Doctoral School of Sociology

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A friendly offer – fairness and social embeddedness

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Introduction

According to one of the most important assumptions of economic theory humans are motivated by self-interest (Williamson 1985). People in various situations would like to increase their perceived utility basing their decisions on increasing their profit without caring for the profit of others – or in other words the ‘vast forces of greed’ (Arrow 1980) is put into the focus of the explanation. The self-interest hypothesis gives accurate descriptions and predictions of pure economical situations where interpersonal interactions do not occur.

In reality, however, behaviour differs from that. If this kind of behaviour would be common and exclusive among people, then cooperation would not be able to emerge (Axelrod and Hamilton 1981), there would be no punishment for free riders – those not participating in producing public goods – (Bowles and Gintis 2003; Fehr and Gächter 2002) altruistic behaviour – unselfishness – wouldn’t be rewarded (Trivers 1971), trust would not be produced (Sobel 2005) and we wouldn’t experience fairness (Rabin 1993). The preferences which guide people to act this way – caring about the costs incurred on or benefits enjoyed by others – may be denoted as other-regarding preferences (Stout 2001).

Laboratory experiments have already proved the existence of non-selfish behaviour, and showing that pure self-interest is usually not observed in non-anonymous interactions. Cooperation was observed most strikingly in public good game experiments (Dawes and Thaler 1988; Bowles and Gintis 2003; Fehr and Gächter 2000a; Fehr and Schmidt 1999) – even though defection pay always better. People are willing to punish free riders or unfair behaviour even when punishment is costly and may not provide a direct payoff (Fehr and Gächter 2000b, 2000a; Bolton and Zwick 1995; Bowles and Gintis 2003; Boyd et al. 2003; Fehr and Gächter 2002). The same was observed for rewarding behaviour (Fehr and Fischbacher 2003). People even think that others would behave this ‘irrationally’, people trust each other as shown in the experiments with trust games (Berg, Dickhaut, and McCabe 1995; Ho and Weigelt 2002)).

A research direction of social psychology categorizes people based on their behaviour into ‘social value orientations’ (first to publish the theory were Messick and

McClintock 1968), an intrinsic motivation existing in individuals. The social value orientation theory states that people have an orientation based on their attitude towards the payoffs of themselves and others. Different orientations correspond to different 'ratios' of these payoffs.

Despite being a sound theory with robust results, social value orientation lacks the ability to fully take into consideration the behaviour of other participants of an interaction and to explain equilibrium formation in sequential games[1].

In other words social value orientation is a rather 'self-centred' theory to explain individuals' behaviour in personal exchanges. It assumes that one's orientations are constant towards everybody and that the given orientation determines behaviour regardless of the identity, behaviour or any other property of the others participating in the interaction. Some of the aforementioned non-selfish behaviour – punishing, rewarding and trust building – are quite difficult to describe accurately using social value orientations, as there are other factors influencing choices in some situations – as pointed out by Doi (1994).

From the perspectives of behavioural economics[2] the explanation of choices in personal exchange also includes the influence of others' behaviour. To investigate the importance of these effects, the experimental games used in behavioural economics usually involve situations where the players have to react, or anticipate other players' behaviour. However the approach of behavioural economics neglects that people differentiate in their behaviour between people – in fact one of its most important rules is the anonymity in most of the experiments.

The tools commonly used in laboratory experiments researching dyadic interactions were taken from game theory[3]. The simplest tools of behavioural economics are the ultimatum and dictator games (Güth and Tietz 1990; Güth, Schmittberger, and Schwarze 1982). On one hand, the ultimatum game models a one-turn bargain of two players with one player offering a split of a pool of goods, which may be accepted

[1] Although we have to note that Van Lange found that behaviour of people with 'pro-social' orientation tend to set their cooperation level according to the partner's willingness to cooperate while people having other orientations acted with much less regard to the partner.

[2] Behavioural economics is usually referred to a the current stream economics, which incorporates the finding of psychology to increase the explanatory and predictive power of economics (Camerer and Loewenstein 2003).

[3] In the following I'll refer to a participant of an interaction as "player'.

(payoffs according to the offer are given) or rejected (zero payoff to both parties) by the other player. On the other hand, the dictator game models simple sharing in which a proposer can voluntarily share a given pool of goods with another player.

Based on numerous experimental sessions (Forsythe et al. 1994) various theories were born regarding the evolution, occurrence and importance of non self-interested behaviour. Some researchers also suggest that besides the norms transferred in the society the 'instinct' for non self-interested behaviour is also genetically inherited (this approach was proposed by biologists and geneticists) (Wilson 1975). Experimental evidence shows that the assumption that this kind of behaviour emerges solely because of long term self-interest has been falsified.

Non self-interested behaviour was found to be emerging especially in case of the interactions of genetically related people. The theory of kinship based altruism says that the level of altruism is proportional to the level of genetic similarity – kinship (Hamilton 1964a, 1964b). People are generally more altruistic with their kin than with acquaintances and particularly with strangers. As it will be shown, this difference is striking particularly in sharing situations. This theory was examined using experimental methods as well (Madsen et al. 2007).

Sociologists recognized that our behaviour is not only different towards family members, but we also tailor our behaviour towards friends, colleagues, and acquaintances. Human behaviour is embedded in the social structure. In numerous situations a certain social relation exists between the individuals in an interaction. They may only see each other, they can meet on a regular basis interacting during work, or they may be close friends. Neither of these theories, nor the experiments deals with the effects of being embedded in the same social network with the person we're interacting with (Granovetter 1985), thus in some sense they lack the sociological insight into these processes.

Some studies were done in different fields taking into account the effect of kinship and friendship on behaviour in trust games (Vollan 2008), and in public good games (Peters et al. 2004; Haan et al. 2006). Existing relationships facilitate cooperation, trust and fairness, but also increases expectations – punishing gets more frequent in friendships, but not when family ties exist. Also other studies were conducted using with dictator games to show that people give different amounts to kin than to others

(Ben-Ner and Kramer 2010). They found strong altruism when people were playing with their kin; not simply higher tendencies for equal sharing but more players gave everything to their kin, than players keeping the total pool of goods. However these experiments did not go beyond this observation – which has been already found in other research – to examine the level of reciprocity exhibited versus strangers and versus kin (of course since altruism is higher in case of interactions with kin, punishment would be harder to observe).

The goal of the studies mentioned here was to prove the existence and importance of these factors, by showing that people behave differently when interacting kin, friends and strangers. They succeeded in this, but did not go further, did not attempt to describe this behaviour from the modelling perspective.

The aim and structure of this thesis

The motivation of this research was that previous research conducted dealing with fairness neglected the embeddedness of the situations where fair/unfair behaviour may occur. Embeddedness is a crucial notion in sociology as it emphasizes the importance of being in a network in the scope of institutions and behaviour (Granovetter 1985). Interactions in social networks are capable of explaining macro phenomena through micro processes (Takács 2001; Buskens and Raub 2002) – in other words agents embedded in social networks and atomistic agents behave differently. The fact that the social networks change the behaviour of agents gives embeddedness a very important role in sociology.

The purpose of my work is to research the effects of embeddedness on fairness. Being in a network is essential in social life and it is included in various norms forming our behaviour. It is assumed in this work that fairness norms are one of them. Much research was conducted examining these norms, yet the role of embeddedness was neglected. Experimental methods applied in earlier research were anonymous and thus it was unable to account for that interactions involving fair behaviour are always embedded in a network context. People acting fairly or unfairly do so with some existing tie, sometimes they are in the same network. My approach in this thesis aims to fill the existing gap between economical and social psychological approach.

The main assumption tested in this thesis is, that the degree of altruism in sharing situations signals the strength of the tie between two people. Thus it is assumed that the altruism exhibited in an interaction provides information about that relationship itself. Further stressing this assumption we may also conclude that different levels of altruism in interactions involving more than two parties can be explained by the differences in the relationship.

I have formulated these assumptions into hypotheses and tested them in my research using experimental methods. I also discuss this question from an analytic modelling point of view. I give a quantitative definition of the strength of the tie by a new utility model based on the model of Fehr and Schmidt (Fehr and Schmidt 1999). Tie strength definitions vary across literature mostly depending on what is being examined. Usually it is modelled by some quantifiable properties (interaction frequency, duration etc) which are limited in their meaning and apply in the scope of the specific research question.

The tie strength is introduced here is a single constant in the discussed model, which is proportional to the split perceived as 'fair' in sharing[4] situations. This yields that in sharing situations more is given to those whom we're close related to, while towards others we're much less altruistic. The same argument can be formulated in terms of punishing and rewarding behaviour (reciprocity) – namely this interpretation of fairness also implies that we're more willing to retaliate and reward those whom we're closely related to. This serves to maintain and reassure the present relationship.

In this sense this definition of the strength of the tie addresses an internalized norm – fairness – in a quantifiable way and thus it is a broader definition. Of course the definitions given by Granovetter explain much more phenomena than the tie strength definition proposed here, but those 'ties' (strong and weak) are not quantifiable, they're rather categories of ties. Using the experimental methods introduced here it's also possible to quantify, 'measure' tie strength. The tools of behavioural economics haven't been used earlier in exploring networks and embeddedness in this depth. Also besides introducing the model and defining tie strength the effects of fairness are investigated

[4] In this thesis I use the term 'sharing situations' for ultimatum games and dictator games. These games involve sharing a pool of goods on a voluntary or bargaining basis – as described before.

using experimental methods and different behaviour is analytically deducted from the proposed model as well.

So this research approaches fairness norms and embeddedness in a new perspective emphasizing their interaction. Neither fairness norms, nor embeddedness was examined in this perspective, thus the results and methods introduced here give a sociological context to fairness it does not currently have. The measure of the strength of a tie suggested in this work opens this approach to social network analysis as well – as it provides a new way of describing the ties –, but this direction is not thoroughly explored in this thesis.

In the first section I review fairness theories; fairness modelling and the social network analysis from both theoretical and experimental aspects. I discuss and analyze existing models of fairness and experimental results. Models describing fairness are analyzed focusing on their descriptive power of behavioural paradoxes and their experimental background. Experimental results on the other hands are analyzed mainly on their representations of specific behavioural patterns such as altruism, reciprocity and the effects of relationships of players.

I introduce a new model of fairness in the second section. The model is a utility based fairness model (IFN), which explicitly includes the strength of the ties. The model is thoroughly analyzed in this section showing that it describes the observed behavioural phenomena (some of which was not described by previous models). Also the model is examined in terms of the hypotheses introduced in the second section. The experimental methods – somewhat different from earlier techniques – are discussed in detail. Since the methods include violation of basic rules of experimental game theory some explanation is given to the reasons of this unconventional approach.

In the third section I introduce my hypotheses to be tested in this work. The *first hypothesis* assumes that the relationship (reported as friendship or kinship) between players has a strong and significant effect on behaviour in sharing situations. The *second hypothesis* describes that people specifically differentiate between others based on their relationships (even when two people are reported to be friends). This hypothesis generally says that the relationship of people can be investigated based on their behaviour in experimental games, thus the experimental games can be used as a test and as a sociometric method for quantifying or comparing relationships. The *third* *hypothesis* deals with norms. According to this hypothesis people have a general attitude towards being better or worse off than others in a given interaction. The general attitude is modified with the relationships between people (this explains why we get jealous of our rich neighbour, but feel much less envy towards an unknown rich firm director). Finally the *fourth hypothesis* describes that people are willing to retaliate even against friends, when a third party is being treated very unfairly.

The fourth section deals with the experimental results. A general experimental result is shown in comparison to the existing data, and also some specific groups are analyzed. General experimental results are used to test the hypotheses, while group and individual level results provide a test of the IFN model's application. Due to the sample constraints of this research these results may not be used to fully evaluate the hypotheses, but rather to investigate them further and improve them. As it will be shown most of the statistical tests were significant, but still the low number of cases does not allow a thorough test of the hypotheses. Still the results show that the experimental design may be used well in investigating these hypotheses.

Finally a summary of the thesis is given in section five. The summary focuses on the fundamental results of this research rather than on the tests of hypotheses. It is concluded that based on the model proposed the strength of a tie between people can be objectively measured, so it enables us to research social networks in a different perspective.

1 Theories and results – fairness and social network analysis

1.1 Fairness, reciprocity and altruism – a summary

Early economic modelling describes humans as purely selfish actors, as *homo economicus* (Mill 1836; Persky 1995), which model was quite soon questioned (Drucker 1939; Marsden 1986). Numerous economists have pointed out that people have other-regarding preferences, which means people care for others' well-being in certain situations (Smith 1761; Becker 1976; Samuelson 1993; Sen 1993, further references in Janky 2005; Hausman és McPherson 1993).

Researchers conducted numerous experiments since the end of 70's to analyze the behaviour unexplained by self-interest[5]. These experiments proved that altruism, reciprocity and fairness – behaviour patterns that had their more explicit definitions thanks to these experiments – play a significant role in behaviour of individuals (Güth et al. 1982; Kahneman, Knetsch, and Thaler 1986; Roth et al. 1991; Fehr, Kirchsteiger, and Riedl 1993; Forsythe et al. 1994; Roth 1995), but also pointed out that people guided entirely by self interest indeed do exist. For a summary on these experiments and the behavioural economics in the early 80's see (Rabin 1993).

The alternative preferences to self-interest – taking into account of well-being of others – can be summarized with the term: *other-regarding preferences*. These preferences are 'the many ways in which we act as if we care about the costs borne and the benefits enjoyed by others.' (Stout 2001).[6]

Three behaviour patterns emerged as the observed alternatives for selfish behaviour. They are fairness, reciprocity and altruism. Before going into the in-depth analysis of the experimental results and tools, clarification and explanation is required regarding these behaviour types[7].

[5] A summary is given on experimental results in a latter section.
[6] pp. 3.
[7] For a summary on fairness theories and experimental methods see (Gulyás 2007).

1.1.1 Fairness, reciprocity and altruism –other-regarding preferences

Fairness

When discussing fairness, the literature available does not really offer a strict definition. Fairness is usually referred to as an abstract concept used in its everyday meaning. Some use it to refer to an attitude, a 'concern for fairness'; while in some context it is also used as a kind of behaviour, 'fair behaviour'. I neither will attempt to give a strict definition to fairness, nor do I think that it is necessary to give one. Literature describes fairness as a combination of different behaviour patterns and thus explains it sufficiently from both behavioural and normative side.

Source	Definition	Emphasis
(Varian 1974) pp. 63.	'Consider the problem of dividing a fixed amount of goods among a fixed number of agents. If, in a given allocation, agent *i* prefers the bundle of agent *j* to his own, we will say *i* envies j. If there are no envious agents at allocation *x*, we will say *x* is equitable. If *x* is both Pareto efficient and equitable, we will say *x* is fair.'	Distribution perceived as fair
(Binmore, Shaked, and Sutton 1985) pp. 1178.	'Subjects tend to seek a 'fair' outcome to bargaining problems. The thrust of the inquiry is then to determine what the subjects will regard as fair in a given situation'	Outcome perceived as fair
(Rabin 1993) pp. 1281.	'... Yet psychological evidence indicates that most altruistic behaviour is more complex: people do not seek uniformly to help other people; rather, they do so according to how generous these other people are being. Indeed, *the same people who are altruistic to the altruistic people are motivated to hurt those who hurt them.* If somebody is being nice to you, fairness dictates that you be nice to him. If somebody is being mean to you, fairness allows – and vindictiveness dictates – that you be mean to him. ...'	Rewarding and punishing others' behaviour
(Fehr and Schmidt 1999) pp. 819	'…in addition to purely self interested people, there is a fraction of people who is also motivated by fairness considerations ... We model fairness as self-centred inequity aversion …'	Inequality aversion

Table 1.1 Definitions of fairness in the literature

The earliest, most clear definition to fairness is given in a game theoretical context by Varian (Varian 1974). Such formalization can be denoted as *distributional fairness* as it deals directly with the distribution of outcomes. This thesis deals with distributional fairness, so in the following I'll refer to distributional fairness, the set of distributional norms simply as 'fairness'. Also Varian's fairness definition may be interpreted as: an outcome is fair for a person, if it yields the same utility to him as the perceived utility to everybody else. Of course this incorporates the subjectiveness of perceiving utility.

There are also less exact explanations for fairness with the same background assumptions. For example the definition of Binmore, Shaked and Sutton means that the maximum of a player's utility function is determined by what is perceived as 'fair' in a given situation (Binmore et al. 1985).. In this aspect fairness is either a psychological barrier or it is an internalized attitude.

A similar, but more exact definition is used by Fehr and Schmidt (Fehr and Schmidt 1999). In their work – discussed later in details – the authors stress that fairness means pursuing equality, or avoiding inequality. They usually omit the use of the term 'fairness', but use the term 'inequality aversion' instead, since this term corresponds better to the behaviour formulated in their model. This convergence on equality is a robust assumption as it explicitly defines the internalized norms and also does not limit behavioural patterns, but defines their goal.

Rabin defines fairness as a set of behavioural patterns which describe the reactions to others' behaviours – in this sense this description is less self-centred. This clearly indicates that fairness is hard to describe as a certain behaviour type or certain norm set. In the first sentence Rabin refers to the followings to as 'altruistic behaviour', which is in turn not only about altruism, but also about reciprocity. The fact that in such an important paper – nowadays mentioned as a milestone in fairness research – these notions are discussed so unclearly indicates that the notion of fairness requires further examination both on its normative meaning and its meaning as a collection of behavioural patterns.

On the normative side fairness is a certain set of behavioural patterns which describes adequate reactions to one's actions and describes sharing certain goods in an acceptable way. These two cases are quite different and that's why giving one exact definition to fairness is problematic. Fair behaviour regarding sharing is different in many cases, depending on the context, the participants of an interaction, or the cultural background[8].

The behaviour types associated with fairness are different types of reciprocity and altruism. These require additional explanation and literature gives numerous examples on both. The meaning of these behaviour patterns is independent of cultural background and context.

Reciprocity

Reciprocity is an 'adequate reaction' to others' behaviour, or in more common terms: 'tit-for-tat'. Reciprocal behaviour means 'be nice to those being nice to you and be mean to those who were being mean to you'.

This includes two behavioural patterns as reactions: punishing and rewarding. Being nice to someone after being treated well is practically a 'reward' for that nice behaviour, while hurting somebody after being treated badly is a 'punishment' for that bad behaviour. Despite being quite clear and distinct, these are not the only criterions to classify reciprocity on its nature (rewarding/punishing).

One possible way is discussed by (Fehr and Gächter 2000b). They classify reciprocity as positive/negative reciprocity based on being good or bad with the other, or in other words as rewarding and punishing. Another way to classify reciprocity is its occurrence. Gintis classifies reciprocity as strong and weak reciprocity (Gintis 2000). Strong reciprocity may be observed in experiments even if it's costly, while weak reciprocity is not observed in this case. Usually both punishing and rewarding is costly for the individual. If the cost of either punishing or rewarding is not high, then this behaviour becomes more and more frequent (Leventhal and Anderson 1970; Janky 2005). In the behavioural sense strong/weak classifications are more consequential and thus more widespread than the simple positive/negative classification.

Reciprocity may be classified also by how it is exhibited. In this sense we may speak of two types of reciprocity: direct reciprocity, and indirect reciprocity.

[8] In a latter section I'll review experiments which exactly show the effect of cultural background and everyday habits on fair behaviour (Henrich, Boyd, and Fehr 2004).

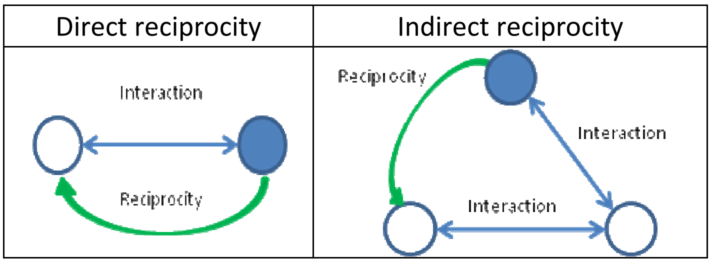

Table 1.2 Types of reciprocity

Direct reciprocity means that the individuals participating in a dyadic interaction punish or reward each other. This is the simplest form of reciprocity as here the player punishing/rewarding the other player does so after interacting with the other player. This type is easily fits into both positive/negative and strong/weak reciprocity classification.

Indirect reciprocity means that if multiple actors are interacting with each other an actor punishes or rewards another actor with whom he did not interact. The simplest example for such reciprocity is the Kula ring (Malinowski 1920) which indirect reciprocity works as a trading system. In the Kula ring the participants of trade are trading in a closed 'chain'. There trading is not an exchange between two parties, but a party giving goods to another, but receiving goods from a third party. Indirect reciprocity assures trade in this case.

Another approach was given by Trivers, who formulated the so called 'general altruism', where the return is directed to a third party (Trivers 1971), which was then extended and denoted as indirect reciprocity by Alexander (Alexander 1979, 1987). In a broader sense indirect reciprocity means that cooperation is channelled to the cooperative members who are expected to pass on this cooperation to other members in the society. Those who are not likely to cooperate with others would not experience cooperation themselves.

The first analytical model of indirect reciprocity was given by Nowak and Sigmund, who introduced 'image scoring' (Nowak and Sigmund 1998). People decide on cooperating based on the image score of others (basically determined by perceived behaviour). The introduction of the image scoring was followed by numerous theoretical and experimental studies (Wedekind and Milinski 2000; Leimar and Hammerstein 2001; Milinski et al. 2001; Wedekind and Braithwaite 2002; Berger 2011) – their further review is not in the scope of this thesis. Considering the models above, reputation can be interpreted as a result of indirect reciprocity, which also serves as a tool to facilitate cooperation.

As shown here, reciprocity is important in numerous aspects. Negative/strong reciprocity assures that norms are upheld (Fehr and Fischbacher 2004), facilitates contract fulfilling and thus increases trade gains (Fehr, Simon Gächter, and Kirchsteiger 1997), so it is important as a control mechanism. Positive/weak reciprocity facilitates trust (Berg et al. 1995) and cooperation. Reciprocity is found to be vital in many social interactions and it is important even in social policy issues (Bowles and Gintis 1998; Fehr and Gächter 2000b). However reciprocity emerges only when there is a previous action to react to: a self-interested or an altruistic one.

Altruism

Altruism was first used by Comte as a totality of all other-regarding sentiments (Comte 1854). There are different definitions to altruism in different scientific disciplines. For example Axelrod formulated a definition in biology: ‘sacrifice of fitness by one individual for the benefit of another’ (Axelrod and Hamilton 1981); Becker gave a definition in economics: ‘an altruist is willing to reduce his own consumption to increase the consumption of others’ (Becker 1976). Altruism can be defined as true (or pure) altruism[9], or reciprocal altruism (Trivers 1971). Pure altruism means giving without regard to any benefit (unconditional giving, it is related to the emotion of empathy), while the reciprocal altruism in an interactionist approach emphasizes the importance of experienced or future benefit.

But also altruism can be described from a purely interactionalist perspective. Three types can be distinguished in this approach: egoistic, egocentric, and altercentic altruism (Khalil 2004).

Egoistic altruism means that the altruist expects future benefits as a result of the altruistic act – so despite its name, egoistic altruism is more reciprocity than altruism. In this sense this behaviour is related to the ‘tit-for-tat’ strategy (Axelrod and Hamilton

[9] Batson gives a deep insight into this type of altruism although he did not denote it ‘pure’ altruism (Batson and Shaw 1991)

1981), so altruism is related to social exchange (Blau 1986; Homans 1958) as well. This approach is similar to 'reciprocal altruism' in biology as well (Trivers 1971).

The egocentric approach was introduced by Becker in an economics perspective; it means that the consumption of others is explicitly included in the altruist's utility functions (Becker 1976). Khalil argues that this approach is rather problematic, because it does not give an explanation to not free-riding; altruists share resources even when they can't enjoy the pleasure of giving and that it altruists are masochists as well (Khalil 2004).

The altercentric approach is different from both egocentric and egoistic approach as it assumes that people are 'built' with a pro-social gene. According to the altercentric approach altruistic behaviour is totally intrinsic, so there's no differentiation between actors. This is a drawback of the altercentric approach. For further arguments on the interactionist approaches to altruism see Khalil (2004).

The analysis of Khalil is restricted mostly to the interactionalist approach. A more brief, but certainly more complete summary on altruism theories was given by Szakadát (Szakadát 2009).

Despite that altruism is a norm, it may be handled as a preference in economics, directly influencing utility (Frank 2009). In this sense fairness (distributional) has the effect of making indifference curve 'move' to produce maximal utility at non-selfish outcomes.

Under some circumstances punishing or rewarding behaviour may be explained by altruism instead of future benefits. Such was the case modelled by Fehr and Gächter by regrouping players in experiments (Fehr and Gächter 2000a). The same condition holds if the situation involves a group and only one person bears the costs of punishing norm violating behaviour for the good of the other group members. Such behaviour is denoted as *altruistic punishment*. *Altruistic rewarding* is similar in this aspect as it describes behaviour when people give costly rewards without direct future benefit. These behaviour patterns may be interpreted as reciprocity, but since this behaviour is not a reaction to an observed behaviour, not an experienced one and the effect of punishment/rewarding does not apply to the punisher/rewarder these behaviour patterns are more akin to altruism. These two altruistic behaviour patterns were investigated in public good games (Fehr and Gächter 2000b, 2002; Fehr and Fischbacher 2003). After the brief introduction of experimental games these two behaviour patterns and the experimental results will be further analyzed in this section.

As shown here 'fair behaviour' is characterized by both altruism and positive/negative reciprocity. Fairness is discussed in the terms of distributional fairness in the following, so deeper analysis of altruism and reciprocity is not in the scope of this thesis. Kinship on the other hand has substantial effect on altruistic and reciprocal behaviour and is very important in this research, so it is reviewed later in this section.

Testing fairness –simple games and rules

The test of fairness, altruism and reciprocity was done mostly in real experiments by using experimental games[10]. To understand these tests and the results regarding these behavioural patterns a short description of these experimental games is required. There are basically four types of games which are used in fairness research: dictator game, ultimatum game, public good game, trust game. This research focuses on ultimatum games and dictator games, but the other two experimental games are also very important in explaining certain behavioural patterns.

The games reviewed here point out irrationality in human behaviour. In these games the players may maximize their certain payoff and thus treating others badly, or may choose to treat others nicely, but that does not guarantee high payoff. So in game theoretical terms the solution of these games is unfair (or bad) behaviour, placing individual interest above all. Yet the experimental evidence reviewed later will show that people do not act so.

The term 'experimental game' refers to abstract games defined by the researcher and undertaken with human subjects[11]. The subjects are denoted as 'players' in game theoretical terms (and will be referred to as players in this thesis). The rules of the games are given to players in various forms starting from a simple explanation to an abstract table of values. The choices in the games are made by players, and as a result each player gets a certain monetary payoff – putting it short, the games are with real

[10] There are of course exceptions, where surveys were used not real experiments, for example see (Fehr et al. 2003; Güth, Schmidt, and Sutter 2007).

[11] The game is usually planned using the tools of game theory. Many kind of situations can be modelled by abstract games; rules defined by the experimenter.

stakes. Thus the actions of the players clearly determine their 'payoff' in a given game and in the experiment. During the game the players are usually kept anonymous to counter some biases. This is very important as the revealed identities introduce other norms into the games which distort the results. Even revealing the names of strangers in such games has an important effect (Charness and Gneezy 2008).

Experimental games may be single-shot or repeated games. The former are used to investigate one-shot interactions, while the latter is used to examine repeated interactions. In case of repeated interactions also learning and trend effects may come into play so the application of single-shot/repeated games may influence the experimental results dramatically depending on the game being played.

In terms of fairness repetition of games with the same players is crucial, because it can act as an enforcement of fair behaviour through reciprocity. If somebody is treated unfairly, repetition allows that player to punish the other, or the other way, if somebody is treated nicely, he's given the possibility to give it back. Note that direct reciprocity occurs only if the game is repeated with the same players. If the players change, then repetition only means that players learn what other behavioural patterns may exist besides their own. For example if there's a group of unfair players, then a newcomer to the group would learn that behaviour from the others if the game is repeated.

Four experimental games will shortly be introduced in this section: the ultimatum game (UG), the dictator game (DG), the public good game (PG) and the trust game (TG). All of these games may be played in a single-shot or in a repeated version; anonymity is kept in case of the UG, DG and TG, while the PG is partially an exception. The players may be aware of each others' identity (may be in the same room), but their actual decisions are kept hidden. So we can't say that the game is perfectly open, or that it is anonymous.

In this research only the ultimatum and dictator games were used as a tool of research, but to be able to shortly review the results on altruism and reciprocity – the two behavioural patterns contributing to fairness – the public good and trust games are important.

The simplest of these games are the dictator game (DG) and the ultimatum game (UG). The basic types of these games are two person sequential games. In both games the players are in the rule of the 'proposer' or the 'responder', which also describes the game turn sequence. In both of the games there's a certain amount of good (determined by the experimenter) to be shared among the players.

The ultimatum game (UG)

The *Ultimatum Game* - first proposed by (Güth et al. 1982) – can also be interpreted as a one turn bargaining. The first step in the game is a proposal given by the *Proposer*. The offer consists of specifying the amount of goods kept and given to the *Responder*. The pool of goods is common knowledge to both the Proposer and the Responder.

Following the Proposer's offer, it is told to the Responder. Then the Responder is given the choices of accepting or rejecting the offer. If it is accepted, then the goods are split accordingly, both players get the payoff. If the Responder refuses the offer, then neither of them gets anything.

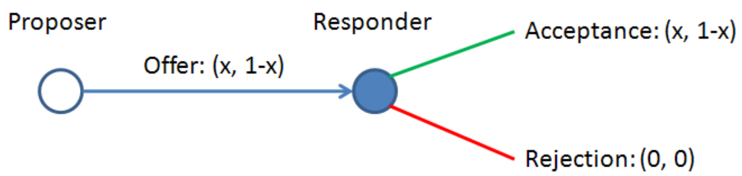

Figure 1.1.: Ultimatum game (UG)

So while the proposer is being asked for a split, the responder only has to make a choice. If the offer is thought to be unfair by the responder, then it will be rejected. In other words rejection is a costly punishment for the proposer being unkind. The cost of punishment is the split for the responder, while the amount of punishment is the split for the proposer. If the punishment is too costly for the responder, then he/she will accept the offer.

An alternative to this type of UG where players may give any offer is the discrete UG used by Falk et al., where players are given a fixed number of choices from certain splits (Falk, Fehr, and Fischbacher 2003). The results of such UGs are easier to interpret – also other norms may be triggered if the available choices are limited.

The dictator game (DG)

The *Dictator game* – first proposed by (Hoffman et al. 1994) – in turn is much simpler; it can be interpreted as voluntary sharing. In this game the Proposer's task is to decide how to split a pool of goods among them. The responder does not have any means to reject the offer – in other words no means to retaliate. In this game the real 'choice' for the Proposer is to give anything to the responder at all. If the Proposer decides to share the goods with the responder, then – if the responder is a PS – the Proposer's allocation is guided by the internalized fairness norms.

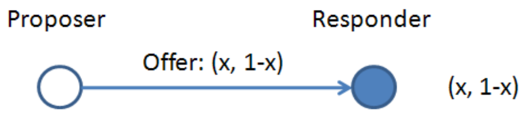

Figure 1.2.: Dictator Game (DG)

These two games capture the emergence of fairness versus self-interest. If we return to the self-interest hypothesis we can draw interesting conclusions. In the UG a perfectly selfish Proposer would seek to offer the smallest offer accepted by the Responder. If a purely self-interested Responder is assumed, then he'll accept every offer bigger than zero, because – simply put – getting something is better than getting nothing. If the Proposer is aware of the Responder's line of thought, his offer would be the smallest offer possible, which should be accepted by the Responder.

The DG is even simpler, because the Proposer does not have to take anybody else's action into account when calculating the split. He'll just have to go for the highest utility, the highest payoff. This would just result in not giving anything to the Responder.

The public goods game (PG)

The *Public goods game (PG)* models the provision of public good, or simply put: cooperation. Unlike the UG and DG this game can be played by any number of players. In the simplest case (below) each player gets an initial endowment of y, what he may contribute g_i to produce a public good – or pay to a common fund etc. Each player makes this decision independently. After the contributions have been made, the common fund is multiplied by a and a return of r is paid to all players regardless of the contribution. The amount returned is determined by the 'production function', which is linear in the following case.

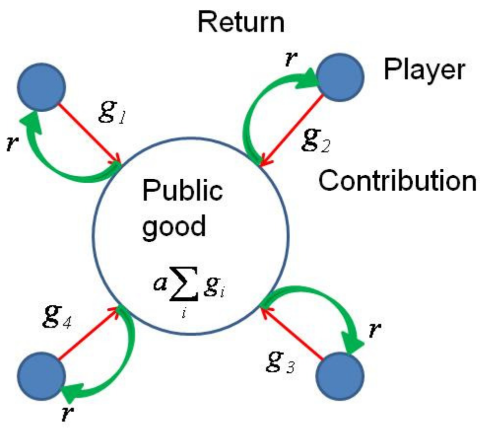

Figure 1.3.: Public goods game with 4 players (PG)

In this game the payoffs are the following providing that $r = \frac{a\sum_i g_i}{n}$ and $\frac{1}{n} < a < 1$:

Contributors: $\pi_i = y - g_i + r$

Non-contributors: $\pi_i = y + r$

As it was described by Olson the dilemma of the public goods is that it pays well to avoid contributions (Olson 1971). In game theoretical terms defection – or non-cooperation – yields more payoff than contribution does, so that is the dominant strategy. But if there are many contributors, then this difference is smaller and smaller, as the contribution of the others increases the return (Granovetter 1978; Oliver, Marwell, and Teixeira 1985; Heckathorn 1988).

The public good game is a very simple model of public good provision and production of individual benefit. Deeper analysis of public goods is not in the scope of this thesis. It's important to note here though, that public good provision is much more complex. For example the 'production function' of the public good also influences cooperation (Oliver et al. 1985), or also if information spreads in the group unrestricted a given ratio of co-operators may trigger cooperation of others depending on their 'behavioural threshold' (Granovetter 1978).

There were numerous studies conducted with this type of public good game (Haan et al. 2006; Peters et al. 2004; Ledyard 1993; Fehr and Gächter 2000a) and different treatments – some of which will be analyzed later.

The trust game (TG)

The *trust game* (TG) or *investment game* is used to examine trust among people (Berg et al. 1995). In this game the truster is given an initial endowment *i* from what any amount can be transferred to the trustee (*c*), at whom this amount gets multiplied (*a)* and he can send back any amount (*r*) to the truster.

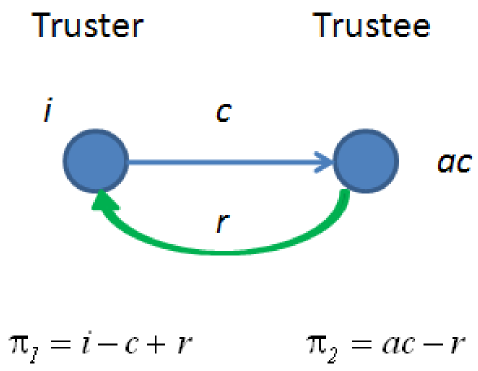

Figure 1.4.: Trust (investment) game

In this game the trust of the truster can be rewarded in by giving a non-zero *r* to the truster. This return can be interpreted as a 'reward' of $r>c$ as in this case the truster gets r-c 'extra' from the trustee above the initial endowment *i*. The TG is used to investigate the extent of trust, and positive (or weak) reciprocity – rewarding (Berg et al. 1995; Barr 2004; Buchan, Croson, and Dawes 2002; Fehr et al. 2003)[12].

Testing altruistic punishment and altruistic rewarding

As mentioned briefly before, punishment and rewarding can be interpreted as an altruistic act, if it does not yield direct gain for the actor (Fehr and Fischbacher 2003).

Altruistic punishment occurs if somebody punishes another to sanction a violation of a norm not committed against him – thus punishment does not yield direct benefit.

[12] There's also a simpler version of the trust game: the Lost Wallet game. In this game the Truster can send only its whole endowment to the Trustee (Dufwenberg and Gneezy 2000).

Sanctioning means costly punishing and the effect of the sanction will increase not the sanctioner's well-being but someone else's. This is also called *third party punishment*, but due to its importance in altruism, it's usually referred to as altruistic punishment (Fehr and Gächter 2002; Fowler 2005; Fehr and Fischbacher 2004).

In three player experiments by Fehr and Fischbacher – where the third party was an observer of the interaction of the other two, but could punish one of the players – it was shown that the altruistic punishment was indeed important. More than that Fehr and Fischbacher also investigated beliefs about punishing and found that those who have been dealt unfairly had higher expectations about third party punishment than those who haven't been. Also they extended their studies to Prisoner's dilemma games - taking a step towards analyzing cooperational norms – and found that third party punishment of non-cooperation is observed (Fehr and Fischbacher 2004).

We can conclude that in the provision of public goods altruistic punishment plays an important role as well. In this case the punisher punishes non-cooperators on his own costs to prevent future detections and thus increase the public good. In sequential public good game experiments this has been proved – in case of punishers in the group average contributions to the public goods have increased (Fehr and Gächter 2000a, 2002).

In their experiment also the learning effects were observed. In case of the punishment option the contribution has steadily increased from the first round, while the lack of punishment came with a decrease in average contributions. This also showed clearly how punishment serves as an enforcement of cooperation.

Besides experimental evidence, substantial evolutional evidence was also uncovered. When engaging in altruistic punishment people not 'hurt' by the cost, but feel rewarded instead (de Quervain et al. 2004)! It was even shown in a recent model that a population of people willing to punish altruistically is evolutionary stable (Fowler 2005).

As seen from these studies altruistic punishment is an important foundation of human sociality and it could not have evolved if altruism would not be able to emerge. But cooperation is not only enforced by altruistic punishment, it is also encouraged by altruistic rewarding.

Altruistic rewarding means that somebody gives some of his goods to another as a reward for certain behaviour. This is often experienced in situations which involve trust – for example non-contractual sequential exchanges, doing favours etc. Altruistic rewarding is tested by the trust game (Berg et al. 1995). Altruistic rewarding in this case is exhibited by the trustee who can send back any amount to the truster as a reward for sharing the initial endowment. Although altruistic rewarding varies between cultures (Buchan et al. 2002; Fehr et al. 2003), we can generally conclude that altruistic rewarding per se is also is a characteristic feature of people – even though more rare then altruistic punishment.

1.1.2 Kinship and friendship effects on altruism and reciprocity

As mentioned in the introduction the purpose of this research is to investigate the effects of social relationships (being in networks) on fairness. In previous studies the investigation of the effects of embeddedness focused mostly on kinship as a relationship type and altruism and reciprocity as behavioural patterns.

Altruism was discussed in evolutionary terms in earlier research since the most ambiguous type of relationship is kinship. This relationship is genetic, so in a sense it is also external. When investigating altruism in an evolutionary perspective the focus of the research is on the subsidence of this behavioural pattern, this strategy. The efficiency of a strategy is measured with the 'fitness' of the individual, assuming that the fittest survive.

It is especially difficult to explain altruism in this aspect, since it means acting for the good of another being sometimes even with a direct cost of the individual. The first rule to give an adequate explanation for the subsistence of altruism including genetic relationship was 'Hamilton's rule' (Hamilton 1964a, 1964b). According to this rule, altruism will evolve in a population if $rB>C$ where C is the cost to the individual; B is the benefit of the subject; r is the probability that they share common genes (have common ancestors). Hamilton's rule specifically points out the importance of perceived kinship in acting altruistically by giving an evolutionary motivation to altruism – assuring of the survival of our genes.

Relationship between altruistic acts and kinship has been shown in various real-life situations, for example cooperation between farmers (Berté 1988; Hames 1987);

inheritance (Smith, Kish, and Crawford 1987) and child care (Bereczkei 1998)[13]. These situations are rather complex, so side effects may not be excluded either.

Experimental analysis of altruism has reported various phenomena. Hamilton's rule was specifically tested in case of humans (Madsen et al. 2007) in three experiments. The experiments involved games where the individual could raise goods for others by paying significant costs – pain. In the games subjects exhibited more altruism towards their relatives than towards non-relatives. Also note that a linear trend was shown between altruism and genetic relations.

Rachlin and Jones had similar results in their experiments (Rachlin and Jones 2008). They investigated the relationship of altruism, social distance and kinship and found that people favour relatives versus non-relatives and are ready to forgo more money in their benefit.

The trust game – described in the previous section – provided another tool of examining the effects of kinship on altruism. Interesting results were provided by Peters et al. about public good production within a family (Peters et al. 2004). Their primary focus was public good production[14] if the group consisted of family members only, or it included strangers as well. Also note that in their study Peters et al. included children as well (an important argument in their study). The experiments consisted of three 8 turn public good games. The 8 turn rounds were played within family or with strangers – thus two treatments were defined depending on the players in the turns: family-stranger-family and stranger-family-stranger treatments.

