the results of one of the participants' responses (Table # 3):

Table 3.

The first-order dominance respondents' responses showed that it was found that the person is indifferent between GEL 20 lari received within a period t=0 and GEL 50 received within a period t=1. In the second-order dominance, the person was indifferent between GEL 20 lari received within a period t = 26 period and GEL 50 received within a period t = 30. The following equation was created for each such case:

$$20=\beta*\delta^1*50$$
$$\beta*\delta^{26}*20=\beta*\delta^{30}*50$$

From which it was established that the delta factor was $\delta = 0.79$, and the beta factor was equal to $\beta = 0.50$. It should be noted that 1 week was taken as the time unit and the quality of the delta factor reflected how many weeks later the choice for the utility was stopped.

In addition to solving risky or time tasks described by us, the respondents also had to fill out a certain type of questionnaire that needed to collect other characteristics of the respondents. For example, in addition to studying risk preferences, we also watched the frequency of use of tobacco, marijuana and other drugs, as well as involvement in gambling, which allowed to divide students into two sub-groups of students with risk-seeking and risk-averse behaviors.

Outcome Analysis

Risk Factors Assessment Experiment Results

Students

To analyze risk factors experiment results, and due to the fact we actually had 5 groups (two subgroups of students, gamers, drug users, who are not involved in treatment and users involved in replacement therapy), so data for each group was summarized separately, and then tests were conducted to determine whether the risk factor affects the way of human life.

Analysis of the data obtained from the risk factor experiments in the case of students showed that the total number of safe options in the low-stake game is 127, and the number of risky variants is 223, which is different from the high-stake game responses - 183 and 167, respectively.

Summary of the safe option and analysis of the combined indicator over the likelihood of profit showed that respondents' answers are in line with increasing risk. The higher is the risk of option B, the more people switch to Option A. The x axis in Figure #1 below shows probability, and the y axis is the total number of safe options in the relevant probability conditions. The dashed line curve - is the option of a risk-neutral subject, which means in the first four options it is better to choose Option A and then switch over and choose option B in the row 5 to 10. The option chosen by the students is somewhat repeating the curve line of the risk-neutral subjects. The blue curve shows a low-stake option in which awards will be presented, and the red curve reflects the curve of the hypothetical option.

Figure 1.

Students have been divided into two conditional groups - students who do not have a history of risky behaviors and students who have a history of risky behavior to find a connection between their responses and risky behaviors. On the one hand, we have compared the risk of students who have not been involved in at least three risk behaviors (cigarettes, marijuana, drug abuse and gambling) (in total it was 19 students), and the students who do not satisfy these conditions requirements (number of such students was 16).

Figure # 2 shows the curve of total safe options of students with less risk behaviors (blue and red curves) and students with risky behaviors (violet and blue curves). The diagram shows that it is clear that the total options of students with disabilities is not the same indicator for students with risk behaviors.

Figure 2.

As an assurance, we used the *t* test for independent option where we tested an alternative hypothesis about the fact that the risk factor is much lower in the students with safe behavior like the results of i test of low- and high-stake games confirm that there is a significant difference between risk option responses among students with risk-seeking and risk-averse behaviors (P=0.0004). In other words, students with risk-averse behaviors in both lotteries chose safe options compared to students with risk-seeking behaviors.

Experiment results of individuals with addictive behavior

As we have noted, gamblers, drug users (DU group) who have not been involved in the treatment and drug users who are involved in replacement therapy (RT group) took part in our experiment.

Unlike students, the total number of safe options for participants with behavioral addiction is significantly lower when the number of risky options has increased (see Table # 4).

It should be noted that the number of safe options chosen by the gamblers in the low-stake game context amounted to the total number of safe options for high-stake hypothetical games, unlike students and drug users, where the number of paid low-stake safe options was lower as compared to the overall rate of safe options, which means that the effectiveness of the utility has not affected the distribution of answers in case of students and drug users.

Table 4.

Below is the dependence of the combined indicators of a safe option (Option A) of all three addiction groups in relation to profit probability - where the *x* axis shows the likelihood and *y* axis are the total number of safe options (Figure # 3)

Figure 3.

The black curve on these images shows an option of a risk-neutral subject, and the color curves show the number of safe answers of low-stake (blue) and high-stake (red) lottery with respect to probabilities. Response to drug users in high-stake games is getting closer to the risk-neutral curve line that we cannot say about gamblers.

