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Utilization of experimental games' methods in the study of cooperation, altruism and fairness and their biological predictors

Využití metod experimentálních her ke studiu kooperace, altruismu a férovosti a jejich biologických prediktorů

MSc. THESIS

Supervisor: Prof. RNDr. Jaroslav Flegr, PhD.

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Declaration

I hereby declare that I carried out this study by myself, under the supervision of Prof. RNDr. Jaroslav Flegr, PhD., and that I acknowledged and cited all information sources I had used. This work or any section of it is not and has not been used to obtain any other degree.

In Prague 3. 5. 2015 ……..

Čestné prohlášení

Tímto čestně prohlašuji, že jsem tuto práci zpracovala samostatně, pod vedením prof. RNDr. Jaroslava Flegra, PhD., a že jsem uvedla a správně citovala veškeré použité informační zdroje. Tato práce ani žádná její součást nebyla použita k získání žádného jiného akademického titulu.

V Praze 3. 5. 2015 ……..

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Abstract

Cooperative, altruistic and fairness-exhibiting behavior is an important topic in evolutionary and behavioral biology and the mechanisms leading to its evolution, ultimate as well as proximate precursors, are subject of much research in biological as well as social sciences, theoretical as well as experimental work.

In light of the life history theory, I focused on the connection of one's health state and cooperative behavior in humans and tested the hypothesis that more healthy individuals would manifest more cooperative tendencies (as they would have more opportunities of future interactions and long-term benefits), and conversely. The data, obtained from a sample of university students engaged in experimental games (Dictator Game, Ultimatum Game, Expanded Ultimatum Game, Trust Game, and Reversed Dictator Game) and a health and personality-focused questionnaire, did not corroborate this hypothesis.

My other hypotheses – that better memory and lower temporal discounting would be related to more cooperative behavior (stemming from the conditions for reciprocal cooperation) – were supported by the data, albeit only partially in the case of memory.

I also used the data from the five experimental games to briefly describe the proportions of different types of behavior (self-regarding, altruistic, fairness-driven and cooperative) in the studied population, focusing on the outcomes of the behavior rather than intentions. This exploratory work showed the prevalence of cooperative tendencies but very low frequencies of purely self-regarding, altruistic, or fairness-driven types of behavior. An analysis of personality factors of the subjects revealed the relative importance of motives. I conclude by pointing out several subtopics worthy of further research.

Keywords: altruism, cooperation, fairness, evolutionarily stable strategy, experimental economics, game theory, human health, life histories, reciprocity, social norms

Abstrakt

Kooperativní, altruistické a férově se projevující chování představuje důležité téma evoluční a behaviorální biologie a mechanismy vedoucí k jeho evoluci, ultimátní i proximátní prekurzory, jsou předmětem mnoha výzkumů v biologii i společenských vědách, teoretických i experimentálních prací.

Ve světle teorie life histories jsem se zaměřila na vztah zdravotního stavu jedince a kooperativního chování u lidí a testovala hypotézu, že zdravější jedinci budou projevovat kooperativnější tendence (a to zejména díky větším možnostem budoucích interakcí a dlouhodobých zisků) a naopak. Data získaná od vzorku univerzitních studentů hrajících experimentální hry (hra na diktátora, hra na ultimátum, rozšířená hra na ultimátum, hra na důvěru – též překládána jako investiční hra – a obrácená hra na diktátora) a vyplňujících dotazník zaměřený na zdraví a osobnost nepodpořila tuto hypotézu.

Mé další hypotézy – že lepší pamět a nižší temporal discounting budou spojeny s kooperativnějším chováním (vycházející z podmínek pro reciproční kooperaci) – byly daty podpořeny, nicméně pouze částečně v případě paměti.

Data z pěti experimentálních her jsem také využila ke stručnému popisu podílu různých typů chování (sobeckého, altruistického, férového a kooperativního) ve studované populaci, přičemž jsem se zaměřovala na důsledky chování oproti motivům. Tato explorační část práce ukázala četnost kooperativních tendencí, ale relativní vzácnost čistě sobeckého, altruistického i férového chování. Analýza osobnostních faktorů poukazuje na relativní důležitost motivací. Práci uzavírám upozorněním na několik podtémat vhodných k následování při budoucím výzkumu.

Klíčová slova: altruismus, kooperace, fairness, evolučně stabilní strategie, experimentální ekonomie, lidské zdraví, life histories, teorie her, reciprocita, sociální normy

List of used abbreviations

DG – Dictator Game
EUG – Expanded Ultimatum Game
ERC – theory of equity, reciprocity and competition (Bolton & Ockenfels 2000)
ESS – evolutionarily stable strategy
FCC – theory of fairness, competition and cooperation (Fehr & Schmidt 1999)
PD – Prisoner's Dilemma
RDG – Reversed Dictator Game
TFT – Tit-for-Tat (a strategy in the Prisoner's Dilemma)
TG – Trust Game
UG – Ultimatum Game

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Introduction

Displays of altruism or fairness, as well as many manifestations of cooperative behavior, remained an evolutionary mystery for a long time. Multiple possible explanations had been proposed for each and every one of them, including kin selection, group selection, allele-level selection, reciprocity, sexual selection and related costly signaling or handicap. Many animal species as well as humans have been observed or experimentally tested to discover more and numerous models have been developed.

Yet the conundrum remains largely unresolved. The selection forces leading to the evolution of these traits often remain unclear and their respective effects are hard to distinguish in case more of them had played a role. The aim of this work is, first and foremost, to investigate whether and how one's health influences prosocial behavior (as life history modulates the impact of different selection forces on an individual), and subsequently to try to determine the proportions of altruism, cooperation and fairness preferences in the studied population, and to view them from the evolutionary perspective. I will first in the theoretical part of this thesis summarize shortly what is known about the topic from research of animal behavior, human interactions and theoretical works – what asserted selection forces and relations between the aforementioned traits the data suggest.

Following that, I will describe the study I have conducted, its results, their implications and possible limitations. The participants in the study have taken part in several experimental games widely used by game theorists, behavioral economists, evolutionary biologists and psychologists. From their results, I would like to be able to test hypotheses regarding health, memory and temporal discounting, and distinguish between altruism, cooperative behavior and fairness (also inequity aversion), and then evaluate their distribution in the population. I will conclude by discussing the gained insights in context of previous studies and pointing out the desirable course of further research.

Background

The big questions and the early pioneers

The questions of altruism, fairness norms and cooperation have been tackled by biologists for a long time now. It had seemed that selection would favor only mutually beneficial cooperation where the benefit of it exceeds that of cheating, while altruistic behavior would not prevail – yet the observations from nature spoke otherwise. The early efforts to explain and model these traits are connected particularly to the names of William Hamilton, George Price, John Maynard Smith, and Robert Trivers.

Hamilton (1964a) formalized the concept of kin selection, later known as the "Hamilton's rule": An altruistic action is profitable for an individual if the costs are outweighed by the benefit for the recipient of the help multiplied by the rate of genetic relatedness between them. At least one of two conditions is needed: recognition of genetically similar individuals, or viscous populations (with a limited dispersal).

Trivers (1971) introduced a model of reciprocal altruism, aiming to explain traits like cleaning symbioses, warning cries or examples of human reciprocal altruism. He distinguishes several cases: Under random dispensation of altruism, an allele disposing an individual for altruistic acts would not prevail. Under nonrandom dispensation by kinship, we get Hamilton's model. The main investigated model rests upon nonrandom dispensation by reference to the altruistic tendencies of the recipient. In this case, the parameters of the alleles disposing for altruism and the species of the agents do not matter; it's the possibility of exchange of the act that favors it. Longer lifetime, low dispersal rates and higher degree of mutual interdependence can tip the balance further in favor of reciprocal altruism (which I would in this case further distinguish into reciprocal cooperation or altruism – see section Prerequisites of cooperation among non-kin). Trivers also includes parental care, hierarchy, and aid in combat as possible mediators of altruism, yet I would argue that these would be better described by Hamilton's framework of inclusive fitness. Notably, in his paragraph on generalized altruism, Trivers de facto describes generalized reciprocity combined with strong reciprocity.

Maynard Smith and Price (1973) introduced the concept of evolutionarily stable strategies (ESS) into biology. These are strategies that cannot be replaced by another strategy once they have prevailed in the population. Under realistic circumstances, it is usually impossible to find an "absolute" ESS (as the strategy space is too large) but we can find an ESS of a present subset of strategies (for example submitted Iterated Prisoner's Dilemma strategies in Axelrod & Hamilton, 1981). ESS can serve as an explanation for some kinds of cooperation, especially in repeated interactions.

Zahavi (1995) looked at altruism through the lens of his handicap theory and proposed that altruistic individuals could gain a direct advantage from their actions by gaining more social prestige (and thus more mating opportunities) as they advertise that they can spend their resources on others.

Though other explanations like various types of group selection have also been proposed in the early research of cooperative behavior, they seem to explain too little of the effect in most cases, compared to the aforementioned explanations (West et al. 2011).

Altruistic, fair and cooperative behavior in wild animals

There are numerous examples of complex helping or cooperative behavior in the wild, from cooperative breeding, hunting, foraging, territory defense or predator lookouts, or inter-species cleaning, all mediated by varying processes, ultimate and proximate cases (Clutton-Brock 2009, Stevens et al. 2005). Social play is also worth mentioning here and Bekoff (2001) makes an interesting case for it as a precursor of more generalized cooperative behavior. However, each of these can be most specific for some taxa and not constitute a general mechanism. For example, cooperative behavior (play signals, equalizing chances etc.) in social play is extremely individually variable in domestic dogs (Bauer & Smuts 2007). Much evidence points toward the proposition of Špinka et al. (2001) that social play enhances the ability to cope with unexpected (especially social) situations.

Animal cooperation can stem from several ultimate mechanisms, most notably mutualism (a situation where mutual cooperation is the most profitable option, the dominant strategy), kin selection (Hamilton 1964a, Hamilton 1964b), reciprocity (Trivers 1971) and punishment (Clutton-Brock & Parker 1995). Stevens et al. (2005) review evidence for each of these mechanisms and find that mutualism and kin selection are frequent in nature and can account for some types of cooperation especially in large groups consisting of related individuals where the benefits of joint cooperation scale steeper than the costs (e.g. large food resource or territory defense). However, reciprocity and sanctioning require more complex proximate mechanisms (good memory and individual recognition, low temporal discounting), for which the authors find scarce evidence. Most of it could also be explained by alternative phenomena like kin selection.

A famous textbook example of reciprocal cooperation is sharing blood in vampire bats (Wilkinson 1984, Wilkinson 1990). Most of the observed regurgitation of blood to feed individuals in risk of starvation occurred between closely related bats but a large portion also happened between likely unrelated individuals. Wilkinson observed associations between the bats. Female vampire bats along with their offspring change trees in which they roost about once a week but they apparently form bonds with other females with whom they interact more often than others. Individual recognition seems to be present (most likely due to acoustic and olfactory cues) and the bats are long-lived creatures, so these criteria seem to be met. Though kin selection is more widespread in this case, the evidence also strongly points toward reciprocal cooperation.

Carter & Wilkinson (2013) later revisited this case and attempted to distinguish reciprocal cooperation from the possible effects of faulty kin recognition, giving away to harassment or indiscriminate altruism between related groups. They conducted a laboratory experiment with fasting individual bats and observing the food sharing. They found that food received was the best predictor of food shared with the other specific individual; donors initiated the aid earlier than recipients (which excludes harassment); the proportion of food sharing among non-kin was as expected in the absence of nepotism. These results together further corroborate the importance of reciprocity in this species. However, some authors (Clutton-Brock 2009) argue that blood sharing in vampire bats can be attributed to kin selection alone or harassment by begging.

Clutton-Brock (2009) also points out that another alleged manifestation of reciprocal cooperation, allogrooming, can in fact result from the cost of interrupting the interaction prematurely and risking increased costs of finding another partner later.

Allosuckling is also a well-known example of apparent altruism. The mother nurtures offspring that are not her own, which has been observed in a variety of species. Various hypotheses have been proposed: from kin selection to milk evacuation, beneficial immunization or neuroendocrine function (Roulin & Heeb 1999, Roulin 2003, Olléová et al. 2012), though they sometimes predict that the females should refuse the young more frequently. Olléová et al. (2012) investigated allosuckling in small captive zoo populations of three zebra species: *Equus zebra*, *Equus quagga* and *Equus grevyi*. The last species, Grevy's zebra, manifested much more frequent and successful allosuckling attempts than the two previous species. The authors attribute it to the different social system of Grevy's zebra, a fission fusion society where allosuckling would not be continuous due to the loose associations and would be less expensive for the mare. Thus it would be an example of cooperation resulting from harassment (Stevens & Stephens 2002).

In many cases including especially cooperative hunting or breeding, group augmentation could account for the evolution of cooperative behavior (Clutton-Brock 2002, 2009) due to generating immediate net benefits not easily exploitable by cheaters. Observations of groups of free-ranging dogs (Bonanni et al. 2010) seem to support this notion in case of intergroup aggression.

So far I've been focusing on direct reciprocity when referring to reciprocal cooperation. However, there are more feasible types of reciprocity. In indirect reciprocity, reputation plays a role and influences future interactions with other individuals. In strong reciprocity, sanctioning for defection exists (even if purportedly disadvantageous for the punisher as their own resources are spent on the punishment). Generalized reciprocity is perhaps the most interesting case when considering animal societies. In many ways it's similar to the indirect reciprocity theory but rests on widespread social norms rather than individual reputations. However, it is often empirically unattainable as of yet to assess the degree of impact of different kinds of cooperation promoters and the literature itself is vague on the definitions (West et al. 2011).

A most interesting trait connected to cooperation is eusociality, which had likely evolved several times independently among Hymenoptera. In some cases, its evolution and persistence can be explained by haplodiploidy, however, that doesn't apply for all eusocial species. Hamilton (1964b) explained altruistic behavior of workers in species with multiple matings of the queen (e.g. honeybees) by not being able to cross back the threshold of eusociality, which had evolved from the simple haplodiploid system with a single mating: Sexualized workers would still be smaller than the queen, unlikely to be accepted by fellow workers and most likely killed. If they survived and mated, they would have a small spermatheca due to their small size and mate only once, which would have restored the typical haplodiploid relatedness ratio and benefits of altruism toward the colony, Hamilton argues. The size of the insects and the spermatheca, the number of queen's mates and climatic conditions (influencing survival and dispersal of the colony members) can shift the probability of workers' reproduction (especially laying of unfertilized eggs and producing male offspring, which is not rare). He concludes that a frequency-dependent equilibrium for “selfish genes” is possible and eusociality can

therefore persist. The disintegration of queenless colonies and inability of individuals to survive on their own can also play a major role in eusociality's persistence on the evolutionary scale.