Their first general observation was that parents contribute more to the public good and that contributions within the family are significantly higher than when playing with strangers. A very important conclusion of the authors is that the general attitude of altruism really matters. Those more altruistic in the family treatments are more altruistic in stranger treatments (with the correlation of 0.55)[15]. In terms of the current research it means, that even though people tend to behave more altruistically towards family members, general attitudes should be considered as well.

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[13] For more examples see (Madsen et al. 2007).

[14] They've used public good games, but denoted them as 'VCM': voluntary contributions mechanism.

[15] The authors noted that there may be problems with the sample – high educational families etc.

Haan et al. conducted a similar research with public goods game where the experimental groups consisted of students from the same class (with a mean age of 15). Thus two types of relationships were analyzed: 'classmateship' and 'friendship'.

The authors were in contact with the experimental groups, so they did not examine friendships with surveys – but using their experiences with the group when determining friendship ties. In their experiment they have made four person groups (from the total of 102 subjects) who played a simple public good game[16].

Their results have replicated previous public good game experiments with an average contribution of 40-60%, and they also found significant statistical evidence that friends' and classmates' contribution is different[17]. It is clearly seen in Fig 1.6 that the contribution of friends is above the contribution of classmaters in each round. Two other observations were that – while other studies for example (Fehr and Gächter 2000a) found that there are declining trends through the game rounds and that there is a strong last round decrease – the trends were increasing and also there was a sharp increase in the last round when friends were playing. The latter argument is even stronger as 53% of the 'classmates' did not contribute anything in the last round and 73% of 'friends' contributed their entire initial endowment. Also gender effects came into play, female players being much more altruistic.

So the results of Haan et al. mostly concern last round behaviour, but their results are important for classmates and friends as well. In their study the subjects knew each other, so they must have had experiences on cooperating and that may give a possible explanation to the rising trends.

A recent study dealing with the dictator game (voluntary sharing situation) found direct evidence regarding the kinship effects in dictator offers (Ben-Ner and Kramer 2010). They ran dictator games with a relatively big sample size (N=222). Their result is very important as it shows that giving in the dictator game is influenced by social relationships.

[16] They used the methodology of setting up such an experiment suggested by Holt (Holt and Laury 1997).

[17] When analyzing individual rounds though the difference is significant only in round 5 and 8.

	Mean giving to			
	kin	collaborator	neutral	competitor
Mean	4.91	3.4	2.49	1.99
Std. Dev	3.59	3.3	2.97	2.61
No of dec.	790	2918	7105	3760

Table 1.3 Giving in the dictator game (Ben-Ner and Kramer 2010)

Classification of a subsample of the players (74) was done by using a survey and one of the purposes of the analysis was to investigate how much is given to these players. As Table 1.3 shows, the kinship effect was very strong, it was more important than the behaviour of the other party.[18]

The results briefly introduced here show that there's a positive relationship between altruism and kinship. Significantly higher altruism is exhibited towards kin, than towards non-kin. This was experienced in all experimental settings – in sharing situations (DG), cooperation (PG), and in situations involving trust as well (TG).

Reciprocity – unlike altruism – may be easily explained, especially when the reciprocal behaviour is punishment (Bowles and Gintis 2003). Also as one would expect kinship may have important effects on reciprocity as well. Kinship would increase the importance of the other's (kin) well being, so it would strengthen the other-regarding preferences of the individual – it may also be interpreted as an obligation to care for the interest of the other. This would mean that we can expect higher cooperation rates among kin and in terms of reciprocity hurting a kin would require a strong incentive to punish.

Also the option of punishment works in a different way. Kinship means a long-term relationship which yields repeated interactions. In this relationship cooperation is vital, but punishment comes also at an emotional cost and rewarding comes at an emotional gain. The positive emotional effects of positive reciprocity were shown in an early study examining the relationship and emotional state of elderly and their care-giving children (Dwyer, Lee, and Jankowski 1994). Subsisting punishment as reciprocity was found in and among street gangs where gang members were getting status to their gangs through reciprocating violence (Papachristos 2007). In this extreme example the murders were

[18] Ben-Ner and Kramer controlled for several personality variables as well, but the results found are out of the scope of this research.

to be considered as negative reciprocity on one hand versus the group, but they were also the tools of attaining and sustaining the social status of the gang – and in this manner a public good for the gang members.

The extent of reciprocity and trust effects can be investigated by using trust games, or sequential UGs and DGs. In a recent paper Vollan studied trust game behaviour and third party punishment among family members and strangers (Vollan 2008). The trust game was a bit different than from the one shown in Fig 1.4. The truster could choose between an equal payoff structure, and giving decision to the trustee. The trustee than could choose between an equal payoff structure (twice the payoff than in the choice of the truster), and a very unequal offer (advantageous for the trustee).[19] Reciprocity was tested by introducing third party punishment into the game. The third player got a fixed endowment and could spend any amount from that endowment to punish either player (with the cost multiplier of 5).

Third party punishment was very important as it increased the probability of trusting behaviour from the truster in case of family members (from 0.64 to 0.78) and friends (from 0.52 to 0.75); and reciprocity from the trustee in case of family members (from 0.37 to 0.61) and friends (from 0.46 to 0.63). When taking into account kinship effects Vollan found that the lack of altruistic behaviour is punished with the same intensity for family members than for friends. But unfair behaviour is punished much more severely in friendship ties than families.

In-group and out-group effects on third party punishment can also be observed. In a study featuring a gift giving game[20] it was observed that when subjects were grouped and punishment was available to certain players, the in-group punishment was more frequent than the out-group punishment (Shinada, Yamagishi, and Ohmura 2004). Also what is even more spectacular is that the amount of punishment was higher for in-group

[19] Note that in a recent study Bicchieri, Xiao and Muldoon concluded, that trustworthiness is a norm, but trusting behaviour can't clearly be classified as a norm (Bicchieri, Xiao, and Muldoon 2011)

[20] Groups of four are formed from the players. Three in a group are assigned to be 'traders', the fourth is an 'observer'. Each trader gets a certain amount of good and he or she may transfer it to another trader, and then is given money from the third trader. The transferred sum is doubled. In this game giving gifts to each other is a public good, group members getting information only about the decisions in the group. The observers are given the information of the decisions of all players (not only those in their own group) then may randomly get the opportunity to spend from its own income on punishing players from either group (both own and the other groups).

punishment, than for out-group punishment. This was explained as the punishing of group members being considered as second order cooperation[21].

As seen from the studies introduced in this section, existence of social relations between players has a significant influence on behaviour in experimental situations. Fair behaviour, altruism and reciprocity are all determinants of human behaviour and also the effects of existing social ties cannot be neglected. So following some experimental evidence it is important to analyze some existing models for these behaviour patterns.

1.1.3 Modelling behaviour with other-regarding preferences – fairness, altruism, reciprocity

Besides describing the nature and evolution of fair behaviour, modelling such behaviour is also important. Models provide deeper insight to economic and interpersonal interactions; they may be used to describe and explain and to predict behaviour. Hence the predictive capabilities of a model may be used to explain social and economic phenomena.

As written before, fairness concerns have a crucial role in various types of interactions, so prediction of behaviour under such conditions helps decision makers and gives further insight to human behaviour. Here I refer to behaviour as the (consistent) choice between different actions in different situations, and the reasoning behind the choice can be explained by a common notion in microeconomic theory: utility (Bentham 1789). According to utility theory the individual wishes to maximize a subjective measure of his/her well-being during making choices; to maximize the 'utility' experienced by the given choice[22] (for a summary on utility theories see (Fishburn 1968, 1970).

When creating utility models for certain behaviour types, it's vital to describe the background motives of people resulting in a specific behaviour. In this case it's necessary to make a distinction between altruism and fairness. In simple utility models the individual's utility is measured by a certain amount of profit gained by making a

[21] Also shown by Fehr and Gächter (Fehr and Gächter 2002).

[22] On a comprehensive description of this approach see Coleman (Coleman 1990). His work extends rational choice theory (Homans 1961) in a formal way more closely related to economics.

choice. In models of fairness and altruism however, something else is included in the utility model.

An altruist always cares for the well-being of others, so practically an altruist's utility function includes the well-being – the utility – of others (Khalil 2004):

$$U_i = U(\pi_i, U_j) \qquad (1\text{-}1)$$

Fair behaviour however incorporates norms, which give preference sets to the profit distribution in a certain situations. That is giving a 'fair amount' to the others in an interaction. So in fairness models the others' well-being is not included explicitly, but their 'share' is included instead.

$$U_i = U(\pi_i, \pi_j) \qquad (1\text{-}2)$$

Fairness models reviewed in this section however do not restrict themselves so these constraints. In certain models other personal incentives and properties are included, which are supposed to describe an individual's attitude towards fairness, or equity.

Modelling fairness became the prime topic of various researchers. The first analytical model of fairness was published by (Rabin 1993) and modelled fairness with the 'concern for intentions'. This model was followed by (Fehr and Schmidt 1999), where fair behaviour was perceived as 'inequality aversion'. Quite similar to this model, a model without a strict analytical expression was formulated by Bolton and Ockenfels. In this model the individual's inequality wasn't compared to every other person in the group, but to the average payoffs of the player's group ((Bolton and Ockenfels 2000).

Another model by Charness and Rabin describes fairness by reciprocity and 'maximin' preferences (Charness and Rabin 2002).[23] Using these models the outcome of certain interactions, emergence of rewarding and punishing behaviour can be predicted. In this section the models by Rabin, Fehr and Schmidt, and Bolton and Ockenfels will be thoroughly reviewed as those are the most important models to this research, while the other models are only briefly introduced.

Fairness modelled with intentions – Rabin (1993)

[23] That means maximizing the minimal payoffs in a certain situations – helping the one worst off.

The first utility theory based fairness model was introduced in (Rabin 1993). Utility theory dictates that the individuals make their choices to maximize their utility. To take account for fairness concerns, one has to include the well being of others into his/her own utility function. In Rabin's model the utility function was extended with a term, which described the other player's well-being weighted by the individual's 'concern' for the other player's well-being. In this regard the concern could mean the player's social value orientation, but in Rabin's model it means the 'intentions' of the players – the 'kindness' functions.

The model states, that if player *i* thinks that player *j* bears good will towards him/her, then being nice to player *j* increases utility. If player *j* bears ill will towards player *i*, then hurting player *j.* would increase player *i*'s utility, if player *i* would normally want to be nice to player *j.* The model also says if player *i.* has ill will towards player *j*, then player *i.* is indifferent of player *j*'s intentions. So this model is partially based on player *i*'s perception of player *j*'s intentions. This kind of approach is closer to psychology, than to economics or sociology. It has significant theoretical explanatory power, but this model is very hard to test in laboratory conditions. The model has the following analytical form:

$$U_i(a_i, b_j, c_j) \equiv \pi(a_i, b_j) + \tilde{f}_j(b_j, c_i)\left[1 + f_i(a_i, b_j)\right] \qquad (1\text{-}3)$$

The first term in this model corresponds to the payoff of player *i.* given the choice combination of a_i and b_j, the former by player *i*, the latter by player *j* as perceived by player *i*. In the second terms the functions denoted by *f(.)* are the aforementioned kindness function. If they are greater than 0, they reflect good will – kindness – while being below 0 means ill will – unkindness. The first kindness function describes player *i*'s beliefs about *j*'s kindness, while the second shows player *i*'s kindness itself.

As per utility theory the player wishes to maximize the utility, which is influenced by the second term in the main model, since payoffs are given. If player *i* thinks that player *j* wants to be unkind then it's rational to be unkind to player *j.* On the other hand, when player *i* thinks that player *j* will behave nicely towards him/her, then player *i* will maximize his utility by being kind to player *j.*

This model is rather psychological as it is based on the perception of the other player's good will. In this sense the model's explanatory power is very good, as it concentrates on what lies behind acting fairly or unfairly, it does not only describe observations. But since perception is hard to be measured in games, the model values can't be checked by experimental tools, so its validation is problematic and its predictive capabilities in practical situations are quite limited. Rabin's model is a good example on the game theoretical approach on fairness as he describes strategies played in games by the parties – also supplying a theoretical background to it in his article.

Fairness modelled with inequality aversion – Fehr and Schmidt (1999), Bolton and Ockenfels (2000)

Inequality aversion was (and currently is) accepted as one of the motives for reciprocity and altruism. Two other very important models emphasizing this motive are the models by (Fehr and Schmidt 1999) and (Bolton and Ockenfels 2000).

In the model by Fehr and Schmidt the individual's utility is determined by the individual payoff and the payoff advantage or disadvantage to the other players simply modelled with the difference. The model has the following analytical form for dyadic interactions:[24]

$$U_i = \pi_i - \alpha_i \max\{\pi_j - \pi_i;0\} - \beta_i \max\{\pi_i - \pi_j;0\} \quad (1\text{-}5)$$

This model explains inequality aversion in the terms of payoff difference. As per the model player *i*'s utility decreases when the other player is better (second term) or worse (third term) off than player *i*. When participating in an *n* person game the player compares him/herself to every other player in the interaction and if there's any difference between his/her payment and the others, the utility decreases.

Inequality aversion means that only the equal split is considered to be 'fair' in any interaction. For each negative effect (being better or worse off than others) the player has a certain attitude, or in other words the emotions associated with being better (guilt) or worse (envy) off than others are important in different ways, they damage well-being differently. Two constants α_i, and β_i denote these effects in the model.[25]

[24] The model may be formulated for *n* person interactions as well, see (Fehr and Klaus M. Schmidt 1999)

[25] These coefficients were associated with the feelings of guilt and envy. Essentially the same coefficients were found in the model of (Charness and Rabin 2002), but they were concerns for the other player's payoff versus the own. In the (Fehr and Schmidt 1999) model these concerns stood for the situation of the individual player compared to the other player. In that sense the Fehr and Schmidt model was more

Essentially this model suggests, that ‘utility is not damaged, when equal split is given’. The most important message of this model though is that equal splits do not necessarily mean the highest utility for the players. Simply put, the model says that acting unfairly in certain situations can be explained by concerns for utility.

If the concern of guilt is not strong (the value of β in the model is lower than 0.5) then players will prefer completely selfish behaviour over splitting equally. Hence this model gives two predictions in a dictator game: fair splits or completely selfish splits – this being an important drawback of the model.

As the experimental results have shown there are many other offers in the dictator game, so in this sense this model can’t be used to predict dictator game behaviour. However the authors give a valid description of ultimatum and public good game behaviour. Just as in the case of the model by Rabin the descriptive capabilities of this model are good, but its predictive capabilities are not as it relies on ‘intrinsic’ constants for the strength of guilt and envy, and these constants are difficult to approximate.

Bolton and Ockenfels modelled fairness with concerns for the difference from the ‘average’ (Bolton and Ockenfels 2000). Also the Bolton and Ockenfels model wasn’t a utility model. They modelled ‘motivation’ rather than utility. Unlike the models mentioned before, the Bolton and Ockenfels model does not have a strict analytical form, but there are conditions for the form of the model. This model was used to explain some existing experimental results (Roth et al. 1991; Forsythe et al. 1994), but there were no experiments conducted to specifically test model predictions.

The model describes a so called ‘motivation function’, in which regard this model can’t be classified as a utility model. The authors denote this function as a ‘special class expected utility functions’, which are stable on the short run. The elements of the motivation function are the payoff of the individual and the average payoff.

Even though there’s no fixed analytical form of this function, the authors still give some constraints, for example continuity, concave shape and its maximum being near the equal shares – accepting the latter would result in a similar approach as the (Fehr

egocentric, while the model introduced by (Charness and Rabin 2002) was closer to the social value orientation theory.

and Schmidt 1999) model. The lack of the fixed analytical form set many boundaries of this model. First of all, the underlying process is not well-defined analytically – it is only stated that people compare their payoff to the average. So its predictions are highly dependent on the function used which makes this model usable only for description, but not for prediction. Also it is more proper to mention 'fitting', as the function is fitted to the observations.

Since the basic notion of both of these models is inequality aversion, they can be compared directly. In their studies Engelmann and Strobel focused on comparing these two models and evaluating inequality aversion in general (Engelmann and Strobel 2000). They found that the Fehr-Schmidt model performs significantly better in their simple experiment (choosing form distributions) than the model proposed by Bolton and Ockenfels. Their other main finding was that efficiency (highest total payoff) also plays a crucial role in deciding between choices which is neglected by both models. In their later experiments they found that besides efficiency concerns the maximin preferences (see later) are also important, and the effects of perceived intentions are to be considered as well (Engelmann and Strobel 2004). Neither of these effects is accounted for in neither Fehr-Schmidt nor Bolton-Ockenfels models.

1.1.4 Modelling behaviour with orientations to others – social value orientations

Following these robust models of fairness also other related social preferences were represented in modelling, these will be discussed in the next section. First the general models of social value orientation will be discussed and then two fairness models based on social value orientation – one by Charness and Rabin (2002); and one by Cox, Friedman and Gjerstad (2007) – will be introduced briefly. These models describe another types of fairness preferences: the quasi-maximin preferences.

Social value orientation (SVO) is a model of a person; it refers to how much one cares for the other's well-being. In a sense SVO describes the utility of a person just like fairness models do. In the simplest framework of the SVO the person is willing to maximize his own payoff as well as the other player's payoff and the 'social orientation' is determined by the weight of these payoffs. So SVO is an additive model (Schulz, Albers, and Mueller 1994; Doi 1994; Liebrand and McClintock 1988; Liebrand 1984):

$$m_i = ax_1 + bx_2 \qquad (1\text{-}11)$$

This model can be described in a Cartesian coordinate system. Note though, that $a^2+b^2=1$ holds for this expression to retain the explanation of the 'orientation' and in order to assign the same 'magnitude' to every person.

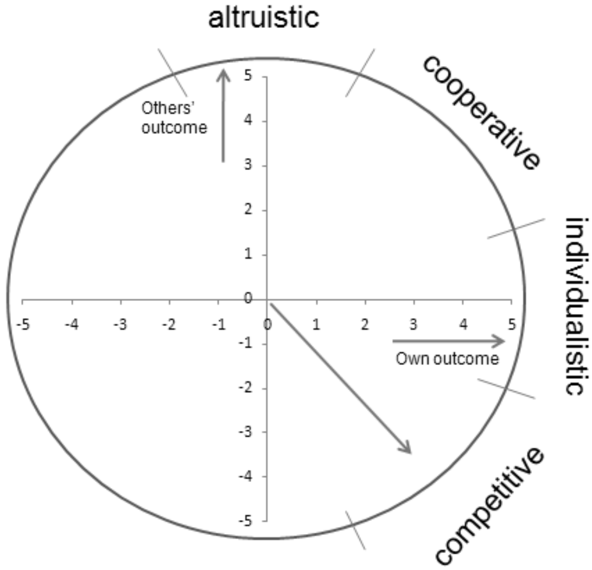

Figure 1.5.: Social value orientation – based on (Liebrand 1984) pp. 219.

Also the orientation can be described by using the angle θ to avoid the problem of scaling entirely. Based on the values of θ the following orientations can be formalized.

θ	interpretation	m_i	maximizing (or minimizing)
90°	altruism	y_i	other's payoff
45°	cooperation	$\frac{x_i + y_i}{\sqrt{2}}$	sum of own and other's payoff
0°	individualism	x_i	own payoff
-45°	competition	$\frac{x_i - y_i}{\sqrt{2}}$	difference of own and other's payoff
-90°	aggression	$-y_i$	(minimizing) other's payoff

Table 1.4.: Simple orientations (Doi 1994)

Besides these simple orientations there are other preferences not accounted for. For example the attitude towards the difference in payoff should be taken into account. This attitude was assumed in many fairness models as seen in the last section (Rabin 1993; Bolton and Ockenfels 2000; Fehr and Schmidt 1999). As behavioural patterns this can be interpreted as either a preference for equity or as maximin (difference minimizing) preference:

$$U_i = ax_1 + bx_2 + c|x_1 - x_2| \quad (1\text{-}12)$$

So table 1.2 can be extended with two more orientations which include *c*, namely with egalitarianism (*a=b=0; c=-1*) and maximin preferences (*a=b=1; c=-1*). This approach defines orientation in '3D' rather than two.

Measuring these orientations may be realized by making individuals select from different choices, with each choice representing one given orientation (Liebrand 1984; Liebrand and McClintock 1988; Schulz et al. 1994). Such a choice consisted of the payoff for the 'self' and the payoff for the other player, e.g.: (150; 20). This method is called 'Ring Measure' or 'pair comparison', in which each subject gets a given number of pairs of choices. The preferred choice is to be selected for each pairs. Then the model can be fit to the answers of the individual. This task is quite simple when using (1-11), but gets rather complicated in case of (1-12). The other method applied by Schultz et al. is the 'ranking' method, where the subjects simply had to determine the preference order of the choices.

In their study Schultz et al. made a two round experiment. They used 15 choices representing various orientations in both rounds and provided real payoff to the subject at the end of the experiment. The first turn consisted of a computer survey with the pair comparison of all possible choice pairs (105), followed by a simple ranking of the choices.

In the second turn they introduced a slight interdependence of players into this setup by the means of having subjects influence each others' payoff slightly. The subjects were facing the pair comparison experiment again, but this time their choice determined another subjects' payoff and vica versa. In the model fitting they assumed the following orientation types: individualism (I), cooperation (C), competition (K), egalitarianism (E) and maximin (M)[26].

Their results have shown that the assumption of such multiplicity in social orientations is indeed valid. But before analyzing their results the methods are still to be judged. In the results the majority of the players did not make choices according to a strict orientation. In the ranking task roughly quarter of the subjects were producing results according to strict orientations, while in the pair comparison task, this number

[26] They also used aggression (AG) and altruism (AL), but neither of these orientations was frequent.

was below 10%. This only shows the imperfectness of this experiment – not necessarily the method.

As it was written the subjects had to choose between pairs 105 times. This takes a long time, so besides being exhausting, subjects are tempted to give rash answers only to ‘get through’ with the experiment. If the length of this experiment would have been reduced, the results may have been more valid. Also note that there were many similar choices which degrade the overall results, which may also contribute to seemingly ‘stochastic’ results.

Fitting the model on experimental data produced the following distribution of orientations:

Class	I	K	E	C	M
Ranking[27]	48.5%	22.4%	7.2%	6.5%	15.9%
Pair comparison	45.7%	21.8%	5.6%	9.8%	16.9%

Table 1.5.: Results – orientations (Schulz et al. 1994)

So the ratio of individualistic orientation is huge followed by competition and maximin orientations. In the fairness point of view this means that mostly people do not care about others at all, or would not be willing to pursue equality. This contradicts the previous assumptions of fairness.

On the other hand this method does not focus entirely on fairness as in some cases one had to select between pairs where he had very low payoff compared to the other in one case, and a very high one in the other. Sometimes one just cannot be fair. Also the authors noted that the sequence of the recording methods could have had a transfer effects as well, but statistical evidence does not show that.

Following pair comparison a ranking experiment was done by ranking a number of choices. The results were not different for pair comparison and ranking. The authors concluded from the contingency table that the connection is significant and strong[28]. When comparing these results with other earlier studies, one can conclude that the results are similar with around half the subjects being individualistic, somewhat less competitive and cooperative, with even fewer egalitarian and altruistic subjects.

[27] Note that 0.7% of the subjects were judged as altruistic (AL) in case of ranking

[28] Having a Cramer’s V of 0.651 with $p<0.001$ significance level.

Another approach to social orientation was presented by van Lange. In his study van Lange used less orientations and tested subjects with methods closer to those used in fairness research (Van Lange 1999). The starting point of this research was that by using a slightly different classification; much less orientations were assumed: pro-social, individualistic and competitive. Pro-social orientation included the concern for cooperation and egalitarianism.

Van Lange defined similar models to pro-social orientation as (1-12) and tested them in three studies. In the first study the subjects were tested twice (N_1=1728; N_2=2360; N_{12}=805 – participated at both times) first using a 'triple dominance measure of social values' (TDM) then pair comparisons. In the TDM they were tested about their orientation (Prosocial, Individualistic and Competitive) and their behaviour in the pair comparison (fitting the model) was interpreted depending on that.

Model: $u = w_1 x_1 + w_2 x_2 + + w_3 \lvert x_1 - x_2 \rvert$	Prosocials		Individualists		Competitives		M	
Weights	Time1	Time2	Time1	Time2	Time1	Time2	Time1	Time2
Outcome for self (w_1)	0.66	0.59	0.78	0.84	0.8	0.67	0.7	0.68
Outcome for other (w_2)	0.13	0.3	0.09	0.02	-0.09	-0.34	0.11	0.14
Equality in outcomes (w_3)	0.19	0.32	0.11	0.05	0.04	0.02	0.16	0.2

Table 1.6.: Study 1 results, model parameters (Van Lange 1999)

Based on the statistical analysis of this data the author found, that it supports the proposed model of social orientations.[29]

The second study was closer related to fairness research as it involved sequential prisoner's dilemma games and it investigated the reciprocity of subjects with different orientations. In this case the sample size was smaller (N=135), and each of them went through the TDM to determine their orientations. As a result 49 prosocials, 38 individualists, and 31 competitors were identified (17 unclassified). Their behaviour in the sequential Prisoner's dilemmas was consistent with their orientations (prosocials being the most cooperative followed by individualists and the competitors).

[29] The author refers to this as 'social value orientations'.

Besides this result an interaction was shown between the reciprocity and the social orientation of the subject. The prosocials were the most influenced by the partner's cooperation in the games, while individuals and competitors were reciprocated less.

The third study further stressed the issue of reciprocity as in this study simultaneous single shot games were played. Even though the authors claimed these to be Prisoner's dilemmas, there were important differences. In these games people had to choose of splitting a pile of four chips between themselves and the other player. The chips kept worth 25 cents and those given to the other worth 50 cents. In this sense this game is more like a trust game, where trust is given 'simultaneously'. The stakes in this game were direct, as the goods worth actual money.

In this study around half of the participants (N=196) were identified as pro-social around third as individualistic and less than ten percent as competitive. Compared to the other experimental groups, there were substantially more prosocial orientations in this group. The authors analyzed the 'offers' of the players and concluded that prosocials were expecting reciprocal behaviour the most, and were expecting less for themselves than the others – individualists or competitives.

So as a conclusion of van Lange's study we can say that the primary orientation types – pro-social, individualistic and competitive – can easily be distinguished both by their preferences and their behaviour. Also it's quite clear that the distinction of these three orientations is sufficient to describe people. From the studies of Doi it was very clear that pure altruism and aggression – caring only for the other's well-being in some way – is very rare, so it was omitted in later studies.

Following the research of van Lange, van Dijk et al. tested the ultimatum game – explained in details in the next section – from an SVO perspective (van Dijk, De Cremer, and Handgraaf 2004). They conducted two experiments to investigate how fairly people are willing to behave in ultimatum bargaining situations. Just like van Lange they've analyzed the experimental orientations within the group before the actual experiment. They worked with groups consisting of many prosocials – unlike Doi and van Lange –, somewhat less individuals and a few competitors.

In the ultimatum games a player has to offer a split among himself and the other player. Then the other player may accept or refuse the offer, which determines their payoff. Van Dijk et al. also introduced information asymmetry into this game by not letting the second player know if the offer was fair. So this situation can be exploited by individualists. In their first experiment they found that while proself (individualist or competitive) players did in fact adjust the offer, prosocials were unaffected by the other player's informedness. Since van Dijk et al. could not uncover some background motivations (motivations behind fair offers), a second experiment was conducted.

In the second study – after assessing the orientations – van Dijk et al. manipulated the information about the second player decision. It was given to first players with a given probability only. After the games the subjects had to fill a survey dealing with motivations (prosocial, individualistic or competitive). They found the same as in the previous experiment – proselfs were adjusting their offer to induce acceptance, to maximize their payoff.

So based on their experiments van Dijk et al. concluded, that proselfs (individualists and competitive subjects) are 'using' fairness strategically to maximize their own payoff.

Besides the ultimatum game another important experimental tool was the dictator game – simply put it's a game of voluntary sharing goods with another player. This was investigated by Cornellissen et al. (Cornelissen, Dewitte, and Warlop 2007). In their research they've assumed that SVO and interpersonal fairness generally influence the volume players are willing to share in such a situation.

So interpersonal closeness itself is not sufficient to explain giving, but the social orientation of the player also determines the amount offered in the dictator game. The third element of the model 'deliberation' meant applying strategies in the decisions. To counter this, an extra cognitive load was introduced – players had to remember an 8 digit number.

Cornelissen et al. have found that when the cognitive load was introduced, the pro-socials were indeed more generous. But when there was no cognitive load, they gave as small offers as did pro-self players. Also note that the games were individual, so 'interpersonal relations' had a limited meaning here – it was important as the subjects were of the similar group (undergraduate students).

Fairness models based on SVO

The previously introduced results clearly show that SVO is a quite attractive approach due to its simplicity, and its robust results. The drawback of the SVO approach is that it assumes 'intrinsic' and constant orientations. The same orientations work regardless of with whom the interaction takes place and without any regard to the action of others' in the interactions.

Fairness addresses these two properties of behaviour so combining the simple robust approach of SVO models and the ability to 'react' of fairness models leads to interesting results. Two models will be shown further here based on SVO: one of the models describes another fairness preference – quasi maximin preference (Charness and Rabin 2002) – and the other incorporating emotional status – a more complex and 'economic' style model of Cox, Friedman and Gjerstad (2007)

The maximin preference wasn't particularly emphasized in the previously introduced SO models as the authors found only a few people with such preferences. However the maximin preferences shouldn't be neglected. Charness and Rabin constructed their model to take into account a 'quasi-maximin' preference. Quasi maximin preference is defined by Charness and Rabin the following way: 'An alternative model of distributional preferences, related to the ideas discussed in (Yaari and Bar-Hillel 1984)) and (Andreoni and Miller 2002), assumes that people don't dislike differences in payoffs per se, but care more about helping low payoff people than high-payoff people. Combining the assumption that people are motivated to maximize the payoff to the minimum-payoff person with the desire to increase total payoffs yields what we shall call 'quasi-maximin preferences'. Such preferences do not induce Pareto damaging behaviour.' (Charness and Rabin 1999)[30] In this sense the 'inequity aversion' is expressed differently versus lower and higher payoff players, so the fairness concerns work differently in their case as well – which is closer to reality then inequality aversion only.

Charness and Rabin formulated the following model for two person games (Charness and Rabin 2002):

[30]pp 3.; Also note that the original citation refers to a working paper of Andreoni and Miller with the same title as the referred paper .

$$U_B(\pi_A, \pi_B) \equiv (\rho r + \sigma s + \theta q)\pi_A + (1 - \rho r - \sigma s - \theta q)\pi_B \qquad (1\text{-}13)$$

In this expression π denotes the payoff, $r=1$ if B is better off than A ($r=0$ otherwise); $s=1$ if A is better off than B ($s=0$ otherwise); and $q=-1$ if A acted unfairly ($q=0$ otherwise). This model differs from the previous model in the sense that it includes the other player's payoff explicitly – it is more similar to social orientation models discussed in the next section. Different preferences can be described using different coefficients with this model. For example for a competitive person $\sigma \leq \rho \leq 0$ – practically assigning negative weight to the other player's payoff regardless of their relative status. The difference aversion (inequity aversion) can be described by $\sigma < 0 < \rho < 1$. Simply taken this model is similar to the basic SVO models in the sense that it describes the 'weights' of the individual's and the others' payoff in the utility of the individual.

The most important feature of this model compared to the other SVO models is the consideration of others' behaviour. In this sense this model is not self-centred: while other SVO models include constant payoff multipliers – real 'orientations' –, here the other-regarding preferences depend on the behaviour of the other player giving way to reciprocity as well. So this model steps out from the boundaries set by SVO theory.

The further analysis of this model is omitted here, as the most important findings of the authors concern their experimental results. The authors find that positive reciprocity is not as frequent as it was observed before and that most of the people follow quasi maximin preferences, when reciprocity is not involved (Charness and Rabin 2002).

Cox, Friedman and Gjerstad followed a different path in their model, as they started from a rather economic point of view in their paper (Cox, Friedman, and Gjerstad 2007). They developed their model from the simplest SVO model ($u=p_1+mp_2$), which included the abstract notion (m) of the emotional state. This multivariate function depended on the 'reciprocity motive' and the 'status motive'. These two motives make this model dynamic and differentiative as well – reciprocity is dynamic and status differentiates between players.

Their complete model was developed to describe the marginal rate of substitution between an individual's and another player's payoff.

$$u(m, y) = \begin{cases} \frac{1}{\alpha}\left(m^{\alpha} + \theta y^{\alpha}\right), & \alpha \in (-\infty, 0) \cup (0, 1]; \\ m y^{\theta} & \alpha = 0. \end{cases} \qquad (1\text{-}14)$$

In their reasoning they derive this model from a constant elasticity of substitution utility function, as it holds for homothetic preferences. They show that their model describes convex preferences with the conditions given and it also holds for negative emotional states (θ) as well – also in some conditions the model describes maximin-like preferences as well.

The authors then introduced their method of fitting the model for DG results to explain altruism. The fixed pool DG data can be written in a payoff space where indifference curves can be drawn and the point where the DG choice touches the indifference curves would correspond to an individual's utility. They used a similar method to describe model behaviour for reciprocal behaviour in duopoly games – not discussed in this thesis – and UGs as well.

The main advantage of this model is that it operates with terms widely used in economics, yet it explains behaviour unaccounted for in classical economics. Their hypothesis about the effects of the emotional status in behaviour also introduced dynamism into an SVO-like approach which was proved using empirical data.

Social value orientation – as introduced here – is another approach in modelling human behaviour from a behaviouralist perspective. The main difference between fairness and SVO is that according to SVO people have a general attitude towards their own and others' well-being. Fairness on the other hand formulates 'reactions' to others' behaviour and also explains such costly reciprocal actions (rewarding and punishment) what SVO is incapable of.

Still the findings of SVO are interesting in the fairness aspect as well. They highlight the fact that people's utility can be maximal even in case of highly unequal payoffs. Also recent studies have shown that despite the 'fixed' orientations defined, the orientations are indeed related to fair behaviour – pro-socials placing emphasis on fairness and cooperation, and pro-self type orientations (individualist, competitive) lacking this attitude.

We can also have to note the similarities between the modelling aspect of fairness and SVO. For example we can compare the parameters in the Fehr-Schmidt model to the simplest SVO model. The parameters reflect a general attitude of a person, similarly to social orientation; and depending on the values of the parameters one will make either a fair or unfair decision in some situations.

But also one can take further steps to close the gap in SVO and fairness models. Such successful attempts were shown in the latter two models. Their main advantage – though not really emphasized in the sources – was that they have introduced fairness into models based on earlier SVO models and thus their general approach is not as self-centred as the SVO models. This alone can explain a huge variance in human behaviour and thus the experimental results.

1.1.5 A short summary on fairness models

As this section showed there is a variety of fairness models currently applied. They differ in their approach, in the mechanisms assumed and in their purposes.

Source	How it models fairness	Strength	Weakness / Critique
Rabin (1993)	Intentions, kindness	Good explanatory power	Rather psychological, very hard to validate.
Bolton and Ockenfels (2000)	Inequality aversion	Flexible model structure	The predictive power is low
Fehr and Schmidt (1999)	Inequality aversion	The model structure and assumptions are very clear	Inequality aversion neglects many factors.
Liebrand (1984)	SVO (not fairness)	Robust and simple	Excludes reciprocity and differentiation
Cornelissen (2007)	SVO included in fairness	Includes orientations and interpersonal relations	Very narrow field of application (the model is not analytic)
Charness and Rabin (2002)	SVO and quasi maximin preference	Combines important assumptions, the structure is clear	Complex model, it includes reactions, so it's hard to use it for prediction and is hardly verifiable.
Cox, Friedman and Gjerstad (2007)	SVO and economic approach, includes 'emotional states'	Economic model, but includes the notions unaccounted for in classical economics, high explanatory power	The economical approach narrows the applications and also the 'emotional states' decrease the robustness of the model.

Table 1.7.: Fairness models

Generally these models aim to explain observed behaviour, but the prediction of behaviour is not always in their focus. In terms of explanation most models do a good job in including many interesting aspects – models using SVO perform particularly well in this sense due to the richness provided by the SVO theory.

But the experimental investigation of these models is quite narrow at some models – this is a main weakness of the SVO models. It is clear that the more factors are included in the model, the narrower the field of application gets. Models concentrating on simple descriptions of fairness – inequality aversion and intentions – were tested with in much more experimental contexts than SVO based models. The basic tools of these tests was the UG, and the DG (PG in some cases as well), hence in the following I'll review the experimental results with these games.

1.1.6 Experimental results in fairness research

In the following I review experimental evidence in fairness research using experimental games. The experimental literature on this field is extensive, so only a select few studies are relevant to this research are discussed in detail here. As it will be shown in section 4 the games used in previous studies reviewed here are appropriate for investigating the relationship between fairness and friendship. So the results shown here serve as a baseline for the evaluation of the experimental results of this research. A comparison between the experimental results of the current study and earlier studies will also be given in section 4.

In fairness research, experimental games are used where players interact with each other, and are given the choice to act fairly or unfairly. Four games were introduced earlier: the ultimatum game, the dictator game, the public good game, and the trust game. The results of the latter two were already briefly discussed, so they'll be omitted in this section as they are not included in the methods used in this research.

The ultimatum and dictator games are in the focal point of this thesis as they are explicit expressions of sharing, the distributional fairness of people. Acting fairly is mostly against the assumption of profit maximization. In the UG for example the Responders should accept any non-zero offers as they are better off than getting nothing – this conclusion can also be drawn from an economist's point of view (Frank 2009). Keeping this in mind, the Proposers should always propose the smallest amount possible. Following the same logic, we should experience only zero offers in the DG – as the Proposer maximizes his own payoff this way.

As it will be shown in this section however, reality proves to be quite different. The results described in the following concern many variables – e.g. gender, stake size, culture. In some cases some of these variables may not be controlled, but the experimental context in behavioural economics has its limits. Also the studies introduced hereafter investigated various phenomena concerning fairness and have used various methods. Hence the comparison of their results is somewhat problematic as here we concentrate on fairness in general and not on the individual phenomena analyzed in the individual studies. Thus for the purposes of this thesis, the easiest way to compare these results is the comparison of the offers in both DGs and UGs and the rejection rates in the UGs. These three quantities will be in the main focus of our analysis, but other factors will not be neglected either.

Experimental two person UG and DG results

The ultimatum game was proposed first by Güth (et.al) and was denoted as 'ultimatum bargaining' (Güth et al. 1982). The first experimental results were already robust and they falsified self-interest assumption in personal exchanges. Among the offers those lower than 20% of the total sum were quite rare, and were rejected. The modal offer was the equal split (with a pool of 4DM and 10DM), but the mean was ~0.37. The experiment was repeated with the same subject one week later – a small decrease in mean offers was observed (~0.32), but in this case only two Proposers gave an equal split. Rejection rates have also increased among the experienced players as the offers decreased.

UGs games were replicated following these studies with more subjects later to arrive at similar results (Kahneman et al. 1986). In their first experiment (with university students from the same class) they found that the majority of the offers were an equal split (for three groups the mean offers were 4.21$; 4.47$; 4.76$ with the pool of 10$) and some positive offers were rejected. The second stage of the experiment was a simple rewarding-punishing (costly) decision. Students generally chose to punish those giving unfair offers and their behaviour was consistent. This stage was similar to a DG, but the Proposer was to choose between different possible payoffs (sharing \$10 with a player who played fairly before, or sharing 12$ with one who didn't).

These initial studies of the UG and the DG(-like) sessions have clearly falsified the game theoretic predictions. It was clearly shown that the subgame perfect equilibrium does not occur in case of UGs in either role, nor does it always observed in case of DGs. So the question of the existence of behavioural difference from the self-interest hypothesis was answered by these studies, but the extent of this difference and other factors were yet unclear. As it was mentioned there were some experiments done with higher stakes as well, but the homogeneity of the experimental groups left ample room for doubts.

Culture was one of the first possible factors examined (Roth et al. 1991). In their study the authors conducted repeated UGs with random pairing and random role assignment in Israel, Japan, Yugoslavia and the US. Besides the comparison of the results of multiple cultures, they also used various stakes in different UGs, and they let players 'learn the game' by letting them play multiple rounds. The latter has yielded interesting results.

In each country, the low offers became less frequent. In the US (Pittsburgh) and Yugoslavia the modal offers were at 50% (though much more equal splits were observed in the US). The players in Japan and Israel on the other hand moved away from the equal split, the modal offer was 40%. The highest change was observed in Japan in the standard deviation of the offers, where even 'overfair' offers were observed. The rejection rates have also decreased due to less low offers. The differences were striking in Israel as well. There were a considerable amount of low offers in the first turn – and many rejections due to that –, but it decreased to the 10^{th} round – along with the rejection rates. The total rate of rejections were 22-28% in all the countries, but a very interesting result was that generally 'low offer' countries have lower rejection rates.

These results indeed indicate that culture plays an important role in making decisions in UGs – such effects may probably be observed in DGs as well. Each of the experiments described above had players play multiple games in succession of two stage games. It is also interesting to examine behaviour on a broader time scale.

