On Competition and Well-Being.

An Experimental Investigation into Rivalry, Social Disposition, and Subjective Well-Being*

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Abstract

This paper experimentally studies the effects of competition in a social dilemma where people's actions can not be contractually fixed. We find that, in comparison with no competition, the presence of competition does neither increase efficiency nor does it yield any gains in earnings for the short side of the exchange relation. Moreover, competition has a clearly negative impact on the disposition towards others and on the experienced well-being of those on the long side. Since subjective well-being improves only for those on the short side competition contributes to larger inequalities in experienced well-being. All in all competition does not show up as a positive force in our environment.

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1 Introduction

In this paper, we experimentally investigate the consequences of competition in an environment without formal contracting possibilities. Our study builds upon the idea that (social) preferences and tastes may not be independent of the institutional environment. For instance, Bowles (1998) argues that different kinds of institutions may affect values, tastes and personalities. A particularly important issue he discusses is closely related to the concern about the effect that competition can have on well-being. In his own words: "(...) there are significant differences in the personality effects on participants in markets (...) for people on the short side (...) and those on the long side of the market, some of which are simply excluded from the exchange process, while others fear losing the transactions they have secured." (Bowles, 1998, p. 78) This statement suggests that people's well-being is influenced by the competitiveness of the environment and the side one is on in such an environment.[1]

There are several reasons why it is important to investigate the relationship between competition and well-being. Well-being and happiness are undoubtedly central goals in human life. This by itself is an important reason for studying their relation to different economic institutions. Kahneman, Diener and Schwartz (1999) provide a wealth of information about the importance of well-being. Recent overviews about research into happiness and well-being and its relation to economics is provided by, e.g., Frey and Stutzer (2002), Ferrer-i-Carbonell (2005), Krueger (2005), and McFadden (2005). The concern for how the environment affects people is also related to issues of procedural fairness. The degree of competitiveness may be viewed as one aspect of the procedure under which interaction takes place. By now there is considerable evidence that supports the premise that satisfaction with process and procedures is an important ingredient of human motivation.[2]

Beyond these direct consequences of competition on well-being there are potentially also derived consequences. Specifically, interacting under competition may change people's disposition towards others and, in particular, towards those individuals they have encountered in the interaction (and may meet again in the future). These potential effects of competition have not received much attention in economics, but need to be studied in order to get a more

[1] In a similar vein, Rabin (1993, p. 1283) argues that: "Welfare economics should be concerned not only with the efficient allocation of material goods, but also with designing institutions such that people are happy about the way they interact with others."

[2] Kahneman, Knetsch and Thaler (1986), Barret-Howard and Tyler (1986), and Bies, Tripp and Neale (1993) find that procedural information influences judgments of market exploitation. Charness and Levine (2000) find that perceived fairness of a layoff is highly dependent on the manner in which the layoff is implemented. Bolton, Brandts and Ockenfels (2005) show that different random procedures affect choice behavior. Frey, Benz and Stutzer (2004) outline a concept of procedural utility and suggest how it can be fruitfully integrated into economics. For a summary of some of this literature see Lind and Tyler (1988).

complete picture of the impact of competition on economic and social life. We investigate both the direct as well as the derived effects of competition on well-being.

We study an environment in which economic interactions are contractually not complete. A stream of theoretical studies initiated by Akerlof's (1970) seminal 'Lemons Market' paper has shown that competition alone is not sufficient to guarantee allocative efficiency (e.g. Klein and Leffler, 1981; Shapiro and Stiglitz, 1984; Levin, 2003). Experimental studies of exchange situations where formal contracts are incomplete or absent have corroborated this view and, moreover, shown that the validity of economic analysis based on standard assumptions of narrow selfishness and rationality may be considerably limited (Fehr, Kirchsteiger, and Riedl, 1993, 1998; Fehr, Gächter, and Kirchsteiger, 1997; Fehr and Falk, 1999; Hannan, Kagel, and Moser, 2002; Brown, Falk, and Fehr, 2004; Brandts and Charness, 2004).

These studies have greatly increased our knowledge about the problems and possible solutions of exchange situations without complete contracts. However, there is still a lack of knowledge and evidence of the effect of competition *per se* in such contract situations. With this study we contribute to filling this gap.

Our experiment is designed in a way that makes it possible to control for the effects of competition as such. We compare subjects' behavior in several experimental conditions with competition and in one condition without competition, while holding all other aspects of the economic environment constant. In our design it is completely transparent whether one is interacting under competition or not. Competition appears in such a way that it is always clear who is on the long and who on the short side of the interaction. Our design captures the essential aspects of competitive rivalry, as defined by Stigler (1987), who writes, that "competition is a rivalry between individuals (or groups or nations), and it arises whenever two or more parties strive for something that all cannot obtain" (p. 531). As a cautionary note we want to stress, however, that we do not examine all potentially interesting facets of competition. In particular, we do not deal with the kind of full-fledged atomistic competition involving a large number of participants that is often studied in economics. We also do not study other potentially important features of competition like how it contributes to an efficient allocation of resources by leading to trade by high-valuation buyers and low-cost sellers.

Another important feature of our design is that we collect data about people's subjective well-being and about their disposition towards others. We use the notion subjective well-being similarly to Kahneman, Wakker and Sarin's (1997) notion of 'experienced utility', which goes back to Bentham. As these authors we claim that 'subjective well-being' is both measurable and empirically distinct from standard decision utility. The actual measurement consists of self-reports concerning a general measure of the hedonic state experienced by our subjects, as well as concerning the intensities of experienced specific emotions. The disposition towards

others is measured with a variant of the social value orientation test (Liebrand, 1984), which involves monetary incentives.