Close inbreeding among termites and the same relatedness ratio of male and female workers explain why males work to sustain the colony too, unlike in Hymenoptera. It also increases the cohesion of the colony and stability of their eusociality (Hamilton 1964b). Aggression toward perceived enemies is another interesting feature of eusociality; especially in species with barbed stings, it's one of the most altruistic acts for the colony and depends a lot on the colony system, its size and queen/worker ratio. Queens of some eusocial species are also known to cooperate on joint nest founding. However, their broods are separated inside the nest and they frequently fight, sometimes leaving only one of the queens alive. The difficulty of establishing a nest and the degree of the young queens' relatedness are of influence on the rate and length of cooperation. Fights or cooperation among siblings depends on whether the brood comes from one or multiple matings or is clonal in case of polyembryony (Hamilton 1964b).

Hymenoptera and Isoptera are not the only taxa in which eusociality can be found. Several crustacean species of the genus *Synalpheus* and order Decapoda are also eusocial (Duffy et al. 2002), as well as in two mammalian species of mole-rats (Burland et al. 2002). The origins of their eusocial system, especially in the Damaraland mole-rat, remain largely an enigma as their genetic relatedness is lower than would be predicted for eusociality.

It is worth attention that some works classify humans as eusocial as well (Wilson 2012, via Gowdy & Krall 2015). However, as we do not have distinct reproductive and non-reproductive castes, I would prefer not to use this much narrower term for humans, despite the grandmother hypothesis being pointed out as a human version of the non-reproductive, helping caste (Gowdy & Krall 2015).

Prerequisites of cooperation among non-kin

Several conditions needed for the evolution and sustenance of cooperation had been invoked by researchers. Mutualism needs the least criteria – only that the situation is such when the benefits of joint cooperation outweigh the payoffs for defection. For kin selection, relatedness recognition with a high degree of success and/or limited population dispersal are needed (Hamilton 1964a, 1964b). In contrast, reciprocal cooperation needs to meet a higher number of criteria.*

Wilkinson (1988) reviewed known examples of reciprocal cooperation and conditions that must be specified before asserting that what has been observed truly constitutes reciprocation: the act must reduce the donor's fitness compared to the selfish alternative; the fitness of the recipient must increase by the act; the act does not depend on an immediate benefit for the donor (separating reciprocity from mutualism); individual recognition and memory of previous interaction exist; there is a large but indefinite number of opportunities of reciprocal cooperation in an individual's lifetime.

* The terms of reciprocal cooperation and reciprocal altruism are often mixed in literature, mostly stemming from Trivers (1971). In this case, I consider them interchangeable as most of reciprocal cooperation does not occur simultaneously and therefore can be viewed as several cases of altruistic behavior toward another individual; the time delay provides an opportunity to defect (“cheat”) and not return the aid. I will use the term “reciprocal cooperation” here unless specified otherwise.

He also argues that reciprocal cooperation is more widespread than usually acknowledged, as occurrence among kin does not exclude reciprocity rather than kin selection. Unfortunately, these mechanisms are hard to distinguish from each other in groups consisting mainly of related individuals.

Wilkinson then examines four cases of suspected reciprocal cooperation (clustered roosting in pallid bats, informing about rich food sources in spear-nosed bats, blood regurgitation in vampire bats and social grooming in coati). In the latter case, allogrooming may not have a negative effect on the donor's fitness and its classification among reciprocal cooperation is questionable. As most bats gain insulation from clustered position, roosting in pallid bats is unlikely to be a case of reciprocity. Sharing information about food resources among spear-nosed bats is a more likely case but not enough data on the reciprocation of the calls had been obtained and the evidence was inconclusive. To further distinguish kin selection and reciprocity among the vampire bats, Wilkinson conducted a Monte Carlo simulation to assess the effects of food sharing on the survival rate of bats and the likelihood of aid in groups of different kin relations. He concludes that reciprocal cooperation represents an important component of food sharing in vampire bats.

Stevens and Hauser (2004) argue that reciprocation requires many criteria including individual recognition (along with recalling and analysing reputation, and potential punishment of cheaters)*, time estimation, numerical quantification, delayed gratification and inhibitory control. These are undoubtedly very challenging criteria which most species, at least to the current knowledge, do not meet.

However, they may not be entirely necessary in some cases. For many types of group cooperation, simple heuristics – such as copying frequent or successful behavior of others – may suffice (Stevens & King 2012). Could reciprocally cooperative behavior stem from them? Does the origin of social norms – both in humans and other animals – at least partially lie there?

Other factors such as social complexity, environment complexity and longevity can increase the likelihood of reciprocity. And if interactions are frequent enough, generalized reciprocity can arise as Pfeiffer et al. (2005) show. It must also be noted that some behaviors usually explained by reciprocity could have alternative explanations as well, such as avoiding the costs of beggar harassment (Stevens & Stephens 2001).

To pull or not to pull the lever? Laboratory experiments on animal cooperation

As the literature on various kinds of animal cooperation in laboratory environment is vast, this brief introduction will focus mainly on tasks methodologically comparable to experiments with humans (resource division dilemmas, experimental games). In these laboratory experiments studying cooperation, fairness, altruistic behavior and related decision-making, the range of studied species is limited yet still encompasses several

* Reciprocal cooperation seems to rest strongly on the memory of the concerned individuals. Larose and Dubois (2011) tested whether impaired memory by elevated levels of corticosterones in zebra finches changed the degree of cooperation in the Prisoner's Dilemma. The experimental group birds' cooperation rates were greatly decreased, compared to the control group. They exhibited impaired learning in general.

groups of mammals (e.g. primates, rodents and dogs) and birds (corvids and other passerines, parrots).

Dogs

Domestic dogs were tested for the presence of inequity aversion when performing an experimental task (paw giving) alongside another dog (Range et al. 2009). They were tested in several conditions: a baseline control (both dogs performing the same task and receiving the same – low – reward), quality inequity (the other dog receiving a higher-quality reward, a sausage, instead of a lower-quality reward, a piece of dark bread), reward inequity (not receiving any reward while the other dog had received one), effort control (both getting the same reward but the other dog without the effort of the task), social control (both performing for no reward), asocial assessment (performing for a reward without the presence of another dog), and no reward asocial control (only performing the task with the experimenter).

Overall, the dogs readily cooperated with the experimenter and completed the task successfully. The only condition under which they exhibited a significant decrease in effort and signs of unease had been the reward inequity. Inequity in the quality of the reward or effort of the task did not make a marked difference. Therefore it seems that dogs are sensitive to inequity but not in all circumstances. The authors argue that several processes may have influenced this perception: effect of training and getting rewarded; facilitation of cooperation in the social conditions; presence of the rewards obscuring the perception of less strong inequity perceptions.

I would also point out that the difference between zero and any positive payoffs may constitute a larger psychologically perceived gap than differences between low and high positive payoffs (Stevens & Stephens 2004).

Rats

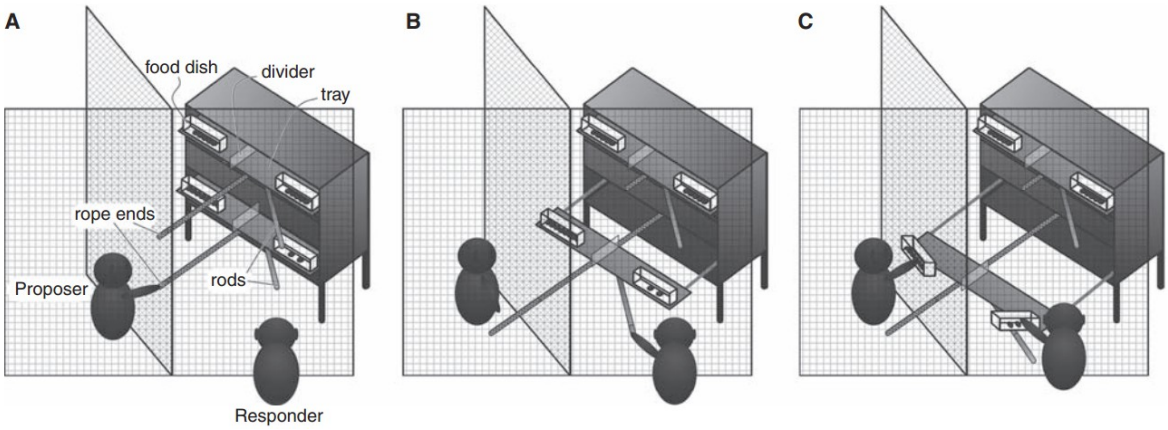
Rutte and Taborsky (2007) found evidence of generalized reciprocity in female Norway rats. Their design included using a two-part cage where a rat could distribute food to the other, not previously encountered individual by pulling a lever. The experimenters tested whether prior experience of receipt of help influences the willingness to cooperate and found a 21% higher frequency of cooperating in the helper treatment. The baseline pulling frequency did not differ between treatments, so the alternative explanation that being helped merely increased the lever-pulling tendency is improbable.

The authors also conducted a follow-up study (Rutte & Taborsky 2008) in which they tested direct reciprocity mechanisms. The rats were paired repeatedly with the same partners (either cooperating or non-cooperating), five times with each of them. In a second part of the study, direct vs. generalized reciprocity had been tested by letting the rats either repeatedly receive help from the same partner and then testing them together, or letting them receive help from three different partners and then testing the focal rat with a completely new partner. The rats cooperated with their cooperating partners significantly more frequently than with non-cooperating ones, as they did for the cooperating vs. new partners in the second part of the experiment. These results indicate that rats are capable of direct as well as generalized reciprocity, direct being stronger.

However, we have to be careful when deriving their importance in natural environment where rats meet many more individuals; the memory constraints on direct reciprocity could render it less important in practice than generalized reciprocity.

Common chimpanzees and bonobos

Chimpanzees' cooperation has been experimentally tested multiple times. Two studies adapted the Ultimatum Game for them (Jensen et al. 2007, Proctor et al. 2013). Jensen et al. (2007) used two cages with levers for obtaining a visible food reward. The first chimpanzee could choose between two rods connected to sliding trays with a different distribution of food on the sides of each chimpanzee's cage, either equal or unequal. When he chose, the other chimpanzee in the second cage could access another rod on the sliding tray, which could be used to pull the tray closer for both chimpanzees to reach the food on their respective sides of the tray (see Picture 1). The results suggested that chimpanzees act as rational maximizers, very strongly tending to choose the more favorable outcome for them as “Proposers” and nearly always accepting any positive offer, no matter how “unfair” as “Responders”. The only case with high rejection rates (44%) had been a zero offer to the Responder. On the other hand, it also means that 56% of zero offers were accepted, which is in line with classic game theory (where the agent does not care about zero payoffs one or other way and chooses to accept or reject the proposed offer randomly) but not with any theory of rational maximizing taking into account payoff relative to the other participant.



Picture 1.: Jensen et al.'s (2007) experimental apparatus design for chimpanzees' Ultimatum Game. Reprinted from Jensen et al. (2007).

However, Proctor et al.'s (2013) study casts a shadow of doubt upon these earlier results. They chose a different experimental approach, using token exchange as a mediator for the game, an equivalent of money in human-subjects studies. One token represented a division favorable for the Proposer (5:1 distribution), the other an equal split. The Responder could accept or reject by giving the token to the experimenter or not returning it. The experimenters also implemented the Dictator Game by omitting the latter step and handing the shares chosen by the first ape immediately. A majority of the chimpanzee Proposers chose the equitable option in UG and the selfish one in DG. No

Responder rejected any offer. The equitable behavior of Proposers is in contrast with the previous study. The authors argue that presenting food directly like in Jensen et al. (2007) is less comparable to studies on humans using money because food, unlike money, is an immediate reinforcer – therefore their use of tokens, representing money for which the subjects could “buy” food indirectly.

Both Jensen et al. (2007) and Proctor et al. (2013) used the so-called mini-UG, restricting the set of options available for the Proposer. In most studies with humans, the pie can be divided any way the Proposer wants, up to some smallest indivisible unit (one cent, dollar, crown etc.). The chimpanzees in both studies could only choose from two options, typically one equitable and the other not. Jensen et al. (2007) varied the options for different trials and also introduced an option favoring the Responder (chosen by 13% of Proposers in that particular choice set consisting of 8:2 or 2:8 division).

Each of the studies has its limitations – possibly direct display of food in Jensen et al. (2007) but also the much more restricted pool of options in Proctor et al. (2013), which doesn't allow us to see how the chimpanzees would react to 6:0 distribution or some division favorable to the Responder subject.

A different cooperation experiment had been conducted earlier by Melis et al. (2006). Dyads of chimpanzees could cooperate to pull forward a tray with food rewards. Without cooperation, the task was unattainable. The levels of cooperation were highest in dyads whose members had a close relationship and where the food was easily divisible (either presented on two dishes or, to less extent, on one dish but sliced in many pieces). In contrast, if the food was easily monopolizable, cooperation was rarer; especially in pairs with marked differences in status/tolerance. The inter-individual tolerance (willingness to share in and outside the experiment, mutually good relationship) had proved the most important predictor of the chimpanzees' behavior. Even those who did not show any cooperation in low-tolerance dyads cooperated with more tolerant partners. On the other hand, presence of a possible competitor on the other side of the food tray did not significantly influence cooperation, though chimpanzees had been observed earlier to cooperate more readily when facing competition.

Hare et al. (2007) conducted a similar experiment comparing common chimpanzees (*Pan troglodytes*) and bonobos (*Pan paniscus*). They found no difference between the species when the dyads cooperated to obtain easily divisible food. However, in case of clumped food rewards, bonobos proved significantly more cooperative than chimpanzees (even though the chimpanzee pairs were matched for high tolerance) and never monopolized the rewards. In the wild, bonobos are less prone to conflict, but they also don't practice cooperative hunting, unlike chimpanzees. The results of this study suggest that at least in this case, selection toward more widespread tolerance plays a more important role in the evolution of cooperation than cooperative hunting does.

It would also be of extreme interest to find out how bonobos' behavior in more of the experimental tasks presented to common chimpanzees would differ, considering their marked differences in social behavior and mechanisms of group cohesion.

The results taken together show that chimpanzees do make a distinction between payoffs of different value and are aware of the possible set of theirs and their co-player's actions. With caution, it can be concluded that common chimpanzees behave as rational

maximizers under some circumstances (but it's unclear to which extent it can be generalized) and their cooperation depends substantially on their relations with the co-player. Bonobos manifest more tolerance and a higher degree of cooperation with any other individual of their species practically regardless of their mutual status. Can the possible selection toward more tolerance in bonobos be compared to a similar process in humans? Further results could hopefully bring us closer to the answer to this question.