Such an attempt was made in another extensive study on ultimatum and dictator games (Forsythe et al. 1994). This study specifically focused on DGs as well and their purpose was to investigate the effect of fairness concerns. Their hypothesis was that fairness concerns drive proposers when making their offer. They tested if the offers in UGs and DGs were similar. The experiments were conducted in 1988, 5 months distant (April and September). Besides exploring Proposer behaviour differences in UGs and DGs the differences between behaviour at the two experimental sessions were examined. The same group participated in both of the experiments.

Each experiment was conducted with ‘pay’ and ‘no-pay’ treatments. They also attempted to control for the stake sizes, but since their experiments were conducted only with 5-10$, no conclusion can be drawn from their experiments in this range. The following figure shows the pooled results of Forsythe et al. including the results of two experimental sessions (April and September).

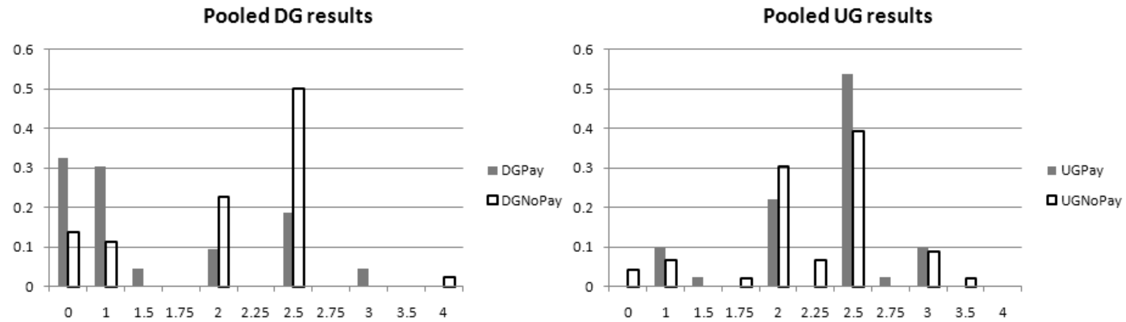

Figure 1.6.: Offers in dictator (left) and ultimatum (right) games using the pooled data of Forsythe et al. (1994)[31]

As the results show the difference between the pay and no-pay treatment offers is huge in case of the DGs, but not so relevant for UGs. In the DGs the modal offer jumped from 50% to 0% if real stakes were present, but in the UG only the ratio of 40% and 50% offers changed significantly. The rejection rates were very low in the UG, only 7% of the total paid UG offers were rejected (3 rejections in total), they were offers of 20% (1$) and 40% (2$).

Time also played an important role here, especially in the DGs with pay. In these games it was quite surprising, that Proposers were more generous in the second session – quite the opposite what could be expected. It was also statistically shown that the experiments – except for the no-pay UG – can be pooled so that April and September results can be analyzed together.

[31] The source of this data may be found in the appendix B of Forsythe et al. pp. 365

The authors conclude that fairness as an exclusive motive does not explain proposals in the games, and that payment matters in the DGs. The authors also analyzed the no-pay treatment results as well, but were unable to draw ambiguous conclusions. This further supports the rule that people have to play with real stakes.

Roth showed that a relatively small rate of people do prefer equal distribution in DGs (Roth 1995). In his experiments fifth of proposers preferred the equal split in the game, while the rest preferred splits between 90%-70%, with a mode at the 70%-30% split. This also contradicts both pure self-interest and pure fairness.

Motivations in the DGs influence behaviour. Motivation is mainly determined by the context and the instructions given by the experimenter. For example if the DG is depicted as a charity, the proposer behaviour changes dramatically (Eckel and Grossman 1996). With a charity treatment the average contribution increased to 30% of the goods as opposed to the 9.2% from the experiments of Hoffman et. al. – still the mode was at keeping the total pool of goods.

Obviously, many other factors are influential in these experiments. For example, the perceived status difference between players also has an influence (Ball and Eckel 1998). Even just by assigning a ‘star’ sign to some players in the group, the UG behaviour changes. The authors used two treatments (low and high pay) and have shown that in the low pay treatment Proposers were more generous with Responders having a ‘star’. In high pay scenarios this effect was not observed.

Gender effects were investigated in a DG experiment as well and it was found that women are less selfish than men (Eckel and Grossman 1998). In their experiments of splitting 10$ in a DG (N=120) ~86% of men gave 0$ or 1$, while only ~56% of the women did the same. Also note, that 15% of women gave 5$ while only ~3.3% of men did so. The statistical analysis of these results also supports that there is a gender effect.

UG refusals were most thoroughly examined by Slonim and Roth in their study (Slonim and Roth 1998). They have analyzed UGs with various stakes starting from relatively small pies (60 Sk) to substantial amounts (1500 Sk).

They found – see pp 582. in Slonim and Roth (1998) – that rejection thresholds tend to change with the stake size. In effect they found that two thirds of 0.75-0.25 offers were rejected in case of smaller stakes, but in case of high stakes half the rejections were experienced. The difference is even more spectacular in case of very unfair splits (10%), where in case of 1500 Sk, 40% of the offers were accepted!

For a thorough description on bargaining experiments see (Roth 1995) and (Fehr and Schmidt 1999). A brief overview of the actual experiments was given by Fehr and Schmidt as well, see appendix 7.1 for the corresponding table.

Later Güth and Tietz pointed out, that in the UGs being a Proposer by chance does influence decisions, thus they introduced an auction for the positions before the game (Güth 1995). The resulting behaviour was different from the game theoretic predictions and they did not observe equal splits (2/3 was the most common demand). Note that in this case the position was 'bought', so economical incentives played a key role in the decisions.

Note that there were other factors in the games. The amount of money to split did have an effect on offers and reactions and also the real stake (paid/not paid) does have an effect on behaviour (Dawes and Thaler 1988; Rabin 1993; Forsythe et al. 1994). It's always important to examine the experimental methods when interpreting experimental results.

The two person experiments briefly described in this section have demonstrated the multiplicity of the factors influencing UG and DG behaviour. Summarizing the two person UG and DG behaviour we can find the following factors: stake size, playing with real stakes, gender, repetition, game assessment.

Stake size did influence responder behaviour much more than proposer behaviour. Responders were less forgiving in case of smaller stake sizes; punishment costs are smaller in this case. Real stakes make people less 'altruistic' in DGs but more 'inequity averse' in the UGs. A strong gender effect was also observed; women were generally more altruistic. These effects may be emerge even more emphasized if the game is repeated – players can gather experiences and 'update' their behaviour.

Besides the simple two person games, there are more complicated situations though. These games can be played with three people to complicate things further and let even more complicated behaviour emerge.

Experimental results of three-person DGs, UGs, and TGs.

When two people play the UG or the DG their motivations are quite clear in these two games. In case of DG we can speak about voluntary sharing on the Proposer side, while in case of the UG the Proposers 'outguess' the Responders' behaviour to get the best possible payoff. However when a third person enters the game, the situation gets more complicated.

In three person DGs (further denoted as DG3) not much changes when introducing a second responder. In this case the Proposer gets to decide if he wants to share or not, if he differentiates between Responders, or not. The UG can be changed more dramatically though by introducing a third player. In the three player UG (denoted as UG3) the second responder is always introduced as a 'hostage', or 'passive' player, only one of the responders has the opportunity to make a choice. Its role consists of only being there in the game without any possibility of directly influencing his payoff. There weren't many experiments ran with the 'classical' DG3 setting[32].

In UG3 the first Responder (denoted as Responder in the following) has the choice of accepting the offer. The real difference between the two and three player UG lies in the fact that the fairness of both Proposer and Responder is tested. The second Responder (denoted as Passive player in the following) is another person towards whom the Proposer can be fair, or unfair. Also the Responder's behaviour is different. In his role the 'fairness' of an offer is not only determined by the share he gets from the interaction, but also the share the Passive player gets. It also depends on if the Responder cares for the Passive player at all. So while in the two person game the fairness of the Proposer is tested, in the three person game, also the Responder's fairness can be examined.

One of the newest studies pointed out, that inequality aversion indeed was observed in the experiment (Johansson and Svedsäter 2009). The players were presented with choices of splits in the DG3. It was shown that players were willing to choose more

[32] The first three person games similar to dictator games – but played in a different context – were conducted by Engelmann and Strobel as a test of fairness models developed in the 90's (Engelmann and Strobel 2004). Those games could be hardly compared to the dictator game as the player faced a different context, so their analysis is omitted.

equal payoffs in two thirds of the games – nearly 40% of the players have preferred equality and only nearly 15% of the players were completely selfish.

The first UG3 experiment was conducted by Opperwal and Tougareva (1992) where they included a third player into the UG who got a fixed proportion (10%; 50%; 90%) of the offer in case of acceptance (Oppewal and Tougareva 1992). Note that in their experiment the 'fairness' towards the Passive player was not really investigated as the treatments were fixed - so the Proposer did not really have the opportunity to act fairly or unfairly towards the Passive player. They have found that the addition of the third player (also the proportion) did in fact influence the offers. But they did not find any difference in the rejections regardless of the proportion given to the Passive player or its presence. This can be explained by the fact, that there could be no acts of unfairness committed towards the Passive player due to the fixed share of the offer.

Güth and Van Damme in a later UG3 experiment investigated the effects of information asymmetry (Güth and van Damme 1998). In their treatments the Responder was informed about all the proposed payoffs; only of his own payoff; or only of the Passive player's payoff. Their results have shown that the Passive players were mostly ignored, they got very low shares, and there weren't many rejections. The authors concluded that the Proposers were 'gamesmen'. They weren't really driven by fairness, but rather by trying to appear as being fair.

One of the most relevant (concerning this thesis) UG3 experiments dealing with the preferences towards equity were conducted by Kagel and Wolfe based mostly on the setup of Güth and Van Damme (Kagel and Wolfe 2001). In their setup both Responders are asked to decide about the acceptance/rejection of the offer of splitting 15$ among three players, but only one decision is picked randomly. Thus neither of the players may be perceived as Passive. The Proposer had to give a satisfactory offer for both of the Responders. They further complicated their setup by providing a 'consolidation' for the randomly assigned Passive player upon refusal. This varied between treatments, but the authors found that it does not have a significant influence on acceptance.

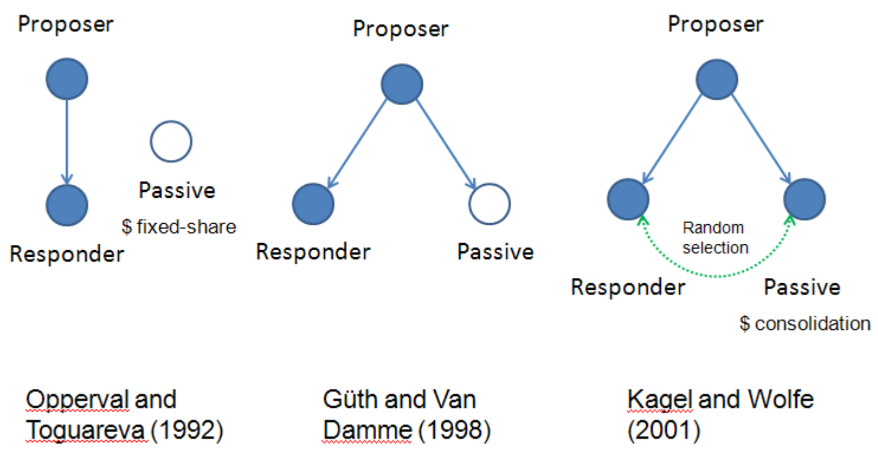

Figure 1.7.:.The game setups used in the UG3 experiments described

The rejection rates in this experiment weren't surprising, however the ignorance of the 'consolidation' paid to the Passive player upon refusal was significant. The players played multiple rounds and while there was a sensitivity towards the amounts of consolidation (the more consolidation, the more the Proposer wished to keep) in the first rounds, it diminished (or even turned around) to the last rounds.

In their results the equal splits were usually accepted, and the 'limit' where the rejection ratio went over 50% was only at a very unfair offers (11$, 2$, 2$). The median offer in this experiment was (7$, 4$, 4$) where they experienced a rejection ratio of 11%. It shows that in three player settings the Responders were considering their positions when they made their decisions, but Kagel and Wolfe's experiment lacked the possibility of 'unfairness' between the decision maker and the other Responder. The same constraint can be put to the results of Güth and van Damme, as they manipulated information, which created again an entirely different situation.

The idea of 'consolidation' for the Passive player was employed in another way in the study of Schupp et.al. (Shupp, Schmitt, and Swope 2006). In their experiments they gave a fixed payoff to the third player upon acceptance, and 0 on rejection (the contrary to what Kagel and Wolfe did). This changed the punishment suffered by the Passive players upon refusal. Due to the fixed payoff of the Passive player its presence did not have significant effects; the offers were similar to what has been experienced in UG2s. Also the rate of rejection was low in their experiment (~10%) compared to others, but the sample size wasn't very high (N=30 in each treatment). The authors also gave an explanation including fairness – they explained the low rejection rates in the 5$ and 10$

fixed Passive player payoff treatments with fairness. Refusals in the 15$ treatment were explained on the other hand by what in the Fehr-Schmidt model denoted as envy.

The three person UGs have shown, that the more complicated situations triggered similar reflexes from the Proposers and also ‘appearing’ fair was an important drive of their behaviour. Surprisingly the presence of the Passive player did not have a very strong influence on the rejections, only the threshold of acceptance of Responder 1 decreased. But in some cases there Passive player was simply ignored. This was partially due to the experimental methods (the treatments), but it has shown their low influence in some cases.

Also it’s to be noted here that the trust game was also played as a three-player variant (Buskens 2003). In this study he found that the findings of two person trust games applies in the three person game, and the presence of a second truster only had an effect if information was shared among the trusters. In this case their trust was indeed influenced by the information available and the trustees behaviour. The role of embeddedness in the three person TG will be discussed later (Buskens, Raub, and van der Veer 2010).

Another interesting study was ran by Sheremeta and Zhang introducing a third person to the TG and combining it with a three person DG (Sheremeta and Zhang 2009). In their multi-level TG the first player was a truster for the second player (the transferred amount tripled); the second player then was a truster to the third player (the transferred amount tripled), and the third player could decide on how to share the money between the three of them. So the third player could act as if he were in a DG. Communication was not permitted during the game. Their basic findings were in line with earlier two player TG results, players in the role of player 1 and 2 have sent substantial amounts, and have gotten back much from the third player. When communication was introduced though, the level of trust has increased at either party.

Reputation in the trust game was proved to be very important as well. In their recent studies Boero et al. found interesting results (Boero et al. 2009b, 2009a). Their general finding was that introducing reputation information into trust games increased cooperation as it ‘encapsulated’ trust. The reputation treatment in their experiment was realized by introducing a third party whose job was to evaluate the players, that evaluation being distributed in some treatments. This is quite similar to real life in the sense that often interactions are evaluated by people not being in the actual interaction themselves. The strong effects of reputation found by Boero et al. also highlight the even minor changes in the game context may influence the application of norms (trusting and trustworthiness in their case).

As these results show the TG differs from the UG and the DG in the three player setting as well. The most important conclusions of these studies were that the effect of information (communication/reputation) does have a significant effect in TG behaviour – yet these treatments were not introduced in UGs and DGs. This öeffect will be analyzed in a later section in details as embeddedness is to be taken into account as well.

Based on these experimental studies we can conclude that the general behaviour patterns observed in two player interactions apply in the three-player setting as well. The presence and role of the third player changes the game context, but still, general predictions on behaviour hold. But most of these experiments were always played with anonymous players, so they were substantially different from real-life interaction. In section 4 a new game treatment will be introduced in which anonymity is violated, but still the fairness concerns are not overruled by simple distributional norms. Playing such games with two players gives information on the effect of simple interpersonal relationships, and having three players in such a situation gives information about what happens if a social interaction is embedded in a more complex network.

1.2 Games beyond the dyad –games embedded in a network

In the previous section mostly two player games were introduced to investigate the effects on fairness. Life, of course, has much more complex structures for social exchange processes. Every person is embedded in some kind of a network and thus every action and interaction shall be interpreted in the aspect of embeddedness as well.[33] The simplest version of the networks is the dyad – such dyadic situations were examined earlier.

[33] For a thorough summary of the corresponding literature on the multiplicity and importance of the embeddedness aspect see (Takács 2010).

The next step which introduces huge complexity in these situations is the introduction of a third person into the dyadic interactions, making them a triad. Simmel studies the different roles in the triads extensively in his works (Simmel 1967). According to Simmel the individuality of a person in the dyad is endangered by the addition of the third person. As the games in the previous section have shown introducing a third player into whichever game requires a much more complex set of rules and will redefine the roles, motives and viable strategies for all of them.

Simmel defines three types of 'third person' of which only one may be of any interest to this research. Due to the methodology taken from game theory the third person does have only a limited set of strategies, so he will not be able to take the role of neither non-partisan, nor arbitrator. That leaves only one type of role, the 'laughing third', the *tertius gaudens.* Indeed in some of the interactions outlined there is a player 'laughing' at the end, but the 'extension' of the games with the third person rarely makes that person the *tertius gaudens*. So while Simmel's theory is very relevant on the functions the triad, the current research can't utilize his views as in the three-person games introduced later, the strategies of the players are very limited compared to what Simmel discussed.

A point what Simmel did not address is the quality of the ties within a triad. He assumed strength of 'positions' rather than ties, but here we have to remark that the choice of strategies (and even the set of strategies) depend on what ties are there in the triad. Does the third person favour one of the dyad, does he like/dislike them both? This is a very important question, which allows us to refine the findings of Simmel as well – but that is not in the scope of this thesis. Putting it short: the strength of the ties influences everything in a network.

1.2.1 Defining and measuring the strength of tie in a network

The relationship, or connection between the people is a rather important, yet the most difficultly described feature of a network. The importance of relationships is usually emphasized in the discussion of the connection between micro and macro processes[34], which were only partially explained with other methods. The simplest description is the

[34] On the network analysis paradigm see (Tardos 1995). The basic literature on network analysis is also reviewed.

existence or non-existence of a tie, this is a dichotomous description. All the aforementioned measures are quite simply determined in this case. When the connection between the nodes is more complex, measuring its strength is necessary to describe the network adequately and to calculate the quantitative measures.

The most fruitful approach to network tie strength was given by Granovetter defining tie strength: ‘a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie’.[35] In this concept the ties were classified as strong or weak according to the time spent together, mutual trust and cooperative attitudes (emergence of reciprocity). The strength of a tie ranges from shallow acquaintance to close friendship or kinship.[36] (Granovetter 1973, 1983)

This classification served multiple purposes. According to (Granovetter 1973) the weak ties are vital in connecting dense networks of strong ties. It means that two groups of close friends are connected by acquaintances. These weak ties between the groups serve as potential source of information, new ideas, which is vital in many processes – labour market processes, thus mobility, fashion spreading, attaining social status, etc. Granovetter however notes that the bridging weak ties are the most important in this regard.

A great example further emphasizing the importance of weak ties was presented by Lin, Ensel and Vaughn (Lin, Ensel, and Vaughn 1981). The authors drawn a sample from working age men and investigated how they got their current job and how they attained their social status. The authors assumed that job seekers used their social resources – accessible through network ties – to get their job. The focus of this study was on investigating the tie to the contact person and the status attained through getting the job. They found that the weaker the tie to the contact gets, the more importance the contact’s and the hiring firm’s tie has. Also utilizing high-status contacts depend on family background and also the weak ties (Lin et al. 1981). This work gave a subsequent proof that the classification of the ties as strong as weak is well based in these situations.

[35] The definition is found in pp 1361, Granovetter (1973).

[36] Granovetter’s main hypothesis in this work was regarding network formation. Namely the weak ties can form “bridges’ between networks of people with strong ties more likely, than strong ties.

The main finding of Granovetter was further investigated in other studies as well. For example Friedkin's study – just preceding Granovetter's 'revisiting' of the strength of the weak ties hypothesis – concerned information in and within companies and found that information spreading is influenced by both strong and weak ties, and the real strength of the weak ties lies in their numbers (Friedkin 1982). Another study by Weimann dealt with spreading through 'conversational' weak ties (Weimann 1983). In conclusion Weimann emphasized various influences of weak ties: public opinion, innovation spreading, etc.

This strong/weak classification is principally functional and has considerable explanatory power in some situations, but its measurability and interpretation of the strength of a tie is somewhat problematic due to its multidimensional nature. Based on Granovetter's work the strength of a tie can't be defined clearly. One can narrow the multiple dimensions of tie strength, but that would result in an incomplete definition. For example using the frequency of interactions alone is not necessarily practical (Szántó and Tóth 1993).

Granovetter's tie classification was widely used, but there were many other assessments of network tie strength. In a recent study Pabjan studied micro processes in several prisons in Poland and classified tie strength – social relations – on normative and interest-based dimensions (Pabjan 2005). The study also showed the dynamic effects of network change on the changes in the normative system.

A much simpler – yet fundamentally also important – approach of network ties is discriminating only between positive and negative relationships. This approach is used to research emergence of certain structures, and structural balance. The earliest formal theoretical use of positive/negative relationships is the balance theory by (Cartwright and Harary 1956) – a formalization of Heider's theory, more thoroughly explained in (Heider 1958). This approach was very productive thanks to the structural balance theory, but it is not in the scope of this thesis.

The use of more complex indices to assume tie strength is practical in the research of personal relationship and social support. Also social relations – unable to be described by only a simple sign – are crucial in economic actions as well (Granovetter 1985). There were many attempts to capture the complex nature of social relations using multiple-item indices. For example (Lund 1985) uses scales for love, commitment and investments in close personal relationships.

Determining network tie strength is a problematic task for network sampling, as people often refer to different notions, different concepts. Marsden and Campbell found that the best measure for tie strength was the closeness or intensity in a research of best friend ties (Marsden and Campbell 1984b). Also duration was more important in this regard than kinship and frequency was weakly associated with duration or closeness. In a study of searching for jobs Wegener determined some aspects of tie strength: intimacy, formality and leisure (Wegener 1991). Closeness, duration and frequency were strongly related to intimacy, what should be the most consequential property of social ties.

An extensive study on tie strength and effect on social support was conducted by Wellman and Wortley propose six explanations for the interpersonal provision of support: strength, access (contact), structurality, kinship, positional resources (capital), and similarity/dissimilarity (Wellman and Wortley 1990). They also defined multiple dimensions of social support, but that is currently not in our scope.

'Strength' in their research was described by three factors: social closeness, voluntary communication and interaction in multiple contexts. This type of 'strength' excludes various factors as it only classifies a tie 'strong' if it involves social closeness (in line with Granovetter's strong tie) – so it may be adequate for given tie types only.

Contact to each other was found important as well because frequent contact may present support in itself and that may not depend on the strength (in the sense discussed in the last paragraph) of the actual tie (Marsden and Campbell 1984a). Weimann and Wortley haven't found association between tie strength and face-to-face contact frequency; telephone contacts were more associated with strength (but still very weakly). This can easily be explained by the difference in the cost of a face-to-face contact and a phone call.

Kinsip was twofold in the importance of social support depending on the degree. Companionship was more important in this aspect as the authors found that companionship was formed rather with non-kin than kin (some subjects specifically expressed their dislike for making friends with relatives). The main reason for that was that the kin had different values and common values were found to be rather important in companionship. (This may point that tie strength is influenced by values shared.) Similarity and dissimilarity in other variables also has an influence on social support, but that’s not in the scope of this thesis.

So generally the study of Weimann and Wortley highlights that ties have many sides and different forms of social capital (emotional or practical support) is generated from their interaction. Also this shows that it’s necessary to be cautious when creating tie strength definitions as in some cases measured variables may be off the mark. The data of Weimann and Wortley shows for example that the similarity measure do classify subjects, but examining social support solely on this basis would lead to incorrect conclusions.

As seen from this brief review plenty of approaches exist in defining tie strength. The explanation for this lack of consensus in the definition is due to the complex nature of relationships between people, and the fact that different types of research take into account different properties of networks. Using the term ‘strength’ is quite unfortunate in this regard, but in the network perspective ‘strength’ describes a feature of a tie that describes its importance, effect in certain processes etc.

The strength can be an objective or a subjective measure of a tie. Some approaches assigned objective measures – frequency, duration etc. – while some assigned subjective measures – closeness, emotional intensity – to the tie, as a tie strength. The advantage of objective measures is that they can be explicitly determined, they can be compared, and their changes can be monitored. Their disadvantage is that they don’t provide information about many interesting features of social relations – applied norms, likes and dislikes, etc. Subjective measures on the other hand provide information about personal properties of the ties. Emotional intensity, types of occurring emotions, closeness etc. are also very important features in some regards – social activities, social capital formation etc. – while they’re marginally important in spreading of information.

Objective measure	**Subjective measure**
Existence	Love
Duration	Commitment
Kinship	Closeness
Frequency	Intensity
Reciprocity	Intimacy
	Formality
	Leisure
Fairness concerns, fair behaviour	

Table 1.8.: Objective and subjective measures of network strength

Measuring the strength of a tie also depends on if it is an objective or subjective measure. Objective measures are measured by the researcher explicitly, while subjective measures are reported by people being in the network. Objective measures are relatively easy to obtain and they can be compared for the nodes and ties. On the other hand subjective measures are sometimes hard to interpret. They're collected using surveys, which have their limitations ((Marsden 1990) gives a summary on these problems) and thus give subjective opinion, or 'subjective strength'.

The purpose of this research is to give an objective measure of strength containing subjective components of the individual. This measure is the degree of how much somebody cares for someone else's well-being. It can be explicitly measured by experiments and contains the norms internalized by the individual. It is an objective measure, since the measurement is done indirectly – because it is a result of an experimental game played by someone else, not a survey, or questionnaire. It is also a subjective measure in the sense that the motivation to behave certain ways is influenced by subjective factors – namely the internalized fairness norms of the individual, and the relationship between the players.

We can conclude that the extent of fair behaviour is different in these aspects as it contains subjective judgement of a tie as well as the internalized norms. But – opposed to other subjective measures – the extent of fair behaviour can be measured. One of the aims of this thesis is constructing a framework to determine the 'strength of a tie' based on the extent of fair behaviour.

1.2.2 Embedded games

The review on ties shows the multiplicity of views and effects of being in relationships. This makes networks especially important in the scope of this thesis, since emphasis is on the fact that social interactions take place embedded in a network. As described before the rules in experimental economics aim to decrease the effects of existing relations, but then do the games really trigger real behaviour? There are plenty other critiques of applying experimental economics (Binmore 1999; Loewenstein 1999)[37], but here I would only like to emphasize a very important object in the framing of the games: that real situations are usually embedded in a network.

Embeddedness made its way to economics and the social sciences through the work of Károly Polányi discussing the formation of the contemporary economic system in England (Polányi 1944). He argued that the economic processes depend on certain social and institutional conditions. Processes present in nowadays economy (redistribution, reciprocity, exchange) have been the parts of everyday life, they were embedded in certain social institutions (cultural and/or religious institutions and sanctions; and kinship – markets in case of the exchange). Despite that Polányi stayed close economics in his argument, his approach has placed him closer to anthropology. He used historical examples to show that the market exchange was guided by the aforementioned processes rather than the rigid rules of modern markets. Of course embeddedness should not be stressed too far either.

Granovetter formulated an extreme argument of 'embeddedness': 'the behaviour and institutions to be analyzed are so constrained by ongoing social relations that to construe them as independent is a grievous misunderstanding' (Granovetter 1985).[38] He emphasized with this sentence that narrow-minded self-interest and over-reaching interdependence are two sides of the coin. He strongly argues to accept embeddedness as an influential property in economic actions, but also warns about its overestimation.

Granovetter separates two aspects of embeddedness, relational and structural embeddedness. Relational embeddedness refers to the ego-network properties, while

[37] Binmore and Loewenstein present great summaries in their articles. They analyze experimental economics from multiple viewpoints, but their general approach is based on economics and behavioural economics..

[38] pp. 482.

structural embeddedness is tied to the structural properties of the entire network. He also argues that the effects of network and embeddedness have to be taken into account when economic action, institutes and outcomes are analyzed. More than that, Granovetter also argues that embeddedness itself may be a key factor in either of these fields.[39]

Another important conclusion of Granovetter is that even though assuming rational actions may be problematic, this assumption should not be abandoned. Embeddedness in fact is such a property of a person which makes determining 'rational' quite difficult. Economically irrational behaviour may be totally rational if embeddedness is also taken into account: 'if we note that it aims not only at economic goals but also at sociability, approval, status, and power'.[40]

If we think of situations which take place embedded in a permanent network, then the aforementioned phenomena do indeed occur. Also we have to add reputation formation to this list. People in the networks interact with each other much more frequently than with others, so in this context their reputation (fame/infamy) may be very important. This was proved in experiments as well.

Clear evidence on that was presented by Buskens and Raub in trust game experiments (Buskens and Raub 2002). The theoretical approach of the authors gives two processes through which embeddedness affects trust: learning and control. The former is basically the use of players' past experiences about each other in their present choices[41]. Simply put: if a trustee has been trustworthy in previous interactions, then he is likely to be trustworthy again[42]. Of course if negative information is revealed about the trustee then trust decreases (Coleman 1990).

Control on the other hand refers to some facts of the future: namely that the long-term well-being of the trustee is in the hand of the truster. Indeed it is quite clear that short-term interests of the trustee is abusing the trust of the truster, so if the interaction

[39] A review on the works of Polányi and Granovetter on embeddedness was given by Szántó (Szántó 1994).

[40] pp. 506. in (Granovetter 1985).

[41] Buskens and Raub also extend learning to getting new information of the context of the game. Here that emphasis is omitted as I focus on the embeddedness, the role of other – related – people.

[42] Szántó has denoted this kind of 'trust' in the other player's 'cooperational' strategy as 'strategy-trust' in his model of buyer-seller relationships (Szántó 2008).

takes place repeatedly the truster may exhibit some control with the amounts given in the trust game. Of course this control can be interpreted as reciprocity as well.

The presence of network adds some special features to these situations. If we assume that information is spread in the network, then ‘learning’ may take place even without actual interactions through reputation. Negative information may spread in the network as well, but the longer the information travels the more actors will doubt it (Buskens 2002). So in this sense control can be exhibited through other actors in the network by providing them information about a trustee’s behaviour.

Buskens and Raub ran survey (‘vignette’) experiments among car purchase managers and among students. They tested the effects of both control and learning in dyadic and network setting. Their simplest finding was that learning (past experiences) is used if future interactions are expected (in case of the purchase managers), thus control was found to be related to learning. Network effects exist in addition to control and learning. In their experiment the third-party information was also included in learning in case of students, which also played a role in exhibiting control. Note that in both experiments only positive information served as an input to learning, so the experiment of Buskens and Raub was very simple in this aspect as well.

Despite that this experiment wasn’t a real lab experiment, but only survey, it has pointed out that indeed, the network effects – namely the third party information and the embeddedness in a network (out degree) – do indeed have substantial influence on the formation of trust. They also showed that the mechanisms defined being related to trust (learning and control) indeed are adequate to describe trust formation (Buskens and Raub 2002).

In their newest experiment though, Buskens, Raub and van der Veer have put this theory under a test in the lab (Buskens et al. 2010). They had subjects play a repeated trust game with real stakes[43]. To include network effects the authors formed tryads of the subjects, having one trustee in a tryad with two trusters. Then the subjects played two player trust games (the trustee played one with each truster) repeated three times[44],

[43] For the ease of understanding the game they have assigned eurocents to the points players could earn in the experiment.

[44] The authors denoted dyadic repeated interactions as ‘dyadic embeddedness’.

so the network effects were modelled with a very simple network structure. There were two treatments in their experiments to test the effect of information spreading.

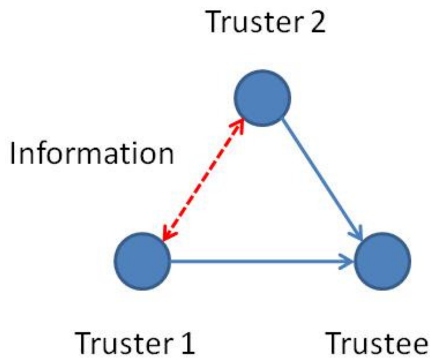

Figure 1.8.: The three person embedded trust game used by Buskens, Raub and van der Veer (2010)

In the first experimental treatment no information was shared among the trusters, this modelled a simple repeated interaction (also denoted as 'partner matching'). By making trusters share information the network embeddedness effect may be observed. The authors found that the effects in dyadic games and network embeddedness are complementary. The no information treatment yielded less trustfulness (smaller amounts sent by trusters) and also less trustworthiness (smaller amounts sent back by the trustee). When third-party information was present, then both trustfulness and trustworthiness increased, but these effects were combined with endgame effects as well. In both treatments the last few rounds involved much less trustfulness and trustworthiness.

From the point of embeddedness the network effects were substantial. The authors concluded that the third-party information had a very strong effect on both truster and trustee behaviour. In case of the trusters it complemented the learning process (past experiences) and thus further increased trust, but in case of the trustees it keeps trustworthiness at high level (>90% of the games) excluding a strong endgame effect (decrease in both trustfulness and trustworthiness).

This trust game experiment has clearly shown the importance of information spreading in the network even when a relationship is 'restricted to' information exchange (so no real social relationship exists). The studies shown here briefly by Buskens et. al. point out two important processes through which network effects are described: control and learning. When speaking in behavioural terms control means reciprocity, but learning has no strict equivalent among the behavioural pattern discussed earlier in this section.

The learning effect corresponds to the reputation of the actors. Servátka investigates this specific issue in a recent study (Servátka 2010)[45] with pairs playing dictator games and information on a past decision was shared in one of the experimental treatments. First ordinary DGs were played among the pairs, and then in the following games the Proposers were given some information on the behaviour of the Responders in the role of the Proposer in an earlier game.

It was assured that in the earlier game the players were not the same with their roles exchanged. This served to avoid the direct effect of reciprocity and to focus on the effects of reputation only. Of course anonymity was assured during the experiment. Servátka found that information on the reputation of the Responders in the DG was significantly influencing behaviour.[46] One of the observations is quite confusing though – the dictator offers are higher when information is spread, irrespectively of the type (positive/negative) of reputation. The author concludes that identification effect was observed.[47] So even though we can't speak of a 'network' in Servátka's experiment, it provides interesting evidence to support the importance of reputation.

Embeddedness of course does not only mean that an information network is available to the actors. Network usually means much more than just plain 'information source'. The other dimensions have been briefly mentioned – the most relevant feature of the networks in our context is that it assumes future social interactions and also some kind of tie (not necessarily economically based) exists between the actors.

The kinship and the friendship effects were already briefly discussed in this section as an influential factor on DG behaviour (Ben-Ner and Kramer 2010). These effects have been thoroughly examined in trust games (Vollan 2011) and public good games as well (Haan et al. 2006). Ben-Ner and Kramer found (comparatively) high levels of

[45] Servátka addressed similar issues in an earlier study (Servátka 2009), but the results of the most recent work is briefly reviewed here.

[46] They found a correlation of 0.35 with statistical tests showing significant difference between treatments.

[47] Even less information is enough to arise identification effects. Charness and Gneezy found that even revealing the family name of a player induces changes in UG/DG behaviour (Charness and Gneezy 2008). Family name is completely irrelevant – or at least it should be – in such situations.

altruism in the DG when the players involved were friends or kin; Vollan's experiments have shown increasing trust when family members or loosely related players played trust games; and Haan has made a clear distinction between being friends or simply belonging to the same formal group (school class).

It is to be pointed out however that nor in these latter experiments (involving related players), nor in the former experiments (information networks) can we speak about a clear network structures, but that is not a prerequisite to call a game 'embedded'. From the viewpoint of this research it is only important that the players are somehow related to each other. In the studies described herein no attempt was made to investigate this issue further – nor did the researchers have the opportunity to do so as most of the games (except for the public good game) were anonymous.

But networks are complex and real-life situations are often played among players who are in a network. Then they have a certain tie between them, so that should definitely come into play when they make certain decisions. Current models on player behaviour do not (and cannot) take into account the strength of a tie between the players. One good reason for this is that the tie strength is very hard to define – as it was shown earlier – and that its influence depends on how it was defined.

In the following section a novel model is introduced which gives a new meaning to the tie strength based on the behaviour of players. The model integrates fair behaviour and network embeddedness and is analyzed based on behaviour in ultimatum and dictator games. Thus it has multiple uses: it provides an explanation to the observed behaviour yet unaccounted for, and also opens up a new – measurable – way of defining the tie between two people.

2 The Integrated model of Fairness and Network ties – the IFN model

Social networks and fairness theory became the object of sociological research only in a few decades before the millennium. As the previous section shows, numerous theories were born on both fields starting from pure theoretical approaches to practical applications. The focal point of both of these fields is the individual.

People are handled by social network analysis as the nodes in the network between which relationships are defined.[48] Relationships can be of various types – as mentioned before – starting from simple objective measures (e.g.: interaction frequency) to very complex subjective measures (e.g.: intimacy, closeness). Fairness theories on the other hand concentrate on the action and interaction of people. The presence of fairness concerns strongly influences interactions as the individual takes into account other individuals in his action. So simply put: the social network defines the social *context* an action takes place in and fairness theories describe the *motive* behind the action. Yet in the modelling approach their combined influence is not taken into account.

When actions are influenced by fairness concerns most economic models fail to predict behaviour. Other behavioural models – social value orientation or fairness models – may take account of other-regarding preferences, but still, comparison with experimental results shows that certain parts of behaviour have not been uncovered yet. These models in general omit the effect (and presence) of embeddedness, so partially they do not take the social context into account.

This deficiency highly constrains these models. Social norms – the focus of these models – come into play in an embedded context in most of the cases, in social networks. People are related to each other in many different ways and isolating interpersonal relations from the interactions (anonymity) deprives players from acting in a real context. On the one hand it is very important to be able to focus on individual norms and behavioural patterns – and of course the experimental evidence clearly indicated the existence of those norms –, but on the other hand it neglects such factors which are taken into account in every single interaction. We may think about either DG,

[48] Of course SNA deals with various units, nodes can be institutions, groups, firms etc. This thesis focuses on networks of people only.

UG or TG played with one of our friends, or a PG with our colleagues or family members.

Friendships and family ties are not uniform; people have several ‘kind’ of friends and family members. Friendship and kinship – or more precisely the ‘obligations’, the norms related to these ties – are different for everybody depending on cultural and social background.

It’s difficult to grasp the difference with experimental games, but social network analysis is capable to give an appropriate framework for differentiating between these relationships – that is the strength of the ties hypotheses (Granovetter 1973). However the connection between the behaviour towards a certain person and having a certain relationship with that person is bidirectional. So close – or in network terms ‘strong’ – relationship facilitates fair behaviour and also make people expect fair behaviour from others. Stronger relationship means stronger emotional attachment – as it was also noted by Granovetter – and in such relationships the emotions related to unfairness are also different. Envy and guilt are usually associated with treating someone unfairly or being treated unfairly (Fehr and Schmidt 2000). Intuitively one can argue that stronger emotional attachment would lead to stronger envy and guilt so this further facilitates fair behaviour in stronger relationships.

Earlier models of fairness omit this completely, although they include some internal concern for fairness. In this section I propose an integrated model of fairness and network ties (IFN) based on an earlier model.

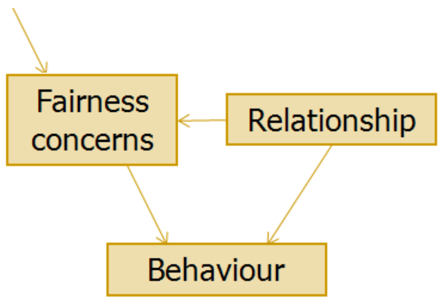

Figure 2.1.: The assumptions of the IFN model

The basic assumption the IFN model describes is that behaviour is influenced by both fairness norms, and the relationship between actors. Further than that, the fairness norms are conditional, depending on the relationship between the actors. Putting it short: we perceive different behaviour as ‘fair’ depending on whom we’re interacting, and sometimes we just disregard them as they are, if we don't care for the other person enough. Fairness norms themselves are assumed here to be culturally determined and they depend on the personality (and socialization) of the person as well. (The arrow pointing at fairness means that.) The thorough description of these exogenous factors is not in the scope of this thesis.

In the following part of this section I'll give a description of the model and a thorough analysis for dyadic and *n* person situations focusing on behaviour in the UG/DG (and its three player variants). It will be shown that the proposed model explains the behaviour yet unaccounted for – in Section 4 I'll use the model to explain experimental results as well.

It is vital to mention the constraints of this model here. Earlier fairness models have been criticized because of the limits of their application and the predictions – they were tested in public good games to explain social phenomena – and the IFN model has its own constraints as well.

First and foremost the IFN model describes interactions in which a certain amount of goods is being split. They may not necessarily be material goods, but goods which have a utility to the players. Second, the goods to be split are not the property of any of the players, and they do not form property rights. The explanation is very simple for this: a person may wish to share a piece of chocolate equally, but will not distribute his salary, or lend his car to anybody. Hoffman et. al. found in their early UG and DG experiments that if property rights are introduced into the game then even very unequal splits are totally acceptable (Hoffman et al. 1994). Since the IFN model is used to introduce friendship, the introduction of property rights may overrule the friendship effects by introducing new norms in the experiments so they are assumed to be nonexistent in the examined situations.