We conducted single-option *t* tests within the three groups and tested hypotheses about the fact whether participation in the low-stake, but paid games had any impact on the risk-level of participants versus to participation in high-stake but non-paid games. It was revealed that the answers of drug users groups differ significantly from each other, and this hypothesis was not confirmed in gamblers answers (P = 0.441). In case of gamblers, the zero hypothesis remains unchanged, i.e. understanding of their risk in the context of low- or high-stake game is the same. As for drug users, there is a high probability of belief here (RT group - P=2.31696E-06 and DU Group - P=0.001824) that in case of drug users their risk depends on the size of the game stake.

Modeling using Risk-Factors

Based on the risk factors indexed in Table # 1 and the experiment results, we were able to create behavioral group models involved in the experiment. The estimated behavior of students, gamblers, drug users and individuals involved in replacement therapy with regard to different stake games was analyzed. Figure # 4 below shows risk-dependency models according to the average answers of all students in relation to the risk-neutral curve in low- and high-stake games. In addition, as in the previous case, we also divided students into sub-groups of students with risk-seeking and risk-averse behaviors and presented the relevant models. Figure # 5 is presented by decision models of persons with behavioral addiction.

The presented curves reflect the decision model and the value of utilities received under the appropriate probability conditions according to $U(x) = \frac{(\Pr(A)*X_1+\Pr(1-A)*X_2)^{1-r}}{1-r}$ function. The left column presents models according to the results of low-stake games and the right column - according to the results of high-stake games. Black dashed-line curves reflect the risk-neutrality. Blue and red curves show decisions of the experiment participants. The crossing points are the place of decision changing. Blue and red curves and crossing points are determined by (r) risk factor that represents a statistical average for each group. The model presented in the Figure shows the human decision making process. In the beginning he follows the blue curve (a safe option – Option A in our experiment), because the possible benefit size is much larger than in the red curve (a risk option - Option B in our experiment). After the decision is changed, the individual is guided by the red curve.

Figure 4.

Figure 5.

If we look at the points of changing decisions by individuals involved in the experiment in each model, they differ from the points crossing the curves reflecting the risk-neutrality (as well as from the risk curves) and in terms of a high-stake game are at a significant distance from each other. The neutral currents of risk are crossed in our experiment when the probability of profit is 40%. However, the participants in the experiment do not follow the rational behavior of this model.

Decision models differ from each other according to the size of stakes. The higher the stake is, the more distinctive are the color curves towards the risk-neutrality. In case of students, this was especially visible when we created separate schedules for students with risk-seeking and risk-averse behaviors. If we look at (d) and (f) schedules of Figure # 4, we find that in case of high-stakes, the utility function of students with risk-averse behavior is significantly lower and is below the risk-neutrality curves, whereas the utility function of students with risk-seeking behavior is above the risk-neutrality curves (like in the decision changing points). This means that a high risk factor in decision-making processes pushes them to make decisions that benefit from which is beyond the rational level, while the benefits of risk-averse individuals also extends the rationality level but is within it.

Such a discussion can explain why the curves of utilities of individuals with behavioral addiction and special gamblers sweep up. First of all, it is noteworthy that in low-stake models the decision curves of the experiment participants are below the risk-neutrality curves, however, in the context of high-stake game, the picture changes and the blue utility curve is sharply moving above.

Risk-neutrality curves can be considered as a rational margin in which the profit can be obtained: in the context of our experiment, this profit is the expected cost of the game. However, unlike the expected profit, the participants of the experiment are experiencing the exposure of the profit risk factors we have calculated, which gives the value of the game to a much larger value than it is expected to play. With this respect, the decisions of risk-averse students and the decisions of individuals with behavioral addicition are irrational, but in case of students, their risk factor is that the expected utility does not exceed the level of rationality, while the expected utility of thee substance-dependent individuals sharply exceeds any earning to be received within any rational scopes.

It is interesting that decision curves of the risk-averse students in high-stake game have convex shapes (see Figure 6b) which indicates to the fact that marginal benefits from the game decreases after the likelihood of changes and they change the decision when the chance of losing the benefit is minimal.

As for a low-stake game, the curve here is a relatively high rate, but in the case of a risky game, it looks as if it stands upward (red curve, Figure 6a). The only explanation for risk-averse students between these two decisions may be that, despite the fact that in a low-stake game, unlike the high-stake game, the utility was awarded, and the small amount of this reward led to its low alternatives to get a higher-paid alternative reward.

In Figure 6 and in the next figure, we have presented the curves that describe the behavior according to the decisions of the participants involved in the experiment. For each group we combine the curves in the decision point drawn according to Options A and B.