Blue jays

In Clements & Stephens (1995), blue jays in three randomly assigned pairs could either cooperate with their partner or defect in the Prisoner's Dilemma by pecking one of two keys in their experimental chamber. The rate of cooperation in PD was very low. When the matrix was switched to the Mutualism game (where mutual cooperation leads to the highest payoff for both individuals), all pairs reached stable cooperation. When switched to PD again, it declined to mutual defection again.

The research team later tested the possibility that strong temporal discounting (a disregard for future rewards in favor of immediate payoffs) could lead to the fragility of cooperation in PD (Stephens et al. 2002). Some of the birds could only get their rewards at the end of each session (though they could see them) instead of each round. They played with stooges either using TFT, or all-defection. In the experimental group and TFT treatment, the proportion of cooperation remained above 60%; in the control group with immediate access to the rewards and TFT stooges, it declined to less than 50%; in the experimental group with all-D stooges, it declined to about 10%; in the control group with all-D as well, though faster than in the experimental group.

In Stevens & Stephens (2004), the authors further investigated reciprocal cooperation in blue jays under the framework of PD and three derived game matrices: one favoring cooperation as the dominant strategy; one favoring defection without any benefit to cooperation; and one “opponent control” where the bird could deliver food to the other player but could not influence his own payoff, which depended on the opponent's choice. The birds were separated by a transparent wall and could observe each other's action, so unlike in the usual implementation of PD, the choices could not really be perceived as simultaneous. The pairs all started with the cooperation-favoring treatment and then went through all of them in random order, always separated by the cooperation treatment chosen as baseline by the experimenters.

The birds really did cooperate in the baseline treatment. Their cooperation decreased dramatically in both PD and defect-only treatments but was maintained above 60% in the opponent control treatment. The results also suggested the birds reacted to their co-player's previous move – as well as in the previous round as when the co-player moved first in the current round – and the probability of cooperation was higher after the co-player's decision to cooperate throughout all treatments. However, their behavior was not consistent with either TFT or Pavlov. It corroborates the results of the previous study – that blue jays apply strong future discounting and prefer immediate payoffs. They also showed what suggested an aversion against zero payoffs – a non-linear response to the payoff's value. Their inclination toward cheap generosity in the opponent control may represent a form of maintaining cooperation in their social environment.

Zebra finches

St-Pierre et al. (2009) conducted an iterated Prisoner's Dilemma experiment on zebra finches paired either with their social partner, or a previously unknown opponent of the opposite sex. Both groups started with low cooperation levels. Then the experimenters switched the payoff structure to the Mutualism game with the highest payoffs for mutual cooperation, and the levels rose rapidly. When switched back to PD, high cooperation was retained in the social partner group (with a decision structure resembling the TFT) but decayed back to zero in the random partner group.

The same team (Larose & Dubois, 2011) later focused on the role of memory in cooperation in zebra finches and found decreased cooperation levels in birds treated with stress hormones, which impair memory, though other effects could have taken place as well (like increased preference for immediate rewards). In the control group, the birds cooperated almost completely in the iterated Prisoner's Dilemma (but played after the Mutualism game, which could have altered the birds' behavior in the following game in my opinion).

Grey parrots

Péron et al. (2012) tested reciprocity in grey parrots by letting them choose between color-coded cups leading to different rewards: green for sharing (both birds would get a food treat from under the cup), pink for selfish (the choosing bird would get a treat), orange for donation of a treat to the other bird, and violet for opting out of the game (none would get anything). The birds previously proved their capacity to discern colors with precision. The birds first learned what outcome each choice had meant. All the cups were placed at the same distance from the bird whose move it had been and their order had been randomized over trials to avoid possible placement effects.

The behavior of the two male birds in the study was greatly influenced by the social status of the bird and the order of moves. The dominant parrot behaved selfishly when moving first but shared when following. In contrast, the subordinate bird typically started with choosing donation to the other one or the null option. Gradually, both birds' choices shifted to selfish reward or sharing over opting out or donating to the other bird.

By sharing reciprocally, the parrots could maximize their rewards, but they did not arrive to any stable cooperation. Little can be derived from a study on two experimental subjects, however, the results at least indicate that the birds understood the connection between different cup colors and rewards, were not eager to reciprocate and their behavior depended largely on their relative status.

Also, taking two treats from under the green (sharing) cup and giving only one of them to the choosing bird could have elicited loss aversion in him and prevented him from further sharing. This is at this point purely a speculation on my part, nevertheless, loss aversion is well-documented in humans and appears to have innate roots, as exhibiting loss aversion and other behavioral biases in capuchin monkeys suggests (Chen et al. 2006). Birds and mammals have diverged long ago but some groups (especially primates and corvids, also some parrots) share a lot of convergent complex cognitive traits (Emery & Clayton 2004) and it's feasible for birds to be capable of feeling loss aversion as well.

It is clear that laboratory studies on animal cooperation possess many limitations: obtaining sufficient sample sizes, making sure the subjects really understand the course of the task, controlling for extraneous variables, comparability of the experimental designs… While studies on humans possess many of the same limitations, these are much more difficult to deal with in studies on animals whose cognition and sensory abilities we don't know as precisely and who cannot answer any post-experimental questions and explain their choices.

Still, from the aforementioned studies, we can draw some conclusions: The tested animal species seem sensitive not only to their own payoffs but also those of their co-players. They exhibit inequity aversion (domestic dogs, possibly chimpanzees), loss aversion (capuchins, possibly grey parrots), and cooperate readily when it yields mutual benefit (chimpanzees, bonobos, blue jays, zebra finches). Direct or generalized reciprocity seems rare but has been observed in rats. Cooperation common among chimpanzees depends a lot on mutual social standing, while bonobos manifest high social tolerance and cooperate very readily under different social circumstances, which could have implications for studying cooperative behavior in humans.

Altruism, fairness and cooperation among humans: *Homo economicus* or *sociologicus*?

A great number of studies tried to address some features of altruistic, fair and cooperative behavior in humans from a whole range of perspectives, be they biological, philosophical, economic, social and other. I will briefly go through the history of this line of research, especially works of evolutionary biology and behavioral economics connected to the methodology and aims of the current study.

In human society, acts of altruism (such as giving to charity) seem to be abundant (Trivers 1971, Gintis et al. 2003, Ariely et al. 2009). Cooperation between both related and unrelated individuals is very frequent and practically forms the basis of our society and fairness considerations often lead to the change in economic or social outcomes (Blount 1995). It is likely that both direct and indirect reciprocity play a crucial role in human cooperation, unlike in animals, though humans cannot be labeled as “the most cooperative species” (Fehr & Fischbacher 2003). Costly signaling or image keeping may also play a substantial part in altruistic behavior (Ariely et al. 2009).

In a number of experimental settings (Dictator Game, Ultimatum Game, Trust Game, Prisoner's Dilemma), a majority of people behave in ways inconsistent with rational maximizing and seem to show concerns for non-monetary payoffs (Camerer 2003, p. 8-12, 43-117).

Many attempts were made to explain the observed behavior in the games. Among the most prominent are Rabin's (1993) intention-based fairness-driven concept, Fehr and Schmidt's (1999) theory of fairness, competition and cooperation (FCC), and Bolton and Ockenfels's (2000) theory of equity, reciprocity and competition (ERC).

Rabin (1993) introduced fairness considerations and sensitivity to intentions into the game-theoretical framework. He assumes fairness sensitivity in agents and describes fairness equilibria where the notion of fairness is satisfied. They may overlap with Nash equilibria, may include them but also lead to whole different outcomes depending on the

payoff matrix and stakes. In his model, the assumption that stakes matter is incorporated and the higher the stakes, the more does the behavior converge to that of the illustrious "*Homo economicus*".

Levine (1998) focused on altruism, modeling the players' payoffs as linear to the income of their own and their opponents. It also depends on the perceived intentions of the opponent. Altruistic and spiteful players can be distinguished in his framework.

Fehr and Schmidt's (1999) modeled fairness as self-centered inequity aversion. Their model predicts different behavioral patterns for the same sets of preferences, depending on the specific economic environment (e.g. two-player or multi-player games, presence of competition between players etc.).

In ERC (Bolton & Ockenfels 2000), the players try to balance their inequity aversion and material payoffs. Fairness is viewed as the individual's share of the total payoff.

Notions of reciprocity seem consistent with the observed behavior in experiments where it can be tested. Diekmann (2004) found that in a sequential DG, most people gave the other player the same amount they received from him in the first round, and the notions of ERC enabled to predict the behavior quite well. Similarly to Church (1993), the subjects also cooperated by mailing back a questionnaire most frequently when a pre-paid phone card had been included in the package and least frequently when it had been promised for a mailed questionnaire – completely at odds with rational payoff maximizing but in line with reciprocal altruism. In this study, people also behaved more equitably under high stakes conditions, contrary to Rabin (1993). However, the Moonlighting Game results of Cox et al. (2002) supported neither the FCC or ERC and the authors concluded that "both intentions and preferences over outcomes are needed to fully explain behavior in the moonlighting game". Kagel and Wolfe (2001) tested both FCC and ERC directly and also found support for neither. It remains unclear which models can describe and predict decisions in experimental games with the greatest precision and simplicity.

Great many lab-based studies of human decision-making, economic and prosocial behavior have been conducted, usually deviating from the classic game theory predictions in two- or three-person games and approaching them in higher-N-person games (Bolton & Ockenfels 2008). However, in some cases we cannot be sure whether and how the results could be generalized and taken as a sign of preferences in the real world.

List and Levitt (2005) investigate whether results obtained from laboratory experiments can be reliably extended to behavior in the real world. They emphasize four main potential concerns influencing the generalizability of experiments, especially economic, on humans: The subjects are aware that they are being watched. Context is not completely controlled by the experimenter (though some framing is often intended). Small stakes are usually used. The participants are most frequently a self-selected sample.

Do laboratory experiments lead to overestimating pro-social behavior? Field experiments and real-world studies tend to suggest that (e.g. Winking & Mizer 2013). Also, List & Levitt (2005) note that though the settings in experimental economics studies are usually anonymous, subjects may still behave more "morally" or "fairly" without being absolutely sure that their own actions will not be scrutinized – when the participants are assured about double-blind settings, the offers or gifts in the games become lower. However, they also note that assuring subjects about absolute anonymity may steer the

results in the opposite direction, making the subjects feel like less acceptable behavior is demanded in these conditions. Field experiments may lead us to the conclusion that virtually all laboratory experiments are too laden with systematic biases. Context matters a lot, as they show on the effect of the set of possible responses in the Dictator Game – when taking is an option, subjects typically give little or nothing to the other player. They also mention that the pattern of life in a given society can influence the results pronouncedly, as Henrich et al. (2010) found; they basically warn about generalizing results obtained from WEIRD (Western, Educated, Industrialized, Rich, Democratic) populations. The warning can be extended to only working with self-selected samples, especially students. The authors conclude that laboratory experiments are useful and provide important insights on the studied phenomena but possible differences from real-world behavior should not be ignored. Certain limitations cannot be avoided; it's their knowledge and acknowledgment that's important. After all, even the model section of List and Levitt's (2005) critical article begins: “We begin by developing a model that makes precise our arguments regarding the potential factors that might interfere with a seamless extrapolation of behavior from the laboratory to naturally-occurring settings. In building the model, we err on the side of simplicity, sacrificing generality in the process. Nonetheless, we believe that the basic insights of the model will hold in a much more general framework.”

Effects of an individual's health on prosocial behavior

Little is known about the potential connection of health and altruistic, fair and cooperative behavior. Post (2005) reviews the works exploring it in some way (especially studies on volunteers' health and well-being) and concludes that helping others has a clearly observable effect on one's mental and physical health, likely modulated through pushing negative emotional responses aside and lowering stress levels.

However, his interpretation of the causality of the relationship does not seem sufficient. While the effect of lowering stress and therefore mitigating its negative health consequences seems undeniable, Post (2005) gives nearly no attention to the possibility that there is a positive feedback and the relationship can work in both directions, with distinguishing the general “first cause” very difficult.

The notion of life histories comes at hand here. First developed as a framework for understanding interspecies differences (e.g. Hatchwell & Komdeur 2000), it became useful for studying behavioral patterns within species too and has also been applied to humans (e.g. Figueredo et al. 2005). Differences in mortality rates, life expectancy and predictability of the behavior could thus influence the extent of prosocial behavior and the main direction of the relationship could be opposite than Post (2005) postulates. One could expect people with lower life expectancy and in more unpredictable environments to behave more selfishly and focus more on immediate than future benefits. Figueredo et al. (2005) studied the heritability of life history traits and used a measure of a K-factor (derived from the quality of relationships, altruism towards kin and non-kin, family and friends support, health control etc.) to assess the life history strategy of the subjects and used another factor, Covitality (derived from subjective well-being, positive and negative affect, general health and medicals symptoms), to find out the correlates of high K-factor.

K-factor loadings were highest in altruism towards non-kin and considerably high in the other variables as well. K-factor correlated closely with Covitality, which was loaded positively by subjective well-being, positive affect and general health, and negatively by negative affect and medical symptoms. The researchers also concluded that while there seems to be a high degree of heritability of life history strategies, developmental plasticity plays a profound role. Figueredo et al. (2006) summarize that "…low-K characteristics could manifest as impulsivity, short-term thinking, promiscuity, low female parental investment, little or no male parental investment, little social support, disregard for social rules, and extensive risk-taking".

The notion of Figueredo et al. (2006) that high-K individuals would have better impulse control, allocate more resources to parenting, their own health and well being and that of their offspring also seems to support the hypothesis that people possessing better health (likely high-K individuals, with higher life expectancy and probability of future interactions) would behave more cooperatively than those of worse health status.

Because of the possible influence of health – respectively perceived life expectancy – on impulse control (Wilson & Daly 1997), I also included measures of temporal discounting in this study, which could in addition explain behavior in the games more directly. In Curry et al. (2008), people with lower tendencies to discount the future behaved more cooperatively in a one-shot Public Goods Game. Pronin et al. (2008) also showed that people tend to treat others as they do their own future selves, which too suggests a possible connection between the level of generosity and temporal discounting.

As far as I know, there has been no work as of yet focusing on the relationship of physical and mental health and cooperative behavior in experimental games. We will not be able to derive the direction of the causal relationship here (if one of them prevails above the other at all) but we should be able to identify the extent of it.

Methods of experimental games

There is a wide variety of experimental games used by behavioral economists, psychologists, ethologists and evolutionary biologists, ranging from competitive to cooperative or coordination games, with one or multiple equilibria etc.

I had chosen five different games for this study, each with different predictions for various types of behavior, to enable to distinguish between different traits more reliably. Two of these games, Reversed Dictator Game and Expanded Ultimatum Game, are de facto new in these settings. Dictator Game, Ultimatum Game and Trust Game have been used in numerous studies across scientific fields (Camerer 2003).