The third constraint is that the IFN model assumes the homogeneity of the players except for their fairness concerns (explained later), so relative material status of the players or the social status is not taken into account at all. As it will be shown in section 4 the experimental groups consisted of subject with similar social status.

All of these constraints are put to keep the IFN model simple enough for the investigation of friendship effects. In more lifelike situations these factors combine with relationships to produce the complex behavioural patterns observed in real life. Such complex description is not in the scope of this thesis nor the IFN model at its current state.

In this section I introduce the IFN model, and give an extended analysis on it (a shorter analysis is given in (Gulyás 2010, 2011b)). Then the model's predictions are described for various games – from which the hypotheses are formulated in section 3 – and the boundaries of the model parameters are given.

2.1 Model description

In this section I introduce the Integrated model of Fairness and Network effects (I'll refer to the model as IFN in the following). The proposed model is based on the model by Fehr and Schmidt (Fehr and Schmidt 1999) due to practical and theoretical reasons (I'll refer to it as the 'Fehr-Schmidt model' in the following).

The main reason for using the Fehr-Schmidt model as a starting point is that it is a very 'clean' utility model, with well defined terms; and also its explanatory power is robust.[49] The background assumption of the Fehr-Schmidt model (inequity aversion) though does not permit behaviour seen in the experiments, neither is it a very good description of fairness per se. The maximum of an inequity averse individual's utility corresponds to the equal split in each situation if his aversion is strong enough (he's indifferent between keeping and giving away the good).

Fehr and Schmidt argue that in the ultimatum game the proposals are motivated by 'guessing what is acceptable' for the responder – if their concerns for avoiding being better off are high enough. This assumes that the proposers have an idea about the responders and excludes any other effects – implicitly it means that players are always 'gamesmen'. For such 'guessing' players the maximum of the Fehr-Schmidt model is always at the zero-offer. This explanation does not permit an intrinsic motive to non-equal splits for inequality averse players and non-zero offers for non-inequalty-averse players.

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[49] For a thorough analysis of the Fehr-Schmidt model and a comparison with other models see Engelmann and Strobel (Engelmann and Strobel 2000, 2004).

A much more important weak point of the model lies in the explanation of the dictator game. As mentioned before the maximum of the model is always the equal split, or the zero-offer, yet there are offers in between (as shown in the experiment). Their argument was the assumption of a non-linear inequality aversion. The assumption may be valid from a modelling perspective but the authors did not provide a solid background on the non-linearity (neither qualitatively, nor quantitatively).

Also note that the Fehr-Schmidt model assumes that the interaction is anonymous, which – as it has been pointed out before – is not a valid assumption in a number of cases. When we assume that there is a certain relationship between the players then the clarity of the Fehr-Schmidt model turns into a drawback as it cannot account for different behaviour of the same player.

The IFN model starts from the analytic form of the Fehr-Schmidt model: the assumption that people feel different regarding being better or worse off than others. So – retaining the terminology of Fehr and Schmidt – there is a difference between guilt and envy. The IFN model takes a step in the direction of including the strength of the tie into the utility of the individual thus giving an explanation for the different norms applied in different ties, and the 'importance' of adhering to these norms.

There are two main assumptions of the IFN model:

1. Conditional inequality aversion: people are inequality averse with others whom they are closely related to. In other terms people behave altruistically with friends and kin (as it was shown in earlier studies) and expect altruism from friends and kin. As the tie weakens the individual gets less and less inequality averse. In weaker ties the 'fair' distribution (at which the model takes its maximum) is not the equal split, but gets less and less.
2. Conditional norm adherence: when a tie gets weak enough people are willing to deviate from the fairness norms by acting completely selfishly.

These assumptions create a direct relationship between fair behaviour and tie strength. Simply put: the more important somebody to us is, the more equal we treat him/her. The tie strength is represented by a parameter in the IFN model.

The structure of the IFN model for a dyadic interaction is the following:

$$U_i = \pi_i - \alpha_i c_{ij} \max\{0, \pi_j - c_{ij}\pi_i\} - \beta_i c_{ij} \max\{0, c_{ij}\pi_i - \pi_j\} \qquad (2\text{-}1)$$

In this model U corresponds to the utility of player i; π denotes the payoff of a given player; α is the parameter which describes envy; β describes guilt; and c_{ij} describes the strength of a tie between the players (from 0 to 1).

According to the model, absolutely unfair behaviour means that the player maximizes his payoff regardless of the other's – this is pure selfishness. Absolutely fair behaviour corresponds to *inequality aversion*, so a player wishes to share absolutely equally. However in terms of the IFN model 'fairness' means something else (discussed in detail later).

The IFN model can be classified as a utility model. It describes the expected utility of a rational actor (or perceived utility depending on the stage of an interaction) taking into account the payoff of others and the relationship with others. Hence if a rational player is facing a decision of choosing a payoff, the choice will correspond to the maximum of the IFN model.

In the IFN model 'π' means the respective payoffs of players *i*., and *j*. These payoffs represent the decision set from which a certain player chooses the 'optimal' combination. The other parameters describe the players individually, and their relationships. The parameters α_i, and β_i describe the general attitudes (fairness) of player *i*. Practically they describe how 'sensitive' is a player to the fairness concerns. Fairness concerns trigger when someone has been treated unfairly, or others were treated unfairly (described in details in the next section):

$\alpha_i c_{ij} \max\{0, \pi_j - c_{ij}\pi_i\}$ - Concern for treating someone unfairly

$\beta_i c_{ij} \max\{0, c_{ij}\pi_i - \pi_j\}$ - Concern for being treated unfairly

The parameters α and β are denoted as **general attitude parameters** as they describe the general attitudes. Parameter α describes how strongly a player's utility is affected when treated unfairly – this corresponds to 'envy'; and β describes the affection by treating someone unfairly – this corresponds to 'guilt'. These parameters show individual preferences and in this form correspond to the parameters in the Fehr-Schmidt model.

The envy and guilt parameters can be compared. The ratios of these parameters correspond to the feelings in reality too. It the value of α is the twice of β, then this means that the player is twice as much disturbed by envy, than by guilt.

The relationship between the players is represented by the c_{ij} parameter in the IFN model. This parameter has a value between 0 and 1, and is proportional with the 'strength' of the tie. The strength of the ties has been discussed in many theoretical approaches, but hasn't been used analytically. The proposed model does not fit into the classifications proposed by Granovetter (1973, 1983).

Besides classifying the ties as 'strong' or 'weak' Granovetter classified ties according to their 'qualities' (emotional, intensity) as well. He assigned such variables to strength, which can't be handled in the proposed model due to the simple model structure. It is possible to classify all relationships by the parameters of the IFN model, but for example it is impossible to make a difference between a strong family tie, or an equally strong friendship – as both may result in the same fair behaviour – also every person separates these types of relationships differently[50].

The model structure clearly reflects the Fehr-Schmidt model, but by introducing the strength of a tie as a variable, or parameter, the notion of 'inequality aversion' changes to 'unfairness aversion'. What a person denotes fair however depends on who's the other participant of a given situation, how 'strong' their relationship is. The strength in the IFN model corresponds to the different application of different fairness norms in the interactions with the other players.

According to this approach the extremes of fair behaviour are the following:

Absolutely fair behaviour means that a player's behaviour is guided by inequality aversion (or a preference for equality) – this corresponds to the principles of the Fehr-Schmidt model, with the condition of $c_{ij}=1$. In case of this tie only equality is perceived as fair.

Absolutely unfair behaviour means pure self-interest in an interaction. This corresponds to the zero-offer. This does not mean, that $c_{ij}=0$, it only means that it is low. It is shown in the following that depending on β the zero-offer is given at different

[50] For some people friends are more important than family. For others, quite contrary applies placing family above any other type of relationship.

c_{ij} values. So in terms of relationship: the zero-offer is never considered as a 'fair' offer; but if the tie is weak enough, we don't simply care about violating the fairness norms, and we give a zero-offer.

The c_{ij} parameter in the IFN model yields significant differences to the Fehr-Schmidt model, so further analysis of the model is required – using the assumptions above as guidelines.

Note however that in this model the notion of 'perfect stranger' requires a bit different interpretation. A PS as a common term represents a person about whom a player has absolutely no information (gender, age, nationality, etc.). However a very important feature of a perfect stranger is that it is a human being and this fact is common knowledge. This results in the player having preconceptions about the existence of certain norms, behavioural patterns etc. in the other player, the perfect stranger.

Thus in the IFN model the relationship to a PS is not described by $c_{ij}=0$, because in this case there fairness concerns are nonexistent. Assuming humans lacking any concern for fairness with similar creatures would be an invalid assumption.

In experimental setups however it's possible to create interactions with $c_{ij}=0$. These are the situations, when players face computer opponents (Blount 1995; Sanfey et al. 2003). In their study Sanfey et. al. conducted experiments also using scanning techniques (fMRI) to identify processes in humans – neuroeconomic experiments – during playing ultimatum games against both real opponents and computer controlled players. The responders rejected unfair offers from humans more frequently than from computer opponents. In fact the fMRI scanning revealed that the processes of the brain differ significantly when people get an unfair offer from a human being and from a computer opponent. The authors also concluded that rejecting when playing against computer opponents was a signal to the experimenter, not a reaction related to the experienced events only. In this regard the behaviour depends on the context as well.

2.2 The analysis of the IFN model

Since the IFN model contains multiple parameters, an extended analysis is required to describe model predictions and its explanatory power. Even when facing a stranger in an interaction[51], people do not act completely selfishly, if their fairness norms do not dictate so – in case if parameters α and β (their boundaries will be discussed later in this section) got the appropriate values. The meaning of the strength parameter is to be analyzed further.

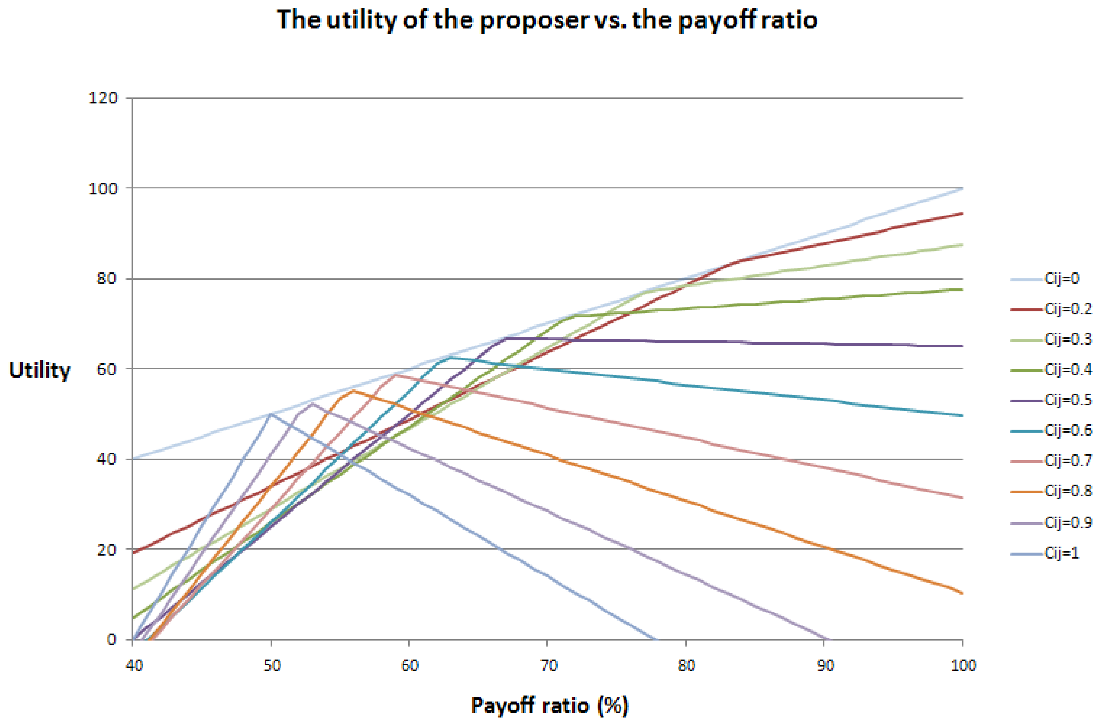

Figure 2.2.: The IFN model (drawn for specific tie strengths; α_i=1.8, and β_i=1.4)

As Fig 2.2 shows the IFN model for various tie strengths. The maximum of the utility may correspond to an allocation between an equal split and a selfish split, or a selfish split itself. If the sensitivity to fairness is high, then the maximum is found at a given – maybe near the equal – split, but if it's low, then the maximum is at the selfish split. In the case shown in Fig 2.2 the sensitivity towards treating somebody unfairly is strong until the tie strength reaches ~0.5.

In this region the maximum of the IFN model corresponds to a payoff smaller than 100%. In other words the player does not prefer keeping everything, but prefers giving something (with the actual parameters, this may be up to giving 32% at a tie strength of 0.5). But if the tie strength is below ~0.5 then the player prefers to keep all of the goods. This corresponds to the norms of the society saying that friends' well-being is just as important as somebody's own, while one should not care as much for strangers.

[51] Still c_{ij}≠0 holds. In the experimental results people do not always behave selfishly in dictator games, and are always punished when doing so in ultimatum games.

The IFN model assumes linearity as it's shown in Fig 2.2, as it's easily handled analytically spoken. However reality often shows that non-linear utility functions may have higher descriptive power. Bolton and Ockenfels also suggested such a function in their model as mentioned before. Assuming non-linearity – and a concave utility function of payoffs as such – would mean a reasonable improvement to the IFN model, but such an improvement would yield a much more complicated analytical form, yet the improvement in the predictive and descriptive would not be that high.

Using concave functions in two player situations is simple (as demonstrated by Bolton and Ockenfels) and it is easy to handle analytically, deducting predictions is not overcomplicated. In *n* player cases though it is quite complex as the maxima of the functions are much harder to find. So in this work only a linear model is considered.

Fairness concerns in the IFN model

The detailed explanation for the maximums of the IFN model can be given by examining when the fairness concerns 'kick-in' to decrease utility in case of a specific tie strength. Let's transform the IFN model to the viewpoint of the individual, exchanging the payoff of the other player.

$$U_i = \pi_i - \alpha_i c_{ij} \max\{0, \pi_{Total} - (1 + c_{ij})\pi_i\} - \beta_i c_{ij} \max\{0, (1 + c_{ij})\pi_i - \pi_{Total}\} \quad (2\text{-}2)$$

Due to the presence of c_{ij} guilt and envy play a very small role against a perfect stranger (low tie strength). The utility is maximal at a certain payoff combination. In the Fehr-Schmidt model this is always the completely equal split, while in the IFN model it also depends on the strength of the tie between the players.[52]

The point where fairness concerns don't decrease utility is found by examining when the negative terms in (2-1) and (2-2) equal 0. Given this condition the ratio of the player's payoff compared to the total payoff is the following:

$$\frac{\pi_i}{\pi_{Total}} = \frac{1}{(1 + c_{ij})} \quad (2\text{-}3)$$

[52] Note that this only holds, if $\beta > 0.5$. If it is not true, then pure selfish behaviour emerges.

This expression defines what is perceived to be a ‘fair’ split depending on the tie strength. Simply put if we have a chance of sharing something with our friends (strong tie, close to 1), then we would be hurt if we wouldn’t share, but we pass by homeless beggars (very weak tie, close to 0) each day without a slightest feeling (or maybe a slight one) of guilt. In the former case we prefer equality, but in the latter case we prefer simply giving nothing.

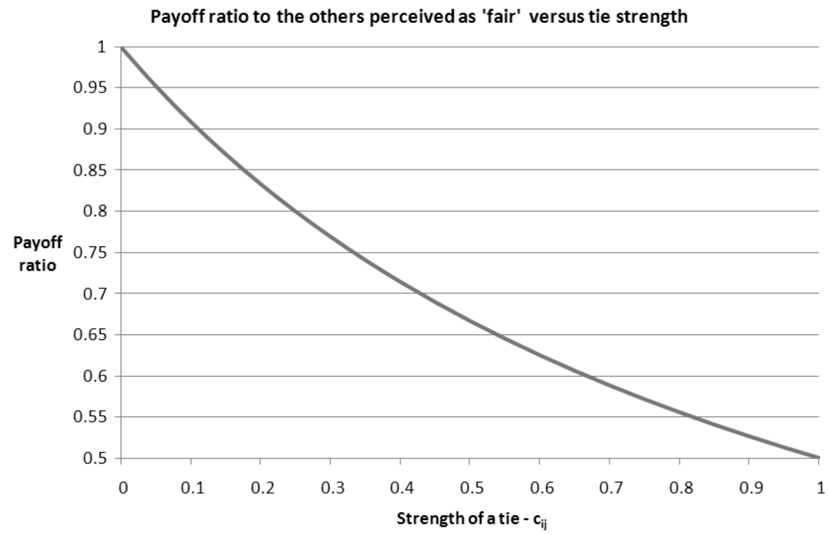

Figure 2.3.: payoff ratio preferred as ‘fair’ vs. tie strength

Figure 2.2 shows (2-3), the payoff ratio where the fairness concerns (negative terms) have the value of 0. This does not correspond to the maximum of the IFN model in all of the cases, since if the tie strength is low, then the maximum will always correspond to a selfish split – as seen in Fig 2.2 when strength is below 0.5.

Players only have abstract ideas about the strength of the tie between themselves and the other players. In the modelling perspective it means that individuals characterize their relationships with thresholds of c_{ij} rather than with one discrete value. So if a player approximates the tie to another player, then as a result a threshold of ‘fair splits’ is also determined, based on Fig 2.3. For example if a player has a tie to the other with strength between 0.75 and 0.85, then the optimal choice in a split is between 0.54 and 0.57.

In the following I’ll analyze behaviour in ultimatum and dictator games based on the IFN model. The analysis shows the differences between the Fehr-Schmidt model, and the IFN model, which further emphasizes the differences between the background and basic assumptions of the classical Fehr and IFN model. Also note that I do only assume Proposer anonymity in the games – further explanation will be given in section 4.

The IFN in n person interactions

The IFN model can be formulated to describe *n* person interactions as well. Here an *n* person interaction means a case of splitting a given pile of good between *n* players. In these cases the terms representing fairness concerns have to be formulated for each other player in the interaction.

$$U_i = \pi_i - \alpha_i \sum_{\substack{j=1 \\ j \neq i}}^{n} c_{ij} \max\{0, \pi_j - c_{ij}\pi_i\} - \beta_i \sum_{\substack{j=1 \\ j \neq i}}^{n} c_{ij} \max\{0, c_{ij}\pi_i - \pi_j\} \qquad (2\text{-}4)$$

This formulation is similar to the formulation of the Fehr-Schmidt model, but the fairness concerns are not ‘weighted’ for the other players. It would not be adequate as then the model would predict absurd utilities in some boundary conditions[53].

This formulation results in a more complex function compared to the dyadic form, so its analytical description is omitted here. The maximum of the model may be found using numerical methods for *n* person interactions. For demonstration purposes a triadic interaction is shown in the following figure.

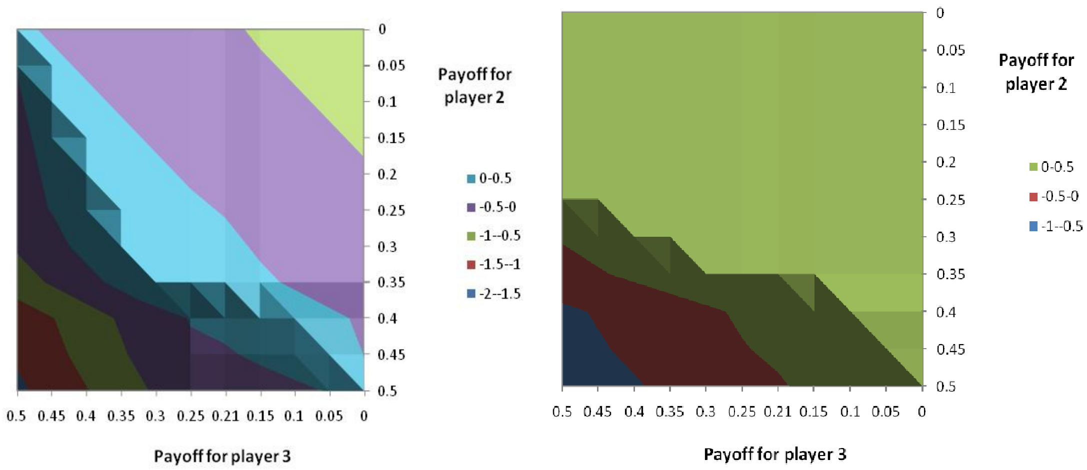

Figure 2.4.: The IFN model in a triadic interaction (*α=1.6, β=0.9,* left: *c_{12}=c_{13}=1,* right: *c_{12}=1, c_{13}=0*)

[53] For example in a triadic interaction if the payoffs are divided as 0.615; 0.385; 0; then the Fehr-Schmidt model would predict positive utility to the second player (in case of α=2; β=0.75). If we assume that the second player has to decide on such a split, then it would be accepted according to the Fehr-Schmidt model even though the inequality in this situation is huge. It wouldn’t be accepted according to the IFN model though, as it will be shown later.

Fig. 2.4 shows a simple situation when a player has strong concerns towards both other players in the triad (left) and when their ties are asymmetric (right). The X axis corresponds to the ratio of goods given to player 3, and the Y axis corresponds to the goods given to player 2. The value (height) of the function is the utility calculated using the IFN model. It may be assumed that player 1 will prefer an allocation which corresponds to the global maximum of the function. The borders between the darker and brighter parts present the local maxima.

The global maximum of the function is at the 0.33-0.33-0.33 split (the equal split) if ties are equal and 0.5-0.5-0 if the player has ties only to one of the other players. Thus as per the initial assumptions of the IFN model the players differentiate between each other depending on their ties. If the ties in a three player interaction are between these boundary conditions, then the IFN's maximum point changes accordingly.

2.3 Model predictions

2.3.1 Behaviour in dyadic interactions

Behaviour in dictator games

Dictator games are examples of voluntary sharing. In this game the decision is only made by one player, so it's sufficient to analyze the IFN model for the proposer only. The Fehr-Schmidt model would dictate that players should split equally in DGs, but the experiments show that behaviour is different. Such proposals in fact do occur, but the median proposal is between 0 and 0.2. According to the Fehr-Schmidt model this would occur when $\beta_1<0.5$. This would mean that a player would gladly give one unit of goods to the other player instead of keeping it.[54]

The Proposers give different proposals depending on the identity of the Responder. The Fehr-Schmidt model does not offer explanation for such behaviour, since according to the model these decisions are based on internalized fairness norms. With the IFN model though both the fully egalitarian and absolutely unfair offers can be explained; plus those offers in between these extremes.

[54] Purely altruistic behaviour corresponds to this. In anonimous interactions with perfect strangers, this does not occur.

In the dictator game the Proposers maximize their utility, so according to the IFN model, they select their payoff so that it would correspond to the maximum of their utility function. In case of a DG offer the fairness concern which describes that the Proposer is worse off can be entirely omitted – it only plays a role when the Proposer would give more to the Responder than what is perceived fair.

$$U_i = \pi_i - \beta_i c_{ij}\left((1+c_{ij})\pi_i - \pi_{Total}\right) \qquad (2\text{-}5)$$

As shown earlier, this does not necessarily correspond to the selfish split of 100-0, but other maximum can be found given the ties between the Proposer and the Responder.

The offers depending on tie strengths can be obtained by calculating the maxima of (2-5). The calculations yield the following results as a prediction for Proposer behaviour in DGs (offer for the other player, the Responder).

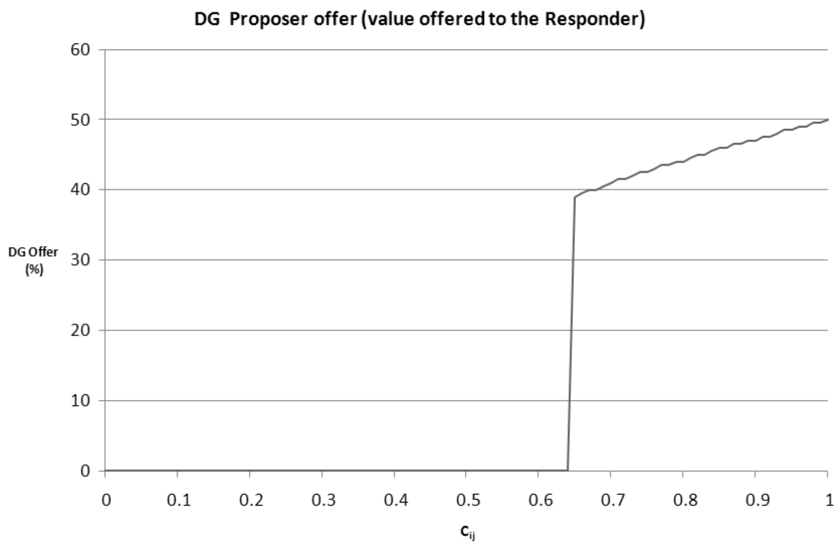

Figure 2.5.: DG Proposal offers vs. tie strength (*α_i=1.8,* and *β_i=0.95*)

According to this figure the Proposer gives a non-zero offer over a given tie strength only. Above that tie strength (0.65 in Fig 2.5) the offer is proportional to the tie strength. The boundary value of the tie strength where non-zero offers are given depending on tie strength may be calculated by further examining (2-5).

As it was assumed in (2-5) only *β*, and the concern against being better off than others should be taken into account in case of DG Proposer behaviour analysis. The tie strength above which non-zero offers are given depends solely on the general attitude (β) of the Proposer.[55]

$$\beta_0 = \frac{1}{c_{12}(1+c_{12})} \qquad (2\text{-}6)$$

If the general attitude toward being better off than others is stronger than the value given by (2-6), then the Proposer gives a non-zero offer.

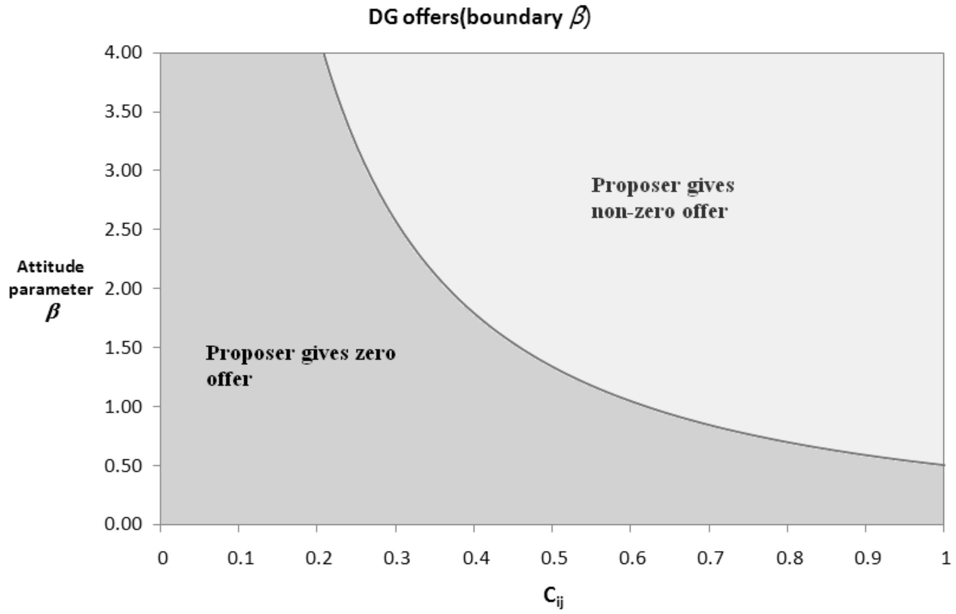

Figure 2.6.: DG Proposer offers depending on general attitude (β) and tie strength

For example if $\beta=0.95$ but the tie is not very strong (<0.65), then a zero offer will be given. Above this value non-zero offers will be given proportionally to the tie strength – as shown in Fig 2.4.[56]

Note that Fig 2.6 shows a weak point of the IFN model – namely that with given attitude parameters some offers frequently occurring in DGs (0.1-0.2) can't be explained. Removing a condition describing the rational actors solves this problem though. As described before the rational actors are able to calculate the explicit values of their utility functions. If we relax the assumption of perfectly accurate utility calculations, this problem does not occur.

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[55] On the deduction of (2-6) see the 7.2 in the appendix.

[56] A further boundary will be given to β in section 2.4.

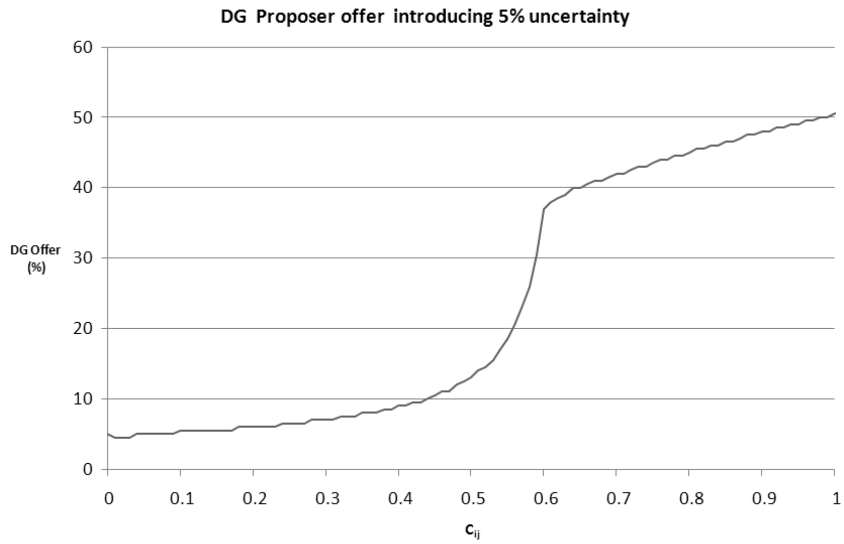

Figure 2.7.: DG Proposal offers vs. tie strength (*α_i=1.8,* and *β_i=1.4*) including 5% uncertainty

In fact just by 'allowing' the proposer to make a 5% inaccuracy in determining the utility (IFN model) maxima these offers may occur. By taking a closer look at the IFN model the reason for this is clearly seen.

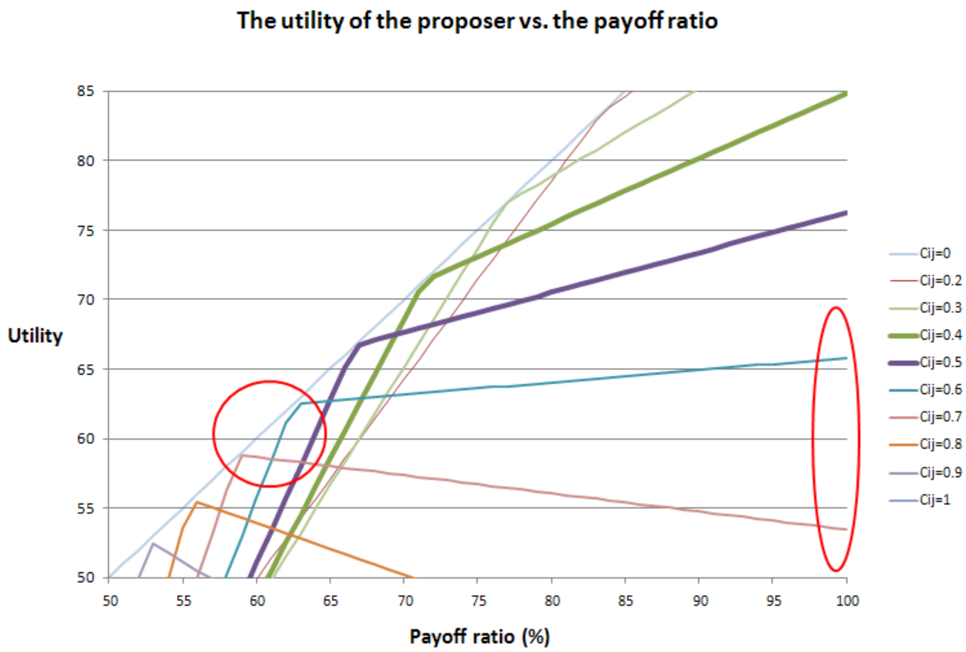

Figure 2.8.: Low difference in utilities at selfish and non-selfish splits

Fig 2.8 shows that in case of certain tie strengths the difference between the utility for a totally unequal offer and a less unequal offer is very small. So while the maxima are at 100-0 offers, a bit uncertainty may turn the offer into a much less unequal one.

As shown here the IFN model predicts that Proposers with strong ties to the Responder will offer an equal split in the DGs regardless of the lack of retaliation, because he's driven by fairness concerns.

If there's a relationship between the Proposer and the Responder, then the Proposer will perceive the game as a situation which would occur in real-life. Due to the anonymity of the Proposer the selfish behaviour is tempting, but the feeling of guilt can't be fully suppressed by the fact that the Proposer's identity will remain unknown for the Responder. Thus it will drive the Proposer to act more 'fairly'. As shown before stronger ties mean stronger preference towards equity.

If there's no relationship between the Proposer and the Responder, then the Proposer will perceive the game as getting goods for free. Without the chance of repetition and without any emotional bounds, the maximum of the utility will be at the 100-0 split. These assumptions are based on the structure of the IFN model. They will be formulated into testable hypotheses in section 3 and will be tested in section 4.

Behaviour in ultimatum games

Since the ultimatum game incorporates the decisions of both proposer and responder, the IFN model has to be analyzed in case of both players. For the sake of simplicity the IFN model is described to the responder first, as the payoff depends on the final decision of the responder. The most important predictions of the Fehr-Schmidt model are regarding the ultimatum responder behaviour, and market interactions. The latter is omitted in this thesis.

Also note that anonymity is totally neglected in this analysis as well, since that would rule out the effect of the ties entirely. This goes against the rules of behavioural economics, but is in line with what we experience in real life. We rarely 'play' UGs with anonymous players. So the assumptions here will describe real life effects, but they will be extended to cover experimental behaviour as well. Responder behaviour in the ultimatum games gives information about Proposer behaviour as well, as the Proposer wishes to anticipate responder behaviour when making the offer.

UG Responder behaviour

The Responder knows the offer of the Proposer, so the game for the Responder is a simple choice. He/she can accept the offer of the Proposer, (getting U_2), or reject the offer, both of them getting 0 (thus having $U_2=0$).

Rejecting an offer is practically a costly punishment of the Responder. Its utility 'covers' the negative utility caused by an unfair offer. This utility is not dealt with in the IFN model (or in the Fehr-Schmidt model). Indirectly it can be measured, because the responder assesses both the relation of the internalized fairness norms and the proposal, and the strength of their relationship, or in other words, how much to 'expect' from the Proposer. The Responder faces the choice of MAX(U_2, 0). If is U_2 negative, then it is rational to reject the offer, if it is positive, then it is rational to accept it (0 represents the value, where a player is indifferent between accepting and rejecting). If U_2 is negative, its absolute value corresponds to the utility 'gained' from the rejection.

The responder's utility can be formalized when accepting the offer (upon rejection it's of course 0):

$$U_2 = \pi_2 - \alpha_2 c_{21}(\pi_{Total} - (1 + c_{21})\pi_2) \qquad (2\text{-}7)$$

So the decision is simple for the responder. Since rationality dictates utility maximizing, the choice is made evaluating the following condition.

$$U_2 \overset{?}{>} 0 \qquad (2\text{-}8)$$

If this condition holds, then the offer is accepted (note that the responder is indifferent between accepting and rejecting if $U_2=0$). Applying the utility function in the expression above, the condition for the payoff ratio at the acceptance is the following.

$$\frac{\pi_2}{\pi_{Total}} > \frac{\alpha_2 c_{21}}{1 + \alpha_2 c_{21}(1 + c_{21})} \qquad (2\text{-}9)$$

Just as in the case of DG rejections, (2-9) is again a non-linear function of the tie strength.

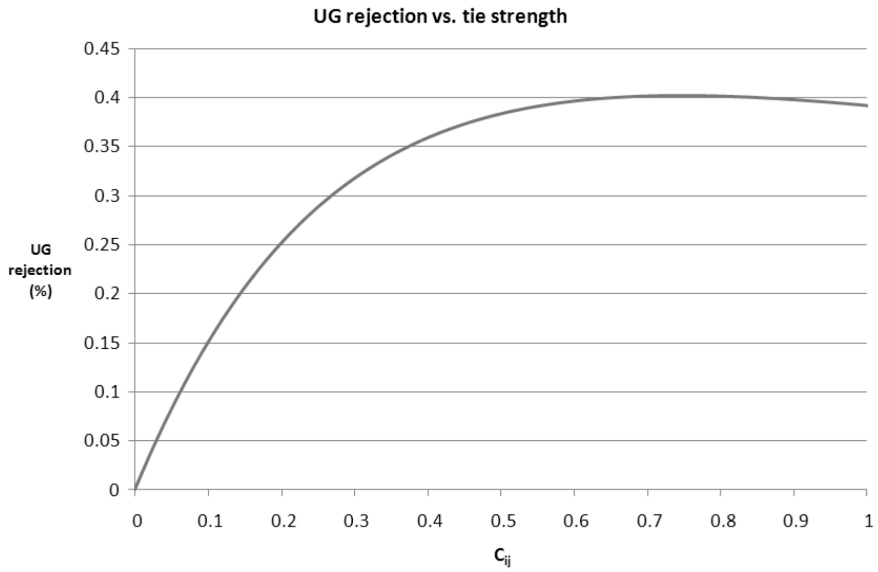

Figure 2.9.: UG rejections (Responder's payoff - %), *α=1.8*

The function is strictly increasing with one maximum which depends on the sensitivity to envy only:

$$c_{21} = \frac{1}{\sqrt{\alpha_2}} \tag{2-10}$$

When considering punishing behaviour, Fig 2.9 describes the willingness to punish depending on the strength of a tie. This figure shows that we get more forgiving with our close friends – note that the difference is not different. Furthermore, if we allow tie strengths to be > 1, then it says that people accept even more unfair offers. This assumption may hold for family ties and thus explains intergenerational redistribution – or why some parents allow their children to exploit them.

Assuming asymmetric ties – and that they're common knowledge – and abandoning anonymity it is possible to describe behaviour with the IFN model using the approach introduced by (Rabin 1993) – the importance of intentions.

The Responder may base his decision based on his beliefs about his tie to the Proposer from the view of the Proposer. In this case the Responder approximates what the Proposer would perceive as 'fair'. This effect can be stronger, when the total payoff is so large, that the Responder would accept a quite unfair offer even from a stranger – the 'stakes' are high enough. In this case the decision is based on what to expect from the Proposer, or to put it differently, what kind of relationship the players have. So responders approximate the strength of the tie perceived by the proposer.

NOTE: This holds purely for asymmetric relationships in the case when the asymmetric property of the tie is common knowledge. More to that, the strength – as stressed before – is not a constant value for the players, but a threshold.

The choice of accepting or rejecting an offer is formalized the following way:

$$\frac{\pi_2}{\pi_{Total}} > \frac{\alpha_2 \overline{c_{12}}}{1+\alpha_2 \overline{c_{12}}\left(1+\overline{c_{12}}\right)} \qquad (2\text{-}11)$$

In this case the responder places him/herself into the proposer's role approximating the tie the proposer perceives ($\overline{c_{12}}$). Based on this assumption the choice is made. This approach is similar to the one introduced by (Rabin 1993), although in this case not the 'intentions' play a major role, but a simple perception of the strength of the tie. In reality it is not always a conscious process, but one based on heuristics and intuition. Since this assumption is hard to grasp empirically, it is omitted in this thesis. If symmetric ties are assumed, then of course this approximation is replaced by the tie c_{21}.

As briefly mentioned before, this analysis concerns real-life behaviour. In the experiments anonymity is used to prevent 'repetition', but in that case the tie strength is not known for the Responder. Still, some conclusions may be drawn taking a look at Fig 2.9. Regardless of the perceived tie, the rejection threshold is usually ~0.35, so we may conclude that even if the Proposer is a PS (which means a low, but non-zero tie strength), the offers below 0.35 are likely to be rejected. As it was shown in the earlier results, this conclusion is valid.

UG Proposer behaviour

The behaviour of the Proposer is influenced by the general attitudes – parameters *α* and *β*. If the fairness concerns are strong (*β* is high), then the split is dictated by the internalized fairness norms. In the other cases the Proposer can maximize his utility if he gives the lowest offer accepted by the Responder.

The offer in this case is given by approximating the envy parameter of the Responder (the α parameter) and considering the strength of their tie. This may be denoted as approximating the 'acceptance threshold' of the Responder and thus determining the set of eligible offers. If the tie is strong and dictates a better offer, than a simple approximation of the Responder's envy, then the Proposer gives that offer. If they're not closely related, the offer is made by approximating the Responder's envy.[57]

The boundary when the fairness norms take over the role of simple selfishness – when the offer is driven by the fairness concerns rather than by guessing the eligible offers and selecting the most advantageous one is described by the following condition:

$$\beta_0 > \frac{1}{c_{12}(1+c_{12})} \tag{2-12}$$

So the general attitudes of the Proposer mainly determine the motives behind a specific offer. A Proposer with high β values (strong concern for fairness) is driven by fairness concerns even at much smaller tie strengths. So such a Proposer gives an offer aiming to abide his own concerns of fairness even with those he's not that closely related to, and not to exploit the weaker position of the Responder in the UG. In this aspect the same thing is observed with guessing-fair behaviour as it was seen in the DGs with zero-non-zero offers. Also (2-12) is the same condition as (2-6) and as seen in Fig. 2.7.