Figure 6. Decision curves of risk-averse students: a – in case of low-stakes, b – in case of high-stakes

Decision curves of the rest individuals involved in the experiments are concave in terms of low-stake and high-stake games. If in the context of low-stake game the curves more or less follow each other, and are not at a big distance from the rational, risk-neutrality curve (Figure #7a), but there is a significant difference in the high-stake game and it is above the curve of the neutrality curve towards the gamblers, RT and DU groups decision curves, and below the curve of united group of students (Figure #7b), at the same time the gamblers curve pushes up (due to high negative risk factor) to distinguish a schedule for more visibility (Figure #7c).

Analysis of the risk factor experiment results allows us to answer one of our main research questions. We wondered whether or not the attitude of the drug-dependent person towards risk had been changed after involvement in the treatment.

To answer this question, we again tested the hypothesis for two independent options, we took into account the risk factors of DU group defined as a result of the experiment, on the one hand, and the risk factors of RT group participants, on the other hand.

The zero hypothesis put forward by us was that the decision to reduce dependence on drugs and the replacement therapy course would not affect the risk factors of the users and that would remain the same. What about the alternative hypothesis is that the decision to participate in the replacement therapy should have an impact on the risk factor (H_0: $\mu=0$ - risk factor remains unchanged, H_1: $\mu\neq0$ - risk factor changes).

In both cases, *t* tests of low- and high-stake risk factors have not confirmed alternative hypotheses: in case of low-stake game - P = 0.76 and in case of high-stake game - P = 0.80. The zero hypothesis that the involvement in the replacement therapy could not have impact on change of the drug user risk dependence remained unchanged.

Figure 7.

Beta-delta factors evaluation experiment results

Students

Like previous experiments, beta-delta factors for discounting factors of utility in time were assessed and an exponential and hyperbolic model was created for the same groups. In this case, we used hypothesis testing to determine the quality of the different discounting factors in comparable groups.

Assessment of the utilities to be received in time was done within the two time ranges (first and second – order dominance) given below. Each period is equal to 1 week. Consequently *t* values are measured (e.g., the period after 1 month is t = 4, the period after 6 months is t = 26, etc.). The results were analyzed in the first and second range of time 20/50 (Table # 5) and 500/1250 (Table # 6) with respect to pecuniary benefit.

The results of addictive individuals are significantly different from the answers of the students group. In Table 5, which gives answers in case of option of GEL

20/50, it seems that the majority of addictive individuals benefit from the immediate benefit of the first-order dominance, DU and RT individuals 4-4 (26%) of choose to take rewards one week later and in all other cases, immediate/tomorrow's utility dominates. As to the second – order dominance, the situation changes slightly - 2 more people prefer to wait for two weeks to get high yield, but in other cases the advantages are still small, but instant.

As for GEL 500/1250 pair, the respondents show similar preference in the first-order dominance, which was recorded in the first-order dominance of GEL 20/50 pair - the advantages are small but immediate. The case is somewhat different in the order dominance, where unlike the first- order dominance, the DU and the RT individuals preferred to wait and get benefits in the distant periods. It should be noted that the gamblers, the DU and the RT individuals, are in the range of both 20/50 and 500/1250 pairs in the second- order dominance and their preference is to make an immediate benefit.

Table 5.

Table 6.

Figure # 7 reflects the percentages of students' and addictive individuals' responses. The *x* axis represents the number of periods, and the y axis - the larger and tomorrow utility answers. The presented schedule clearly illustrates the difference between the different types of interest towards the future utility. In the first- and second- order dominance, in pairs of both utilities, future/tomorrow's utilities are clearly prevalent in the students' responses, which shows that students are more prone in time as compared to the addictive individuals. This is especially important in the utility pair of 500/1250 where the expectation of the tomorrow's utility in the first-order dominance reaches 26 weeks between the students, while the maximum expectation period of the tomorrow's utility is 4 weeks (Diagram C).

The attitude towards future benefits of the addictive individuals is similar. In gamblers answers, based on their attitude towards the game, the advantage of instant utility is more felt in the first-order dominance, and in both pairs 20/50 and 500/1250 they consistently choose small but instant benefits. In the second –order dominance, answers concerning the tomorrow's utility were recorded, however, the postponement period was still small - only 13% (2 respondents) in the 20/50 pairs opted to receive large benefits two weeks later, and in the 500/1250 pair - 20% after 2 weeks, and another 20% after 4 weeks. The answers of DU and RT individuals are somewhat different from the gamblers in the first-order dominance - if the preference in the gamblers was given to immediate utilities, some respondents preferred the tomorrow's utility.