Ultimatum Game (UG)

The first-developed of the hereby used experimental situations, Ultimatum Game, was introduced by Güth, Schmittberger and Schwarze (1982) to study strategies in the following "bargaining-like" situation: Two players (sometimes called the Proposer and the Responder; for consistency when speaking of any of the games, I'll refer to them as Player 1 and Player 2 here) are in a situation where Player 1 receives an amount of money or tokens which he can divide between herself and Player 2, who can either accept the

offered share or reject it. In case of rejection, neither gets anything. In case of acceptance, each gets their respective share. In the basic setting (as in this study), the subjects do not know or see each other and all contact between them is mediated by the experimenter or a computer interface. The game is played without repetition – which is known to the players – unless the researchers specifically aim to study behavior in the long-term version of the game.

According to classic game theory, Player 1 would propose the smallest possible positive share, as Player 2 would accept any non-zero share and would be indifferent about zero. But real experiments showed that people do not behave as such rational profit-maximizers. Offers perceived as "too low", "unfair", and in rarer cases even "too generous", are often rejected. The modal offer in most experiments is exactly a half of the amount at stake, the mean offer is usually around 30–40%, and offers below approximately 20% are often rejected (Camerer 2003, p. 49).

Dictator Game (DG)

Dictator Game was first described in a paper by Kahneman et al. (1986) and first conducted by Forsythe et al. (1994). It is a variant of UG where, however, Player 2's role is passive. She cannot influence the outcome of the game in any way: whatever Player 1 offers her, she receives. Since DG doesn't include any variant of "bargaining" and Player 2 is entirely passive, it was suggested to reveal altruistic tendencies of Player 1. As the other player cannot make her lose the amount at stake, she has no monetary incentive to give Player 2 any share. Nevertheless, a majority of players choose to allocate some positive share to the other player, averaging around 28% (Engel 2011). As Engel (2011) found in his meta-analysis of 131 studies on DG: "36.11% of all participants give nothing to the recipient. 16.74% choose the equal split. As many as 5.44% give the recipient everything."

Reversed Dictator Game (RDG)

In the Reversed Dictator Game, it's Player 2 who receives an amount of money. She's a passive player, however, as well as in DG. Player 1 has the option to take any share of the money from Player 2. This is an uncommonly used situation; to my knowledge, similar designs as RDG or "taking game", had so far been applied in only several studies (Cox et al. 2002, Bardsley 2005, List 2007), and due to their slightly different design, their results are not plausibly comparable to ours.

Cox et al. (2002) focused on the "Moonlighting Game" (basically a variant of TG where both players have an extended set of options, including taking money from the other player), however, they also included variants of DG as another treatments. In their versions of DG, only one player (the first in one treatment, the second in another) was able to make decisions and could give money to the other player as well as take it from her. However, as their "DG" was a truncated Moonlighting Game, some of the amounts sent or taken were multiplied by the experimenter. That makes their results of even less relevance to our approach. To summarize their findings briefly, in the situation with Player 1 as the dictator, the vast majority of players took the maximum of 5 dollars from Player 2 (not multiplied). In the treatment with Player 2 as the dictator, Player 2 had received some money presumed to have had come from Player 1, so these results are not relevant to us.

Bardsley (2005) conducted DG with an extended set of options: Both players received an endowment initially, and Player 1 had the opportunity not only to give something to Player 2, but also take from her. He had introduced several taking-involving treatments. In the first, Player 1 could give up to 4 dollars from 6 in total (and the amount given was doubled by the experimenter) as well as take (up to 2 dollars, where a dollar taken by Player 1 had cost Player 2 twice as much). In another treatments, both player received a 4-dollar show-up fee and Player 1 also 7 dollars in addition. She could give up to 7 dollars or take up to 2 dollars from the other player, with no multiplying. In the third treatment with taking, Player 1 received a 10-dollar endowment, while Player 2 a half of this amount. Player 1 was allowed to either choose no action, or take up to 3 dollars from Player 2.

In the first treatment, only 1 of 29 subjects *gave* money (3 dollars out of 6); almost a half of the subjects chose to take the maximum of 2 dollars, while the rest mostly divided between choosing no action or taking 1 dollar. In the second treatment, nearly a half of the subjects gave Player 2 money (ranging from 1 to the whole 7 dollars). However, more than a third of the sample chose to take the maximum of 2 dollars. About 5% took one dollar, about 13% neither gave nor took anything. Finally, in the third treatment, 17% of the participants took nothing, while the rest used the opportunity to take something from the other player (most chose the maximum of 3 dollars).

These experiments show that even given a choice between giving and taking, many people choose the opportunity to take from another. Bardsley's (2005) results indicate that their decision can be influenced by the (in)equality of the initial endowment and the transfer rates.

List (2007) had given the players a similar choice. Both players received 5 dollars at the beginning, Player 1 also got an allocation of further 5 dollars. Two taking treatments were used: In one, Player 1 could give up to 5 dollars or take up to 1 dollar. In the other, the set of choices was symmetrical, allowing to take up to 5 dollars from Player 2.

In his first treatment, 35% of players gave a positive amount to the co-player. The median offer was zero, the mean 33 cents. The largest portion of the subjects neither gave nor took anything. However, in the second treatment, the results differed dramatically. Only 10% players gave positive allocations. The median was -4.50 dollars, the mean -2.48 dollars. The largest portion of players chose to take the maximum of 5 dollars. List (2007) argues about the influence of the range of options available to the players on the perception of what's “morally wrong” and what is “acceptable”.

However, extending the set of options in DG can also complicate the interpretation of the results. It's useful for different kinds of predictions, but as we wanted to study especially equity concerns (fairness, inequity aversion) by this game, truly reversing classic DG could enable us to distinguish altruism (where the subject would not take anything from the other player) and fairness *per se* (where it would be perceived as fair to take a half of the endowment) – see more in predictions and hypotheses.

Expanded Ultimatum Game (EUG)

This game is a three-player version of UG where Player 1 makes an offer to Player 3, who is, however, a passive player. Player 2, who doesn't have any monetary

incentive in the game, decides whether to accept or refuse the offer on behalf of Player 3.

Somewhat similar games had been used before, but they nevertheless had a different three-player setting: Knez & Camerer (1995), Güth & van Damme (1998), Kagel & Wolfe (2001). There were one Proposer and two Receivers in the game, to whom both the Proposer could offer some share (and the decision whether to accept or reject had been up to one or both of the Receivers, either specified from the beginning or chosen randomly), whereas in our setting the deciding player stands outside the incentive flow. In these previous studies, the results were mixed, most likely due to the wide range of settings used.

Knez & Camerer (1995) implemented the two-receivers design with adding a known outside option (earning 2–4 dollars, while the whole pie between the Proposer and each of the receivers had been 10 dollars) for all the players in case of rejection. That likely resulted in an unusually high ratio of rejections: almost half the cases. Also, the subjects could see the other players known to be in their triad. The strategy method (the player stating beforehand which offers would be accepted or rejected by her) was used. Some players demanded the more for themselves, the less the other responder had been offered; some were indifferent; some were willing to accept the less, the lower the offer for the other responder had been. On average, the pattern had been U-shaped. The experimenters were mainly concerned with the matter of social comparison. Their design is more accurately viewed as two UG whose receivers can compare the offers, but each of them decides about their own offer and the outcome of their part of the game.

In Güth & van Damme (1998), the results depended a lot on the specific treatment, as the experimenters varied the information given to the deciding Player 2. They concluded that the players in the Proposer's role do not possess a strong intrinsic motivation to *be* fair, however, for strategic reasons they often do want to *appear* fair. About the responses they say: "…there is not a single rejection that can be clearly attributed to a low share for the dummy [Player 3]. Hence, responders do not seem to care for the dummy."

Kagel & Wolfe's (2001) experiment was closest to the original UG from the three aforementioned studies. Player 1 made an offer for both the other players, from whom Player 2 was chosen randomly. The primary concern was to evaluate whether and to what extent the players care for the distribution of payoffs, as proposed in the models of Fehr & Schmidt (1999) and Bolton & Ockenfels (2000). To test them, the experimenters introduced a "consolation prize" of different amounts (even negative) across treatments for the "dummy" player. That enabled different levels of inequity, which should lower the rejection rates if the tested models really described the decision process. However, rejection rates had been much higher than expected, leading the experimenters to reject the application of both models. They suggested intentionality and/or negative reciprocity as more likely sources of the observed behavior in UG as well as their three-player UG.

As can be seen from this short comparison, our design differs substantially from all these three, especially by excluding Player 2 from the endowment exchange. Due to this step, our experimental design allows for eliminating own monetary payoff concerns and studying purely other-regarding preferences (see more in predictions and definitions).

Trust Game (TG)

Trust Game, developed by Berg et al. (1995), was designed to study trust and reciprocity. The setting is again similar: There are two players anonymous to each other. Player 1 ("Investor") receives an amount which she can divide between herself and Player 2 ("Trustee"). The share sent to Player 2 is multiplied (usually by the factor of three). Player 2 then has an option to send some of the money back to Player 1.

As the Player 2 has no monetary incentive to send anything back to Player 1, the presumption of classic game theory is that Player 1, knowing this, will not entrust any share to Player 2. However, that's not how people actually behave in the game. In the original Berg et al. (1995) experiment, the vast majority of the first players sent roughly 50 % of their endowment to Players 2, who in most cases returned more than Player 1 originally sent them. In overall, subjects in the position of Player 1 usually "invest" about a half of their endowment and return approximately a half of the multiplied amount in the position of Player 2 (Johnson & Mislin 2011).

Synthesis: Searching for the patterns

The literature on cooperative behavior is both broad and vast, comprising of thousands of papers ranging from mathematical and computer models or theoretical propositions to observation of wild animals of across wide spectrum of species, laboratory experiments of many designs with animals or humans and human psychology studies. Yet we can still point out several conclusions stemming from the literature:

1. Altruistic and/or cooperative behavior is very abundant among many species, however, it likely stems from different ultimate processes including mutualism, kin selection, adopting stable strategies, likely to a lesser extent reciprocity, costly signaling, punishment, harassment, in some specific cases perhaps some types of group selection.

2. Laboratory studies, which can enable us to distinguish these processes in more detail, are as of yet too few to enable a model of phylogeny of the studied traits and processes involved in their evolution. We also need to learn more about the cognitive abilities of various species to find out more about the origins of their behavior.

3. Animal models can help us understand the evolution of human altruism, fairness and cooperation better. For example the important role of tolerance in bonobos vs. common chimpanzees offers a line of research to pursue further.

4. Various explanations and models were proposed for the cooperation, altruism and fairness preferences in humans; the evidence does not seem to favor any one so far.

5. Life history theory could hold a partial key to understanding both interspecies and intra-species differences in cooperative tendencies, likely mediated through impulse control and valuing long-term benefits.

6. Though experimental games methodology is highly useful, we must not forget its limitations and must be careful about possible biases and interpretation of the results. They can also be misleading in the sense of encouraging us to view them as completely distinct situations, while there can be a continuum as Clements and Stephens (1995) note: "Despite our enthusiasm for mutualism as the most parsimonious alternative to the Prisoner's Dilemma, we feel that neither model captures all the biological possibilities.

Mutualism and the Prisoner's Dilemma represent end points of a range of conceivable cooperative situations. Perhaps it is time to explore the rich set of possibilities between mutualism and the Prisoner's Dilemma."

Sample and methods

In this section of the study, I describe the experimental sample, the course of the experiment, its methods and finally my hypotheses, definitions and predictions.

Sample and course of the experiment

The sample consisted of 148 volunteers, students of the Jan Evangelista Purkyně University in Ústí nad Labem who had been invited to join the experiment through the university's social networks and flyers in the university's common spaces. 81 (54.7%) were female, 67 (45.3%) male. Their age was between 19 and 28 (mean 22, median 22).

The experiment has been conducted several sessions over two runs, in April and November. The subjects were randomly assigned into sessions and given individual numbers through which they would log into the experimental interface (programmed by Jan Jolič). Each time, there were 17 to 20 participants in one room, along with two experimenters prepared to answer questions regarding the course of the experiment and to solve the potential problems, should any arise.

After having sat at the available computer stations and read the experimental instructions (listed in the Appendix), the subjects were asked if they understood everything and the experiment could begin. They first played the five experimental games which are the core of the experimental part of this work, and then participated in a dice rolling experiment, a questionnaire focused on their health and personal characteristics, especially related to altruistic, cooperative and fair-perceived behavior, a hypothetical task of future discounting, and a risk-taking experiment. All of the experimental instructions can be found in the Appendix.

At the end of the experiment, the subjects received their earnings from the experimental games, dice rolling and risk-taking parts of the experiment, and were asked to fill in a post-experimental questionnaire (asking whether they had any ideas or complaints for the experimenters consider and what they thought had been the purpose of the experiment).

Methods

To evaluate the studied traits in the sample of subjects, I used a set of experimental games, which are widely used in game theory, behavioral economics, and evolutionary biology as well as psychology (some potential shortcomings of this approach are summarized in the section Limitations). They were the Dictator Game, Reversed Dictator Game, Ultimatum Game, Expanded Ultimatum Game and Trust Game (in this order). Each game in my experiment was played with 400 tokens as the initial amount at stake, equal to 40 CZK in the monetary compensation for the participants.

To summarize the contribution of each of the games, I shall characterize different types of behavioral traits as they can be observed in the games, in the next section. We have seen that people in reality rarely behave as the classic game theory would predict. Therefore, several frameworks incorporating different kinds of payoffs were developed. Emotion, conscience, altruism, spite, envy – these are some of the characteristics

introduced into further research to analyze the observed behavior more accurately. While the highly simplified assumptions of classic game theory, as well as one-level-selection biology models, are useful in many analyses, we need more detailed descriptions and predictions of behavior and a careful analysis of the individual traits. This work aims to contribute to the growing field of inter-disciplinary research in this respect.

Hypotheses

Building upon the literature presented in the previous section, I have formulated three key hypotheses, the first one concerning the effect of health on prosocial behavior (or conversely), the second one on the effect of memory and the third one on the effect of temporal discounting. Memory and temporal discounting seem to play a role in cooperation in some animals (Larose & Dubois 2011, Stevens & Hauser 2004, Stephens et al. 2002) as well as humans (Curry et al. 2008, Stevens & Hauser 2004, Milinski & Wedeking 1998) and it would be useful to find out how they impact behavior in the experimental games used here. The potential impact of health has received little attention as of yet and it would be highly desirable to explore this possibility.

1. Subjects with worse overall health would exhibit lower generosity in all the experimental games and would have higher acceptance rates in UG, as their chances of long-term future interactions would be perceived as lower. They would also take more from the other player in RDG. Related is the stress hypothesis: that women could react to stress (e.g. worse health) by behaving more prosocially (Lindová et al. 2010).