For example if we assume a Proposer with $\beta=1$ then he'll be driven by fairness concerns and will try to give a fair offer even when the tie strength to the other person is higher than 0.62. However if for example $\beta=0.5$ then the Proposer would want to be fair with closely related Responders only ($c_{ij}\cong 1$); he'd give the lowest offer possible (to be accepted) to anybody else.

If (2-12) holds, then the proposer is 'sensitive' enough at the fairness concerns so that the offer is guided by the fairness norms rather than guessing what the Responder would just accept. Figure 2.2 shows, that with fixed attitude parameters the IFN model may have a maximum at non-zero offers for the responder depending on the strength of the tie. This case corresponds to ties, which are strong enough to trigger fairness concerns.

If (2-12) does not hold, then even though the Proposer's utility would suggest giving a low offer to the Responder, but he's aware that its utility may be negative for the Responder. The offer would then be refused, thus the Proposer won't give that offer.

[57] This holds, when the guilt parameter has a lower bound of 0.5, which means that a unit of good yields in higher utility for the proposer than for the responder.

Instead the goal of the Proposer is to find an offer which would yield in the highest payoff for the Proposer and a very small, but positive utility for the Responder – and would assure acceptance. If we consider this case, then the condition of the offer is the following.

$$U_2 \overset{?}{\approx} 0 \tag{2-13}$$

This is different from the condition than the one for Responder behaviour. As per the fourth assumption the Proposer wants to give an acceptable offer, but to maximize his utility, the offer should be as ‘unfair’ as it can be (to provide the highest payoff). So the Proposer is goal is to approximate the point where the Responder would be indifferent between accepting or rejecting; and offer slightly above this level.

Since the Responder parameters are not known to the Proposer, his offer is based on approximations:

$$\frac{\pi_2}{\pi_{Total}} > \frac{\overline{\alpha_2} c_{12}}{1 + \overline{\alpha_2} c_{12} (1 + c_{12})} \tag{2-14}$$

Formally it is also the same as the condition for Responder reaction (see Fig. 2.8), but it includes an approximation for the Responder’s envy ($\overline{\alpha_2}$). This condition also corresponds to the condition formulated with the Fehr-Schmidt model when assuming a strong tie ($c_{12}=1$). The Proposer could also consider approximating the strength of his relationship to the Responder from the Responder’s point of view. In this case (2-14) would include another approximation on the tie strength c_{21} as well.

Summary of UG behaviour

As shown in this section the behaviour of the Proposers and Responders can be fully described by the IFN model. The Proposers are mainly guided by fairness concerns depending on their general attitude – this is an important deviation from the Fehr-Schmidt model –, or may disregard them and would try to guess the lowest acceptable offer for the Responder.

The Responders’ decision depends solely on their fairness concerns (which are composed of their general attitude and the strength of the tie to the Proposer). If we assume Proposer anonymity then the model is to be calculated with assuming a PS as a

Proposer. In this case the tie towards a PS should be taken when calculating (2-9), so the acceptance is based on the general attitude towards fairness only. Note that when the Proposer is assumed to have no fairness concerns at all (e.g. computers) then much lower offers are also accepted.

A comparison with predictions of other fairness models

A wide variety of fairness models was introduced in section 1, so it is an important benchmark of the IFN to give a comparison on what predictions the IFN has for two-person DG and UG behaviour.

Generally the IFN model has predictions in the DG on a wide scale starting from purely selfish offers (if the tie strength is low) to egalitarian splits (if tie strength is high). In the UGs the offers are expected to be near the equal split and the deviation is explained by players having a weak relationship and Proposers trying to guess the acceptance range of the Responder, and responders refusing based on the tie between themselves and the Proposer.

In numerical terms the IFN is worthy of being compared in the DG and UG to the models by Fehr and Schmidt, and Bolton and Ockenfels. The Fehr-Schmidt model allows only 0 and equal splits in the DG, which is clearly not the case, so in this sense the Bolton-Ockenfels model does a better job. In doing that the lack of analytical expression in the Bolton Ockenfels model allows too much flexibility degrading its predictive power. In this sense the IFN model outperforms both Fehr-Schmidt and Bolton-Ockenfels models. This is easily explained by the extra component of the relationships.

The UGs are different in this aspect as they're well described by both Fehr- Schmidt and Bolton-Ockenfels models. Both models allow different acceptance thresholds but the proposer motive in both cases is exclusively guessing the lowest acceptable offer by the Responder. Adding the relationships as a motive for the offers enables the inclusion of altruism into the UG.

In theoretical terms the IFN model shall be compared with the other models mentioned in section 1, including models, by Rabin (Rabin 1993), Charness and Rabin (Charness and Rabin 2002), Cox et. al. (Cox et al. 2007), and Cornelissen et al.

(Cornelissen et al. 2007). Each of these models offers the inclusion of other explaining phenomena resulting in higher descriptive power to the lack of predictiveness. One of the most important factors in behaviour is reciprocity, which is accounted for by Rabin's model (incorporating intentions), Charness and Rabin (giving a simple SVO model including earlier behaviour), and in the model of Cox et. al. (who use their model specifically to analyize reciprocity). In terms of explanatory power each of these models outperform the IFN model. Cornelissen et. al. base their model on SVO and incorporate perceived interpersonal closeness, so it's the closest to the IFN model in terms of explanation. The advantage of the IFN model versus these models is its analytical structure and thus its descriptive power.

These models were used by the authors to provide explanations to existing data rather than to formulate 'exact' predictions, so they shouldn't be compared to the IFN in this sense, but their validity was proven by the experimental results and model fitting. A similar fitting is attempted in section 4.

2.3.2 Behaviour in triadic interactions

Various three player games can be examined by the IFN model, but in this section only two very simple games will be analyzed: the three-person DG and UG. These were the only three player games used in the experiments for this research, so the explanation of other three-player games is omitted in this section.

Behaviour in three person dictator games

Assume that players play a simple type of three person dictator game. In this game the Proposer has to decide on a split between him and two Responders.[58] The decision made by the Proposer consists of splitting the pie into three parts, one part for himself, and the other two parts for the two Responders – it is essentially the same as a dyadic DG, but the goods are to be split among three person by one of them.

This behaviour may be described by using the *n* person form of the IFN model, (2-4). The DG offers are given based on the maximum of the function, which may be

[58] More thoroughly described in section 4 along with the three player ultimatum game used.

calculated with numerical methods. For example if we assume that *β=0.9*, then the DG offer predictions are summarized in the following figure for triadic interactions:

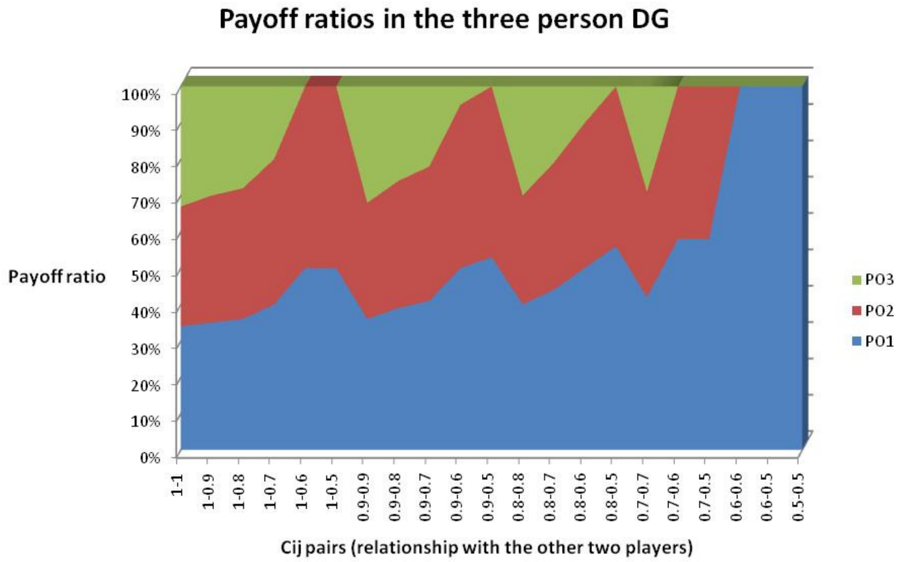

Figure 2.10.: Predictions of the three-person DG offers

Fig 2.10 shows that as the tie strength decreases (shown in pairs) the proposer keeps more and more with offers turning to zero offers only if the tie strength (towards both other players) decreases below 0.6. In analytical terms the payoffs where no fairness concerns are triggered (the third term in the IFN model yields zero) may be calculated similarly to (2-3):

$$\frac{\pi_{Pr}}{\pi_{Total}} = \frac{1}{1 + c_{Pr\,R1} + c_{Pr\,R2}}$$
$$\frac{\pi_{R1}}{\pi_{Total}} = \frac{c_{Pr\,R1}}{1 + c_{Pr\,R1} + c_{Pr\,R2}} \qquad (2\text{-}15)$$
$$\frac{\pi_{R2}}{\pi_{Total}} = \frac{c_{Pr\,R2}}{1 + c_{Pr\,R1} + c_{Pr\,R2}}$$

Note that the values calculated in this manner do not correspond to the offers per se, as they ignore the effect that if the attribute towards guilt and the tie strengths are small enough, then the higher payoff for the proposer simply overrules the fairness concerns. So (2-15) may be used to approximate offers if the tie strength is high enough.

Generally (2-15) summarizes the conclusion of the IFN model: the offers in the three person dictator game are expected to be shared depending on the tie strength (provided that the feeling of guilt is strong enough in the proposer). The Proposer will differentiate between the Responders giving more to the one closer to him.

The three person ultimatum game is an ultimatum game with a second Responder, who does not have any opportunity to take action during the game – it is denoted as the Passive player. Its presence is only to trigger fairness from both the Proposer and the Responder.

In this game the Proposer wants to give an acceptable offer to the Responder given his own tie to the Responder, and his perception of the tie between the Responder and the Passive player. The condition for the acceptance of the offer is formulated by using the aforementioned form of the IFN model adhering (2-15) and assuming the $\pi_{Pr} \geq \pi_{R1} \geq \pi_{R2}$ and the ties are sufficiently strong ($\pi_{Pr} > c_{RPr} * \pi_{Pr}$ and $c_{RPa} * \pi_{R1} > \pi_{R2}$). In this case the IFN model yields the following utility for the Responder:

$$U_R = \pi_R - \alpha_R c_{RPr}(\pi_{Pr} - c_{RPr}\pi_R) - \beta_R c_{RPa}(c_{RPa}\pi_R - \pi_{Pa}) \qquad (2\text{-}16)$$

If this utility is positive for the Responder, the offer will be accepted. If the ties are weaker then these effects are also weaker. Weak ties correspond to unequal splits referred to as 'fair enough', thus the fairness concerns are much weaker in these cases[59]. So the Responder makes his/her decision based on (2-16) being greater than 0 and the Proposer wishes to give such an offer. Hence here it is enough to analyze (2-16) as the Proposer approximates this value when the offer is determined[60].

The Responder's task is to evaluate (2-16) and decide on the acceptance of the offer. But unlike the dyadic situation the decision involves a third player, so it's more complicated. It is more practical to describe the acceptance limit with the payoff ratios. The limit may be derived from the IFN model for the payoff of the Responder and the Passive player:

$$\frac{\pi_R}{\pi_{Pa}} > \frac{\alpha_R c_{RPr}}{1+\alpha_R c_{RPr}^2 - \beta_R c_{RPa}^2} * \frac{\pi_{Pr}}{\pi_{Pa}} - \frac{\beta_R c_{RPa}}{1+\alpha_R c_{RPr}^2 - \beta_R c_{RPa}^2} \left(= a\frac{\pi_{Pr}}{\pi_{Pa}} - b \right) \qquad (2\text{-}17)$$

[59] Such a distribution also shows a weak point in the Fehr-Schmidt model. Calculating with their model results in 0.6-0.4-0 offers accepted by the Responder (*α=2, β=0.75*).

[60] The Proposer also has to approximate the tie between the Responder and the Passive player. For the sake of simplicity it is assumed in this analysis that assumptions are correct.

This expression means that the Responder evaluates his/her own payoff 'status' compared to the other players given the proposed split[61]. If the Proposer and the Responder are indeed close friends (2-17) will converge to (2-9) as both *b* and the last term in the denominator of *a* becomes negligible (since $\beta<\alpha$ as well).

A very interesting question arises when the Responder has a relatively strong tie to the Proposer, but a weaker tie to the Passive player. In this case where's the threshold the Responder would refuse the offer? Which offer would be so unfair, that the Responder would punish his friend to 'avenge' the unfair behaviour versus the third person?

If the tie between the Responder and both other players is strong, then *b* will influence this limit as well. In a sense this defines the 'baseline' of accepting an offer. In certain conditions the strong relationship between the Proposer and the Responder may overrule some fairness concerns. For example if all tie strength is 1, then such extreme offers may be acceptable as 0.5-0.42-0.08. This is highly unfair towards the Passive player, still the IFN model predicts that this offer is above the acceptance limits. Note that offers which contain a zero offer to the Passive player are still rejected – as opposed to the prediction of the Fehr-Schmidt model.

As the relationship between the Responder and the Proposer player changes, the accepted offers become more equal (provided that the tie strength is high between the proposer and the responder. In the table below some extreme predictions of the IFN model are shown. The table shows the offers (green) which are on the verge of being rejected depending on tie strength (red), the structure of the triad. In this sense Table 2.1 shows an 'acceptance limit' for the Responder. It also contains the *a* and *b* parameters defined in (2-17) and the accepted payoff ratio for the Responder.

[61] The expression was formulated as a linear function for the sake of simplicity. The parameters *a* and *b* are used to refer to the more complex expression to simplify the explanation.

Payoffs			*Ties*		*Payoff ratios*		Parameters (2-16)		π_{Rlim}
π_{Pr}	π_{R1}	π_{Pa}	c_{Pr}	c_{Pa}	$\frac{\pi_{Pr}}{\pi_{Pa}}$	$\frac{\pi_R}{\pi_{Pa}}$	a	b	
0.5	0.42	0.08	1	1	6.25	5.22	0.89	0.333333	0.417778
0.54	0.41	0.05	1	0.75	10.8	8.16	0.78	0.218182	0.408
0.58	0.415	0.005	1	0.5	116	82.4	0.71	0.133333	0.411778
0.599	0.4	0.001	1	0	599	399	0.67	0	0.399333
0.46	0.46	0.08	0.75	1	5.75	5.73	1.09	0.545455	0.458182
0.529	0.47	0.001	0.75	0.75	529	466	0.88	0.330275	0.465578
0.425	0.425	0.15	0.5	1	2.833	2.78	1.33	1	0.416667
0.56	0.43	0.01	0.5	0.5	56	42.4	0.76	0.285714	0.42381
0.98	0.01	0.01	0	0	98	0	0	0	0
0.98	0.01	0.01	0	1	98	-3	0	3	-0.03

Table 2.1: acceptance limits of the Responder in the three player UGs (*α=2, β=0.75*)

As seen in table 2.1 if the tie between the Proposer and the Responder are strong then a bit less fair offers are also accepted, while if the tie is weaker then the limits correspond to more equal splits with the most equal expectations arising at around the tie of 0.75. A similar effect was observed in the dyadic form of the IFN, see Fig 2.8.

The most spectacular effect seen in Table 2.1 is the huge unfairness versus the Passive player. The Passive player hardly gets anything in the examples and still the utility of the Responder is positive in case of the IFN model – it is to be emphasized though that zero offers to the Passive player are still rejected.

In common terms the predictions of the IFN model in three player interactions are dramatic. Taking a look at the accepted offers it is very clear that according to the IFN model if we are in a situation where we're about to decide on accepting a split by a given person, we're satisfied with the split even if it gets very unfair to others. Not even the strong relationship helps that. This is even further emphasized if the tie versus the third person is weak, in which case even a token share is judged 'fair enough'.

But also Table 2.1 shows that if we perceive that 'we're lucky to have anything at all' (the tie strength to the Proposer is 0), then we'd gladly accept even very unfair offers. Here we may refer to Simmel's grouping of third player's roles in a triad, because we have a 'laughing third' (tertier gaudens) (Simmel 1967), but here the proposer may take this role according to the predictions of the IFN model, not the third player.

However here I have to make a critique on the IFN model's predictions. People having strong ties, yet treating each other unfairly is not commonly observed behaviour. The very reason for this is that the IFN model lacks the dynamism of repetition excluding both positive and negative reciprocity. If people have strong ties, they expect to interact with each other frequently, and thus they expect to uphold these strong ties by punishing unfairness. So in this case reciprocity may be observed which is unaccounted for in the IFN model.

Still the experimental results of this research are quite controversial as it will be shown later, as in the experiments the Responders in the UG3s always accept offers in which they're better off than the Passive player. These results are found in section 4.

2.4 Boundaries of the model parameters

The extended analysis shows that the IFN model differs significantly from the Fehr-Schmidt model, so the boundary values of model parameters also have to be reconsidered. The analysis of the IFN model has shown that the envy and guilt parameters have the following boundary values:

$0.5 < \beta \quad \alpha \geq \beta$

There are two more boundaries to be set for the parameters, as some values would predict surreal behaviour.

$\beta \leq 1 \quad \alpha \leq 2$

These boundaries are defined to make the IFN model correspond to rational behaviour as it will be introduced in this section.

Boundary of the attitude towards being better off (β)

The first bound gives a lower bound to the general attitude towards being better off – or treating someone unfairly. If this bound is not upheld, then the IFN model (and the Fehr-Schmidt model as well) produces maxima at totally selfish offers only. It means that in DGs there would only be zero offers. As seen in the experimental results, this does not happen.

One logical upper bound for *β* is *α* itself, which means that people are generally more hurt be being treated unfairly, than be treating someone else unfairly. This bound was also formulated for the Fehr-Schmidt model and is concluded based on earlier experimental results (Bolton and Zwick 1995).

Note however that in some cases this would predict completely irrational behaviour. For example if $\beta=1.5$, then irrational choices can be made when choosing between different alternatives. Suppose, that the proposer in a DG played with his best friend ($c_{ij}\approx 1$) has to choose from the following splits: (0.6; 0.4) and (0.3; 0.3). In this case the IFN model yields the following utility.

For the (0.6; 0.4) alternative:

$$U_i = 0.6 - 1.5(0.6 - 0.4) = 0.6 - 0.3 = 0.3$$

and for the (0.3;0.3) split:

$$U_i = 0.3 - 1.5(0.3 - 0.3) = 0.3$$

When considering rational actors, this would mean that the Proposer would rather hurt both himself and the responder to achieve a fair outcome – these alternatives are equivalent! This assumption goes against rationality. We can't neglect that there may be some people who prefer to be fair at all costs (both to themselves and others), but here a higher level of rationality is assumed, so a higher bound for *β* shall be found.

In the previous example the (0.6; 0.4) split should have had more utility – in other words the concern for fairness should be smaller than 1.5. We may assume that there would be Proposers who would sacrifice their well being to come to a better offer, in this terms, they'd prefer an offer of (0.4; 0.4). It is to be assumed that in this case the utility from such a choice is bigger or equal than the utility of (0.6; 0.4). The upper boundary for *β* can be deducted by writing this equation with the IFN model.

$$U(0.6;0.4) = 0.6 - \beta(0.6 - 0.4) = 0.4 = U(0.4;0.4)$$
$$0.6 - 0.2\beta = 0.4$$
$$\beta = 1$$

We can conclude that the acceptance of any lower equal split is not rational so this yields the upper bound for *β:*

$$\beta \le 1$$

Boundaries of the attitude towards being worse off (α)

The second bound is easier to grasp than the first one. It means practically that the envy felt by people when getting unfair offers is stronger than the guilt felt when giving unfair ones – this also corresponds to the Fehr-Schmidt model. Opposed to the Fehr-Schmidt model however, the boundaries of the envy shall be stricter. According to the Fehr-Schmidt model, it's impractical to put an upper bound on envy, since there are people grudging people without any feeling of guilt.

The IFN model behaves differently in this regard as well. According to the IFN model the players are less sensitive to the same unfair offers gotten from strangers to the same gotten from friends. In other words responder behaviour is closing to pure selfishness (accepting nearly anything) when they play with proposers with low tie strength close to 0 (Sanfey et al. 2003). From friends, the unfair offers are mostly rejected. In other words friendship is an 'obligation' to fairness.

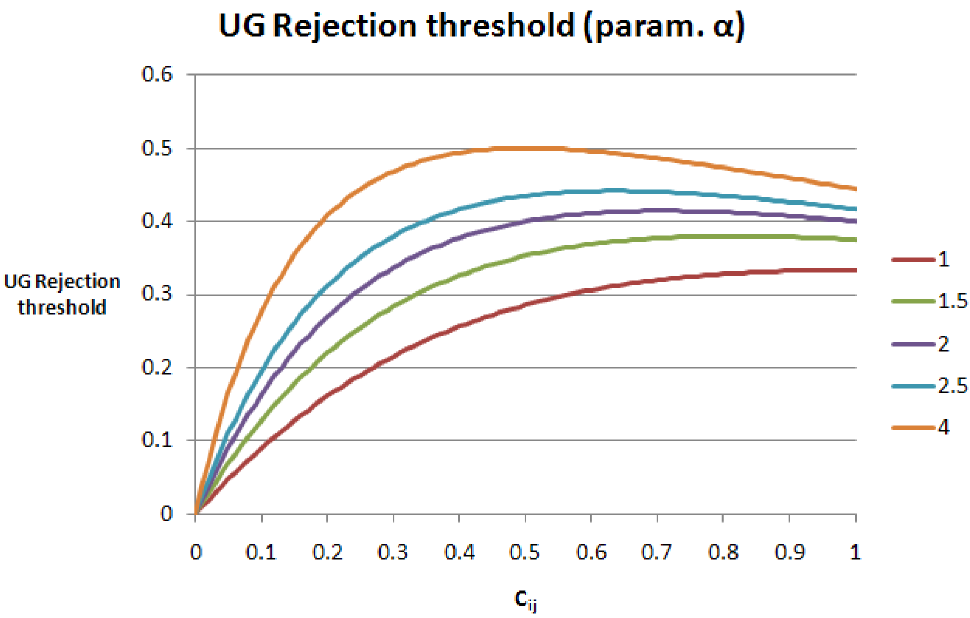

Figure 2.11.: UG Rejection thresholds (multiple curves show dependence on *α*)

This in itself wouldn't suggest that an upper bound should be given to envy, but the interpretation does. If the envy was relatively low (*α=1*), then an offer of 1/3-2/3 was accepted when playing with friends, while if the envy is bigger (*α=4*), then even considerably larger offers were rejected (44%).

In case of the IFN model though the effect of ties should be considered when giving an upper bound to *α*. As Fig. 2.11 shows, if we assumed *α=4*, then the UG rejection values would be unreasonably high (it would even suggest, that equal splits would've been rejected in the UG at a tie strength of 0.5). The experimental results show that rejections were observed up to ~0.44, thus an upper bound shall be put to α keeping in mind this upper bound. Since this corresponds to $\alpha \sim 2$ this should be taken as an upper bound for α.

The upper bound of the strength of the tie corresponds to the analytical limit, as in this case the IFN model is the same as the Fehr-Schmidt model. Between these two boundaries, the rejection limit and the strength of the tie are in non-linear relationship as shown before. So it would be practical to assign certain tie strength threshold to certain types of relationships (known from sight, pal, buddy, and friend). This assignment is not in the scope of this work yet, as it would require a deeper analysis of experimental results obtained from experiments described in the next section.

The IFN model in an SVO perspective

Let's take the example of intergenerational transfers (Kohli and Künemund 2003). In these relationships giving more to another player (the child) is most often observed – and of course we all think it is rational. This corresponds to strength above 1 in the IFN model. If we take a look at it from the social value orientation perspective this can be defined as altruistic behaviour. In this case SVO measures can be put to parallel with the strength of the tie in the IFN model. That means if SVO is denoted with an angle on the space of payoffs (Doi 1994), then the strength of a tie c_{ij} can be interpreted as:

$$c_{ij} = 1 + \sin(\Theta - 45^{\circ})$$

This would explain social orientation and when the individual is altruistic, it yields a number above 1. In this case the IFN model dictates giving most of the resources to the other player, and accepting unfair offers. Correspondence is not perfect though. If the expression holds then at an altruistic player having a SVO angle of 90 degrees cares solely for the other's well-being. In case of the IFN model the proposal in the dictator games is 36%, and people are not willing to give everything to the other player, they care for their own well-being, so they're not purely altruistic.

In the modelling perspective the lower boundary given explicitly means that one is indifferent between sharing equally and keeping everything with the people closest to him/her ($c_{12}=1$). When the tie is not this strong, and concern for being equally off (guilt) is not that strong either, self-interest is a dominant strategy. This would correspond to the behaviour of a sociopath except that sociopaths are usually guided by self-interest (Widom 1976)[62]. The upper bound – as it was stated in the assumption – is essentially the same as of the Fehr-Schmidt model with the exception that the utility of one unit of extra good decreases with the weakening of the tie. So it does correspond to the assumption of the Fehr-Schmidt model when the tie is strong.

[62] Practically the IFN model does not describe 'fairness' anymore at these β values. Sociopath behaviour can not be described by models incorporating the well being of others.

3 Research hypotheses, relevance

3.1 Main hypothesis – fairness and tie strength

The purpose of my research is to present an empirical approach to the definition of the ‘strength of a tie’. To achieve this I have introduced the Integrated Fairness Network model (IFN). In the previous section I have thoroughly examined the IFN model analytically and explained observations in earlier experiments. The strength of the tie is included explicitly in the IFN model as a dimensionless unit.

It is a simple numerical value between 0 and 1, but the idea that it may exceed one is not rejected (it was a possible extension to the model to incorporate intergenerational distribution and family ties). A higher value means stronger tie or in other words more importance. It is thus assumed that the tie strength influences behaviour in bargaining and sharing situations.

As per the IFN model the tie strength influences behaviour in ultimatum games and in dictator games. In the dictator game the proposer should give offers depending on the tie strengths and in the ultimatum game refusals also depend on tie strength.

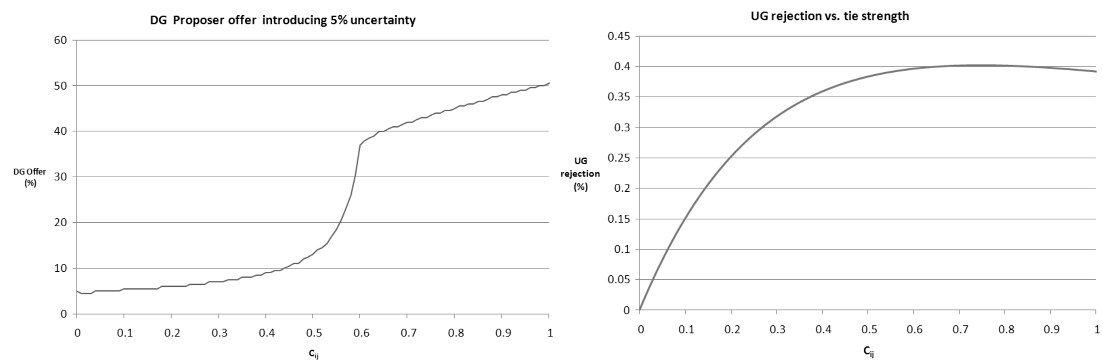

Figure 3.1 (2.7, 2.9).: DG offers (left) and UG Rejection thresholds (right)

In case of stronger ties the offers will be above 30%, but in case of lower ties the offers will converge to the zero offer. The ultimatum game responders will not refuse unfair offers that frequently when they’re not related to the proposer. If the proposer is anonymous, then the proposer will give an offer considering the rejection thresholds.

Hypothesis:

H1. The behaviour in bargaining and sharing situations is influenced by the strength of the tie between the actors. Thus if a actor has a friendship tie towards the other one, then in a dictator game he will likely give a non-zero to the other actor. If there's no relationship between the players in the dictator game, then zero offers and unfair offers will be observed. Also if the tie is strong between players, then the ultimatum game offers will be slightly smaller than when the tie is weaker. This is the conclusion of the IFN model. If the Responder is known in the ultimatum game, then lower rejection rates will be observed.

3.2 Differentiation between friends

Examining the IFN model it can be assumed that the friendships can be 'tested' using DGs. When somebody plays a DG with a friend then the offer will be influenced by the tie between them. If the situation is repeated with another friend, then depending on the tie to the other friend a different offer may occur[63].

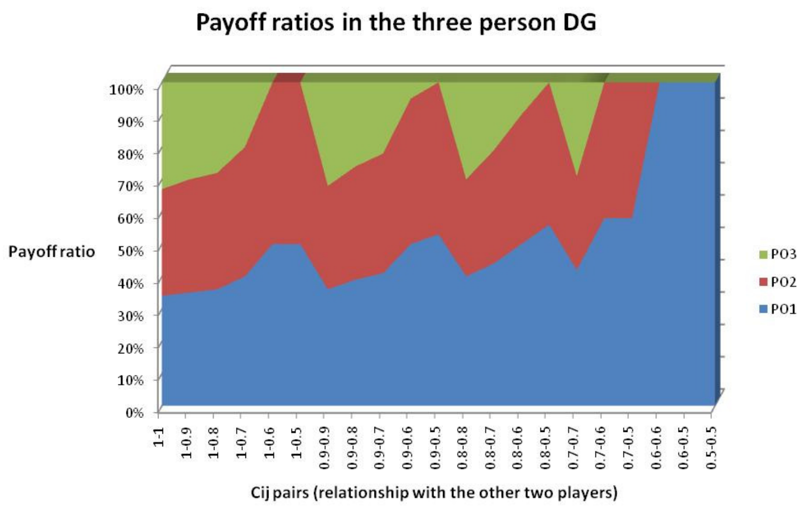

Figure 3.2 (2.10).: Predictions of the three person DG offers

But if an actor plays a DG with multiple Responders, then the Proposer differentiates between friends. The 'fair' split is perceived differently for each tie combination as seen

63 However due to the repetition of the game, learning effects, or temporal effects may influence the offer as well.

in Fig 2.10. If the Proposer remains anonymous, then – given sufficiently strong concerns towards guilt and envy – depending on the ties with the two players different splits may be observed. In case of weaker ties highly unequal splits may also be observed. For example, if a player plays with a friend and a stranger, then the stranger may get a zero offer, while the friend may get a substantial – even equal – amount. It is more interesting if a player plays with a close friend and another friend not so close. In this case the close friend should get proportionally more to their tie strength.

Hypothesis:

H2. When playing three-person dictator games (two Responders) with Proposer anonymity the Proposers will give a different offer to the Responders. The difference depends on the reported (or determined by earlier results) tie strengths according to the predictions of the IFN models.

3.3 General attitudes towards friends

As it was concluded in the analysis of the IFN model people have a general attitude towards being better or worse off. In other words it means that two people having the same tie towards a third one may give behave completely differently in different situations. There are people who are generally more concerned towards treating others fairly or being treated fairly than others.

Hypothesis:

H3. Those Proposers who give higher DG offers in general, refuse higher offers when playing the role of the Responder in UGs, Proposers giving low DG offers tend to accept lower UG offers as well.

3.4 Punishing friends to help strangers

As the IFN model says the UG offers are refused if they are perceived as unfair depending on the tie strength. However in some situations more complex phenomena may occur. In three person ultimatum games fairness concerns may be superposed if the Responder is being much better off than the third party (a Passive player), but worse off than the Proposer by the offer.

In this case these concerns strengthen each other as both terms may substantially decrease utility as per the IFN model. Of course in this case much lower rejection threshold will be observed as the smaller split will be perceived as 'fair'. As per the prediction of the IFN model highly unequal offers given to the Passive player may be observed.

Hypothesis:

H4. In a three person ultimatum game the Responders are willing to punish even if they're substantially better off than the Passive player. They will do so even if they may think that one of their friends has given such an offer. Thus they punish their friends when they treat strangers (playing as Passive players in the 3 person UG) highly unfairly.

3.5 Relevance

3.5.1 Theoretical relevance

The approach of tie strength presented in this thesis cannot be fit into currently used fairness models. By proving these hypotheses it's possible to define the 'strength of a tie' differently than it is in the current literature. The definition based on the IFN model is analytically strong – as it is a numerical model parameter, and also it contains the subjectivity of the individual. A certain relationship can be perceived to be of different strength by the two participants even though they apply the same norms to each other. The individual relation to the norms also influences behaviour. This is in accordance with the SVO literature, but in this case it corresponds to the individual's preferences toward guilt and envy (the parameters in both the classical Fehr and the IFN model).

On the other hand defining the strength of a tie this way connects fairness theory to social network theory. This definition means that even though we have preferences and fairness concerns, we care for whom we're interacting. Thus we 'value' the relation to a person we're interacting in some way, and this can be perceived as the strength of a tie in a network. So the notion of 'strong and weak ties' – as written by Granovetter – are explained in a different, analytically more accessible way. Thus when mapping interpersonal networks the network strength can be denoted by a numerical value.

Also such a value given to the strength of a tie may yield new results in the cases of structural balance theories. In the classical theories (Cartwright and Harary 1956; Heider 1958) the formation of the structural balance was a crucial question concerning unbalanced and balanced tryads. The conclusion says that people always tend to be in balanced tryads. But what happens during balancing? Shall a negative relationship turn into positive or a positive turn into negative? Am I going to make friends with my friend's friend if he was my enemy before, or am I going to express negative behaviour towards my friend and get 'disconnected' from them? These questions are hard to answer, but if we know the strength of the ties, answers can be sought. Thus giving a more accurate definition to the strength of ties which is centred on the interactions between people may contribute to structural balance as well.

3.5.2 Practical relevance

To confirm the hypotheses several types of fairness-network experiments are required. The term 'fairness-network experiment' refers to two and three person UG and DG experiments – the latter explained more extensively later – with participants being friends to some degree. The introduced experimental methods in this paper are working with dyads and tryads with existing relationship – always retaining proposer anonymity to give way to self centred behaviour too and suppress the possible effects of repetition in real life.

Besides supporting the hypotheses the three player experimental games introduced in this paper show a new method to analyze networks. Many fields can make use of these games either as a sociometric method, or as a method to explore latent networks. There were many studies explaining the importance of informal networks for example in companies. One of the most robust studies was (Lund 1985), showing that caring only for the formal networks of a company is not enough. In the study the authors have drawn the trust network, as the informal network behind the company structure to solve the crisis evolving in the company.

Using the experimental games to map organizational networks has more uses than that (Friedkin 1982). Partially it says something about the individual's preferences for fairness, and it also supplies information about the network structure itself. Thus it can be used not just to solve trust crises, but to help in the design of effective formal networks.

It has long been established that the informal networks play a very important role in the efficiency of organizations as well (Krackhardt and Hanson 1993). Multiple types of networks may be found in a company starting from simple communicational networks (advice networks) to deeper relationships, such as trust networks. Some of these networks overlap, some of them are separate. Also the perceived network was found to be determinant in efficiency – misperception of the network of key employees at higher hierarchical levels by themselves results in decreases in efficiency.

Informal networks may work against efficiency in organizations as well, but in this case we may speak rather about conflict between lower and higher sections in the organizational hierarchy (Marschan, Welch, and Welch 1996). It emerges as employees at low hierarchical levels develop a strong informal network in which the negative opinion about higher hierarchical levels (particularly management) spreads. This yields negative attitudes towards the higher levels and decreases compliance with their orders. (Because of this very reason does management try to constrain informal networks in some cases.)

Networks often take each others' places as well. For example in a recent study it was shown how formal networks are disregarded in favour of informal ties in a hierarchical company (Rank 2008). Rank found – examining the data of two German multinational companies – that the managers at higher level effectively use informal networks even disregarding their contacts prescribed by their formal networks. Moreover, a higher number of vertical ties were found to be built than horizontal one, still horizontal formal ties are more frequently disregarded in favour of the informal ties.

Another proof of the importance of informal networks is the field in network analysis, which deals specifically with the issues of organization – that is Organizational Network Analysis. ONA focuses on communication and trust networks mostly, it is used to explore the potential in the organization and to improve efficiency (Cross et al. 2007, 2008).

'Interactional' and 'distributional' fairness and its perception is very important in the efficiency of the organizations (Lamertz 2002; Schminke, Cropanzano, and Rupp 2002). It was shown in these studies that at higher levels of organizations and more formalism facilitates distributional fairness and interactional fairness is positively related to an employee having multiple relationships to higher hierarchical levels (to managers). Note though that these studies were addressing the issue of fairness from the 'justice' perspective, so the interpretation of their results is different from what was done in this research.

Another practically relevant outcome of this research are the novelty in the experimental tools used. They enable a new way of analyzing the informal network by providing a new measure (what is perceived as fair with the other person) to the ties. This may enable uncovering another layer of relationships without actually affecting the relationships themselves.

From the viewpoint of experimental economics this research provides some experience concerning the anonymity effects. Anonymity effects have been breached to some extent, but real life networks have not been tested with UG or DG so far, and also the applied information settings haven't been used in experiments yet. The next section discusses the experimental method in details along with the results.

4 Methodology and results

Using the tools of behavioural economics the model can be validated and the parameters can further be explored. The analysis of the IFN model shows that in the experiments various types of relationships shall be represented. The experimental tools used in this research are – partially because of comparability and the available results – the ultimatum and dictator game.

These games are in use since decades and have been explained earlier, so deeper analysis is omitted here. Besides conducting 'simple' bargaining experiments, the use of three person ultimatum and dictator games proves useful, when examining ties between people. Certain variants of these games have been used in behavioural economics (Büchner et al. 2004), but for validating the models I use three person games with special features.

In this section I'll give a description on the tools used in this research, the experimental design, and finally the results themselves. I give a review on the rules of the experiments focusing on the specific features enabling the investigation of the research hypotheses and the possible biases in the experiments. The presented experimental method is new in the sense of applying one-sided anonymity – an artificial information asymmetry with repeated interactions.

I use the results of the experiments to test my hypotheses formulated in section 3. Due to the low number of cases (64 players, ~1600 played games in total) I do not aim to give a strict proof to the hypotheses, but only to test them with simple means to raise new questions and research directions. Also I used several kinds of treatments and games – this presents a limit to the data usability and clarity, and the experimental focus.[64] The exact case numbers are given at the analysis of the results.

[64] Note that the total experimental budget was app. 750 EU, which of course presented a constraint to sample size.

4.1 Methodology

4.1.1 The experimental design

There are only a few golden rules in experimental economics which have to be kept in mind when conducting games regardless of the specific game being played. The experiments described in this section abided most of these rules (exceptions are explicitly mentioned).

The first one is that the game should be played with real stakes. Players shall be paid in hard currency at the end of the experiment. So the players' goal is to get a good sum at the end of the game in the experiments. Giving real money in a game makes individuals behave selfishly, so it really makes fairness sometimes a painful option. Still if fairness concerns are strong, people will behave altruistically, they will reward and they will punish.

Another golden rule is that the rules have to be common knowledge. Practically every player has to know the rules and that every other player knows the rules[65]. Otherwise some players would take advantage over others and that would result in negative attitude between players or generally towards the experiment itself.

Also anonymity may be very important – in some cases this can also be taken as a golden rule. In some situation researchers are concerned about internalized norms and behavioural patterns regardless of the presence of others. These cases require that no emotions are present between the players. Anonymity assures that. In such games the notion of a 'Perfect Stranger' (PS) is used. A PS a person about whom no information is available to a given player – not even partial information about the identity such as gender, age, ethnic group, etc. Only one information is shared about the PS – that it is a human being. This causes those norms regarding interpersonal exchanges to trigger in game situations.

These rules may be violated in order to investigate interesting effects – as it will be shown in several studies in this thesis. These methods are used by social psychology rather than pure economics. The effect of violating these rules introduces various norms

[65] In literature deviation from that is referred to as information asymmetry.

into a simple experiment – the investigation of the effects of these norms is our purpose in this case; a common research task in social psychology.

The purpose of this experiment was to investigate behaviour in situations where the players are somehow related (mostly simple friendship with a few exceptions only) to each other. To do this two and three player ultimatum games (UG2 and UG3) and dictator games (DG2 and DG3) were played (see details later in this section). Earlier experiments have been conducted with groups of related players, but in those experiments the effects of 'being in the same group' were investigated (Henrich et al. 2004; Vollan 2011). To test my hypotheses and validate the IFN model another approach is required, so some golden rules of behaviour economics have been ignored (discussed later).

The experiment was conducted in a computer lab where players were separated in a way they couldn't communicate (they sat far enough) and their decisions and current roles were not visible to the others. At the beginning of the experiment all players were asked to choose a nickname and enter it in the experimental software. The nicknames were written on the blackboard. These nicknames were used through the whole experiment – they were mostly the real first names.