It is noteworthy that in the first-order dominance the curvature of answers of the DU and the RT individuals coincided to each other (Diagram A and C), while the majority of respondents (27% - 4 respondents) in the 20/50 pair gave preference to the utility received in the second week, while in the 500/1250 pair only 13% (2 respondents) chose the tomorrow's utility. The distance in these answers is derived from the volume of the utility expected by us. Apparently, the preference on receiving immediate utility for the DU and the RT individuals is directly dependent on the value of these benefits. In our case, the receipt of 500 GEL instantaneously became more important than receiving immediate benefits of 20 GEL.

It is interesting that in the second-order dominance, the attitude of the DU and the RT individuals was changed in contrast to the tomorrow's utility. In particular, in 20/50 pairs respondents showed comparative sequencing - two out of 4 people preferred to receive the tomorrow's utility (GEL 50) after 2 weeks, while another two individuals - after 4 weeks (Schedule b), while in 500/1250 pair - 80% of the respondents were oriented on the tomorrow's utility, and the distant period of the most "goal-oriented" individual was a period of 13 weeks (Schedule d). Such a change can be explained by inconsequential dependence of the DU and the RT individuals towards the tomorrow's utility which have not been identified in any other target groups. The DU and the RT individuals in the first-order dominance have preference for immediate utilities, and the higher the preference is, the more the amount of immediate utility is, but in the second-order dominance, reflecting the period of half a year, the DU and the RT individuals have shown less interest in the larger immediate utilities.

Based on the statistical average of beta and delta factors, utility function for addictive individuals received the shape of the curves shown in Figure # 8. Schedules A and B, the preference for immediate utilities compared to the group of students with behavioral addiction is obvious. The statistical mean of the beta factor in minority groups has been significantly replaced in 20/50 and 500/1250 pairs (as well as in students). This suggests that the value of the beta factor does not depend on the size of the utility and can be considered as a universal characteristic for a particular group.

Figure 7.

If we recall that the beta factor is used to describe a person's impatience, then the fact that the beta changes slightly, suggesting that the quality of the impatience is more or less unchanged and may predict his/her behavior in the decision-making process. It is noteworthy that the beta factor was the same for the DU and the RT individuals in the utility pairs and has been slightly changed between the pairs, which also indicate that decision making concerning treatment does not affect the effect of the beta factor (P = 0.91) and that the beta factor can be used to describe behaviors of homogeneous groups.

As for the delta factor, it depends on the utility volume - the utility curve in the expectation of a big gain will not approach zero so fast (the fast impairment of the future) as it was expected in the low utility. If we look at the blue dot line of

Figure 8.

Schedule A, for 20/50 pairs, the utility curves in the first – order dominance discount the tomorrow's utility so that its selection becomes irrational. For the 500/1250 pair, the attitude changes only for the group of students. The tomorrow's utility is attractive for them up to almost the second-order dominance, while waiting for the tomorrow's utility of the addiction groups loses its significance for the first-order dominance. There is no significant change in the value of delta factor between the DU and the RT individuals (P = 0.27 in 20/50 pairs and P = 0.64 in 500/1250 pairs). The average statistical behavior of these groups remains unchanged by the influence of the beta-delta factor and the advantage is the immediate utility of the first-order dominance.

Conclusion/Recommendations

Analysis of the economic models of risk and time-consuming utilities showed a significant difference in risk factors and beta / delta factors in test groups of individuals with behavioral addiction and the control group of students.

Risk factors have shown the preferences of drug users and gamblers towards risky behaviors more than expressed in the group of students.

The exponential and hyperbolic discounting factors identified in the test groups proved to be a sharp preference towards immediate utility, which in turn was different from the similar parameters of the comparable groups of students where there was a preference towards the tomorrow's utility.

Based on the results of the experiment, the main question of the survey - whether the decision of substance-dependent users on commencement of treatment and quitting use of drugs change the discounting factors of risk and time of such individuals have shown that their dependence on risky and myopic decisions remains unchanged.

This causes us to prove that treatment is not a precondition to stop drug use. In the event of appropriate encouraging environmental conditions, the users will still demonstrate preferential treatment towards risky and immediate utilities and return to drug use after treatment.

Furthermore, the inefficiency of repressive policy towards dependence and dependence-caused harm reduction was confirmed within the framework of our research.

Our recommendation is to develop a single addiction policy, which should take into account the economic nature of decision models, the value and the utility of alternatives related to these decisions.

It is important to develop a multi-functional alternatives-based addiction policy that will allow individuals to change their risky and myopic decisions with safe and far-reaching alternatives.