2. Memory is one of the key aspects of reciprocity (Trivers 1971), therefore I expect people with lower scores in the Meili pictures memory test to behave less generously, have higher acceptance rates in UG and higher taken amounts in RDG.

3. Strong temporal discounting is connected to low impulse control and preference for immediate benefits over possible future ones. I predict observing subjects with strong temporal discounting levels to behave less generously and cooperatively.

Definitions and predictions

The definitions of fairness, altruism and cooperation in the literature and mixed and often very overlapping. Based on the settings of the particular experimental games I had used, I defined different behavioral traits for the subsequent analysis as follows, using a similar methodological framework as Cox et al. (2002) who set to identify self-regarding, altruistic, positively reciprocal and fearful types of behavior in their Moonlighting Game.

Purely **self-regarding** profit-maximizing behavior would be characterized by not giving anything in DG; taking the whole pie in RDG; offering the smallest possible positive amount in UG, accepting any positive amount in UG; offering zero in EUG, being indifferent about accepting or rejecting anything in EUG; not sending anything in TG and returning nothing in TG if given anything.

Pure **fairness/inequity aversion**-driven behavior would be consistent with giving 50 % in DG; taking 50 % in RDG; offering and only accepting 50 % in UG. The case of EUG depends on the extent of fairness preferences: if including oneself and thinking of an outcome equal for all three involved players, a strictly fair outcome would be if no player

received anything, because Player 2 always gets nothing. Therefore, the player would offer nothing and always reject any offer. However, if we allow for considering a fair outcome between the two players between whom the amount at stake can be divided, the fairness-driven decision would be again to offer and only accept 50 %. In TG, sending half the initial endowment to Player 2 and returning half the multiplied amount to Player 1, can be seen as a manifestation of fairness preferences.

Altruistic behavior can be defined by giving any positive amount in DG; taking nothing from the other player in RDG; offering a non-zero amount and always accepting in UG as well as EUG; in TG, returning more than the amount Player 1 had sent them in the position of Player 2.

Cooperative behavior is the broadest category evaluated here and partially overlaps with all the previous ones, as a cooperative individual can be behaving selfishly, fairly or altruistically as well. Though it's a different level of category, it's useful to study it especially to evaluate the types of cooperation and hopefully learn more about different mechanisms of its evolution and persistence not only in humans. Here, cooperation can be described simply as never "defecting": offering some non-zero amount in UG/EUG/TG, always accepting offers in UG/EUG, and returning at least the amount sent by Player 1 in TG. As DG and RDG lack any kind of *interaction* between the players, they are not regarded in assessing cooperation solely.

It must be noted that these are not the only types of definitions used in the relevant literature. For example, Fehr and Fischbacher (2003) differ from them in labeling rejections of less than fair offers in UG as altruistic punishment. However, as it is a one-round two-player game, I would disagree with this designation. We can observe true altruistic punishment for example in public goods games with punishment, where punishing a free-rider can enhance the overall payoffs of the whole group, though costly for the punisher (Fehr & Gächter 1999). The inconsistency in the usage of some of the involved terms has been criticized by West et al. (2012).

All of the above described "behavioral types" are concerned with the outcome of the game. However, we can also consider intention-based utility functions: regarding intentions of the involved players rather than solely the outcome. Reciprocity is an important intention-based type of behavior. I wanted to focus on the difference of strategy types and their prevalence in the population here; for investigating the effects of reciprocity, one-shot experiments are not well suited and iterated games would yield more applicable results for that case. I also argue that we should not view outcome and intention-based behavior as two completely distinct frameworks as they could both play a role in decision-making at the same time, each weighed differently depending on the conditions of the game (payoff structure, low/high stakes, knowledge of the opponent's set of options etc.).

Statistical analysis

The analyses of the gathered data have been performed in R, with the exception of the factor analyses, for which the statistics suite Statistica was used. The individual methods are always described with the corresponding results.

Results

I will first show the descriptive statistics of the games-related variables, then move to the analysis of the players' strategy types, and finally test the hypotheses stated in the previous section and show the relationship of the behavior in the games with several other factors which may strongly influence it, namely gender of the player, family income and personality/experience-related traits, as shown by a number of previous studies.

Table 1: Relative allocations in the experimental games

		Mean	Median	Mode	s.d.
DG given		0.32	0.38	0.50	0.17
RDG taken		0.53	0.50	0.50	0.24
UG offers	all	0.40	0.50	0.50	0.16
	accepted	0.44	0.50	0.50	0.12
	rejected	0.26	0.25	0.25 & 0.50	0.18
EUG offers	all	0.38	0.39	0.50	0.18
	accepted	0.41	0.45	0.50	0.15
	rejected	0.30	0.25	0.25	0.24
TG sent		0.44	0.38	0.50	0.27
TG returned		0.28	0.33	0.33	0.20

DG = Dictator Game, RDG = Reversed Dictator Game, UG = Ultimatum Game, EUG = Expanded Ultimatum Game, TG = Trust Game. The allocations are shown in % of the tokens at stake, resp. the multiplied amount from the first player in case of TG returned.

In Table 1 above, you can see the average, median and modal responses in each of the games. These findings are in accord with most previous studies (see Camerer 2003, p. 48-58). Other basic results were also to be expected: A logistic regression has shown that the acceptance or rejection of an offer in UG was highly dependent on the amount offered (est. = 0.0180, std. error = 0.0035, z = 5.097, p = $3.45*10^{-07}$). A two-sided Mann-Whitney *U* test confirmed the significant difference between the rejected and accepted offers (W = 756, p < 0.001). The mean accepted offers were 177.54 (44.39%) tokens, whereas the mean rejected offers were 105.12 (26.28%) tokens.

The acceptance/rejection of an offer in EUG followed the same pattern (regression: est. = 0.0093, std. error = 0.0030, z = 3.062, p = 0.002; Mann-Whitney: W = 1251, p < 0.001), which shows that it did matter for the subjects deciding upon an offer for someone else. The mean accepted offers were 163.94 (40.99%) tokens, whereas the mean rejected offers were 120.28 (30.07%) tokens.

Unsurprisingly, the share returned in TG was influenced by the amount received from the first player (linear regression: est. = $1.506*10^{-4}$, std. error = $5.041*10^{-5}$, t = 2.988, p = 0.003, mult. R^2: 0.061). I also looked at how it was influenced by the amount the player sent in the role of the first player (linear regression: est. = 0.0004, std. error = 0.0002, t = 2.363, p = 0.020, mult. R^2: 0.039). When both of these explanatory variables are included, they explain 9.8% of the variability in the share returned (amount sent as Player 1 in TG: est. = $3.545*10^{-4}$, std. error = $1.480*10^{-4}$, t = 2.395, p = 0.018; amount received from Player 1: est. = $1.492*10^{-4}$, std. error = $4.957*10^{-5}$, t = 3.009, p = 0.003).

Concerning giving in DG and taking in RDG, I ran a two-sided Spearman rank correlation test to test whether there is a negative relationship between the amount given in DG and taken in RDG that I had expected. The correlation was not significant (rho = 0.050, S = 513045.1, p = 0.543).

Identifying behavioral types

"Selfish", "fair", "altruistic" and "cooperative" types of behavior were defined accordingly to their description in the previous chapter. I used the "which" and "length" R functions to list the cases meeting these conditions. The results were as follows:

Purely self-regarding behavior: 0 cases of 148 (0%) were identified.

Fairness-driven behavior: 2 cases of 148 (1.35%) were identified.

Altruistic behavior: 1 cases of 148 (0.68%) were identified.

Cooperative behavior: 78 cases of 148 (52.70%) were identified.

As shown above, few if any cases met the very strict conditions defined for pure self-regard, fairness and altruism while the more broadly defined cooperative behavior proved quite abundant. I looked at the conditions for each of the games separately to find out the frequency of the types in the individual games:

DG

Self-regard, characterized by giving nothing: 4 (2.70%)

Fairness, characterized by giving exactly a half: 51 (34.46%)

Altruism, characterized by giving a non-zero amount: 144 (97.30%)

RDG

Self-regard, characterized by taking all: 7 (4.73%)

Fairness, characterized by taking exactly a half: 63 (42.57%)

Altruism, characterized by taking nothing: 4 (2.70%)

UG

Self-regard, characterized by offering the smallest non-zero amount: 2 (1.35%)

Fairness, characterized by offering exactly a half and only accepting a half: 51 (34.46%)

Altruism and also cooperation, both characterized by offering a non-zero amount and always accepting: 111 (75%)

EUG

Self-regard, characterized by offering zero: 5 (3.38%)

Fairness as a self-centered inequity-aversion does not relate to EUG. However, we can look at a broader scope fairness, characterized by offering exactly a half and only accepting a half on behalf of Player 3: 31 (20.95%)

Altruism and also cooperation, both characterized by offering a non-zero amount and always accepting: 105 (70.95%)

TG

Self-regard, characterized by giving nothing to Player 2 and returning nothing to Player 1: 1 (0.68%)

Fairness, characterized by giving exactly a half and returning a half of the multiplied payoff: 8 (5.41%)

Altruism, characterized by giving a non-zero amount and returning more than the amount Player 1 had sent them: 76 (51.35%)

Cooperation, characterized by giving a non-zero amount and returning at least the amount sent by Player 1: 76 (51.35%)

Note that when looking at the games separately, the conditions for fairness and cooperation overlap substantially, only weakly divided by the share returned in TG. In individual non-sequential games, distinguishing altruistic and cooperative tendencies becomes difficult. However, if we compare the conditions and see that only 2.70% of players in RDG took nothing from the other player and thus behaved altruistically, we can conclude that a majority of people manifested cooperative behavior but the group included few pure altruists.

The results for self-regarding behavior are highly interesting. While no player exhibited all the signs together, each of the conditions was fulfilled at least by one player. Twelve players in total met one or more of the conditions. Eight of them only met one, three fulfilled two of the conditions and one player fulfilled four (all except TG). While meeting one of the conditions could be attributed to effects such as risk-aversion, meeting more suggests self-regarding behavioral tendencies. The one player who met four conditions only did not meet conditions in TG because she (the player was female) sent 1 token instead of 0 (the condition of not returning anything back was not fulfilled).

Fairness was more abundant, its proportion ranging from 5.41% in TG to 42.57% in RDG. While only two players met all of the conditions, the subsets did overlap noticeably.

Gender

A number of studies reported significant differences between behavior in the experimental games by gender, usually in the direction of higher altruism in women;

others did not find such effect. To evaluate the possible effect of gender, I conducted an analysis on our sample. The general data for each gender are displayed in Table 2 below.

Table 2: Relative allocations in the games by gender of the player.

		Mean	Median	Mode	sd
DG given	**Female**	**0.29**	**0.25**	**0.50**	**0.17**
	Male	**0.36**	**0.45**	**0.50**	**0.17**
RDG taken	Female	0.52	0.50	0.50	0.24
	Male	0.54	0.50	0.50	0.24
UG offers	Female	0.39	0.50	0.50	0.17
	Male	0.42	0.50	0.50	0.14
EUG offers	Female	0.37	0.38	0.50	0.19
	Male	0.38	0.44	0.50	0.18
TG sent	**Female**	**0.36**	**0.37**	**0.50**	**0.19**
	Male	**0.55**	**0.50**	**1.00**	**0.31**
TG returned	Female	0.31	0.33	0.50	0.19
	Male	0.26	0.33	0.33	0.21

DG = Dictator Game, RDG = Reversed Dictator Game, UG = Ultimatum Game, EUG = Expanded Ultimatum Game, TG = Trust Game. Variables displaying significant differences between responses of men and women are shown in bold.

As the data do not have normal distribution and therefore *t*-test is not applicable, I tested them by the two-sided Mann-Whitney *U* test. There was a significant difference between men and women in two cases: the amount given in DG (W = 2038.5, p = 0.008) and sent in TG (W = 1840.5, p = 0.0007). In both games, men sent higher amounts than women (see Table 2 above). Gender did not influence acceptances/rejections in UG/EUG significantly.

Biological predictors of prosocial behavior

Aside from gender, another possible biologically relevant predictor of prosocial behavior is health throughout life. A factor analysis (using varimax raw treatment and mean substitution of missing values) of health-related variables (mental condition, physical condition, taking antibiotics, visiting specialized physicians, need of acute medical help, taking medicine, self-perceived life expectancy) produced two factors with eigenvalues of 1.951 and 1.196, explaining 27.87, respectively 17.08% of variability.

The first factor stemmed especially from the variables of taking antibiotics, visiting specialized physicians, need of acute medical help, and taking medicine. The second one's

loadings were highest in the other three variables: mental condition, physical condition, and self-perceived life expectancy (see Table 4 in Appendix for the factor loadings). It can therefore be reasoned that the first factor represents “objective” health indicators, whereas the second one represents a subjective perception of the subject's health state. The factors will from now on be referred to as “objective health” and “subjective health” for greater clarity, though it must be stressed out that this is subject to interpretation.

As per the numeric coding of the variables, a higher factor score in objective health would mean a worse objective health state (more taken ATB, more visits to physicians etc.), whereas a higher score in subjective health would mean a better subjective health state (higher perceived life expectancy and scoring higher on the scale from 1 to 6 in physical and mental state, 1 meaning bad and 6 meaning great). The objective health factor had been multiplied by -1 to also indicate the better health, the higher the score is.

When correlated with the games variables (using two-sided Spearman correlation) for all subjects together, objective health produced no significant correlations and subjective health showed two non-significant trends: with money sent in TG (rho = -0.16, S = 613135.2, p = 0.056) and share returned in TG (rho = -0.15, S = 525329.9, p = 0.079). When analysed for both genders separately, neither of the health-related factors showed no significant results.

The possible influence of health on acceptance rates in UG and EUG was tested by logistic regression (to control for the effect of the amount being decided upon). Neither of the health factors influenced acceptances in either of the games significantly.

Because of the connection of life history strategy and impulse control previous studies had found, I also tested (using two-sided Spearman correlation tests) whether subjects with better overall health scored higher in the Cognitive Reflection Test (CRT). None of these tests yielded significant results.

Memory in relation to prosocial behavior

Because of the tight connection of memory to reciprocal cooperation, I also tested a hypothesis whether subjects with higher scores in the Meili pictures memory test would show more generous and cooperative behavior compared to those with lower scores. I used two-sided Spearman rank correlation to test the hypothesis.

For all the subjects together, only the correlation with UG offer was significant (rho = 0.25, S = 389951.7, p = 0.003). In women, the correlation with UG offer was also significant (rho = 0.25, S = 66010.54, p = 0.022). In men, again only the correlation with UG offer was significant (rho = 0.25, S = 34469.47, p-value = 0.048).

Logistic regression to test whether memory scores had any impact on acceptance rates in UG and EUG was not significant, regardless of the gender of the subjects.