The number of game rounds varied between the groups from 50 to 80. In each round the players were randomly (or semi-randomly – see experimental treatments) formed into dyads or tryads with roles randomly (or semi-randomly) assigned. The players did not know how many rounds are there exactly in total (however they knew that the maximum number of rounds), nor at which round they're currently at. The players were informed about their own payoffs in the round, and of those whom they played with, but not of the other players' payoff (nor of their identity).

The players were not allowed to communicate during the experiment (nor before) in any way in order to maintain the PSs anonymity. Unfortunately the PSs couldn't be completely separated from the friends in the experiment due to technical and logistical barriers.

The players were paid at the end of the experiments in HUF depending on their payoffs in the experimental games. 6 rounds were randomly chosen from the 50-80 rounds they played, and they were paid according to their payoff in those rounds (in some cases the average was paid, in other cases they were ranked, and a fixed sum was distributed based on their ranking). The average payoff was 3200 HUF (~11.5 EU), which is a non-negligible value for a student. (In the experiments they were asked to share 8000 HUF in each game type.)

The most important feature of the experimental games not abiding the rules of experimental economics was ***one-sided anonymity***. This means that in the UGs and DGs the Proposer was anonymous, but all Responders (in three-player games there were two) were known to the Proposer and each other. Non-anonymous games raise several questions, as if somebody hurts the other person in the games, then the conflict may evolve in their real relationship – this effect is even more emphasized since the experimental groups were in a network in real life. This could be a problem if a Responder accepts a very unfair offer in an UG3 where the Responder and the Passive player are friends[66]. In other cases the Responders may feel being treated well or badly, but since the Proposer is always anonymous, this does not yield the continuation of the game in real life.

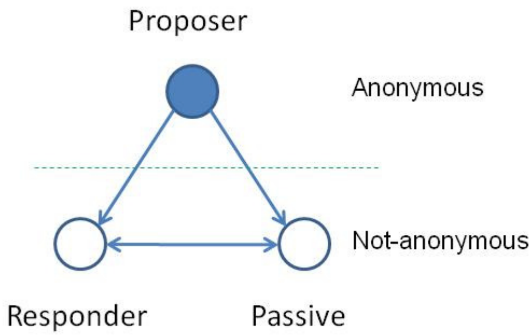

Figure 4.1.: Information asymmetry in one-sided anonymity

The information asymmetry introduced by one-sided anonymity gives the upper hand to the Proposer. To counter its negative effects, each player played numerous rounds of UGs and DGs in random roles. Hence one-sided anonymity was once a drawback, then an advantage.

Being anonymous was relevant for Proposers to trigger ‘real’ decisions. There was no possibility of a re-match in the experiment, as the Proposers’ identity was always kept hidden. So it might have occurred that two players had a re-match, but they were not aware of it. The first-proposer knew who he’s playing with, but once becoming a Responder, he was not aware that the roles were switched.

[66] This issue will be investigated later in this section.

So one could ignore the possibility of retaliation (as his/her identity was not revealed during the experimental round), and make the 'most selfish' decision (keeping everything) possible – the boundary of these decisions were the feelings induced by thinking about not giving anything to the other player. Even though it is not common knowledge, the Proposer 'would know' that he acted unfairly. That itself was enough to deviate from the selfish split even in DGs.

Responders were also asked in some turns to guess whom they were playing with (this information was important in evaluating UG rejections and acceptance). In total the Responders gave a right guess in 32% of the cases. Due to the length of the experiment, they weren't asked each turn. Still, 21.9% of the players reported that the experiment took too long, and 12.5% reported that it was too exhausting.

In the proposed experimental design the number of the players should be a common multiple of two and three. This is practical, because this way dyads and tryads can be formed from the whole groups who play two and three person games. Also one has keep in mind that since the IFN model can be validated by network strength mapping, the size of group shall be able to be handled in a relatively low number of experiments. A practical group size keeping this in mind is either 6 or 12. Since the IFN model is also used to map existing networks, a number of players shall be an existing network. Depending on the ratio of different games played, the players in the network can be different. In the experimental groups consisted of 6 subjects. With this treatment both 3 person and 2 person games can be played simultaneously through the whole group resulting in shorter experiments.

Four among the group members were 'friends'. They were asked about their network via a pre-experiment survey. The other two players were 'perfect strangers' in the sense that they knew neither each other nor the group. Each of the players was given a pre- and post-experimental survey. The pre-experimental survey included the network survey for the friends (in which they had to evaluate their ties from 1 – acquaintance to 5 – closest friend; strangers were coded as a 0 tie), and data about general attitudes towards risk and fairness. The post-experiment survey was designed to collect experiences regarding the experiment. This is required to evaluate the adequacy of the experimental data. Also demographic data was collected. The players had to give their names at both of the survey, but were assured that no data is used by third parties, or outside of the analysis of the experimental results and this research.

Possible biases

As mentioned earlier, there were many rules of behavioural economics violated during the experiment. Some of these violations were intentional (one-sided anonymity), while some were caused by the logistical and technical barriers (size of the computer lab). There were some biases within the experimental groups as well.

<u>One-sided anonymity:</u>

One-sided anonymity may initiate feelings of exposedness and subservience in the Responders. The effects of one-sided anonymity were not investigated in this research, since they were countered in the experiment by having players play each role randomly multiple times. Thus it wasn't a drawback to neither of the players – it was specifically pointed out in the explanations, that every player will be playing in all of the roles.

<u>Personal contact:</u>

The experiments were conducted in a single computer lab, thus there was no way of visually separating players from each other. It was large enough to deny the possibility of communication, but players were able to meet the PSs in person, so they weren't 'perfect' PSs anymore. Since there were only two of them, their behaviour may be affected by the fact that they may be recognized by their offer, and thus gave higher offers than they would in real anonymous situations. Seeing each other during the experiments may have triggered sympathy and gender effects as well.

Also since the groups were composed of friends, we can assume that they'll keep on 'playing the game' in real life, or also they may 'share the sum' at the end. This may caused some intention to work on a profit maximizing strategy for all of the players, but the random structure of the experimental payoffs omitted the use of such strategies.

<u>Group behaviour bias:</u>

There were some experimental groups where considerably more zero-offers were observed than in other groups – see the analysis of the results. It may have been caused by numerous zero offers in the first few turns. The same may apply to 'overly fair' groups.

Group composition bias:

There were three groups consisting entirely of girls, and five groups having only one male player. As shown in earlier experiments women are less selfish than men (Eckel and Grossman 1998), so this may present a bias to general results – but does not affect individual analyses. More than that, two of these groups were game theory class students (unaware of the actual game type played though). These groups also have provided interesting information, but to have their data pooled with the rest, their behaviour has to be examined independently.

4.1.2 Experimental games and treatments

The experiments consisted of multiple rounds of two and three player ultimatum and dictator games. As mentioned earlier the average payoff of 6 randomly selected rounds were paid at the end of the experiments and the payoffs of players participating in the same game (but not their identity) were revealed at the end of an individual turn. So in this sense these games should not be interpreted as repeated interactions, as the pairing was random – and it was told the players that randomness is always assured.

One-sided anonymity was used through the whole experiment for all groups in each game. There were two and three person games of both UG and DG. The games were conducted in a computer lab using networked PCs. The group members were simultaneously playing with each other. They entered the offers and the decisions via their keyboard, there were no other interactions during the experiments.

In two person ultimatum or dictator games they do not really have to explicitly think of their relationship to the other player. They just do rash classifications on the relationship and decide accordingly also including their internalized norms.

Three player UGs and DGs in turn were applied to force Proposers to compare two of his/her relationships, and in this case more thought shall be given to the relations; they have to be compared. Decisions given in these circumstances, and differences in the offers reveal relevant information about the two relationships. In three person DGs for example even the smallest differences in the offer for the two Responders matter, it signals a difference between the tie towards the two of them.

One of the assumptions of the IFN model and the strength of the tie were that people have only assumptions on their tie strength – c_{ij}. They implicitly define thresholds of the tie strength, which are relatively hard to grasp. In three person games however it may occur that these thresholds may overlap. Still people are always able to decide whom they like more in a situation like that, or if the evaluate them as equals.

These three person situations are important not only in the fairness and network perspectives, but also in the structural balance perspective – yet the latter is omitted in this research, but could be a future aim of this research.

Three player ultimatum game

In a three person ultimatum game there's a third person, who's deemed to be 'passive'. The passive player does not have to make any choices, but his presence is very important.

In the game the Proposer proposes a split of goods among them, also knowing their identity. Both Responder and the Passive player get to know the offer instantly. Then the Responder is asked to accept or refuse the offer. As per a simple ultimatum game, if the responder accepts, the payoff in the offer is given to the players. If the responder rejects, neither of them gets anything. After the decision of the Responder each player gets to know the payoffs of himself and all other players.

So in this case the proposer has to approximate not only the fairness preferences of the responder, but also on the preferences regarding sharing with a third person. The proposer has to approximate if the responder cares for fairness toward the passive player, and if in itself the offer is fair enough for the responder.

In this game according to one-sided anonymity only the Proposer had perfect information, he knew the identity of the other two players. The other players only knew each others' identity but not the Proposer's. As the offer was given by the Proposer, it was made available to the other players.

Nor Responder, nor the Passive player had the opportunity to punish, as the Proposer's identity is kept hidden. It may be important to share the identities of the Responder and the Passive player, as in our experimental framework guessing the proposer's identity was also included. So guessing is not about 'blind' guesses in this case, but one done by knowing whom the proposer was asked to split.

Three player dictator game

The three person dictator game is much simpler. In this there is a Proposer, and two Passive players. As per the normal dictator game the Proposer decides how to split a given pool of goods among them. The identity of the Responders is given to the Proposer and to each other. Only the Proposer's identity is hidden in this game – just as in three player UGs. Once the Proposer decides on the split, it is made available to both Responders.

So this game serves information about the relation of the two relationships. If the proposer wishes he/she may give more/less to one passive player than to another one. Thus the purpose of this game is to uncover the differences in the relationships of the Proposer and the Responders. One-sided anonymity is kept in these games as well, so guessing the Proposer's identity may give information about the ideas about the norms of the Responders. Practically if the guess right, then they know who they had been playing – but their 'guess' was still a guess.

Guessing Proposer identity

When Responders play the ultimatum game in such a small group, they inevitably guess the identity of the Proposer (in the experiment the Responder was asked to guess one of the other five people - only four in case of three player games). As mentioned before each player selected a specific ID at the beginning of the experiment, which was used through the experiment (usually a name, or a nickname). This was specifically implemented in this experiment as the Responders (and Passive players) were asked to guess the Proposer's identity in some games after the payoffs have been determined. The players were asked by the experimental software to guess the name of the Proposer. There was no feedback on the outcome of the guessing (nor was the Proposer informed about the guesses), it was only used in data analysis.

Responders give their decision (acceptance/refusal) depending on if they would accept the offer from the Proposer they guess. In the dictator game 'guessing' is not important in this sense, the Responders are not urged to do so, as there's no choice to take. But what the Responders think also gives information about their network – more precisely from who would they get such an offer they got in the DG.

In three person games the same process takes place in a different context. Since Responders are aware of each other's identity, only the Proposer is hidden from them, their guess is based on their perception on the Proposer's connection to them. If they perceive that the Proposer 'equally' likes them, they would expect an equal offer for both of them (not necessarily equal with the Proposer's payoff). So Responders guess the Proposer's identity keeping this in mind.

In the DGs, guessing was done after the Responders got the offer from the Proposers. In UGs it was entered simultaneously with the decision about the offer. There's no reason to expect any effect of the timing of the guessing on the Responders' choice in the UGs.

Treatments in triadic interactions

Due to the mixed relationships within a group purposefully assigning the roles may help in determining the relationship between the group members and the norms applied in similar situations. For example if Responder 1 is a friend of the Proposer and Responder 2 is a PS, then it's expected from the Proposer to give an offer reflecting this difference, for example 50-50-0. A very interesting situation occurs when the proposer plays with two friends. In this case the offer clearly shows if the Proposer feels differently towards the Responders – the most interesting phenomena occur if the Proposer reports the two Responders as equally important in the survey. In this case even the slightest difference between the offers has a meaning.

Of course the game type again mainly influences the offers. In DGs we can observe clear differentiation, while in UGs more complex strategies may be examined. The norms triggered depend generally on the composition of the tryad playing the game. To be able to investigate research hypotheses the tryads were created sometimes artificially (but still randomly). The methods of creating these triads are denoted here as treatments.

The tryads may consist of friends, strangers, and two friends and one stranger. During the experiments the players play in random tryads to avoid adaptation and learning. Interactions among perfect strangers are suitable to explore the fairness concerns of the players and in interpreting the results of the three person games.

Taking into account that an experimental group consisted of 'friends' and 'strangers', there are two possible types of dyads in two player games: 'friend' dyad, or 'stranger' dyad depending on if it contains a strangers.

In three player games the situation gets more complicated. There are 5 combinations: 'friends', 'strangers', 'proposer stranger', 'responder stranger', and 'passive stranger'. The combinations are determined by which role the stranger fulfils.

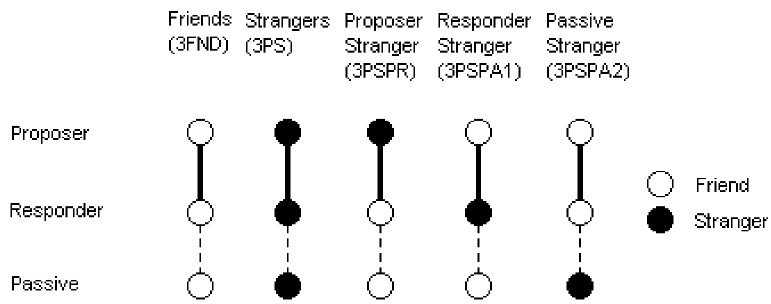

Figure 4.2.: treatments in the three player experimental games

Treatment – Friends (3FND)

The 3FND treatment is a very simple treatment, as the triad involves friends only. If the participants of the triad are friends, and have equally strong attachment to each other, then equal split and acceptance is expected in the UGs. In DGs equal shares shall be paid to friends equally close to the Proposer (but maybe unfair in terms of Proposer share). The relationships can be symmetric or asymmetric. It would be convenient to allow symmetric ties only, but reality dictates otherwise.

The purpose of having friends interacting in a triad in a three player dictator game (DG3) is related to network mapping, or simply put, evaluating their friendship. As mentioned the participants are asked to fill a survey before the experiment takes place. This survey includes questions regarding the network the players are in and it serves as a control for the games, and also as a subjective measure of network strength. Comparing the answers with the results provides us both with information on network and data to help applying the IFN model to the people in the network.

The three player ultimatum game (UG3) shows how control is exhibited in a relationship. In this treatment the Responder and a Passive player was told that one of their friends gave the given offer, so the Responder had a real ‘control’ in deciding upon refusal, and this may be interpreted as a control (since it is committed against a friend) to avoid unequal offers in the upcoming games.

Treatment – Strangers (3PS)

The 3PS treatment corresponds to the experimental conditions in classical experimental economics including PSs only. Using this treatment gives information on what people perceive as a ‘perfect stranger’ in terms of norms, and how they handle them. In other words, what do they expect from an unknown human being? What norms and what expectations were internalized by the person? In the terms of the IFN model: what tie strength does a perfect stranger correspond to?

In three player dictator games this treatment shows the general attitudes of players, the α and β parameters in the IFN models. In three player ultimatum games this treatment lets Responders exhibit control by punishing very unfair offers and shows the Proposer’s assumptions on what ‘tolerance’ can be expected from the Responder.

Treatment – Proposer strangers (3PSPR)

In this treatment a stranger is located in the proposal location, and friends are located at passive/responder positions. Note that this treatment is different from the 3PS treatment, as the Proposer is interaction with people who are somehow related to each other. Playing DG3 in with this treatment shall provide information regarding the self-group effects if the stranger is given the information that the passive players are friends. In this case we would expect more selfish behaviour, giving less to the individuals in the ‘group’ – as a result of not-belonging to the group. If this information is not given, then this treatment is equivalent with the 3PS treatment.

UG3 played with this treatment provides information of in-group solidarity of friends. The most important information extracted from experiments like this is the situation when the friends know each others’ identity, and the stranger does know that the other players are friends. The stranger will have to contribute a substantial amount to both other players, as the Responder shall reject the unfair offers where the Passive player (a friend) is not offered anything because of their friendship. The best offer from the Proposer (stranger) is the equal third split. In this game the Proposer's task is to find out the accepted threshold.

Treatment – Responder stranger (3PSPA1)

Playing DG3 with this treatment shows the emergence of the in-group vs. out-group (stranger) norms. It shows how much more a proposer prefers his own kind versus a stranger. This game does not give explicit information regarding the IFN model parameters, but it certainly supplies information regarding the subjective tie strength – subjective in this case means preference of one player vs. the other. Or in other words it shows how much 'unfairness' is tolerated by the proposer, how 'unfairly' can a friend or a stranger be treated. This is clearly shown in this game, as here the relationships are 'compared'.

In UG3 this treatment is quite important. When the proposer gives an offer, a dilemma emerges. The proposer has preferences for the Passive player (friend), but the acceptance of the offer depends on the Responder (stranger). How much should one propose? The Proposer wishes to have the offer accepted, so it has to be large enough for the responder. In the same time the Proposer has to care for his/her friend. Other than that, this treatment also shows a self-group effect on the side of the Responder, as the rejection is a punishment to both other players (the members of the group the responder does not belong to).

An interesting situation is when the Proposer proposes less to the Responder (stranger) than to the passive player (friend). In this case it would be interesting to see if there is an amount when the stranger accepts the offer which is a bit unfair, but understandable given that the Proposer and Passive players are friends. Also rejection of relatively fair offers may be observed if the Passive player's payoff is judged too high by the Responder as an indication of strong self-preference.

Treatment – Passive stranger (3PSPA2)

In this treatment friends are in the proposer and responder role and a stranger is the passive player. In case of dictator games this treatment is equivalent to the 3PSPA1 treatment.

When playing UG3 though, the proposers may have different choices. One choice is to completely neglect the presence of the Passive player (stranger), and play the UG only with the Responder (friend). But will the Responder agree to this? Will the Responder allow to the Proposer (friend) to give an absolutely unfair offer to the Passive player (stranger)? The most important feature of this treatment that it can show when the responder punishes his/her friends when unfair offers are given to the stranger (for example an offer of 50-50-0).

This treatment gives information on in-group vs. out-group solidarity. When the in-group solidarity is high, responders tend to accept those offers unfair with the passive players. If the out-group solidarity is high enough, then punishing behaviour will emerge as well.

Summary of the treatments

Depending on the number and the role(s) of the PS-s in the three player interactions, various treatments may be applied as shown in the table below.

	Observed phenomenon	
Treatment	**DG3**	**UG3**
3FND	Network mapping	Control
3PS	General attitudes	Control
3PSPR	Self vs. group effects	In-group solidarity
3PSPA1	In-group vs. out-group solidarity	Self vs. group effects
3PSPA2	In-group vs. out-group solidarity	In-group vs. out-group solidarity

Table 4.1.: the use of three person games

As seen the three person games are capable of producing group effects. Some of these do not contribute to the validation of the IFN model, or the explanation of the strength of a tie, but they do introduce important phenomena in structural balance theory, and network mapping – a practical application of the IFN model.

The predictions of the IFN model vary across these treatments. In 3FND treatments the DG3 predictions are given in section 2.3.2 – summarizing it, the offers in the DG3 correspond to the tie between the Proposer and the two other players.

In UG3 the predictions of the IFN are mixed. Even if both friendships are strong, unfair offers may be accepted – note however that such offers won't necessarily be given. A general prediction of the IFN model is that a low number of rejections may be expected if the offer of the Proposer is not too low for the Responder (but may be very low to the Passive player). This prediction does hold for situations where friends are in the role of the Proposer and the Responder.

If the stranger is in the role of the responder in the UG3 then even very unfair offers may be accepted when the Passive player gets nothing. The IFN model predictions for the Responder in this case are similar to the two player games, so even less fair offers are accepted (the Passive player is generally neglected).

4.2 The experimental groups

Using these games along with survey methods the networks can be explored in a different way, asymmetries and relations can be explored with different treatments as described here.

In the experimental sessions 11 groups were tested in total. Each group consisted of 6 players, in total 64 subjects participated in the experiments (two players participated in two separate groups). The only requirement for the groups was that they contained a group of 4 friends, and 2 PSs.

The experimental groups consisted of university students – each subject was currently participating in a programme or has already obtained a degree. The mean age was 22.17 years with a std. deviation of 2.979, so the subjects were of a homogenous age group. (There were only 2 subjects above 30.)

In terms of gender the experimental groups were non-ideal (as previously mentioned at the biases), as the ratio of female and male subjects was 71.2% and 28.8% as opposed to the current distribution of 52.53% and 47.47% (KSH 2005).

In total there were 3 groups consisting only of girls. As shown in earlier experiments, the dominance of women in the experimental groups does have a significant effect on the results (Eckel and Grossman 1998).

Besides gender effects, the cultural background and the perception of the individual's material status also affects behaviour in UGs and DGs. More data on the demographic variables of the subjects may be found in the appendix.

To further control adequate behaviour – meaning that subjects understood their task and the consequences of their behaviour – a test experiment of 4 experimental rounds was ran with the groups. After the experiment they were also asked some questions about their experiences and their opinion about certain details of the experiment. This has shown that subjects understood their task and acted accordingly. Only one subject reported finding the experiment too complicated and too complex; the majority (81.3%) reported not having any problems with the experiment in this sense.

A strong critique of the UG and DG is that it may be harder to compare it to real situations than for example the trust game. A substantial ratio of the subjects (34.4%) reported that the experimental games were not like a real situation, they did not encounter similar situations in life. It's hard to draw conclusions from such a statement regarding the reliability of their behaviour, but no experimental evidence suggests that this factor should be taken into account.[67]

In the following I will analyze the experimental results first giving an overall comparison to earlier experimental results, and then focusing on testing the hypotheses formulated earlier. Some details of the calculations may be found in the appendix.

4.3 A general result compared with earlier experimental results

The general results of the experiments with give an overall picture of the experimental performance and biases (Gulyás 2011a).[68] Besides two-person dictator and ultimatum game (DG2 and UG2 in the following) offers and performance discussed here, three player game (DG3 and UG3) are described shortly as well. For representational purposes (and for simple calculations) the offers have been recoded

[67] This question was used rather to improve the experimental description handed to the subjects.

[68] Note that all results referred to in section 4 are found in the electronic appendix of this thesis.

into centiles. Thus for example 0.4 in the following figures represents all offers between 0.4-0.4999. So in this particular dataset there are numerous fair offers in the 4th centile as well.

Also note that in the experiments with which current results are compared with the steps of offers was 0.1 of the total offer, while in the current experiment it was 0.00013 – so in these terms the players had a much wider scale to choose their offers.

4.3.1 Two person dictator game results

First, the DG2 offers are shown in Fig 4.3 (N=594).[69] The results are recoded so that centiles are shown (for example 0.5 corresponds to offers between 0.5-0.599). It's clearly seen, that there were many offers around the equal split. Compared to the experimental data (with (Hoffman et al. 1994)) the ratio of fair offers is spectacularly higher.

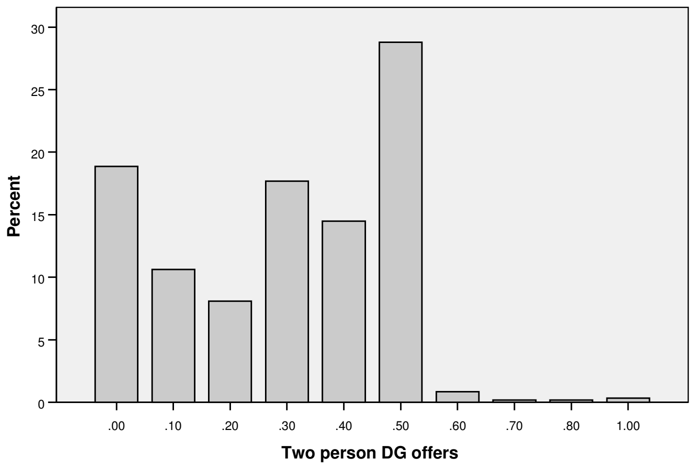

Figure 4.3.: Two person DG offers

The explanation of this phenomenon is quite simple. In the experiments the anonimity was violated (on the proposer side) and the players were in the same room. In case of perfect anonimity (as in Hoffman et. al. – see pp. 365) people are only partially motivated to share – they're influenced by only knowing that they are nice or mean to another human being. In the current experiment the proposers actually knew the

[69] In case of the first two groups some players indicated that they perceived 2 person DGs as UGs (66 games). Checking the means has shown that this had a significant effect only at group 1. After these experiments the experimental software was updated with a clearer description of the task.

responders (but they were anonimous to the responders!), so here even personal motives mattered.

Also note that it was shown in earlier experiments, that women are generally less selfish than men. This has a strong effect in this experiment, as the majority of the subjects were girls. In an earlier study, ~5 times more women offered an equal split in the DG (Eckel and Grossman 1998).

Since the groups were mixed of strangers and friends, a strong effect of the ties can be anticipated. There' a significant difference if people played with strangers or friends. When played with strangers the ratio of the equal splits decreased dramatically, 65% of the offers were below 40%; while when playing with a friend this value was 32% - so players were much less willing to give relatively unfair, or zero offers. The latter cases decreased even more. While zero offers were given in 25% of the cases when playing against a stranger, this decreased to ~5% when playing against a friend. There's a significant statistical relationship (Spearman's ρ=0.383, p<0.0001) between the DG2 offers in the experiment and treatment (2PS/2FND)..

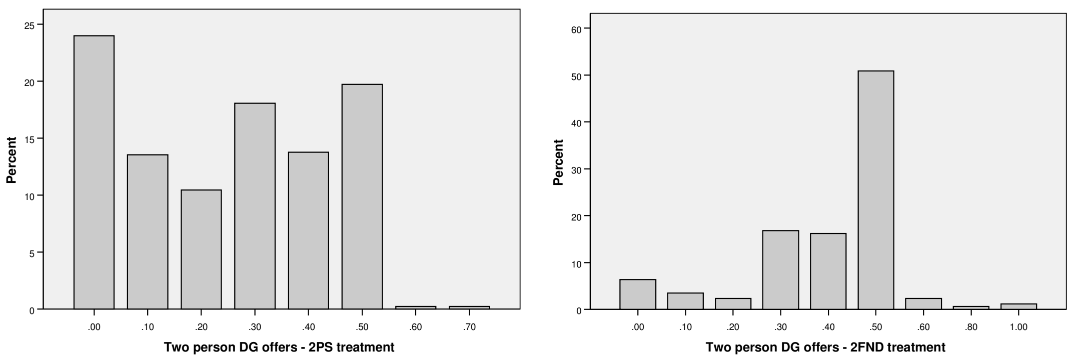

Figure 4.4.: DG offers: played with a stranger (left, N=421) and when played with a friend (right, N=173)

Due to the lower number of male players, no correlation is found between the offer and the gender of the proposer. This is not improved even when the treatments (2PS and 2FND) are examined individually. Comparing the means of the offer shows that the difference is minimal – 0.3 for female Proposers and 0.27 for male Proposers.

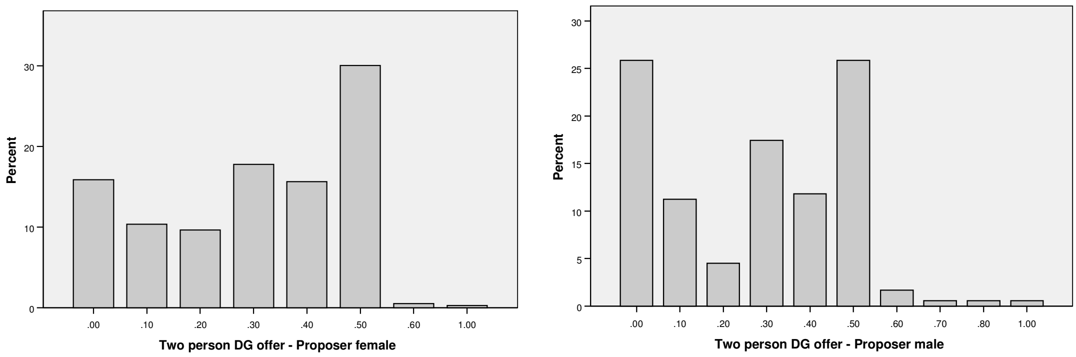

Figure 4.5.: DG offers: women (left, N=416) men (right N=178)

These robust differences shown that the relationship to the other player has a huge impact on the DG offers. Also note that there were groups of game theory students as well – in their case, the offers were even more unequal. Compared to earlier results we can conclude, that the results are in-line with earlier experimental results. Low sample sizes doe not enable us to test the hypotheses, but is enough for an evaluation and an attempt to fit the IFN model to the data.

4.3.2 Two-person ultimatum game results

The UG behaviour shall also be influenced by the ties between players. The general results of UG offers are shown in Fig. 4.6 (N=546) compared to earlier results (Forsythe et al. 1994). Note that the column assined to 0.4 also contain the 0.475 (fair) offers as well.

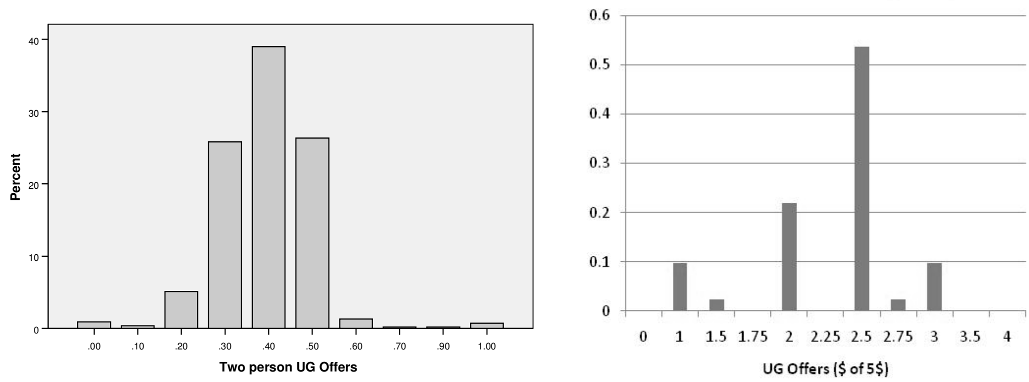

Figure 4.6.: UG offers (left) and the results of Forsythe et. al (1994) (pp. 354) – Pooled UG offers, experiment with pay

Analizing the data in details we can conclude that the experimental results are in line with earlier results. In this case again the identity of the players should be an influencing factor as per the assumptions of the IFN model. Results show, that friends indeed have preferred the equitable outcomes compared to when playing with strangers. The UG offers and the Treatment (2PS or 2FND) are correlated (Spearman's ρ= 0.366, p<0.0001).

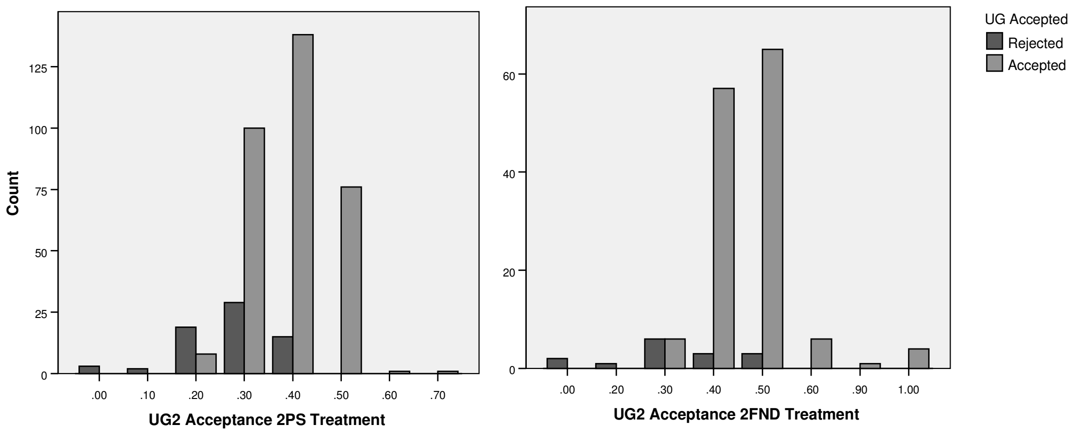

Figure 4.7.: UG offers accepted/rejected in case of playing against strangers (left, N=392) and friends (right, N=154)

Low offers were observed in both treatments, but they were rejected in both cases. If friends were playing though (right), the rejection rate is much higher in case of more unfair offers (below 40%). Also note that when playing against strangers (left), the offers are geneally lower and even not very fair offers were often accepeted.

Rejections were quite frequent in case of lower offers and gender effects were not significant. Offers given by women had a mean of 0.404 and those given by men had a mean of 0.39, there's no significant correlation between gender and UG offers.

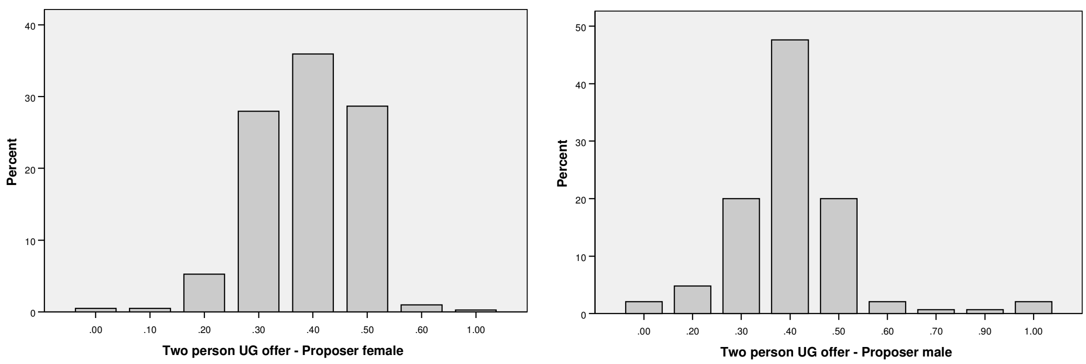

Figure 4.8.: UG offers: women (left, N=401) men (right, N=145)

The same applies to the acceptance rates. As seen in figure 4.8., both women and men rejected all the offers below 0.2., but even higher – still unfair – offers are often rejected. The experimental data shows, that the refusal is not associated with gender at all.

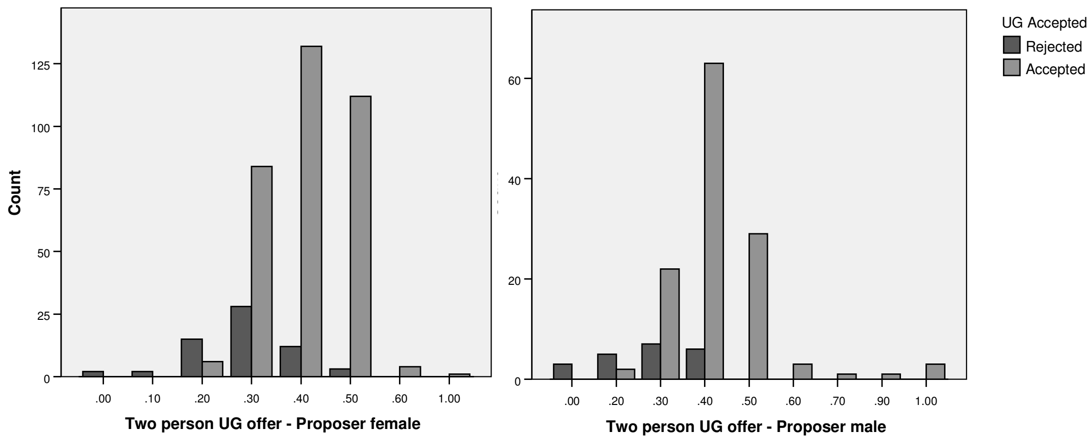

Figure 4.9.: UG acceptance: women (left, N=401) men (right, N=145)

So the general results show, that in both UGs and DGs friendship ties indeed matter. Friends generally preferred equity in their offers regardless of game types, but no gender effects were shown in UGs. Partially this may be due to improper gender ratios, or women dominated groups. The results are in line with earlier experimental results for both UGs and DGs, thus they're adequate to test the hypotheses and fit the IFN model.

4.3.3 Three person game results

The three person games were ran in the treatments described earlier, but here only their overall results are shown. In case of both DG3 and UG3 games there was a wide range of offers. There were many offers in both games which both responders got equal offers (but generally less than what was given to the Proposer.

In the UG3 games (N=220) nearly no double-zero offers were observed. In most of the cases the Responder was offered at least 0.2, but no such statement can be formulated for the offers to the Passive players. Taking a look at possible correlations between the acceptance and the offers we may find that there's a significant correlation (Spearman's $\rho=0.409$, $p<0.001$) between acceptance and the offer to the Responder. The other players' payoffs are disregarded when making a decision on acceptance. Also a logistic regression shows the same result – the only significant term is the ratio offered to the Responder[70].

[70] On the details of the logistic regression, see the appendix.

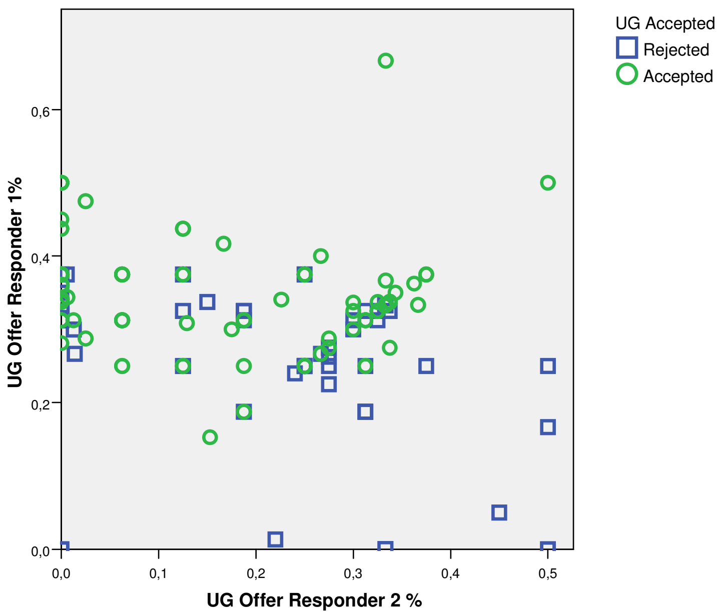

Figure 4.10.: UG3 offers and acceptance (N=220)

The UG3 results shall be compared to the study of Kagel and Wolfe (Kagel and Wolfe 2001), and Güth and van Damme (Güth and van Damme 1998). In the study of Kagel and Wolfe the reacting Responder was chosen randomly. That context is very different from the current one, yet it shows Responder preferences. In these experimental sessions relatively unfair offers were observed of in which the rejection ratio was low, and only very low unfair offers were refused frequently.

The results of the UG3 in our experimental sessions were different, acceptance mostly related to the offer to the Responder. Still, due to the different context the results of Güth and van Damme, and Kagel and Wolfe cannot be explicitly compared with our results.

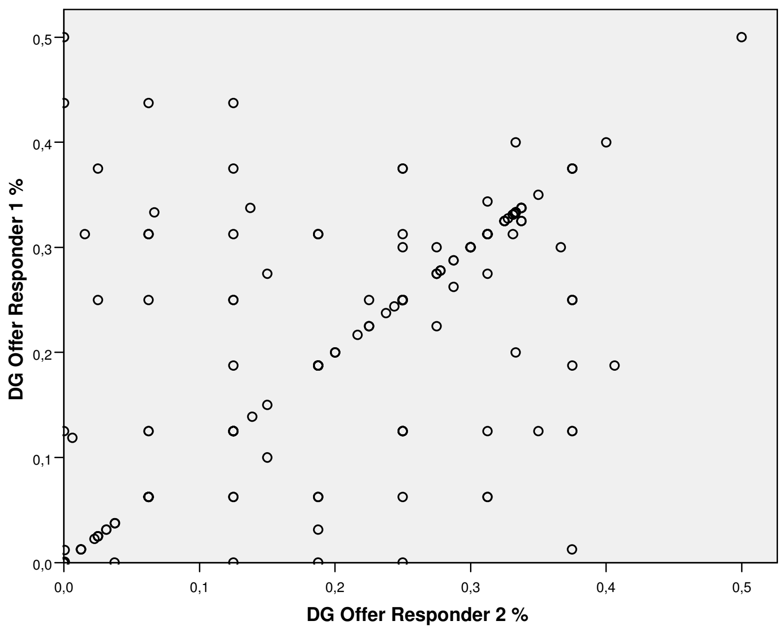

Figure 4.11.: DG3 offers (N=270)

The DG3 results (N=270) showed a much clearer picture. In Fig. 4.11 below a strong tendency of equality is found. Several equal offers are found, but differentiation is clear in several cases. Only a low fraction of offers (3%) resulted in the Proposer having actually less than the other players.

Unfortunately DG3 results can't be compared to the results in the literature as the context was different. The DG3 introduced earlier used other treatments, but anonymity was assured in each sessions. This in itself yields a huge difference to the experimental settings in this research making the DG3 results of Engelmann and Strobel (2004) non-comparable to the current results.

4.4 Testing hypotheses

4.4.1 Main hipothesis, fairness and tie strength

H1. The behaviour in bargaining and sharing situations is influenced by the strength of the tie between the actors. Thus if an actor has a friendship tie towards the other one, then in a DG he will likely give a non-zero to the other actor. If there's no relationship between the players in the dictator game, then zero offers and unfair offers will be observed. Also if the tie is strong between players, then the UG offers will be smaller than when the tie is weaker. This is the conclusion of the IFN model. If the Responder is known in the ultimatum game, then lower rejection rates will be observed.

To investigate this hypothesis one has to look at the DG2 data in the experiments. In this sense this hypothesis means that there is a correlation between DG2 offers and Treatments (2PS and 2FND). So generally we'd expect higher DG2 offers in the 2FND treatment.

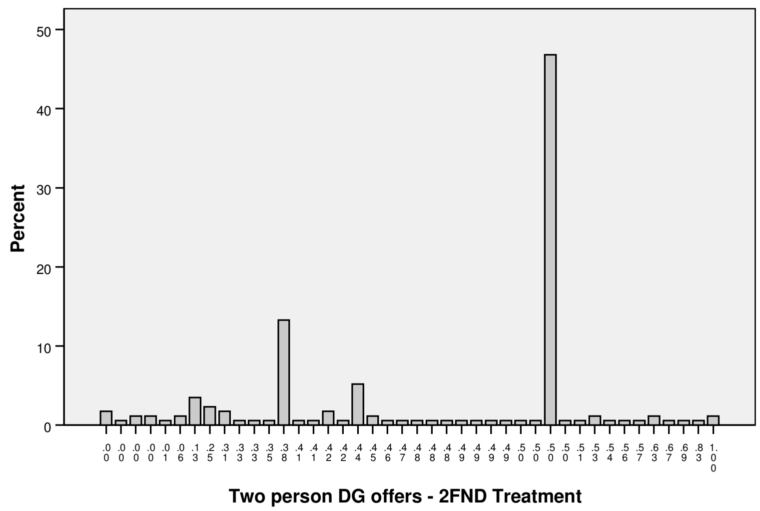

Figure 4.12.: DG offers in the 2FND treatment (N=173)

The offers in the 2FND treatment were very high compared to data from earlier experiments, with a mean of 0.4324 and a std. dev. of 0.15762. Only roughly ten percent of the offers were below 0.3.

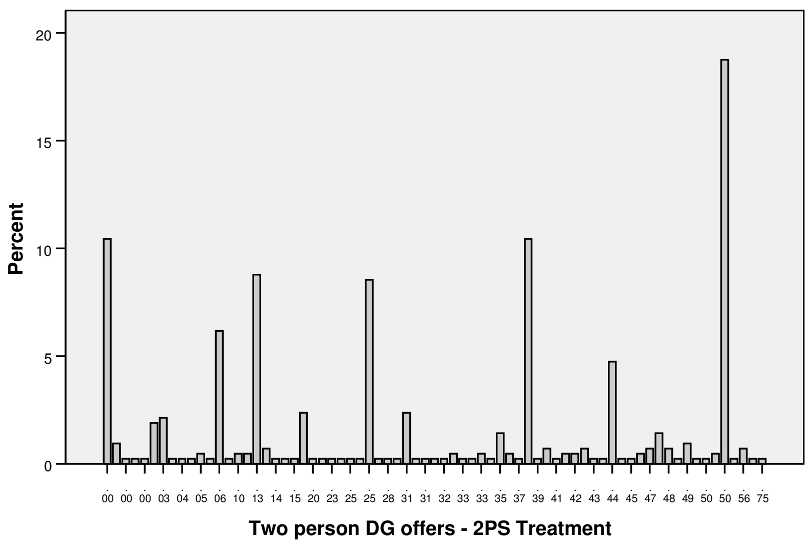

Figure 4.13.: DG offers in the 2PS treatment (N=421)

The 2PS treatment shows quite a different picture though. Here the mean offer was 0.2784 with the std. dev of 0.18698 – so the mean was considerably lower, but the std. deviation increased a lot.

These data show, that there's a difference between 2PS and 2FND offers. This is further backed up by the results of the Wilcoxon-Mann-Whitney test and that the treatment (2PS and 2FND was used only) is significantly correlated with the offers (Spearman's Rho ρ=0.383, p<0.0001). The following tables show the results of these tests.

All these tests are significant, and they **support the first statement in H1.**

The second statement of H1 describes the connection between ties and UG proposer behaviour. In the 2FND treatment the friends shall get better offers than strangers. As shown earlier there is a correlation between UG offers and treatments.

Analyzing the results individually, the offers are not particularly unfair, and as seen in the previous section, the refusals are mainly observed at levels below 0.4. The mean of the offers is 0.4119 with the std. dev. 0.08375. The offers are relatively high with a low std. deviance.

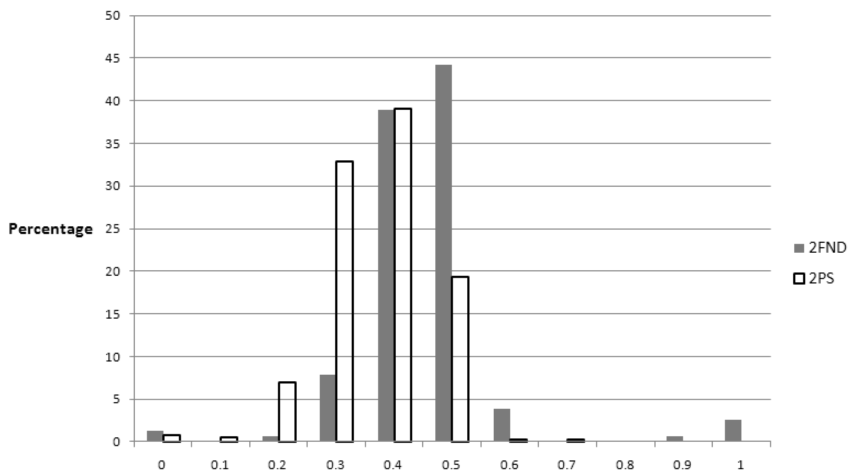

Figure 4.14.: UG offers in the 2PS (N=392) and 2FND (N=154) treatment

In the 2FND treatment the offers were even higher (with less rejections of course, as there's no correlation between rejection thresholds and treatments) with a mean of 0.4881 and a st.dev. of 0.12157.

Note that there are a number of very high, overly fair offers in the UGs. This was observed in case of siblings, and in cases of very close friends only. As it was discussed in the analysis of the IFN model these cases correspond to totally altruistic relationships.

Again there is correlation between the UG2 offers and the treatment (2PS/2FND) and the Wilcoxon test also confirms this (Spearman's Rho ρ=0.331, p<0.0001). Thus it is concluded that since these correlations and the Wilcoxon test are significant they **support H1.**

The results of 2 person DG and UG offers show that, H1 should not be rejected, meaning that there may be a statistical relationship between friendship and UG/DG behaviour. Due to small sample sizes H1 may not be accepted per se, but it is already proved that H1 would worth a more thorough investigation in further research.

4.4.2 Differentiation between friends

H2. When playing three-person dictator games (two Responders) with Proposer anonymity the Proposers will give a different offer to the Responders depending on the tie strengths.

The IFN model assumes that people are influenced in their decisions by the well-being of others depending on their tie. This also means that when more than two are involved in an interaction, different ties affect a person differently. So when somebody is interacting with a friend and a stranger at the same time, a differentiation process takes place.

As mentioned before, a pre-experimental survey was run where the subjects had to report their ties to the others. In the following tests this data is used as a measure for tie strength, as the model fitting (see later) is done by examining behaviour in the experiment. Of course it is not assumed that the answers given to the survey can be used explicitly, so here only the differentiation between two subjects (reporting different 'strengths' of friendship) is used.

In the UG3s and DG3s differentiation means that different offers will be given depending on the reported ties of the Proposer to the Responders. This effect is relatively simple in three player DGs. Here the Proposer has a very easy way to make this differentiation; he simply gives different amount of goods to the others (if he gives any).

In the experiments the DG3 (N=270) results show, that there's indeed a connection between the tie strength difference and giving different amounts to the Responders[71]. As Fig. 4.15 shows if the Proposer has reported different relationships towards the Responders in the pre-experimental survey, then the offers were mostly consequential.

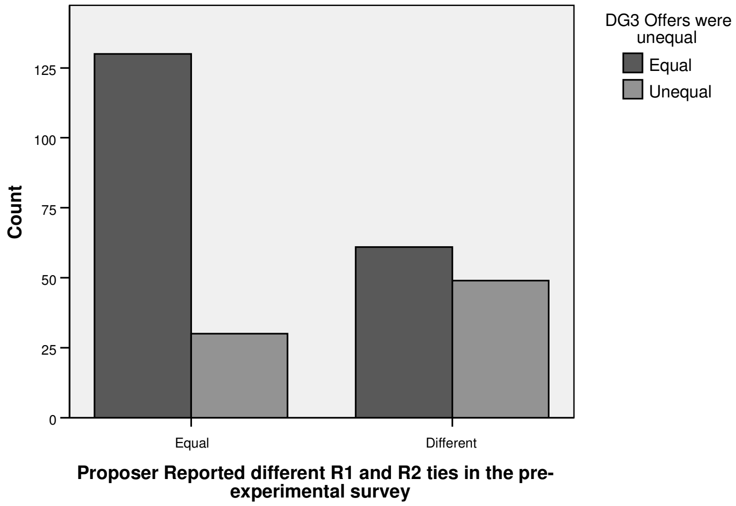

Figure 4.15.: Unequal offers and ties in DG3

When reporting different ties, the results are not so ambiguous, as there are still more equal offers in the DG3-s as Unequal. Note that these also contain zero offers for both Responders. Still, removing double zero offers (N=21) from the sample does not change this connection significantly. The results of the statistical tests are shown in the table below excluding double zero offers.

Taking a look at tie differences reported in the pre-experimental survey and differences in the offers we can find a significant correlation confirmed by the Wilcoxon test as well (Spearman's Rho ρ=0.470, p<0.0001). **This significant connection supports H2** despite that the correlation is weak. Again we have to note here that small sample size does not allow a thorough test of H2, but as in the case of H1 the data gives a solid base for further research.

[71] Cramer's V=0.279 with the significance level of p<0.000 for these variables.

Besides examining DG3 results in this aspect, the UG3 results may be of interest. In the UG3 (N=220) the task of the Proposer is more difficult, as he has to give an offer which is accepted by Responder 1. The offer has to be fair with Responder 1 and not 'too unfair' with Responder 2 to have it accepted by Responder 1.

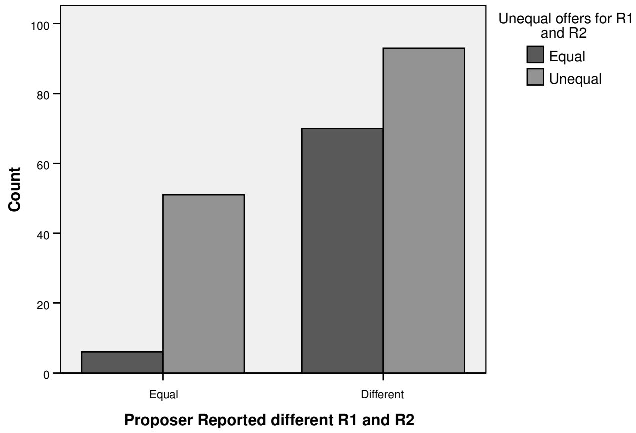

Figure 4.16.: Unequal offers and ties in UG3

Generally the Proposer played with Responders towards whom he had different ties. The connection between having different ties and giving different offers is also significant, but in this case we cannot find relationship (Spearman's Rho ρ=0.144, p<0.033).

This is very easy to explain though. There are many cases, when the Pr-R1 tie is much weaker than the Pr-R2 tie (the 3PSPA1 is specifically this treatment N=70), and in these cases the Proposer has to give a substantial amount to the PS (Responder 1), but does not want to give much less to his friend either (Responder 2).

4.4.3 General attitudes towards fairness

H3. Those Proposers who give higher DG offers in general, refuse higher offers when playing the role of the Responder in UGs, Proposers giving low DG offers tend to accept lower UG offers as well.

In order to check this hypothesis first it's required to see what UG offers were rejected. In UG2-s the refusals (N=83) are strongly connected to the level of the offer –

as it is expected[72]. As H3 states, those players giving high DG2 offers should be those refusing higher UG2 offers.

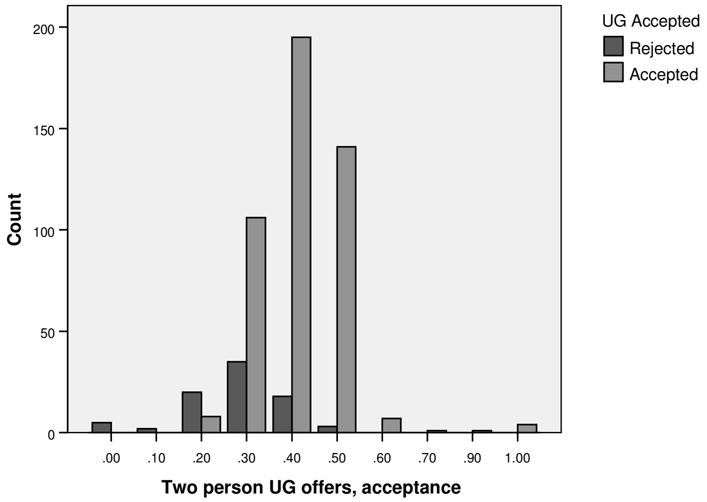

Figure 4.17.: Two person UG offers

Calculating correlation between the refusals and the average DG offers of the Responders refusing the offer shows that there is a significant relationship between refusing an unequal offer and being kind with others at other times (Spearman's ρ=0.333, p<0.002).

The correlation is significant and **supports H3.**

We have to check H3 for the cases of UG3-s as well, though UG3 responder behaviour will be further examined when testing H4. Refusal was experienced in 25% of the UG3-s (N=55). No significant correlation can be found in this case[73], so the UG3 refusals **cannot be used to support H3.**

Based on these results **H3 holds for UG2, but not necessarily for UG3s.** UG3 behaviour is investigated when testing H4, so an explanation for this phenomenon will be given shortly.

4.4.4 Punishing friends to help strangers

H4. In a three person ultimatum game the Responders are willing to punish even if they're substantially better off. They will do so even if they may think that one of their

[72] Cramer's V=0.519 with a significance of 0.000 for the UG2 offers and acceptance.

[73] Spearman's Rho takes a value of -0.124 significant at the p<0.368 level.

friends has given such an offer. Thus they punish their friends when they treat strangers unfairly.

The test of H3 has shown, that the general attitude (DG offers) does not determine UG3 Responder behaviour. So another effect has to be taken into account in this case, which is implicitly stated in H4. Namely that Responder 1 in the UG3 does care for Responder 2. Thus if Responder 2 is treated badly compared to Responder 1, then Responder 1 will refuse the offer.

This phenomenon can occur in the 3PSPA2 treatment only (N=37), with the Proposer and Responder 1 being friends. H4 says in other terms, that we shall experience refusals even when Responder 1 gets substantially more than Responder 2.

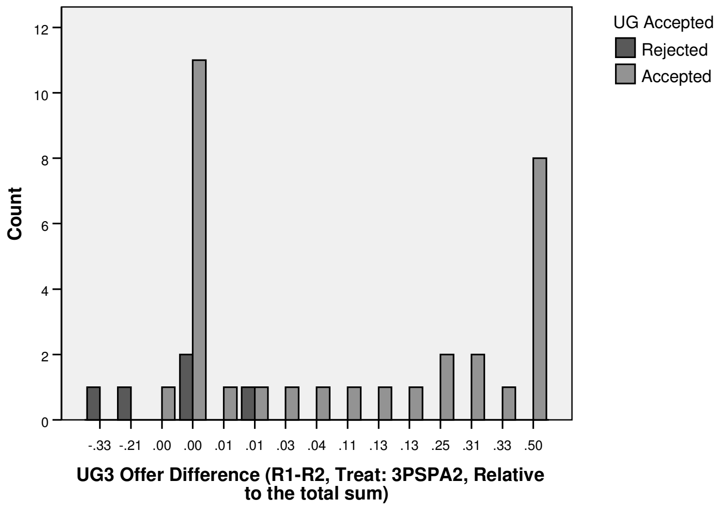

Figure 4.18.: UG3 acceptance/refusal vs. payoff difference in the 3PSPA2 treatment

As Fig. 4.18 shows there practically no refusals if Responder 1 gets more than Responder 2 in the UG3 in this treatment. In fact we may observe quite the contrary, Responder 1 exploits the passive position of Responder 2 – 0.50 corresponds to the case, when the Proposer gave a 50-50-0 offer.

Despite that these results are in line with the predictions of the IFN model, the experimental results **may not be used to investigate H4,** due to the low number of cases (N=37) and the extremely low number of refusals (N=5)**.** Note that these results do not suggest that H4 holds.

4.5 Model fitting and calibration - using experimental data

4.5.1 Methods of model fitting

The research hypotheses of this work emphasized, that if people are closely related with each other, they act more fairly as well. It is intuitively logical, that this phenomenon works the other way around as well – if somebody treats others fairly, he's probably more closely related to him/her or/and his general concerns for fairness are strong.

So in this section I describe how the general attitudes of subjects and their ties may be determined using the IFN model, using data from experiments gathered with the methodology described before. Here I do not aim to compare the IFN model to any other models, since the measure proposed here – the strength of a tie – is too different in nature for a reasonable comparison.

The advantage of the IFN model is that it describes behaviour taking into account the general attitudes of people and their relationships. Thus using the experimental data the behaviour of the subjects may be used to determine the subjects' general attitude parameters and evaluate their relationships.

By fitting the IFN model we're able to map the ego-network (limited to the experimental group of course) of each player. This means that based on experimental results we can approximate the strength of the tie between people. The experimental games with treatments proposed here force people to make choices (offers) according to their intrinsic attitudes and their relationship between people.

Here the IFN model is fit to a set of experimental results – due to low answer rate to a post-experimental survey and unavailability of contacts not all the subjects are able to be included in fitting the model adequately. In their cases approximations are done on their experimental parameters only when determining their relationships (in their cases symmetric ties were assumed and their attitudes were approximated using other subjects' data as well).

In this section the ways of obtaining the general attitude parameters are described first. Some survey questions are given and translated into the terms of the IFN methodology, and general remarks will be given about the parameters. Then the exact methodology of model fitting will be described for the different game types (both two and three person) with a group level model fitting attempt found in the appendix for the current experimental groups. The section concludes with some interesting phenomena observed in different experimental groups.

In case of such a complex model the interpretation of behaviour is very difficult. Before fitting the data from the individual experiments though, the general attitudes of a player should be investigated to improve the accuracy of fitting the model. These attitudes were obtained by using rather complex surveys.

The survey questions are not easy to answer and this presents a serious barrier in model fitting. Also these surveys were post-experimental surveys and the response rate was ~50% (including that the email addresses of some subjects weren't available).

Obtaining α

The first attitude parameter describes how envious a player may be. In terms of the experimental methods used in this thesis it corresponds to ultimatum Responder behaviour. In the UG envy plays a role when the Responder gets an offer different from the non-equal split. If envy wouldn't influence behaviour, then the responders would be willing to accept whatever offer and would even accept zero offers (indifferent in this case). In other words, without feeling envy nobody would be concerned to get the 'fair' split.

According to the IFN model envy takes over rationality, when the offer is so unfair, that its acceptance would yield negative utility – as described in (2-8). Finding this specific limit for an individual player gives his α parameter.

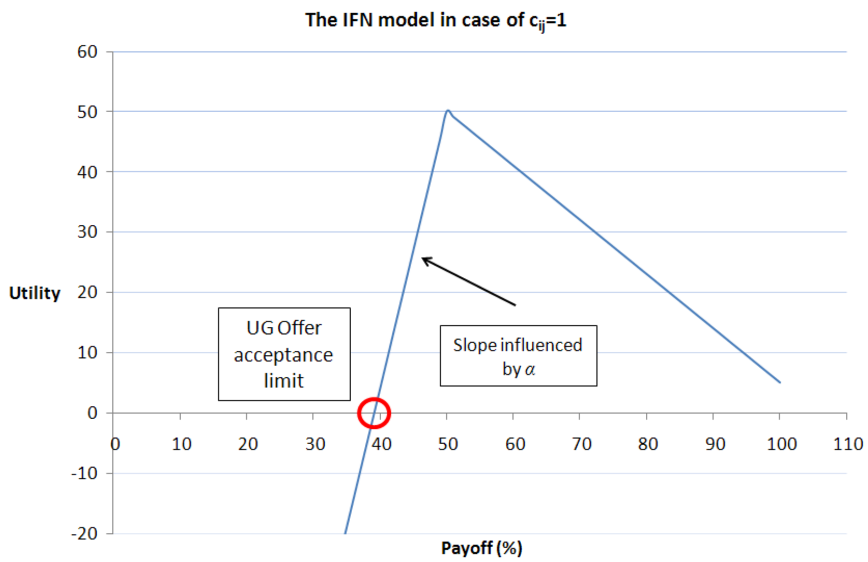

Figure 4.19.: The UG acceptance limit when playing with a friend

When a subject is playing with his/her best friend (*c=1*) then the Fig. 4.19 describes the IFN model. As seen the slope of the model is determined by the envy and the intersection of the IFN model with 0 (the x-axis) shows the point what helps in determining α (as the maximum of the model was predefined by assuming *c=1*), the limit of acceptance/refusal.

Thus if a survey method is used to determine this limit, questions with the following properties should be formulated: they should focus on UG refusals; they should assume playing an UG with the best friend. For example:

'Suppose you're playing the following game with your **best friend**: there's 10000 HUF to be distributed among you, and your best friend. Your best friend will make an offer of the split. If you like the offer and accept it, then both of you gets the money. If you don't like the offer and refuse it, neither of you gets anything. The only other rule in this game is that you can't redistribute your winnings after the game. What offer would you find so unfair that you'd refuse it?'

However as experience shows, such complex questions can hardly be answered by whole numbers as the question itself shall be interpreted into attitudes first. Even though we have brain functions similar to utility calculation, they rather calculate 'desirability of choices' (Glimcher, Dorris, and Bayer 2005). This means that a person can choose between two outcomes by their desirability, but asking somebody to create for example the most desirable split of the pie only in theory (not in real action as in experimental games) may be misleading and overly difficult.

To counter for this effect yet obtain the required limit, the following questions were asked in the post-experimental survey:

‘Suppose you’re playing the following game with your **best friend**: there’s 10000 HUF to be distributed among you, and your best friend. Your best friend will make an offer of the split. If you like the offer and accept it, then both of you get the money. If you don’t like the offer and refuse it, neither of you gets anything. The only other rule in this game is that you can’t redistribute your winnings after the game.

The following table contains the possible choices. Please indicate if you would accept such an offer!

Also please think how you would feel given such an offer! Does the offer hurt you enough to refuse – and thus punish – the proposer if you weren’t playing with your best friend?

Offer	**Accept? (y/n)**	**Would it hurt? (y/n)**
(5000; 5000)		
(5200; 4800)		
(5400; 4600)		
(5600; 4400)		
(5800; 4200)		
(6000; 4000)		
(6200; 3800)		
(6400; 3600)		
(6600; 3400)		

If you have answered only ‘yes’ to the first question then please indicate the value where you’d refuse this offer from your best friend!: ....‘

It is important to notice that it was asked how individuals would feel. This is very important as ‘envy’ is a feeling triggered by the unfair offer. In many surveys the first ‘no’ for acceptance corresponded with the first ‘yes’ for the second question. In some other cases all offers were accepted, but also subjects reported that the offer would hurt them. This indicates that people fight their negative feelings, likely because of the perception that games will continue in real life. Thus the second question contains the information to use in determining α.

The subject’s answer (theoretical behaviour) is described by using the following form of the IFN model:

$$U = \pi_1 - \alpha(\pi_{tot} - 2\pi_1) \quad (4\text{-}1)$$

The boundary condition of the UG refusal is the following:

$$0 = \pi_1 - \alpha(\pi_{tot} - 2\pi_1) \quad (4\text{-}2)$$

Assuming that the total pool of goods is 1 (calculating in relative units) the following α can be calculated using the answer for the question above.

$$\alpha = \frac{\pi_1}{(1 - 2\pi_1)} \quad (4\text{-}3)$$

If the offer to be refused is close to 0.5 (the equal split), then the envy is very strong in the player. In other words being better off would hurt him so much, that even relatively high offers would be refused as well.

Generally the boundaries given to the IFN model in section 2.4 hold, as the values exceed both the β values and are mostly bigger than 1 (the average is 1.58). There were some subjects who did not turn in usable answers. Looking at the model boundaries it's seen, that very few α is above 2, this would mean that the offer of 0.4 is refused even from the best friend by most of the subjects. Higher values correspond to subjects who indicated that even less unfair offers would hurt them.

Obtaining β

This general parameter describes the attitude towards 'guilt' – if somebody is better of then another person, then he's hurt by it. Of course being better off does not yield negative feelings towards others, if there's no relation to the others. For example we're giving zero offers to strangers without any second thought. But if there is a connection, being better off doesn't always feel good.

Obtaining this value however is much more difficult. In the games used in the experiment guilt influences the DG Proposer behaviour. Proposer behaviour in the DG is mainly influenced by the relationships between players, so it can't be used to obtain β – since players maximize their utility and the maximum is influenced by the relationship.

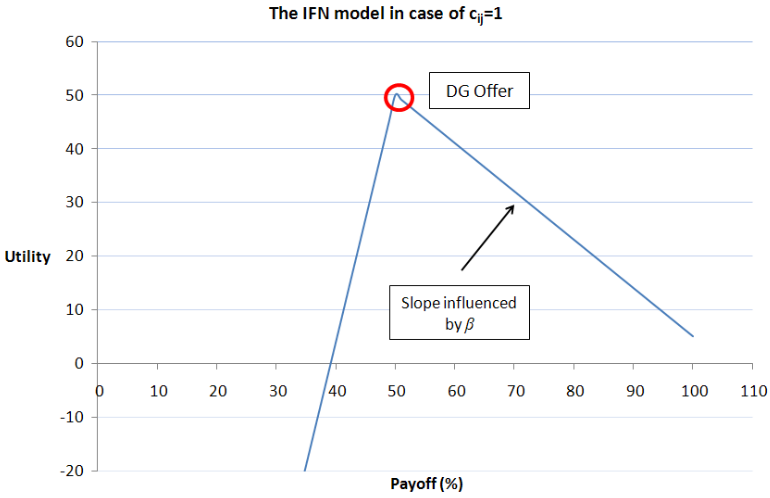

Figure 4.20.: DG offer, the maximum of the IFN model, if $c_{ij}=1$.

The slope of the IFN model – and thus the value where it crosses the payoff axis – is determined by *β*. So if this value could be obtained, then the attitude could be calculated. The player should be forced into a situation where the guilt would drive behaviour rather than the relationship. Keeping the maximum of the model fixed – making the player behave as if he'd be playing with his best friend – is still useful as thus one point of the model is exactly known.

After that either a point on the slope (indicated in fig 4.19.) should be 'found' as through that the slope can be determined, which gives an explicit value of *β*. Such a situation is choosing between situations where a player can be fair, or unfair with others, but introducing different stakes. It means that a player has to choose between accepting an unfair offer (for example 80-20), or a fair offer with considerably less payoff in total (for example 40-40).

In a post-experiment survey the players were asked the following:

'Suppose you're playing the following game with your **best friend**: a third person – unknown to both of you – proposes different splits of 10000 HUF among you, and your best friend. The decision of choosing from the offer is yours. Your best friend is not aware of your possible choices; he/she'll only be notified of his/her winning. The only other rule of the game is that you can't redistribute your winnings after the game. Which choices would you make in the following games?

a.) (7000;3000) or (3000;3000)?
b.) (7000;3000) or (3250;3250)?
c.) (7000;3000) or (3500;3500)?

d.) (7000;3000) or (3750;3750)?
e.) (7000;3000) or (4000;4000)?
f.) (7000;3000) or (4250;4250)?
g.) (7000;3000) or (4500;4500)?
h.) (7000;3000) or (5000;5000)?'

Which decision was the most difficult? (a-h)

Please think in exact amounts now. What would be the equal split what you'd choose as likely as you would choose (7000;3000)? (E.g. (2345;2345)).

The games continue. Which would you choose?

a.) (6000;4000) or (3000;3000)?
b.) (6500;4500) or (3250;3250)?
c.) (7000;3000) or (3500;3500)?
d.) (7500;2500) or (3750;3750)?
e.) (8000;2000) or (4000;4000)?
f.) (8500;1500) or (4250;4250)?
g.) (9000;1000) or (4500;4500)?
h.) (9500;500) or (4750;4750)?
i.) (10000;0) or (5000;5000)? '

When answering these questions the player will opt for the unfair offer (left choices) up to a certain value, and then he'll stick to the fair split (right offer). Denoting the first choice set (a-h) as 'game 1' and the second set (a-i) as 'game 2', it's likely that no player will choose the equal split in the first few choices in game 2, as it'd decrease only his own payoff, but wouldn't mean gain for the other player. It would be a senseless sacrifice in terms of payoffs.

Also it's likely that the players would prefer the fair split in the last two choices in game 1 – their sacrifice 'pays off' in these games. The value of β can be approximated by finding the point where the players turn from the unfair offers to fair offers. In terms of the IFN model this game corresponds to the following expressions in game 1:

$$U(unfair) = 7000 - \beta(7000 - 3000) = 7000 - 4000\beta \tag{4-4}$$

$$U(fair) = \pi_f \quad \pi_f < 7000 \tag{4-5}$$

The latter expression shows that a player is willing to stick to the half of the original offer just to make up for the difference with the other player, or to increase the payoff of the other player. The gains in game 1 can be described the following way:

Choice 1		Choice 2		Sacrifice	Gain	Relative gain
7000	3000	3000	3000	4000	0	0
7000	3000	3250	3250	3750	250	0.066
7000	3000	3500	3500	3500	500	0.143
7000	3000	3750	3750	3250	750	0.231
7000	3000	4000	4000	3000	1000	0.333
7000	3000	4250	4250	2750	1250	0.455
7000	3000	4500	4500	2500	1500	0.6
7000	3000	4750	4750	2250	1750	0.778
7000	3000	5000	5000	2000	2000	1

Table 4.2.: sacrifices and gain from the choices

As table 4.2 shows choice 2 produces less total payoffs for all cases (except for the last). Relative gains show the ratio of the sacrifice done by the player and the gain of the best friend of the player – the ‘efficiency’ of the sacrifice. Of course the sacrifice is biggest in the last game, but then it’s the most effective.

Suppose that a player chooses 1 in case if it is (7000;3000), but chooses 2 (3750;3750) in the next game. Let’s suppose, that both of these games correspond to the case when the choices are near equal. So (4-4)=(4-5) has to be calculated.

$$\pi_f = 7000 - 4000\beta$$
$$\beta = \frac{7000 - \pi_f}{4000} \qquad (4\text{-}6)$$

So for this case we can conclude based on (4-6) that $\beta=0.81$. The same calculations are omitted for game 2, the games are shown analytically instead.

Fig. 4.21 is not easy to interpret though. The dashed lines represent the IFN model for various β values and the solid lines important lines representing games. Game 1 is represented by the simple vertical line its intersection with the IFN model containing important information.

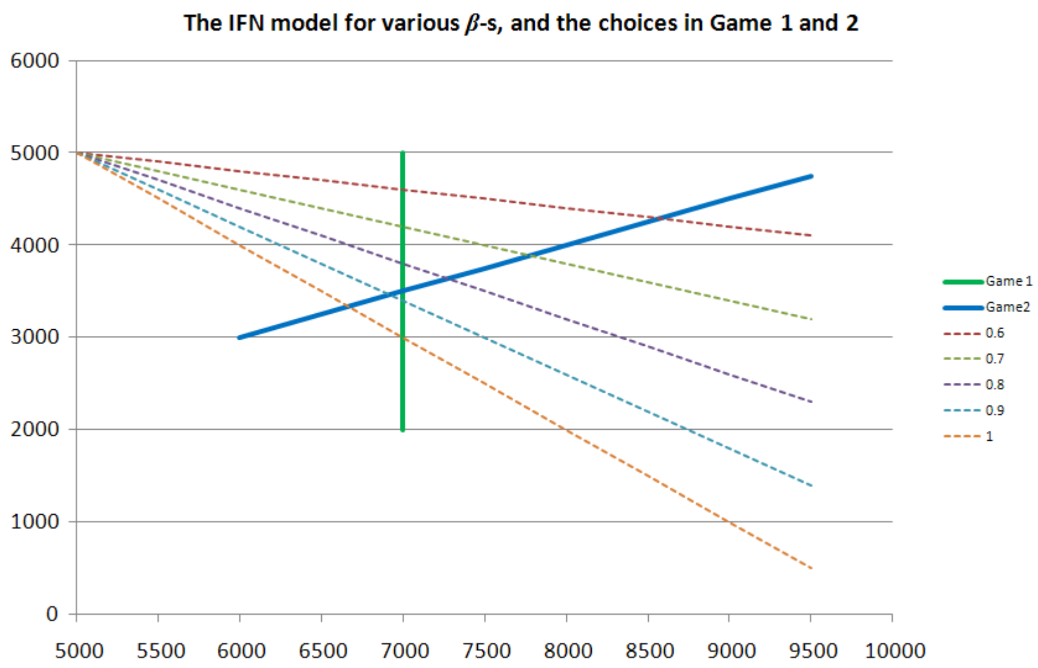

Figure 4.21.: Analytical representation of game 1 and game 2 and the IFN model, if $c_{ij}=1$.

The choice of an individual is the hardest when the utility of the offered equal split is similar to the utility of the offered unequal split. The twist lies in the fact that the offered equal split is always less (in total) than the unfair offer which is about splitting (10000 HUF). So Fig. 4.21 in case of game 1 explicitly tells what equal payoffs yield the same utility as the 7000-3000 split. For example with a $\beta=0.9$ the player will assign similar utility to the split of 3400-3400 than to 7000-3000; with a $\beta=0.6$ this offer will be 4600-4600. So if the equal offer is below these values, the player would choose 7000-3000 instead.

Game 2 is visualized similarly, but in that case the unequal offer changes. The blue line shows the utility of the equal split offered as an alternative to the more and more unequal split. For example the value at 6000 shows the utility of the choice given as an alternative to the 6000-4000 split – in this case 3000-3000. The intersection of the IFN models in this case explicitly show which choice is made, depending on β. For example if a player with $\beta=0.7$ would face the choice between 7500-2500 and 3750-3750, he would choose the latter one – in Fig 4.21 the IFN model for this player gives a lower utility (3000) at 7500 than the line representing game 2 (giving a utility of 3750).

Note that in case of game 2 the existence of different pools in the splits may be confusing for this figure, but note that the absolute utility is shown in all cases making the different pools comparable in utility terms.

The results of these two games were used to determine the β-s of the experimental subjects. Taking a quick look at the data, the condition, that $\beta<\alpha$ holds for each subject who answered the survey questions to determine α adequately. Also $\beta\leq 1$ holds for most of the players. Those who indicated otherwise answered irrationally to the first question in both game 1 and game 2 in the survey.

Model fitting using DG and UG results

According to the IFN model behaviour in the DG and UG can be described by formulating the IFN model for a given player. So if the general attitudes of the player are known and also the strength of the tie between the players is known, the IFN model can predict the offers in the DG and the acceptance limit in the UG.

The IFN model works like this in theory only, the practical application is quite different. While it was shown how the behaviour can be fit to the IFN model, in real applications we have to fit the model to the behaviour to obtain information regarding the ties between players.

Different information can be gathered from UG and DG data. Proposer behaviour is used in case of DGs, while Responder behaviour is used practically in case of UGs. As it was shown in section 2, the IFN model describes these behaviours if the general attitude parameters are known.

As discussed above both general attitude parameters can be determined using surveys for a given subjects, thus there is only one variable left in the IFN model: the tie strength.

$$U_i = \pi_i - \alpha_i c_{ij} \max\{0, \pi_j - c_{ij}\pi_i\} - \beta_i c_{ij} \max\{0, c_{ij}\pi_i - \pi_j\} \qquad (2\text{-}1)$$

In DGs the payoff represents the maximum of the IFN model for the Proposer, so the tie strength can be determined based on the behaviour. It can be assumed that the offer given by the Proposer corresponds to the maximum of the IFN model. In this case the second term in (2-1) is assumed to be 0 (the offer is <0.5), and the same holds for the third term. The Proposer aims to ‘set’ the third term to zero as it corresponds to the maximal utility. Obtaining the tie strength from (2-1) and (2-3):

$$c_{ij} = \frac{\pi_{total}}{\pi_i} - 1 \tag{4-7}$$

If the pool is normalized then this expression is even simpler. Suppose for example that the offer is 0.55 – in this case (4-7) results in $c_{ij}=0.81$. Of course it is difficult to determine the relationship if the Proposer gives a zero offer. In this case only a condition can be formulated based on the condition of the zero offers.

As described in section 2 the zero offers depend on the attitude towards being better off than others, the β value of a player. So the zero offers can be expressed using (2-5) – see 7.3 in the appendix.

$$c_{12} < -\frac{1}{2} + \sqrt{\frac{1}{4} + \frac{1}{\beta}} \tag{4-8}$$

This expression gives the upper bound for tie strength. For example if the Proposer having a $\beta=0.85$ gives a zero offer than we can conclude that the tie strength between them is *less than* 0.694 – the latter value calculated with (4-8).

The UG results can be used from the Responder side mostly as the UG Proposals are influenced rather by strategies (the perception of the fairness norms of the Responder) than the fairness norms of the Proposer. The most important feature of the UG is the refused offers. We cannot give an exact tie strength value based on UG rejections, but a limit can be given according to (2-8).

$$\frac{\pi_2}{\pi_{Total}} > \frac{\alpha_2 c_{21}}{1 + \alpha_2 c_{21}(1 + c_{21})} \tag{2-8}$$

The method of calculating this limit is deducted from this expression - see appendix.

$$c_{21} < \frac{\left(\alpha_2 - \alpha_2 \frac{\pi_2}{\pi_{Total}}\right) \pm \sqrt{\left(\alpha_2 \frac{\pi_2}{\pi_{Total}} - \alpha_2\right)^2 - 4\alpha_2 \left(\frac{\pi_2}{\pi_{Total}}\right)^2}}{2\alpha_2 \frac{\pi_2}{\pi_{Total}}} \tag{4-9}$$

Again, if the payoff is normalized to 1 then the analytical function is simpler. This yields that there are two tie strength values for each payoff, but this is due to that (2-8) is concave and (4-9) is practically its inverse.

It is easier to use a graphical method to determine the limit than the analytical solution of (4-9). Fig. 4.22 shows (2-9) for a fixed α, from which the limits can be determined.

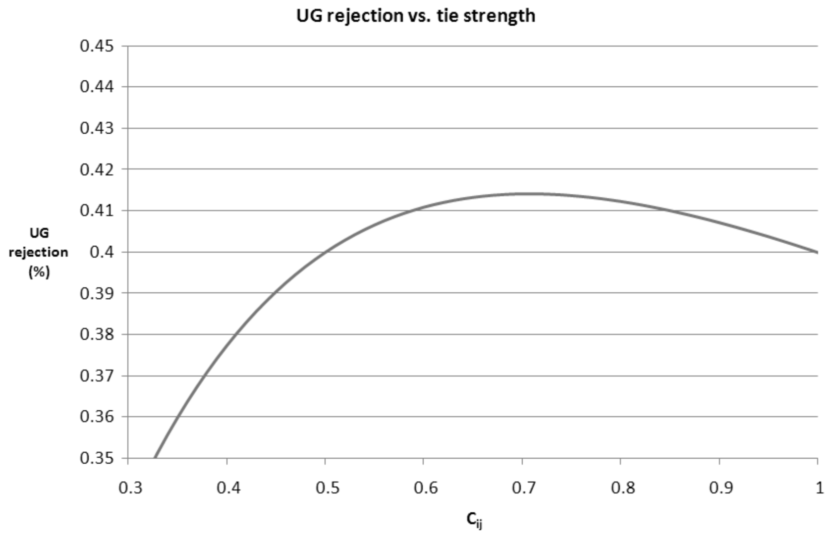

Figure 4.22 (2.7).: UG rejections (Responder's payoff - %), α=*1.8*

Let's suppose for example that such a player has *refused* an offer of 0.3875. Thus we can conclude that the tie strength is higher than ~0.45. If the same player has *accepted* an offer of 0.41 then we can conclude that the tie strength is above 0.85 or lower than ~0.6. Naturally using UG refusals (and acceptance) in this manner should be used in conjunction with DG results, but in some cases only such results were available.

4.5.2 Summary of the group level fitting

The experimental groups in this research were quite diverse. Unfortunately the post-experimental survey response rates were poor (40%), so the exact model fitting is difficult. The reported attitudes are also quite diverse and many responders could not answer all the questions adequately.