Personal values and experience-related predictors of prosocial behavior

The questionnaire distributed to the participants of the study contained questions aimed at their experience with altruistic/selfish acts and their own propensity to such actions and expectations about others. To be able to find a common pattern and analyze them along with the behavior in the games, I ran a factor analysis of these variables

(number of occasions of being conned during the last year and ever; level of criminality in the subject's area of residence; behavior related to tendency for cheating, cooperating or helping others: crossing the road on red lights, giving a cashier back an overly returned amount of money, buying bus/train tickets for a shorter distance than really traveled, reminding a friend who forgot about having lent them money, making up excuses for not having done assigned tasks, keeping or returning a found wallet, expecting a waiter to give a guest back a mistakenly given excessive amount of money, reporting a thief in a shop, using cheat sheets, sharing with friends, and giving to charity).

Varimax raw treatment was used, factors with eigenvalues greater than 1 were computed and missing cases were replaced with mean values. Six factors were extracted, explaining 59% of variance in total (see Tables 6 and 7 in Appendix for the factor loadings, explained variance values and eigenvalues). Factor 1 stemmed mainly from having been conned more frequently, Factor 2 from the greater propensity to return a found wallet and higher level of criminality in neighborhood, Factor 3 from the greater propensity to return mistakenly given money to a cashier and the lower propensity to cross the road at red lights, Factor 4 from making excuses and using cheat sheets more frequently, Factor 5 from the greater propensity to report a thief, share with friends and give to charity, and Factor 6 from expecting a waiter to return mistakenly given money back to the host, giving to charity and from more frequent buying of tickets for a lower distance than really traveled. While some factors can be easily interpreted (Factor 1: “trusting”, Factor 3: “honest, respecting rules”, Factor 4: “dishonest, cheating”, Factor 5: “altruistic”), Factor 2 is peculiar in the opposite influence of propensity to return a wallet and criminality in neighborhood. It could signify a tendency to remain altruistic and obey the rules even in a higher-criminality environment but this interpretation would need more support to have a better standing. Factor 6 is even more surprising as it includes “altruistic” as well as “cheating” behavior and at the same time expecting someone else to behave honestly. I did include Factor 6 in the further analyses despite of its unclear meaning, nevertheless with greater caution in interpretation of the results connected to it.

I ran two-sided Spearman rank correlation tests of the extracted factors with the games- and health-related variables. Properties of the significant results or trends are listed below; the rest of the tests' results were statistically insignificant.

Factor 1

Correlated significantly with:

DG given (rho = 0.17, S = 449173.6, p = 0.041)

RDG taken (rho = 0.20, S = 434596.2, p = 0.017)

TG sent (rho = 0.17, S = 438612.8, p = 0.038)

RDG taken (rho = 0.24, S = 67188.33, p = 0.030) in women

TG sent (rho = 0.28, S = 61392.57, p = 0.012) in women

Factor 2

Correlated significantly with:

TG returned (rho = 0.16, S = 384884.3, p = 0.062) (only marginally)

TG returned (rho = 0.29, S = 30977.48, p = 0.020) in men

Factor 3

Correlated significantly with:

DG given (rho = 0.20, S = 434501.3, p = 0.017)

EUG offer (rho = -0.13, S = 104627.5, p = 0.044) in women

DG given (rho = 0.36, S = 31873.29, p = 0.002) in men

UG offer (rho = 0.22, S = 39235.9, p = 0.078) in men (only marginally)

Factor 4

Correlated significantly with:

DG given (rho = -0.22, S = 108086.5, p = 0.048) in women

Factor 5

Correlated significantly with: no tested variable

Factor 6

Correlated significantly with:

UG offer (rho = 0.29, S = 384996.1, p < 0.001)

EUG offer (rho = 0.16, S = 443101.5, p = 0.049)

UG offer (rho = 0.37, S = 55786.29, p < 0.001) in women

UG offer (rho = 0.21, S = 39572.17, p = 0.088) in men (only marginally)

Family income

Another variable I focused on was the family income, as previous studies (Ensminger 2004, Carpenter et al. 2005, Chen et al. 2013) had found it to be one of the important predictors of players' behavior in the experimental games.

As the family income was an ordinal variable, I used the Kruskal-Wallis test for this analysis. Because of the differences shown above, I analyzed the data for men and women separately. In female participants, the family income had a significant effect on the amount sent in TG (chi-squared = 13.9275, df = 4, p = 0.007), and marginal on the offer in EUG (chi-squared = 8.2186, df = 4, p = 0.084). In male respondents, it only had an effect on money sent in TG (chi-squared = 9.0197, df = 3, p = 0.029). Overall, the effect seems to be positive but not linear (mean amount sent in order of increasing income: 151, 202, 155, 223, 300 tokens; in case of the highest income group, N had been only one).

Temporal discounting

In our sample, we used two sets of questions to measure temporal discounting. The subjects were first asked whether they would prefer 10,000 CZK today, or another amount (choices: 10,000; 10,020; 10,050; 10,100; 10,150; 10,200; 10,300; 10,500; 10,750; 11,000; 12,000; 13,000; 14,000; 15,000; 16,000; 17,000; 18,000; 19,000; 20,000 CZK) in a month. In the second set of questions, they were asked whether they would prefer to receive 10,000 CZK in a month or the other amount of money in two months' time.

Only two subjects consistently chose the immediate payoff in the first setting; most chose the delayed greater payoff from 10,500 CZK further. In the second setting, seven subjects chose the lower but sooner payoff (including the two previous subjects); the majority chose the delayed payoff from 11,000 CZK further. Three, respectively two subjects' choices were inconsistent (meaning they would prefer to wait longer for a higher monetary payoff but then refuse an even higher one in favor of the immediate but lower payoff). These subjects were excluded from the analysis of temporal discounting and behavior in games (their threshold step was not recorded, as it would be impossible to assess it from their data).

Table 3: Proportion of subjects choosing an immediate, respectively sooner, payoff or the same or greater delayed payoff.

The amount offered beside 10,000 CZK	Chose to have 10,000 CZK immediately	Chose the delayed payoff	Chose to have 10,000 CZK in a month	Chose the further delayed payoff
10,000	90%	10%	98%	2%
10,020	80%	20%	93%	7%
10,050	77%	23%	90%	10%
10,100	72%	28%	85%	15%
10,150	68%	32%	82%	18%
10,200	61%	39%	78%	22%
10,300	57%	43%	74%	26%
10,500	42%	58%	61%	39%
10,750	36%	64%	55%	45%
11,000	22%	78%	43%	57%
12,000	16%	84%	30%	70%
13,000	12%	88%	22%	78%
14,000	9%	91%	18%	82%
15,000	4%	96%	12%	88%
16,000	4%	96%	10%	90%
17,000	3%	97%	10%	90%
18,000	3%	97%	9%	91%
19,000	2%	98%	9%	91%
20,000	2%	98%	6%	94%

Note in Table 3 that when the result of the choice itself is delayed a month, more people prefer the sooner payoff. People really were more inclined to take the lower but sooner payoff in the one month vs. two months setting, as a two-sided Wilcoxon test confirmed ($V = 711$, $p = 7.796*10^{-11}$).

For all subjects with consistent discounting functions, the first step when they preferred the more delayed payoff had been recorded and used for further analysis.

A two-sided Spearman rank correlation test showed that the subjects' choices under both settings corresponded strongly (rho = 0.63, S = 180473.9, $p < 2.2*10^{-16}$). I then, using the same method, looked at whether and how the level of their temporal discounting correlated with their choice in the experimental games.

When discounting under the two above described settings was analyzed separately, only temporal discounting in setting one correlated with the amount sent by Player 1 in TG (rho = -0.17, S = 596351.1, p = 0.037) and expressed a non-significant trend with the offer in EUG (rho = -0.16, S = 588003.8, p = 0.059). When analyzed together (the values from both discounting variables added), the correlation with the offer in EUG was significant (rho = -0.17, S = 568904.9, p = 0.046) and correlation with the amount sent in TG showed a non-significant trend (rho = -0.15, S = 562038.4, p = 0.068).

When performed for each gender separately, the analysis yielded the following results: In women, temporal discounting correlated strongly with EUG offers (setting one: rho = -0.25, S = 102798.5, p = 0.026; setting two: rho = -0.25, S = 110612.3, p = 0.025; all discounting: rho = -0.30, S = 106924.2, p = 0.007), and expressed non-significant trends with UG offers (setting one: rho = -0.20, S = 98918.8, p = 0.071) and money sent in TG (setting one: rho = -0.19, S = 97764.11, p = 0.094). In men, it only showed a non-significant trend with money sent in DG (rho = -0.23, S = 59144.54, p = 0.058).

Logistic regression showed no impact of discounting on acceptance rates in UG/EUG. I also performed two-sided Spearman rank correlation tests for temporal discounting, health factors and CRT results, respectively. None found any statistically significant correlation.

Discussion

Overview of the results

I tested hypotheses regarding health, memory, and temporal discounting in relation to cooperative behavior. The hypothesis that health state correlates positively with the level of cooperation was not corroborated by the results. The second hypothesis (expected positive correlation of memory and cooperation) was only supported by the UG data. The third hypothesis – that lower future discounting would be connected to more cooperation – was corroborated by the overall results. I also tested the relationship of gender, family income and personal values on the behavior in the experimental games. Men sent higher amounts of money in DG and TG. Family income only had a low significant effect on money sent in TG. The personal values and experience-related factors suggest that especially trust and honesty play a role in the observed behavior and generally lead to greater altruism and cooperativeness. In the exploratory part of the work, I looked at the proportion of different behavioral types in the studied population. While cooperation in general proved abundant, pure self-regard, altruism or fairness were much rarer.

General results

The general behavior of subjects in the experimental games was fully in accord with results across previous studies where applicable (summarized in Camerer 2003, p. 48-58), which suggests reliability of our approach. There were three interesting basic results: Players generally paid attention to the offer in EUG, suggesting regard for other players' payoffs. In TG, not only the amount received, but also the amount sent as Player 1, was an important predictor of the share returned. This is in accord with Glaeser et al. (2000) and suggests that more generous players are also more trusting.

And finally, the lack of correlation between amounts given in DG and taken in RDG was surprising for me, as I would have expected there to be a negative connection between those two variables, modulated by the subjects' position on the altruism/selfishness spectrum. This spectrum may therefore not be the best way of looking at subjects' behavior, as the low frequencies of altruistic or self-regarding players in this study, compared to fair and especially cooperative in general, also suggest.

The finding that men were more generous in DG than women is surprising, as other studies previously found the opposite trend (Engel 2011, Novakova & Flegr 2013). However, Bolton and Katok (1995) found no effect of gender in DG. Croson and Buchan (1999) found women more generous in returning money in TG and Eckel and Grossman (2001) found the same pattern in UG. Andreoni and Vesterlund (2001) varied the value of tokens in DG and found women more generous than men in high stakes conditions but men more generous when altruism had been “cheap”. 400 tokens at stake in this thesis' experimental part, equal to 40 CZK, are worth a little less than a lunch in university canteens. It may be the reason why men proved more generous in this study. In TG, it may also be related to greater risk-taking as the return is uncertain.

The significant effect of family income on amounts sent in TG adds to the growing but so far inconsistent literature on the role of income in experimental games: Ensminger

(2004) found that among the Orma people, the presence of income correlated positively with offers in DG and UG. Carpenter et al. (2005) and Chen et al. (2013) found a negative effect of family income on money given in DG. Chuah et al. (2007) found no significant effect of income on UG offers. Burks et al. (2003) did not find any effect of family income on behavior in either of the roles in TG. Outside of experimental games, Yen (2002) found household income to be a highly important predictor of donations to charity and other organizations. However, the effect of income on money sent in TG was not linear in my study and only one participant belonged to the highest income group, compared to at least 22 in each of the other groups. To evaluate the relevance of this effect more reliably, higher N would be needed. So far, we can conclude that two main explanations are possible: Subjects from higher-income families are less risk averse here, as the loss of the amount at stake would be marginal for them, especially compared to the possibility of a greater benefit if the other player repays the gift; or these subjects are more trusting.

Behavioral types in the studied population

The proportion of subjects in the tested sample exhibiting purely self-regarding, altruistic or fairness-driven across the games as per the definitions stated in Methods was very low (or nonexistent in case of self-regard). In a way, this result is not surprising as mixed rather than pure strategies would be expected in a complex social environment with many possible outcomes. In contrast, cooperative behavior, which had been defined most broadly, proved prevalent. Cooperation can be caused by a wide range of motives (Ariely et al. 2009) depending on the specifics of each game and the individual players, so it is not that surprising that more than 50% of our sample could be classified as cooperators across games. In each of the games alone, all types of behavior were present and some players approached the strict across-games definition criteria very closely.

While alone these data cannot yet lead to any new evolutionary implications, this work can act as a pilot study for further works directly working with players' utility and testing which kinds of behavior play are most prevalent in which situations. There have been few works aimed specifically at this, led by Cox et al. (2002) who had used the Moonlighting Game and its several versions including a DG control.

It would also be worthwhile to pursue the connection of other behaviors to these types, for example the degree of personal tolerance, which could have an impact on cooperation as the conducted chimpanzee/bonobo studies suggest. It would still be a very long way (if possible at all) to learning more about the change of prevalence of different utility functions throughout human evolution, but a methodically interesting and potentially fruitful beginning nonetheless.

Hypothesis 1: Health and prosocial behavior

The results presented in the previous section do not support my hypothesis stemming from the life history theory that worse health status would lead to more “self-centered” behavior in the games. This assumption does not seem valid. Nor do they support the stress hypothesis that women would behave more prosocially under stress (e.g. worse overall health status) than men.

However, it also may be possible that by using a student sample, consisting of people between the ages of 19 and 28, all enrolled in university education, the possible effect of health (affecting the life history strategy) had diminished, although it could be found in a general population. The hypothesis needs to be tested on a demographically broader and larger sample before it can be more reliably rejected.

Hypothesis 2: Memory and prosocial behavior

The hypothesis that good memory promotes cooperation is only supported by UG data, not by results from the other games. Absence of the effect in DG and RDG can be explained by the fact that they're not cooperation games and only one player has the ability to decide upon the payoffs. Its absence from EUG may be because the deciding player is kept out of the money transfer. However, its absence from TG is more peculiar and casts some doubt upon the original hypothesis. We cannot conclude whether memory truly had a connection with the cooperativeness in our sample. Also, only short-term memory could have been measured in this study design, while long-term memory would be of much more importance in reciprocal cooperation.

Personal values, experience and characteristics in connection to prosocial behavior

In our sample, Factor 1 ("trusting personality") correlated positively with money sent in DG and TG, suggesting the "trust" interpretation of the factor loadings to be correct. However, it also had a positive correlation with money taken in RDG, which is an interesting effect. While it had been shown that when the option of taking is introduced, most people use it (Cox et al. 2002, Bardsley 2005, List 2007), should we expect more trusting people to take more from others? That does not correspond with the notion that people would expect others to behave similarly to them; but in Cox et al. (2002), some subjects motivated by trust in the first step of the Moonlighting Game then took money from their co-players, so it does not seem out of place – but requires further investigation.

Factor 2 (possibly altruism, honesty and rule-obedience?) correlated marginally with money sent in TG in all subjects, significantly in men, in both cases positively, which seems in accord with the possible meaning of the factor. Yet with such a small effect on one game, we should be careful in its interpretation.

Factor 3 ("honesty") correlated positively with money given in DG (in all subjects and men, not in women), marginally positively with UG offers in men and negatively with EUG offers in women. While most of these results could be expected, the latter one is surprising. A possible explanation that increased honesty could have led to less strategic (not motivated by fairness, "dishonest") offers in women needs to be tested.

Factor 4 ("dishonesty") only had a negative correlation with money given in DG by women. That it showed in DG, where the other player cannot do anything, is not surprising. The fact that it only became apparent in women may be caused by the greater generosity of men in DG in our sample, as discussed above in general results.

Factor 5 ("altruism") correlated significantly or marginally with no games-related variable, which was a surprising result given that allocations in DG are typically viewed as a clear sign of altruistic behavior. Together with the results from Factor 1 and Factor 6, it tells a cautionary tale about altruistic intentions compared to outward behavior.

Factor 6, which was hard to place as it had involved both altruistic and cheating behavior, correlated positively with UG and EUG offers. It may be that people scoring high in this factor only apply strategic altruism – trying to *appear* rather than *be* altruistic, as some previous studies had found quite prevalent in case of "fair" offers (Kagel et al. 1996). Possibly, they could have been more honest about the occurrences of their "cheating" behavior. For our purposes of evaluating the proportion of different types of behavior, the role of intentions had been set aside, as the outcome of wanting to appear or be fair or altruistic remains the same, but precisely this part of the analysis reminds us that it cannot be left out of an analysis of proximate causes of the observed behavior.

Hypothesis 3: Temporal discounting

In all games but DG and RDG, at least a marginal effect of temporal discounting had been observed. The results generally support the hypothesis that strong temporal discounting is connected to a lower degree of cooperation (not altruism), albeit the effect is not very strong. People who have a strong preference for immediate rewards seem to behave more "selfishly" and could potentially fare less well in iterated games setting where discounting of future benefits could prevent reciprocal cooperation, which is in accord with Pronin et al.'s (2008) findings about relating oneself to others and own future self and Curry et al.'s (2008) results connecting lower future discounting to higher contributions in the one-shot Public Goods Game. However, it may not be the only effect; discounting of the future can take place in many areas of human life.

Frederick (2005) found a positive connection between CRT results and patience, or low temporal discounting. However, we did not replicate this result on our sample.

Ganguly et al. (2014) tested whether subjects would be willing to pay a small sum for learning immediately or postponing the information whether they did or did not win a possible reward (if they chose not to, they would learn so in about 40 minutes or right at the moment, respectively) and a higher sum to forgo or participate in testing for STDs prevalent among the sample population of students from near Claremont, California.

Most subjects chose to pay for the de facto worthless information in the reward experiment. More than a third was willing to pay 10 USD for being tested for STDs, which was not surprising given that normally the test would cost them 40 USD; however, about 15% of the subjects would pay 10 USD in order *not* to be tested, even though their blood would still be drawn (and the sample discarded). A majority of people studied by Ganguly et al. (2014) would spend money for absolutely no reason other than changing the time of getting an information slightly, whereas a considerable percentage would pay to avoid potentially useful information. These results show that discounting of the future is quite abundant in the population and it would be of much interest to test them in light of the life history theory.

Limitations

The study possesses several limitations due to its design. First, the sample consisted of Czech university students and it is unclear to what extent the conclusions can be applied to the general population. Some studies found more educated people more generous (Brown 2005, Bekkers & Wiepking 2006). In TG, Johnson and Mislin (2011) found students

less generous in the returned shares than general population. Bekkers (2007) compared students and non-students and found no difference in giving in the DG; it seems that if there is a general effect of education, it becomes salient after graduation, most probably because of the increase in income after graduating and finding a job. We would also have to be very careful when trying to generalize the results to people outside the so-called "WEIRD" countries. Previous research has shown that there exists some cross-cultural variability in behavior in experimental games and responses outside WEIRD countries are generally more diversified (Roth et al. 1991, Chuah et al. 2007, Henrich et al. 2010). Moreover, the size of the sample was limited by using real financial incentives for the participants and the numbers of the subjects were small especially when analyzing men and women apart. For any follow-up work, a larger sample would be desirable.

Second, we are using a highly artificial laboratory experimental framework to find out more about people's behavior, its predictors and possible evolutionary forces. List and Levitt (2005) warn before putting too much weight on experimental results with regard to processes in the real-world settings. Also, the definitions of different types of behavior in the games are to some extent arbitrary and various authors differ in the specifics (e.g. Straub & Murnighan 1995, Diekmann 2004, Croson 2008, Murnighan 2008). We must know that there is no absolute definition of self-regard, altruism, fairness or cooperation. However, with this in mind, trying to assess their proportions in the population is a task that can after further research help us understand their evolution better and perhaps even develop a model more closely describing the involved preferences.

Third, and I would say most importantly, the subjects played a series of more different games in a row and their experience from earlier games could possibly influence their behavior in the later ones. Even playing both roles in one game can steer the results a little, as the meta-analysis of TG (where engaging in both roles had been found to have a slightly negative impact on trustworthiness) in Johnson and Mislin (2011) shows. Yet the fact that the descriptive results obtained from the games in this study mirror the typical ones for most Western countries (Camerer 2003, p. 48-58) suggests that the influence could not have been substantial. And a similar approach has been used before by Blanco et al. (2011) who report no fundamental between-games influence, only that players adhere to certain social norms across games and do not behave randomly or irrationally.

Yet no one so far attempted to evaluate to what extent the results from each game would be influenced by each other, which is surprising (even though a very large sample to randomize the order of the games would be necessary), especially as there would be a possibly fruitful direction for the methodology to evolve. As List and Levitt (2005) point out: *"Interestingly, for a relatively new field that is developing quickly, we find it surprising that little methodological discourse has occurred in experimental economics. Perhaps this is not surprising in light of Samuelson's (1963, p. 231) tongue-in-cheek remark some four decades ago: 'Methodological discussion, like spinach and calisthenics, is good for us…'"*

Conclusion

I did not find evidence for the hypothesis that better health status would promote cooperation and generosity. The hypothesis that good memory promotes cooperation is supported by data from the Ultimatum Game but not the other experimental games. The hypothesis of strong temporal discounting's connection to lower cooperation level is corroborated by the data.

The data on proportions of different types of behavior in the studied population suggest a prevalence of cooperative tendencies and low frequency of unconditional self-regard, fairness and altruism. However, in the individual games the frequencies of these behaviors were higher which suggests that conditional strategies are more common in our social environment. The analysis of several personal values and experience-related factors also reveals that intentional altruism seems even less frequent than previously thought and that the type of behavior in a given situation can depend a lot on its specifics (e.g. appearing vs. being fair or altruistic). It also added more details to the influence of one's gender on their behavior in the experimental games.

Learning more about the biological predictors of behavior, its psychological motivations and frequencies of different types of behavior in the population could help us determine the evolution of altruism, fairness preferences and cooperative tendencies in humans vs. other species in greater details. This work can serve as a pilot study for further research into the specific topics. More research needs to be devoted to the life history theory, study of different strategies and psychological precursors. I hope to fill some of the intriguing gaps this pilot study has shown with data obtained in further studies.

Appendix

1. Experimental instructions (in the original Czech version, available in English per request)

INSTRUKCE K EXPERIMENTU

Ujistěte se, že jste si přečetli, podepsali a odevzdali informovaný souhlas dříve, než experimenty začnou. Od této chvíle je experiment již přísně anonymní.

VYPNĚTE SI TELEFONY A S NIKÝM, PROSÍME, NEMLUVTE!

Pokud vám v jakékoliv části experimentu nebude něco jasné, přihlaste se mlčky zvednutím ruky a vyčkejte příchodu experimentátora, který vám situaci vyjasní.
Postup experimentu:

1. Až dostanete pokyn od experimentátora, najděte na ploše monitoru odkaz s názvem **„část A“** a otevřete ho. V odkazu jsou připraveny experimentální situace. Postupujte dále dle uvedených pokynů. Až všechny dílčí experimenty dokončíte, vyčkejte na pokyn experimentátora.
2. Experiment házení kostkou. Až dostanete pokyn od experimentátora, najděte na ploše monitoru odkaz s názvem **„házení kostkou“** a přečtěte si instrukce k této části. Přítomný experimentátor zároveň hromadně vysvětlí postup experimentu. Až vás experimentátor vyzve, začněte vyplňovat výsledky. Až skončíte, přejděte k dalšímu bodu.
3. Na ploše monitoru najděte odkaz **„část B“** a otevřete ho. V odkazu je připraven dotazník. Dotazník vyplňte. Až jej dokončíte, přihlaste se mlčky zvednutím ruky a vyčkejte poté na pokyn experimentátora.
4. Na ploše monitoru najděte odkaz s názvem **„část C“**. Nahlédněte do instrukcí k této části. Až tuto část skončíte, experiment končí. Přejděte do místnosti MO-226, kde vám bude vyplacena odměna za experiment.
5. V místnosti MO-226 vyplníte post-experimentální dotazník a na základě výsledků z experimentů získáte odměnu v hotovosti (zaokrouhlenou na desetikoruny). Potvrdíte její převzetí, budete poučeni a experiment tím pro vás končí.

Děkujeme za účast.

V této sérii online experimentálních situací bude Vaší úlohou rozdělovat set žetonů mezi sebe a dalšího účastníka. V každé situaci budete spárováni s novým účastníkem. Každého dílčího experimentu se také budete účastnit dvakrát (třikrát v případě čtvrté situace): jednou v každé z účastnických rolí. V těchto nových kolech také budete spárováni s jiným účastníkem než předtím. Všichni účastníci zůstávají přísně anonymní, veškerá interakce se odehrává přes počítač s náhodně přidělenými uživatelskými čísly. Své výdělky vidíte jen Vy, celkový výdělek bude vyplacen v závěru dnešního experimentu. Mezi dílčími experimenty budete požádáni o vyplnění několika otázek.

Na konci celého experimentálního sezení obdržíte peníze za žetony získané během jednotlivých experimentů. 10 žetonů se rovná 1 Kč.

***

1) V tomto experimentu jsou dva účastníci, účastník A a účastník B. Účastník A obdrží set 400 žetonů a jeho úlohou je rozdělit jej mezi sebe a účastníka B, který neobdržel žádné žetony (nechat si a poslat mu část žetonů).

a) V tomto kole prvního experimentu jste účastník A. Ponecháváte si ___ žetonů, účastníku B posíláte ___ žetonů.

b) *V roli účastníka B v prvním experimentu Vám bylo posláno ___ žetonů od účastníka A.*

***

2) V tomto experimentu jsou dva účastníci, účastník A a účastník B. Účastník B obdrží set 400 žetonů. Účastník A, který neobdržel nic, může tento set rozdělit (vzít si a ponechat část žetonů).

a) V tomto kole druhého experimentu jste účastník A. Vezmete si ___ žetonů ze setu, ponecháváte účastníku B ___ žetonů.

b) *V roli účastníka B v druhém experimentu Vám účastník A ponechal ___ žetonů.*

***

3) V tomto experimentu jsou dva účastníci, účastník A a účastník B. Účastník A obdrží set 400 žetonů a jeho úlohou je rozdělit jej mezi sebe a účastníka B, který neobdržel nic.

Pokud účastník B souhlasí s počtem žetonů, které mu účastník A nabízí, získá je a účastník A si ponechá zbytek. Pokud účastník B s nabídkou nesouhlasí, oba účastníci v tomto dílčím experimentu nezískávají žádné žetony.

a) V tomto kole třetího experimentu jste účastník A. Ponecháváte si ___ žetonů, účastníku B nabízíte ___ žetonů.

Vaše nabídka byla přijata/odmítnuta. V tomto kole třetího experimentu jste získali ___ žetonů.

b) V tomto kole třetího experimentu jste účastník B. Účastník A Vám nabízí ___ žetonů. Přijímáte/odmítáte.

V tomto kole třetího experimentu jste získali ___ žetonů.

***

4) V tomto experimentu jsou tři účastníci, účastník A, B a C. Účastník A obdrží set 400 žetonů a jeho úlohou je rozdělit jej mezi sebe a účastníka C, který neobdržel nic.

Účastník C má v tomto experimentu pasivní roli. Přijetí či odmítnutí nabídky účastníka A vůči účastníku C závisí na účastníku B (který v tomto experimentu nezískává žetony).

Pokud účastník B souhlasí s počtem žetonů nabízených účastníkem A účastníkovi C, účastník C je získává a účastník A si ponechá zbytek. Pokud účastník B s nabídkou nesouhlasí, účastníci v tomto experimentu nezískávají nic.

a) V tomto kole čtvrtého experimentu jste účastník A. Ponecháváte si ___ žetonů, účastníku C nabízíte ___ žetonů.

Vaše nabídka byla účastníkem B odsouhlasena/odmítnuta. V tomto kole čtvrtého experimentu jste získali ___ žetonů.

b) V tomto kole čtvrtého experimentu jste účastník B. Účastník A nabízí účastníku C ___ žetonů. Souhlasíte/odmítáte.

c) *V tomto kole čtvrtého experimentu jste účastník C. Účastník B odsouhlasil/zamítl nabídku účastníka A ve výši ___ žetonů. V tomto kole čtvrtého experimentu jste získali ___ žetonů.*

***

5) V tomto experimentu jsou dva účastníci, účastník A a účastník B. Účastník A obdrží set 400 žetonů a jeho úlohou je rozdělit jej mezi sebe a účastníka B, který neobdržel nic. Počet žetonů poslaných účastníku B je experimentátorem ztrojnásoben. Účastník B může tento nový počet rozdělit mezi sebe a účastníka A.

a) V tomto kole pátého experimentu jste účastník A. Ponecháváte si ___ žetonů, účastníku B posíláte ___ žetonů.

Účastník B Vám posílá zpět ___ žetonů. V tomto kole pátého experimentu jste získali ___ žetonů.

b) V tomto kole pátého experimentu jste účastník B. Účastník A Vám poslal ___ žetonů, což bylo ztrojnásobeno – proto máte v tomto experimentu ___ žetonů. Kolik žetonů posíláte zpět účastníku A? ___

V tomto kole pátého experimentu jste získali ___ žetonů.