Still there were many quite interesting phenomena uncovered in the experiments and accounted for by the general attitudes – as predicted by the IFN model. The overall results of fitting the IFN models show that the ties may be compared and that players are consistent in their behaviour. Players gave PS-s much less in the DGs, while some PS-s exhibited positive reciprocity in some cases (due to one-sided anonymity this was misplaced in some cases). Also an interesting 'common grudge' was shown in case of group 6 of two siblings versus a member of the group. In the experimental results family and partnership ties (2 cases) proved to be very different from the friendship ties, as very generous offers were generated. This may well be interpreted a simple bias (as the relationship is a repeated game), but the strong tie (in the Granovetterian term) may also have played a role. The detailed results of model fitting may be found in the appendix.

Even though the lack of data does not permit an in-depth statistical analysis of the IFN model the general observations are promising. The boundary conditions for the general attitudes (α and β) were fulfilled with a few extreme values only.

The results give good guidelines for further experiments as well. The key question of model fitting is the connection of behaviour in the experiments and the reported relationships expressed in network surveys. Both methods have biases as discussed earlier, but their results were in line in the introduced results. The general attitude parameters are hard to determine and sometimes hard to interpret. In this research the only tool used was a survey which may prove inaccurate. So in further research its update is required as well. The games included in the survey though are quite useful for determining the attitudes, thus they should be included in the experiment.

The exact results of fitting should be compared to the pre-experimental survey results as well in which the subjects 'rated' their relationship with the other players. Ideally the pre-experimental survey and the ties calculated using the experimental data and the IFN model would be in correspondence.

But there's a contradiction between the survey results and the experimental behaviour in several cases (also taking into account the general attitudes) – group 6 is a good example for that. This shows that the 'declared' relationships may differ from the 'materialized' ones, and that suggest that the experimental methods used in this research may represent an improvement to currently used network mapping methods.

So while current data from these groups (low response rate for the post-experimental survey) are inadequate for examining the fitting methods for the IFN, the results point in a good direction. The major point of improvement in this research methodology should be the application of an improved pre-experimental survey, and adaptive research software. The pre-experimental survey should include the questions uncovering general attitudes in this section, but as the experiences show, simpler questions should be phrased. The 'adaptive' research software means constant monitoring of the experimental behaviour and determining 'random' pairs based on the result. The pre-experimental survey may point out interesting relationships, or interesting triads which would be interesting to examine. In the current research software totally random dyads and tryads are created (using the treatments of course), so in some cases important pairings were not included in the experiment. Also if the research software is capable of uncovering discrepancies in the decisions and the pre-experimental survey results, then certain rounds may be 'repeated' to investigate causes and extents of the discrepancy.

Certainly the extent of this research sets solid barriers to the validity of the results, but all the results show that the introduced experimental methodology may be used effectively in investigating ties.

5 Conclusion and discussion

5.1 Summary of results

The purpose of my thesis is to connect two formerly detached fields – social psychology and experimental economics. Both of these fields neglect the embedded environment that the social interactions take place in. Two approaches compose the theoretical framework of this thesis: embeddedness in social networks – namely the importance and characteristics of ties –, and fairness theory. Social network theory is a sound approach to describe this embeddedness from the structural perspective, and fairness theory describes several motives behind human behaviour. By merging certain aspects of these theories embedded social interactions can be explored by experimental methods as well.

In social network theory a fundamental notion is the definition of the strength of a tie between the members of the networks. The strength of a tie can be defined in numerous ways. In former studies it was defined according to the requirements of research – frequency, intimacy etc. They were either objective measures – missing some subjective properties of the perceived relationships which may change behaviour – or subjective measures – which are often incomparable and may suggest asymmetric networks even in case of symmetric tie.

Another definition of tie strength is given in this thesis, which is based on the perception of 'fair' behaviour with others. With the methods introduced in this thesis the tie strength may be measured. The importance of this objective measure is that it contains several objective components, yet its underlying processes (fairness concerns) involve subjective motives.

A new model of fairness and embeddedness was introduced – namely the integrated fairness and network model (IFN) – incorporating network strength into an existing fairness model (Fehr and Schmidt 1999). The model defines fairness concerns as the motivation for 'inequality aversion' which does not hold in all cases. Due to that the fairness concerns in the IFN model corresponds rather to the 'unfairness aversion' – unfairness meaning the individual's perception of unfairness. While in the classical Fehr model the equal split was considered to be the fair behaviour, the IFN model takes the strength of a tie into account.

To test the model an experimental method was developed incorporating experimental games used in earlier research played in networks with various dyadic and triadic settings. These methods may be used not just to test the group but also to examine informal networks, in real-life settings.

The model was tested with the developed experimental framework on a small sample group of 64 people with a relatively high number of interactions (N=1630). The main results of the experiments have shown, that friendship and fair behaviour are indeed related – a result which is logical even for the first sight, yet there was no method to test it up to now. Also it was shown that with a thorough method, the individual tie strengths may be compared.

The hypotheses tested in this thesis concerned fairness and tie strength. The simplest such statement was tested first, the relationship between the tie strength and the fairness norms applied. The tie strengths were taken from pre-experimental surveys and it was shown that the reported tie strength indeed correlates with the offers gotten and given in two-person dictator and ultimatum games.

Three person games were used to test behaviour in more complex situations. Such dictator games have shown that in triadic interactions people indeed differentiate based on their perceived ties. The results have shown, that if people feel that there's a difference between the ties to the other two parties in an interaction – and the differentiation is 'free' –, then they differentiate depending on their perceptions.

Using three person ultimatum games enabled the investigation of the extent of fairness concerns if strangers participate in the triadic interaction. The results have shown that fairness norms are in effect even against strangers, and in the ultimatum games the presence of a Passive player does not trigger significant fairness norms. No relationship was found between rejecting offers and the offer to the Passive player, but there was a relationship between offers to the Responder in the three person ultimatum game, and its rejection.

Also the general fairness concerns were investigated. A relationship was found between the refusals in two person ultimatum games, and the offers given in the dictator games. Those who were giving higher offers in the dictator game – who were willing to give more voluntarily – had higher expectations in the two person ultimatum games. Such relationship was not found in three person ultimatum-games, but this may be explained by the different context as well.

Also – besides not having it formulated into hypotheses – the model introduced in this research was used to check the relationship with the reported ties and what has been reflected through the behaviour in the experiments. This methodology is very complex and needs more improvement before it may be applied, but the initial results highlight its potential.

All of these results point out that fairness concerns and the ties the individuals have determine the selection and use of fairness norms in both dyadic and multi-person interactions. However the novelty of the methods and the sample size limit the conclusions of this research.

5.2 Limitations

The multiplicity of the factors influencing human behaviour naturally gives limitations to both the proposed model and the conducted experiments. There are several cultural determinants, specific norms which influence behaviour and that automatically causes diversity in behaviour. In terms of using such models it means that several experimental sessions for the same person may yield different results for general attitudes and tie strength to others.

Also the IFN model neglects several phenomena due to modelling constraints. A possible extension of the IFN model should be the inclusion of reciprocity in the model. Currently the strongest initial assumption of the IFN model is that behaviour is influenced by the tie between the actors and their general attitudes. Although this allows differentiation between people – as it was shown in the experiments and what other models lack – this also means that there's no dynamism in the model.

'Memory' is not included in the IFN model. If there's an asymmetric tie and the actors interact repeatedly, they would wish to balance their ties. The strength of their tie changes so that they could make such offer which corresponds to what they experienced earlier – they'd reciprocate. Balancing may be observed if multiple interactions are examined with the IFN model, but in this case the model will not be able to serve with an explanation for the balancing mechanism. The balancing mechanism in this case is reciprocity. So the most serious constraint on the IFN model is the assumption the ties are 'constant'.

Other constraints of the IFN model concern its application. It was pointed out that an important feature of the IFN model is its capability to be used to map tie strength in the network. Model fitting is a very difficult process, because the model is very complex and finding reference points is problematic, since the tie strength parameters is essentially higher than zero in case of humans. So the first challenge of applying this model is determining the general attitude parameters and the set which describes the relationship to a perfect stranger – for which a survey method was suggested here. Once these parameters are found, the model can be applied, but the dynamism of the relationships – temporal changes in the relationship – may confuse results.

As for the current experimental tests of this model it's vital to note that the sample size was not adequate for a thorough test for the model, it only suits the requirements of preliminary testing. Thus the research hypotheses were 'evaluated' rather than tested with them.

The experiments also included some types of bias. First of all, participants were at the same room, thus sympathy effects could have come into play. Also the experimental rules were relatively complex, but it was mostly controlled by having groups play test rounds before the actual experiment. The experiment was also quite lengthy which was reported by several players. Still we have to note that the experiment complied with most of the rules of experimental economics.

5.3 Applications

This leads us to the applications of the IFN model outside the lab. First of all its theoretical relevance and explanatory power is to be mentioned. The IFN model connects social psychology and fairness theories. Interactions are described in an embedded context, and a very important feature is modelled: the fairness norms applied in the interactions. The current fairness models lack the inclusion of embeddedness, and current network models do not consider fairness norms, so in this sense this model is a 'bridging tie' by connecting the 'norms' and the 'networks'.

Once data is fit, this model may be applied on many practical fields. The general use of the IFN model is mapping an existing informal network. Mapping a network has many uses; we may mention networks in schools, where concerns of fairness are in the process of development in children. It also has uses in mapping the informal ties in formal organizations. Informal ties have multiple layers and they influence operational efficiency in an organization, so they are very important in the management perspective. Organizational network analysis currently focuses on collecting objective measures of networks – communication, advice networks and trust networks –, but besides them the fairness and perceived fairness at workplaces is very important. As it was mentioned earlier, the strongest advantage of the IFN model is that it describes norms and ties yet uses measurable – if not objective in the strict sense – quantities.

The methodology applied in this research is also novel as the rules of experimental economics were manipulated to include those interpersonal effects which are to be ruled out in standard economical experiments. This allowed using certain *treatments* which may correspond to real world situations through the use of 'manipulated' triads. Such an approach is not uncommon in the behavioural sciences, but in the context of fairness, such an attempt was not made yet. Also the findings underline the importance of this method, as the behaviour exhibited in the experiments differed from earlier results in a way entirely explained by the IFN model. Hence the methods introduced here shall be considered in other areas of experimental economics and behavioural game theory – still the importance of the context can't be underemphasized.

5.4 Further research

The results and the main findings of this research point towards several further directions. First and foremost the experimental methodology has to be refined. The methods introduced here are applicable per se, but the way they are implemented, and the network settings and anonymity settings applied hugely influence results. Due to the sample size and a small methodological laxity the model fitting has to be further tested and the experiments should be ran with bigger samples in order to obtain valid and accurate results.

Secondly the multiplicity of relationships has to be taken into account. There was one family tie and a partnership tie included in the experiments and interesting behavioural patterns were observed in both cases. As it has been widely known since the thorough work of Granovetter the importance of the multiplicity of the relationship dimensions cannot be overemphasized. First the experiments shall concentrate on one individual relationship type. Having a group consisting of mixed family and friendship ties may lead to confusing results without adequate experiences – just as it was seen in two experimental groups including partners (group 1) and siblings (group 6). Once friendships and family ties are analyzed adequately, networks including multiple types of relationships may be examined.

A third direction worthy to mention is organizational network analysis. As it was discussed briefly the IFN model may be applied to map informal networks in formal organizations and these networks may have interesting properties in terms of fairness norms. It would be interesting to examine the relationship of people at specific roles (centres of stars, those on periphery) and their internalized fairness norms, and the level of embeddedness.

Due to the same properties would it be another possible direction of applying the experimental methods and the IFN model the context of school, or other public educational institutes, where children or teenagers are in the process of socialization. Fairness norms are shaped drastically in these years as children become parts of larger networks and learn the different roles in the networks by being in them themselves. The methods here also allow t9he research of this area.

These were just a few examples where the IFN model and these experimental methods may be used to uncover newer layers of social behaviour and fairness norms. Nowadays as social network analysis is improving, advanced managerial approaches are available and the organizations grow larger and larger aiming for higher efficiency the introduction of novel methods and the exploration of the network phenomena is crucial.

The purpose of this work was of course to provide such methods in which I hope I succeeded. Despite the weaknesses of the model and the methods discussed here and in earlier sections the approach presented here may be an important step in further widening the scope of experimental economics by including more and more social properties which were until the last decade intentionally omitted.

So connecting two such distant approaches as fairness theories and embeddedness in social network with the modelling and experimental approach described in this thesis has an important message. Besides the fact that social interactions shouldn't directly handled as economic interactions – even if the interaction itself involves economic decisions – the embeddedness should not be left out of the picture. Ties indeed matter, as the ties serve as a source of internalized control mechanisms. Despite that the current research did not aim to demonstrate which overrules the other in a specific interaction, it was shown, that they coexist, they influence each other, and they influence behaviour in all of our interactions should it be at our workplaces or at our homes with our family.

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7 Appendix

7.1 Experimental results of UG and DG

Study	Payment method	Number of observations	Stake size (country)	Percentage of offers with $s \leq 0,2$	Percentage of offers with $0,4 \leq s \leq 0,5$
Cameron [1995]	All offers paid	35	40 000 Rp (Indonesia)	0	66
Cameron [1995]	All offers paid	37	200 000 Rp (Indonesia)	5	57
Forsythe et.al [1994]	All offers paid	67	5-10 $ (USA)	0	82
Güth et.al [1982]	All offers paid	79	4-10 DM (Germany)	8	61
Hoffman–McCabe–Smith [1996]	All offers paid	24	10 $ (USA)	0	83
Hoffman–McCabe–Smith [1996]	All offers paid	27	100 $ (USA)	4	74
Kahneman–Kentsch–Thaler [1986]	20% of the offers were paid	115	10 $ (USA)	?	75[a]
Roth et.al [1991]	random payment method	116[b]	App 10 $ (USA, Slovenia, Israel, Japan)	3	70
Slonim–Roth [1997]	random payment method	240[c]	60 kr (Slovakia)	0,4[d]	75
Slonim– Roth [1997]	random payment method	250[c]	1500 kr (Slovakia)	8[d]	69
Aggregate results[e]		875		3,8	71

[a] Percentage of equal splits. [b] Observations from the final period only. [c] Observations of all 10 periods. [d] Percentage of offers below 0,25. [e] without *Kahneman–Knetsch–Thaler* (1986)

Table A1.: Percentage of offers in various studies (Fehr and Schmidt 1999) pp. 827.

7.2 Extended analysis of the IFN model

Proposer behaviour in DG

The IFN model is described for the Proposer taking into account the concern against being better off. In these expressions $\pi_{total}=1$. The question in this case is the maximum utility for the Proposer, as he'll make an offer corresponding to this maximum. First the IFN model is described for the Proposer in this case. It is assumed that the offer would be disadvantageous for the Responder (the terms with α are neglected, they're 0).

$$U_1 = \pi_1 - \beta_1 c_{12}\left((1+c_{12})\pi_1 - \pi_{Total}\right) \qquad [(2\text{-}5)]^{74}$$

$$U_1 = \pi_1 - \beta_1 c_{12}\left((1+c_{12})\pi_1 - 1\right) = \pi_1\left(1-\beta_1 c_{12}^{\,2} - \beta_1 c_{12}\right) + \beta_1 c_{12}$$

We're looking for the maximum of this function depending on the payoff – so which payoff should the Proposer choose to maximize payoff, zero, or non-zero?

$\frac{dU_1}{d\pi_1} \stackrel{?}{=} 0$ should be evaluated. As it is seen it depends on the general attitude and the tie between the players.

$$1-\beta_1 c_{12}^{\,2} - \beta_1 c_{12} = 0$$
$$\beta_1 c_{12}^{\,2} + \beta_1 c_{12} = 1$$
$$\beta_1\left(c_{12}^{\,2} + c_{12}\right) = 1$$

$$\beta_1 = \frac{1}{c_{12}^{\,2} + c_{12}} = \frac{1}{c_{12}(1+c_{12})} \qquad [(2\text{-}6)]$$

So if the individual's concern for fairness is higher, then the IFN model predicts a non-zero offer. Otherwise the concerns are not strong enough, and thus the maximum of the IFN model will be at the zero-offer – this condition is formulated graphically in Figure 2.5.

[74] In the deductions here the notation of the different expressions are taken directly from the main text. Those expressions without notation are steps in the deduction

7.3 Model fitting

Obtaining c_{ij} using DG zero offers and β values

Tie strength may be obtained by observing DG offers given that *β* is known for the proposer in the DG. The limit where zero offers are given is defined with the following expression:

$$\beta_0 = \frac{1}{c_{12}(1+c_{12})} \qquad [(2\text{-}5)]$$

From this expression tie strength may be expressed as the following:

$$c_{12}(1+c_{12})\beta = 1$$
$$\beta c_{12}^2 + \beta c_{12} - 1 = 0$$
$$c_{12} = \frac{-\beta \pm \sqrt{\beta^2 + 4\beta}}{2\beta} = -\frac{1}{2} \pm \sqrt{\frac{1}{4} + \frac{1}{\beta}}$$

Then assuming that tie strength is always positive (this does not mean neglecting spitefulness though) the tie strength is given by:

$$c_{12} = -\frac{1}{2} + \sqrt{\frac{1}{4} + \frac{1}{\beta}} \qquad [(4\text{-}8)]$$

So this limit may be used to define an upper bound to a tie strength if a zero offer is observed in the DG.

UG refusal behaviour

The UG refusal is influenced by the concern for being worse off than others (*α*) and the tie strength as well, given by the IFN model. The limit of refusal is defined by the following expression:

$$\frac{\pi_2}{\pi_{Total}} < \frac{\alpha_2 c_{21}}{1+\alpha_2 c_{21}(1+c_{21})} \qquad [(2\text{-}8)]$$

From this expression tie strength may be expressed based on the refused offer and the value of *α*.

$$\pi + \pi\alpha c(1+c) - \alpha c < 0 \quad \pi = \frac{\pi_2}{\pi_{Total}}; \alpha = \alpha_2; c = c_{21}$$

$$\alpha\pi c^2 + (\alpha\pi - \alpha)c + \pi < 0$$

$$c < \frac{(\alpha - \alpha\pi) \pm \sqrt{(\alpha\pi - \alpha)^2 - 4\alpha\pi^2}}{2\alpha\pi}$$

Finally the boundary condition of the refusal is the following given the offer refused and the general attitude assumed to be known:

$$c_{21} < \frac{\left(\alpha_2 - \alpha_2 \frac{\pi_2}{\pi_{Total}}\right) \pm \sqrt{\left(\alpha_2 \frac{\pi_2}{\pi_{Total}} - \alpha_2\right)^2 - 4\alpha_2\left(\frac{\pi_2}{\pi_{Total}}\right)^2}}{2\alpha_2 \frac{\pi_2}{\pi_{Total}}} \qquad [(4\text{-}9)]$$

This gives an upper bound for the tie between the players. The exact value of the tie can't be determined solely by using UG refusal data.

7.4 Background variables of the experimental subjects

The following demographic data was collected from the subjects following the experiment: gender, age, father's education, mother's education, perceived material status. The gender distributions in the different groups are shown in the following table:

Group Idx	1	2	3	4	5	6	7	8	9	10	11	Total:	Total (%):
Female	4	6	5	2	2	5	6	6	5	4	2	47	71.21
Male	2	0	1	4	4	1	0	0	1	2	4	19	28.79
Average age	23.2	21.7	23.5	20.7	23	21.8	21.2	22	20	21.7	26	22.24	0

Table A2.: gender distributions in the experimental groups

Besides gender effects, the cultural background and the perception of the individual's material status may also affect behaviour in UGs and DGs. To be able to take these effects into account as well, the subjects were asked about their parents' educational background and to give their subjective judgement on their own material status. The parents' background showed that the groups were mostly homogeneous as in most of the cases the parents had a higher educational degree (of course there's a correlation between the mother's and the father's educational background[75]).

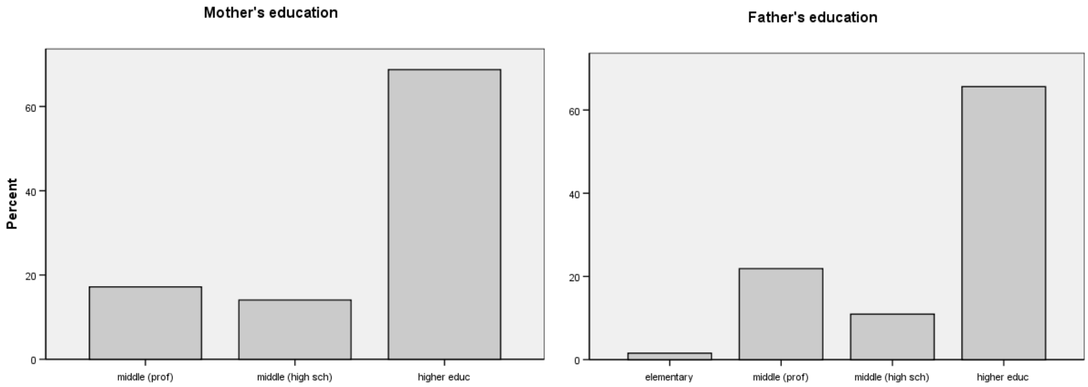

Figure A1.: Educational background of parents

As usual most of the subjects have reported that their material status is just average. Nearly third of the subjects reported having better than average material conditions.

Material status	Percentage
Worse than average	3.03
Average	60.60
Better than avg	28.78
Much better than avg	4.54

Table A3.: material status

These data show that the group of 64 subjects participating in the experimental sessions are quite homogenous both in terms of age and background. This means that the effects of age and cultural background are controlled for in the experiments, but this does not hold for gender, as the girl's dominance probably distort the results.

7.5 Model fitting using group level fitting

The purpose of fitting the IFN model to the experimental data is twofold. First an attempt is made to determine the tie strength between players using calculations proposed in section 4. Then the IFN model may be numerically validated (the background assumptions are tested through the hypotheses) if these results are in line with the ties reported in the pre-experimental survey. Secondly the striking differences

[75] Examined with a Spearman test, the correlation is 0.655 and is significant.

between the ties reported in the pre-experimental survey and calculated using the IFN model should be further investigated. In some cases subjects may 'lie' in the surveys – even unintentionally – while the experiments will make 'real ties' emerge.

To be able to do that of course the general attitude parameters are to be known. In the experimental groups it was difficult to determine the general attitude parameters due to low response rates to the post-experimental survey. In those cases the general attributes were approximated using experimental data adhering to the boundaries defined in section 2.4.

The data indicated in the following tables represent the data obtained in the experiments and the pre-experimental surveys. In the pre-experimental survey the subjects were asked to indicate the strength of their ties on a scale of 1-5 (1 – known; 3 – buddies; 5 – close friends). The survey results are included in the analysis.

The DG offers are generally used to determine tie strength using (4-7) for the calculations. So for example an offer of 0.75-0.25 means tie strength of 0.33, an offer of 0.66-0.33 means 0.49 etc for non-zero offers. In case of zero offers an upper bound can be given to tie strength using (4-8). A similar method can be used for refused UG offers if α is available for the given subject.

The data is represented as 'survey/experimental' to make comparisons easily (e.g. '3/0.83'), the Perfect Strangers are denoted as PS. The interesting phenomena are indicated in different ways for each group.

Group 1 and 2 can be classified as pilot groups as in those groups the explanation did not prove to be detailed enough – as it was verbally indicated by some subjects. Some subjects indicated that they couldn't distinguish between UGs and DGs from the description of the games (despite the presence of the practice session).

Still in case of group 1 an interesting phenomenon was found. ('S' columns represent the answers given in the pre-experimental survey, 'E' represents the calculated tie strength with the IFN model.)

Group 1	F1 (C)		M1 (C)		M2		F2		F3 (PS)		F4 (PS)			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
F1 (C)			5	0.5	3	1	4	1		0.5			2.1	1.04
M1 (C)	5	11			5	0.967	3	1.143				0.69		
M2	4	1.069	5	3E-04			3					1		
F2	5	1.174	0.9	1.001	3	1.609				0.905		1		
F3 (PS)		1		1		1		1				1		
F4 (PS)		0.875						0.935		0.905				

Table A4.: Group 1 results

As the results indicate there was only one zero offer in this group (M2-M1), and most of the offers were equal (or near equal) splits resulting in high tie strengths (~1). This was the case of both PSs as well further indicating irrational DG behaviour.

Despite the methodological problems at this group a partnership effect was observed (highlighted in red, players marked with (C) = couple). Unexpectedly a couple was included in this experimental group and their behaviour was interesting. The man in the couple gave nearly everything to the girl twice during the experimental session, but received 'only' an equal split in return. There may be many explanations to this phenomenon, but this suggests that strong ties (in the Granovetterian sense) should be further investigated with this methodology, as redistributional norms may be in effect.

The second pilot group (Group 2) consisted only of female students. The groups were organized by the subjects – one subject was asked to bring 3 of his/her friends to the experiment for a relative small amount of extra payoff (500 HUF).

Group 2	F1		F2		F3		F4		F5 (PS)		F6 (PS)			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
F1			5	0.6	3		3	1		1		1		0.58
F2	4				5	0.596	5	0.6		0.905				0.53
F3	3	0.6	5	0.29			3	1		0.739				
F4	3		5	0.778	3	0.6								
F5 (PS)		1		0.966								1	1.58	0.65
F6 (PS)		0.999				1		0.99		0.974			1.58	1.25

Table A5.: Group 2 results

In this group F2 was the 'organizer' of the friend group. As seen the others knew each other, but probably weren't from the same closely knit group. The interesting phenomenon in this group is the behaviour of F2 (small offers given and gotten). In the post-experimental survey she reported low general attitudes (α was very low, off the measurement scale for F1 and F2). She was a 'gamesman' in classical terms, less affected by norms ($\beta < 0.5$ would predict only zero offers in the DG). It seemed that the others also behaved like gamesmen when playing with her giving less. The group was generally less altruistic among themselves than with those not from the group. No explanation can be given to this behaviour from the experimental data.

The third group consisted of a group of girls, a male and a female PS. Group members were more altruistic among themselves than with non-group members. Especially M1 was treated relatively cruelly getting numerous near-zero offers from F1 (exactly 3). There was another phenomenon observed in the behaviour of F3 and M1. After giving an 'over fair' split to F5 (PS), F3 was asked to give an explanation. She specifically stated that she believed she got an earlier offer from F5 when she wanted to reward. In reality though, it was M1 who consciously gave the offer to F3.

Group 3	F1		F2		F3		F4		M1 (PS)		F5 (PS)			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
F1			5	0.6	5	1	3			0.043		0.333		
F2	3	0.951			5		3	1		0.843			1.17	0.81
F3	5	1	5	1			4	1		0.455		1.286		
F4	2	0.778	3	1	3	1				0.818		0.92	1.58	0.81
M1 (PS)						1.286						0.441		
F5 (PS)		0.6		0.28		0.455				0.6				

Table A6.: Group 3 results

This is an exact proof of reciprocity. M1 on the other hand got to be the Proposer in the DG only three times through the experimental sessions (twice with the other PS). He did not express any specific motives. His results show that he generally got near-equal splits right before his overly fair offers.

Group 4 and 5 were mixed groups not following the 4 FND, 2PS structure. The members of these groups were students attending a language class (from various faculties). Their pre-experiment survey did not reveal useful data about their relationships, so that data was simply omitted.

Group 4	M1	M2	M3	M4	F1	F2
	E	E	E	E	E	E
M1		0.143	0.778	0.538	0.111	0.322
M2				0.143	0.087	
M3	0.03	0.182		0.143		0.41
M4	0.067	0.524	0.067		0.103	0.333
F1	0.6					
F2	0.333	0.758				

Table A7.: Group 4 results

Group 4 was composed of 4 male and 2 female students. As their results show they gave each other relatively low offers. Due to the relatively low numbers of DG in their experimental session it's not practical to draw complex conclusion from their interaction. It is very clear though that the lack of friendships among them is seen in their actions. They gave many lower offers. In the UG sessions the offers were around 0.4 with a few rejections of offers around and below 0.375. In this sense this group reproduced earlier UG results.

Group 5 was created from the same language class with six other students. Unlike group 4 they reported differences in their relationships. Especially one of the subjects (M4) was reported to be 'relatively unknown' to the others – as he did not attend the class frequently. Despite this difference the offers she got from the others weren't lower neither in DG nor UG sessions. Their detailed data does not provide explicit information. They've also reproduced the UG results of earlier experiments. (Their detailed results are omitted here.)

Group 6 consisted of a usual setup of 4 friends and 2 perfect strangers. The group of friends had an interesting composition as it included siblings (brother and a sister – denoted with (S) in table A8) which presents a bias. There was also a member who barely knew two of the others – so this group was far from the ideal group. Note that it's hard to gather adequate groups, as the subjects interpret 'friendship' differently. (For some subjects 'friends' were indeed close friends, for others they were simple classmates or acquaintances).

The reported relationships also show that the experimental group was not perfect. There were two real PSs (F4 and F5), but to some extent F2 can also be classified as a

PS, as she only knew one other person in the group, F3. Also their tie as they report it is not very strong.

Group 6	F1 (S)		F2		M1 (S)		F3		F4 (PS)		F5 (PS)			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
F1 (S)					5	1	4	0.143		0.333				0.65
F2		0.2					3	0.6		0.333		0.143		
M1 (S)	5	1000		0.231			3	0.194		0.548		1		
F3	5	1	4	1	2	6E-04				0.333				
F4 (PS)		0.6										0.263	1.58	0.71
F5 (PS)		0.778		0.778		1		0.778		0.455			1.58	1.25

Table A8.: Group 6 results

It's important here to point out the results of F5. Despite being a PS she consistently exhibited strong fairness concerns towards the group members, and weaker towards the other PS. So she consistently did not behave as a PS, which has to do with her general attitude towards other humans – as it is shown by her high β obtained from the post-experimental survey.

Another important behaviour pattern was shown by F1, M1 (sister-brother) and F3. The survey has shown, that the brother and sister had a good relationship, and a less strong one with F3. In the experiment though, it seemed that they had a common grudge against F3 – denoted with red. They consistently (twice) gave unequal share in the DG to F3. Also F3 did give a low amount to M1 – still we have to emphasize that Proposer anonymity was assured during the experiment.

The behaviour of the brother and sister was also very interesting (highlighted in green). In the survey, they reported a strong relationship, but DGs proved that it's biased in favour of the sister. She gave an equal split in the DG, but the brother gave all of the goods to the sister (that's the reason for the 1000 value of c_{ij} in this case). Clearly, this couldn't have been shown using the survey.

Groups 7 and 8 again were female student groups from a game theory class. Their relationships were quite mixed they reported ties from non-existing to strong. In case of group 7, emphasis was placed on UGs (only a few DGs were played), while in case of group 8, there were mostly DGs played.

Group 7	F1		F2		F3		F4		F5		F6			
	A	R	A	R	A	R	A	R	A	R	A	R	α	β
F1			0.375	0.313		0.313	0.5		0.375		0.375	0.313		
F2	0.25	0.288			0.347		0.375					0.313		
F3	0.354	0.25	0.375	0.25			0.375		0.313	0.313	0.344		3.67	1.25
F4	0.375		0.313		0.324				0.312				6.79	1.25
F5	0.375	0.288	0.333	0.25	0.314		0.375				0.313			
F6	0.313		0.25	0.238	0.344		0.5		0.313	0.25				

Table A9.: Group 7 results (Acceptance and Rejection in the UGs)

Table A9 shows accepted/rejected UG2 offers (column players gave the offer, row players reacted: A- smallest accepted; R- highest rejected). The offers are rarely above 0.4 and sometimes even below 0.3. Note that there was only one offer accepted below 0.3. The relatively low offer shows that the players weren't close knit in this group which is also confirmed by the pre-experiment survey.

Group 7 ties (pre-exp survey) /DG offer	F1	F2	F3	F4	F5	F6
F1		1	2	4	0	3
F2	1/0		1	2/0	0	3
F3	2/0	1		2/0.344	3	3
F4	4	2	1/0.375		1	5
F5	1/0.325	1	3	1		1/0.03
F6	3	3/0.375	1	5	0	

Table A10.: Group 7 ties (scale: 0; 1-5) reported in the pre-experimental survey and the DG offers

Since there were only a few DGs, the offers are indicated in table A10. It's seen that the results mostly reflect the reported ties. The behaviour of F3 and F4 are the most interesting in this aspect. In the post-experiment survey both of them reported irrationally high β values and it seems to be reflected in their behaviour as well. As seen they gave relatively high offers for weak ties (0.375 and 0.344). The offers of F3 to F1 and F4 show that there is a difference between the ties despite the reported equal ties.

The players in group 8 were as diverse in their ties as the players in group 7 (they all knew each other). Unlike in group 7 all players reported ties towards the others – even though relatively weak ones (the S columns). The list 'liked' person in the group was F5. It is also clearly seen in the offers given to her. There was no other player who got such low offers.

Group 8	F1		F2		F3		F4		F5		F6			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
F1			4	0.243	3	0.519	3	0.044	4	0.013	2	0.013		
F2	3	0.371			5		5	1	1	0.046	1	0.185	1.58	0.62
F3	3	0.27	4	0.5			5	1	1	0.111	3	0.281		
F4	3	1	4	1	5	1			1	0.032	2	0.768		
F5	3	0.096	4		5	0.013	1	0.103			1	0.124		
F6	3	0.905	4	0.174	5	0.6	3	0.333	1	0.351			1.58	0.65

Table A11.: Group 8 ties reported in the pre-experimental survey and the DG offers

It is also clearly seen that the calculated results do not directly correspond to the reported ties. Experimental behaviour was much more unfair than one would predict from the pre-experiment survey. Since this effect may be observed at all of the players (except at F4), this is probably a bias of the survey – there weren't very close friendships in the group so their classification in the 5 value scale may have been biased.

The behaviour of F4 on the other hand is very interesting as it mostly corresponds to the reported ties. Similar pattern may be observed F2 and F3 if the survey results are rescaled.

Group 9 was a mixed gender group with only one PS. As seen from the post-experiment surveys the players had low concerns for being better off, so lower offers can be expected. Theoretically F5 was included as a PS in the group, but it was found that F1-4 knew F5 from elsewhere (thus it is not marked as a PS here).

Group 9	F1		F2		F3		F4		F5		M1 (PS)			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
F1			5	0.839	4	0.653	5	0.655	2	0.333		0.231		0.63
F2	4	0.5			4	0.649	5	0.905	2	0.614		0.231	1.31	0.75
F3	5	0.842	5	0.778			5	0.714	1	0.702		0.616		
F4	5	0.919	5	0.951	5	0.949			1	0.411		0.379		
F5	1	0.231	1	0.185	1	0.176	1	0.28						0.63
M1 (PS)		0.379		0.595		0.566		0.46		0.691				0.88

Table A12.: Group 9 results

Results show that reported relationships mostly correspond to the experimental results. M1 was indeed treated as a PS and handled others as if they were PSs as well. His results are similar to F5, who also gave and got low offers despite her existing weak tie to the others. Among the players the behaviour of F4, F5 and M1 was consistent (survey and experimental), the behaviour of F3 was nearly consistent, and it indicates that she has a stronger tie to F5 than reported. The same applies to F2 whose tie to F1 and F3 is weaker than reported and F1's behaviour is not consistent with reported data – having low concern for being better off accounts for her low offers.

The remaining two groups were ideal in terms of group composition: 4 friends and 2 PS in both groups. Group 10 was a mixed gender group, with male subjects in the friend group and two female PSes.

Group 10	F1		M1		F2		M2		F3 (PS)		F4 (PS)			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
F1			5	0.778	5	1	1	1		0.73		0.333		
M1	2	0.684			5	1	3	0.778		0.882		1.667		
F2	2	0.983	5	1.078			3	1		0.882		0.916	1.43	0.98
M2	2	0.778	4	0.684	3	0.846				0.067		0.103		0.65
F3 (PS)		0.811		0.951		0.793		0.951				0.803		
F4 (PS)		0.185		0.333		0.067		0.255		0.032			2.1	1.25

Table A13.: Group 10 results

Their results show that the reported ties correspond to the experimental behaviour in most cases (inconsistent behaviour is marked). In these results the behaviour of F2 is interesting as she reported strong concern for being better off in the post-experiment survey, so her high offers in the DGs are backed up by that. F4 shows quite the contrary, despite her strong concerns shown in the survey she gave low offers – her behaviour was consistent with her role, being PS.

As shown earlier (Fig 2.4) the IFN model predicts non-zero offers in case of weaker ties as well – this was exactly seen in the behaviour of F4 (also her concern for being worse off were stronger). The inconsistent behavioural patterns point out that the tie between F1-M2 and M2-M1 may be different than reported in the survey. Also note that the PSes got relatively high offers from the first three players – data do not provide explanation for this phenomenon.

Group 11	M1		M2		M3		F1		F2(PS)		M4 (PS)			
	S	E	S	E	S	E	S	E	S	E	S	E	α	β
M1			4	0.416	3	1	3	1		0.27		0.117		0.91
M2	5				2	0.8	3	0.939		0.003		0.117		
M3	3	1	1	0.18			2	0.92		0.111			0.64	0.65
F1	4	1	3	0.6	2	0.352				0.231			2.1	0.88
F2(PS)		1		0.064		0.846		0.224					1.29	0.55
M4 (PS)		1		0.049		0.161		0.2		0.143				

Table A14.: Group 11 results

The last experimental group (11) was the only 4 fnd-2ps group where there were more male than female subjects. The most significant result of this group was the in-group and out-group behaviour.

As seen in table A14 the group members gave low offers to the PS-es. The calculated ties are all below 0.3. Taking into account the relatively high β values of M1 and F1 the offers given to F2 can be explained. Only M1's behaviour is inconsistent in this group, the other subject's behaviour is consistent. This may be explained by the difference between real and reported ties, and also a higher concern for being worse off may provide an explanation here.

Fitting the IFN model on this data proved to be difficult because of several reasons. One reason was a methodological laxity, distributing the post-experimental surveys (using to determine general attitudes) not immediately after the experiments. This meant lack of data in the fitting process. Also the post-experimental surveys show that the method is still to be improved, as the situation pictured in the questions is not always clear. Another reason is the difficulty of adequate groups in the sample. The groups were far from ideal, mostly mixed, only rarely being close enough to the specifications. In real life settings this is an advantage, but for calibrating the model, this was clearly a constraint.

In light of that the analysis of the reported and fit data shows a weak relationship (Spearman's Rho ρ=0.324, p<0.001), which is promising, since this correlation was obtained using 107 players' data. When considering more data – with more accurate general attitude parameters, thus more accurate fitting – this value is probably much higher. Due to the current technical constraints however its improvement may only be the topic of future research.

7.6 Acceptance in three player ultimatum games – a regression model

The acceptance of the UG3 offers (dichotomous) was modelled with a logistic regression having the relative offers as independent variables. The regression was run in STATA, the output of the logistic regression is shown below.

```
. logit  OfferUGAccepted OfferUGR1Prop OfferUGR2Prop

Iteration 0:   log likelihood = -123.71373
Iteration 1:   log likelihood = -101.40148
Iteration 2:   log likelihood = -99.820213
Iteration 3:   log likelihood = -99.765808
Iteration 4:   log likelihood = -99.765712

Logistic regression                        Number of obs  =       220
                                   LR chi2(2)      =      47.90
                                   Prob > chi2     =     0.0000
Log likelihood = -99.765712                Pseudo R2      =     0.1936

------------------------------------------------------------------------------
OfferUGAcc~d |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
OfferUGR1P~p |   15.56615   3.138636     4.96   0.000     9.414536    21.71776
OfferUGR2P~p |  -.1595576   1.380944    -0.12   0.908    -2.866158    2.547043
       _cons |  -3.683772     1.0825    -3.40   0.001    -5.805432   -1.562112
------------------------------------------------------------------------------
```

As this regression shows the offers to the Passive player are not significant (nor have high coefficients) in the acceptance. The importance of the offer to the Responder is the highest. Logistic regression post-tests confirm the model.

```
. linktest

Iteration 0:   log likelihood = -123.71373
Iteration 1:   log likelihood = -101.30343
Iteration 2:   log likelihood =  -99.88217
Iteration 3:   log likelihood = -99.763973
Iteration 4:   log likelihood = -99.762392
Iteration 5:   log likelihood = -99.762392

Logistic regression                        Number of obs  =       220
                                   LR chi2(2)      =      47.90
                                   Prob > chi2     =     0.0000
Log likelihood = -99.762392                Pseudo R2      =     0.1936

------------------------------------------------------------------------------
OfferUGAcc~d |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   .9895838   .2279197     4.34   0.000     .5428694    1.436298
      _hatsq |    .007716   .0940264     0.08   0.935    -.1765724    .1920044
       _cons |  -.0038205   .2676552    -0.01   0.989    -.5284149     .520774
------------------------------------------------------------------------------

. estat gof
```

Logistic model for OfferUGAccepted, goodness-of-fit test

number of observations = 220
number of covariate patterns = 88
Pearson chi2(85) = 103.31
Prob > chi2 = 0.0861