Dotazníková část

Jaký je Váš studijní obor?
Jaký je Váš typ studia? (bakalářské/magisterské)

Vaše barva očí:
Spíše modrá STUPNICE 5 BODŮ Spíše hnědá

Vaše přirozená barva vlasů:
Spíše světlá STUPNICE 5 BODŮ Spíše tmavá

Vaše krevní skupina v systému AB0 je:
Nevím/nejsem si jist(a)
A
B
AB
0

Vaše krevní skupina v systému Rh je:
Nevím/nejsem si jist(a)
Rh pozitivní
Rh negativní

Jste:
Pravák
Nevyhraněný pravák
Nevyhraněný levák
Levák

Jaké cizí jazyky znáte (alespoň pasivně na čtení novin apod.)? (volné pole pro odpovědi)

Paměťový test

Následující část pokusu zahrnuje testování paměti. Po kliknutí na tlačítko Další uvidíte 30 prázdných čtverečků a tlačítko Start. Po kliknutí na Start ve čtvercích uvidíte 30 jednoduchých obrázků po dobu 60 sekund. Poté obrázky zmizí. Po dalším kliknutí na Start se obrázky začnou postupně objevovat v horní části obrazovky. Kliknutím na příslušný čtverec označte, kde se podle vás obrázek původně nacházel. Na to máte vždy 10 sekund. **Vždy máte pouze jeden pokus na umístění každého obrázku, proto vždy klikejte pouze jednou a vyčkejte na zobrazení dalšího obrázku.**

Házení kostkou

V následujícím experimentu budete házet kostkou. Budete mít 20 hodů a po každém hodu si zapíšete počet získaných bodů, tedy 1 – 6 bodů. **Za každý získaný bod obdržíte 10 žetonů (tj. 1,- Kč).** Vyčkejte na pokyn experimentátora a poté stiskněte tlačítko „SPUSTIT“. Před Vámi se objeví tabulka, ve které budou políčka, do kterých výsledky z jednotlivých hodů doplníte a potvrdíte.
Po doplnění a potvrzení posledního políčka tato část experimentu končí, přesuňte se k další části.

II. ČÁST DOTAZNÍKU

Vaše tělesná výška je ___ cm.
Vaše tělesná hmotnost je ___ kg.
Vaše velikost bot (v evropském číslování) je ___.

Nyní budeme potřebovat, abyste si změřili délku prsteníčku a ukazováčku na levé i pravé ruce. K tomu máte k dispozici pravítko. Délka se měří při pohledu na dlaň od proximální rýhy (té blíže k dlani, pokud máte u kořene prstu více rýh) ke špičce prstu (nikoli nehtu, pokud přesahuje). Před měřením si opřete ruku hřbetem o podložku, oddalte prsty a propněte, poté změřte. Snažte se změřit délku co nejpřesněji a zapište ji s přesností na poloviny milimetru, psáno s desetinnou čárkou (tedy např. 65,5).
Levý prsteníček:
Levý ukazováček:
Pravý prsteníček:
Pravý ukazováček:

Následující otázky jsou *hypotetické*; představte si, že jste v tento okamžik postaveni před uvedená rozhodnutí. Zaškrtněte, kterou z možností byste si vybrali.

10 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 020 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 050 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 100 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 150 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 200 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 300 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 500 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
10 750 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
11 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
12 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
13 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
14 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
15 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
16 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
17 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
18 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
19 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes
20 000 Kč, které dostanete za měsíc NEBO 10 000 Kč, které dostanete dnes

10 000 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc
10 020 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc
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10 750 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc

11 000 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc
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15 000 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc
16 000 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc
17 000 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc
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19 000 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc
20 000 Kč, které dostanete za dva měsíce NEBO 10 000 Kč, které dostanete za měsíc

Na vyplnění následujících čtyř otázek máte max. dvě minuty, poté budete přesměrováni na další stránku.

Pálka a míček na stolní tenis stojí dohromady 110 Kč. Pálka stojí o 100 Kč více než míček. Kolik stojí míček?

Pěti strojům zabere vyrobení pěti výrobků pět minut. Jak dlouho by sta strojům zabralo vytvoření sta výrobků?

V jezeře se nachází lekníny. Každý den se plocha jezera pokrytá lekníny zdvojnásobí. Pokud leknínům zabere 48 dní pokrýt celé jezero, jak dlouho by jim trvalo pokrytí poloviny jezera?

V závěru závodu předběhnete 2. běžce. Na jakém místě doběhnete?

Zde je několik osobnostních vlastností, které se na Vás mohou, nebo nemusí hodit. Zaškrtněte, do jaké míry souhlasíte či nesouhlasíte s určitým tvrzením. Měl/a byste hodnotit celou dvojici vlastností, i když jedna z charakteristik na vás platí více než druhá.
Sobě se jevím jako:

	Rozhodně nesouhlasím (1)	Spíše nesouhlasím (2)	Mírně nesouhlasím (3)	Ani nesouhlas, ani souhlas (4)	Mírně souhlasím (5)	Spíše souhlasím (6)	Rozhodně souhlasím (7)
Společenský, nadšený (1)							
Kritický, hádavý (2)							
Spolehlivý, disciplinovaný (3)							
Úzkostný, snadno zneklidnitelný (4)							
Otevřený novým zážitkům, složitý (5)							
Zdrženlivý, tichý (6)							
Přátelský, laskavý (7)							
Neorganizovaný,							

nedbalý (8)							
Klidný, emočně stabilní (9)							
Konvenční, málo tvořivý (10)							

Setkali jste se Vy nebo Vaši blízcí s tím, že by Vás za poslední rok někdo značně podvedl (např. na Vás či Vašich blízkých vylákal pod falešnou záminku větší sumu peněz, požádal Vás o zapůjčení mobilního telefonu na krátký hovor a utekl s ním, apod.)?
Ano, vícekrát
Ano, jednou
Ne

Setkali jste se Vy nebo Vaši blízcí s tím, že by vás během celého Vašeho života někdo značně podvedl (např. na Vás či Vašich blízkých vylákal pod falešnou záminku větší sumu peněz, požádal Vás o zapůjčení mobilního telefonu na krátký hovor a utekl s ním, apod.)?
Ano, vícekrát
Ano, jednou
Ne

Finanční situace Vaší domácnosti (rodiny) je:
Dobrá
Spíše dobrá
Průměrná
Spíše špatná
Špatná

Vaše (berte v úvahu jen svoji) finanční situace je:
Dobrá
Spíše dobrá
Průměrná
Spíše špatná
Špatná

Připadáte si, že jste:
Zcela neatraktivní,
Spíše neatraktivní,
Spíše atraktivní,
Velmi atraktivní

Vaše fyzická kondice je
Špatná STUPNICE 1-6 Skvělá

Vaše psychická kondice je
Špatná STUPNICE 1-6 Skvělá

Kolikrát jste maximálně použil/a antibiotika v jednom kalendářním roce? (nikoli pouze z preventivních důvodů)
STUPNICE 0 – 5x a více

Kolik lékařů-specialistů jste pravidelně navštěvoval nebo navštěvujete (ne kvůli prevenci) v minulých dvou letech?
STUPNICE 0 – 5 a více

Kolikrát jste musel v minulých 5 letech vyhledat akutní lékařskou pomoc – např. nutnost rychle jít na ambulanci – kvůli vážné nemoci (ne poranění), která trvala více než 3 dny?
STUPNICE 0 – 5x a více

Kolik různých léků předepsaných lékařem užíváte denně?
STUPNICE 0 – 5 a více

V jakém věku zemřel Váš vlastní otec? (nevyplňujte, pokud žije)
V jakém věku zemřela Vaše vlastní matka? (nevyplňujte, pokud žije)
Jakého věku odhadujete, že se dožijete Vy? (100 znamená 100 a více)

Jakého vzdělání dosáhla Vaše matka?
Primární (základní škola)
Sekundární (střední škola)
Terciární (vysoká škola)
Nevím

Jakého vzdělání dosáhl Váš otec?
Primární (základní škola)
Sekundární (střední škola)
Terciární (vysoká škola)
Nevím

V oblasti, v níž jste vyrůstali, byla kriminalita:
Nízká
Spíše nízká
Průměrná
Spíše vysoká
Vysoká

Přecházíte přes přechod, svítí-li červená barva?
Vůbec ne,
Vzácně,
Občas,
Pravidelně,
Skoro vždy

Pakliže by Vám pokladní v obchodě vrátila nazpět více peněz než měla, ozvali byste se?
Ano
Ne

Kupujete si lístky (na autobus či vlak) na kratší vzdálenost, než ve skutečnosti jedete?
Vůbec ne,
Vzácně,

Občas,
Pravidelně,
Skoro vždy

Kamarád Vám půjčil peníze, ale na půjčku zapomněl. Připomenete se mu?
Ano
Ne

Používáte ve škole taháky či opisujte?
Vůbec ne,
Vzácně,
Občas,
Pravidelně,
Skoro vždy

Přispíváte někdy na charitu?
Ano, pravidelně
Ano, občas
Ano, vzácně
Ne

Vzali jste na sebe či Vám byla přidělena povinnost v rámci skupiny Vašich přátel – např. rezervace vstupenek do kina či zjištění informací o společném výletu apod. Na povinnost jste však zapomněli. Místo přiznání se vymluvíte – kupř. že vstupenky byly vyprodány. Vymlouváte se takto?
Vůbec ne,
Vzácně,
Občas,
Pravidelně,
Skoro vždy

Dělíte se rádi s přáteli o svůj majetek (např. zvete je na jídlo nebo do kina či divadla, dáváte jim svá DVD či knihy, když se jim líbí, apod.)?
Ano, běžně
Ano, občas
Ano, vzácně
Ne

Pakliže byste nalezli peněženku, v níž je zhruba 2 000 Kč, předali byste ji na policii, či si peníze nechali a peněženku odhodili?
Odevzdali
Ponechali

Číšník hostovi vrátí omylem zpět více peněz, než měl. Myslíte si, že host jej upozorní?
Vůbec ne,
Vzácně,
Občas,
Pravidelně,
Skoro vždy

Vidíte v obchodě zloděje. Nahlásíte ho?
Ano
Ne

V dotaznících, jako je třeba tento, lžete?
Vůbec ne,
Vzácně,
Občas,
Pravidelně,
Skoro vždy

Pro ženy:
Následující otázky se týkají Vašeho menstruačního cyklu. Jedná se o důležitá biologická data, a tak Vás prosíme o vyplnění těchto otázek. Pokud Vám ale odpovídání na ně z jakéhokoli důvodu vadí, nechejte je nevyplněné.
Délka Vašeho menstruačního cyklu (tedy od začátku trvání jedné menstruace k další, obvykle kolem 25 – 35 dnů) činí ___ dní. Vaše poslední menstruace začala před __ dny.
Berete v současné době hormonální antikoncepci? ANO/NE

III. ČÁST DOTAZNÍKU
Nyní máte možnost ještě změnit výši svých výdělků z předchozích částí experimentální série. V každém řádku můžete zaškrtnout jednu z možností. Zaškrtnete-li první, s pravděpodobností 50 % získáte navíc 40 Kč za daný řádek a s pravděpodobností 50 % Vám bude z dosavadních výdělků odečtena určitá částka (dle řádku). Pravděpodobnosti se řídí hodem mincí, panna znamená výdělek, orel ztrátu. Software pro virtuální hod nelze nijak zvnějšku ovlivnit a obě pravděpodobnosti jsou 50 %. Zaškrtnete-li druhou možnost, s jistotou v daném řádku nic nezískáte ani neztratíte.

+40 Kč s 50% šancí a -4 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -8 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -12 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -16 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -20 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -24 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -28 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -32 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -36 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -40 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -44 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -48 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -52 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -56 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -60 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -64 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -68 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -72 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -76 Kč s 50% šancí NEBO 0 Kč s jistotou
+40 Kč s 50% šancí a -80 Kč s 50% šancí NEBO 0 Kč s jistotou

2. Factor loadings, eigenvalues and explained variance

Table 4: Factor loadings for two health-related factors

	Factor 1	Factor 2
psychicka_kondice	-0.216448	0.646613
fyzicka_kondice	-0.239180	0.683610
antibiotika	0.544767	-0.346179
lekar_specialista	0.674106	-0.122489
akutni_pomoc	0.588558	-0.110546
leky	0.610511	0.147937
doziti	0.267867	0.668014
Expl.Var	1.646123	1.500623
Prp.Totl	0.235160	0.214375

Table 5: Eigenvalues and explained variance for two health-related factors

	Eigenvalue	% Total	Cumulative	Cumulative
1	1.950878	27.86968	1.950878	27.86968
2	1.195869	17.08384	3.146746	44.95352

Table 6: Factor loadings for six personal experience and psychology factors

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
prechod	-0.015600	0.192799	-0.561792	0.404086	-0.069524	0.319352
pokladni	0.040629	0.118487	0.798628	0.092071	0.031121	0.144850
listky	0.263255	-0.242899	-0.287459	0.109328	0.015043	0.610605
pujcka	0.147777	0.428281	-0.141422	-0.454915	0.129818	-0.250604
vymluvy	0.036443	0.116149	-0.031271	0.748996	-0.003527	-0.161112
penezenka	-0.117604	0.722667	0.288836	0.052777	-0.156765	0.031749
cisnik	0.015303	-0.062115	0.201015	-0.118289	-0.175426	0.719051
zlodej	-0.038499	-0.127171	-0.011335	-0.069278	0.780918	-0.168193
podvedeni_rok	0.806236	0.048851	0.018910	0.110954	-0.072959	0.074030
podvedeni	0.756798	-0.016575	0.013104	0.020731	0.090009	0.026413
tahaky	0.270531	-0.169693	0.029670	0.653835	0.024345	0.068911
deleni	0.210510	0.101942	0.104050	0.289072	0.492040	0.188501
charita	-0.022807	0.261854	0.136188	-0.005987	0.498255	0.517051
kriminalita	0.246704	0.617386	-0.288659	-0.028622	0.109677	-0.160814
Expl.Var	1.511556	1.340986	1.295096	1.497894	1.204483	1.470560
Prp.Totl	0.107968	0.095785	0.092507	0.106992	0.086035	0.105040

Table 7: Eigenvalues and explained variance for six personal experience and psychology factors

	Eigenvalue	% Total	Cumulative	Cumulative
1	2.045878	14.61341	2.045878	14.61341
2	1.517057	10.83612	3.562935	25.44953
3	1.418375	10.13125	4.981309	35.58078
4	1.175776	8.39840	6.157085	43.97918
5	1.123528	8.02520	7.280614	52.00438
6	1.039961	7.42830	8.320575	59.43268

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