We measure subjective well-being and the disposition towards others in the different experimental conditions, which allows us to study the impact of competition on these measures in a controlled way. In the environments with competition we can also distinguish between well-being on the short and on the long side of the interaction. We also study how subjective well-being and disposition towards others are related to interaction success (monetary earnings) in the different conditions.

We find that in our experimental environment the very presence of competition does not show up as a positive force. In our experiment competition does not lead to an increase of efficiency (in terms of total earnings) and does not yield any material gains to the short side of the interaction. In addition, it leads to lower subjective well-being for participants on the long side of the interaction compared to those not subject to competition. Only the subjective well-being of those on the short side is improved, implying that competition leads to an increase in inequality in experienced utility. Moreover, competition has an adverse impact on the disposition towards others of those on the long side.

Importantly, our data show that earnings alone are not sufficient to explain the differences in subjective well-being, but that the environment itself and the role taken in this environment are important, too. Finally, regression analysis shows that people's disposition towards others after interacting is strongly affected by their *position* in the interaction *per se*. This holds in particular for people on the long side who are often excluded. This supports the conjecture of Bowles (1998) concerning the "personality effect" of competition (see quote above).

The rest of the paper is organized as follows. In Section 2 we present in detail our experimental design and procedures. In Section 3 we present and discuss our results and Section 4 contains some closing comments.

2 Design and Procedures

Our experimental set-up consists of one condition without and three conditions with competition, each consisting of three parts. In part 1 subjects make decisions in the circle-test, a task designed to elicit people's initial disposition towards others. Part 2 is a finitely repeated social dilemma game played by a fixed group of subjects. In part 3, participants' subjective general well-being and experienced emotions are measured using a computerized self-assessment questionnaire. This is followed by a second application of the circle test measuring subjects' post-interaction disposition towards their interaction partners. Table 1 depicts the sequence of events. The data from the first circle test, part 1, yield information to control for people's

Table 1: Sequence of events

0.	General information → experiment consists of three parts	
	PART 1	
1.	Instructions for first circle test only	
2.	Circle test measuring disposition towards random stranger	
	PART 2	
3.	Instructions for interactive game	
	in NCC	in CC-90, CC-90DC & CC-10
4.	Interaction in dyad	Interaction in triad
	PART 3	
5.	Measurement of general subjective well-being	
6.	Measurement of specific emotions	
7.	Instructions for second circle test	
	in NCC	in CC-90, CC-90DC & CC-10
8.	Circle test measuring disposition towards partner and random stranger	Circle test measuring disposition towards both interaction partners

baseline disposition towards others. In part 2 we observe interactive behavior under different conditions and in part 3 we measure the repercussions of what occurs in the interactive phase.

In the following we present each of these parts in detail. The four conditions differ with respect to the interactive game played in part 2. We, therefore, start with the description of this part.

Part 2 - The interactive game: In this part our aim is to compare behavior with and without competition. To do this we use one condition without competition and three conditions with competition. In the *No Competition Condition* (hereafter NCC) the repeated game is played in a dyad, by a *pair* of fixed partners, labeled A and B. In contrast, in the three *Competition Conditions* (hereafter CCs), the game involves a *triad* of fixed players with fixed roles: A, B and C.[3] Such ongoing relationships, which are characteristic of many if not most market and organizational environments, are the natural context in which to study the issues at hand. It opens the possibility for the creation of emotional and social ties (Lawler, Yoon, Baker, and Large, 1995; van Dijk and van Winden, 1997) and more general psychological effects of competition to accumulate over time. The three competition conditions will be denoted by CC-90, CC-90DC and CC-10 for reasons that will be explained shortly.

In all four conditions the number of repetitions (rounds) is 30. In each round of the game of the three CCs the subject in the role of A has to choose to play *either* with B *or* with C. Since player A can only choose one of the other two players the situation of players with

[3]A related game is studied in Davis and Holt (1994).

roles B and C is one of competition as defined by Stigler (1987), as a rivalry in which several parties strive for something that not all of them can obtain. Thus, the CCs reflect in a simple but effective way the kind of competition we want to study.

The stage game of the repeated social dilemma game implemented in part 2 is shown in Figure 1. The representation corresponds directly to the NCC condition, where the game is played by two fixed partners, A and B. In each round the two players simultaneously choose between the numbers 0 and 10. The choice possibilities represent 'cooperation' and 'no cooperation' in a social dilemma situation and may be interpreted as, e.g., wage and effort choices in a gift-exchange framework or quality and price choices in markets of experience goods. Below, we refer to the choices in terms of (rates of) cooperation.

The CCs involve one more choice for one of the players. In each round of these conditions, player A also chooses between two partners, B and C. Player A and the chosen partner then play the above game while the not chosen player obtains a fixed payment. Note that at the outset the B and C players are identical.

	0	*10*
0	$160, 160$	$410, 40$
10	$40, 410$	$290, 290$

In CC-90 and CC-90DC the player not chosen receives 90,
in CC-10 the player not chosen receives 10.

Figure 1: The stage game

The fact that both A and the chosen partner can freely choose their action in a round represents the absence of formal contracting on both sides of the business relation. We consider this to be more interesting than the case of one-sided completeness in which one side's responsibilities are completely fixed. It also makes the players symmetric with respect to the choice possibilities. This is a desirable feature because we want to isolate the effect of competition from possible influences related to choice or payoff asymmetries. This is also the reason why the stage game is symmetric with respect to the payoffs. The symmetric set-up facilitates a straightforward comparison of behavior and earnings across different conditions and player types.

The three conditions with competition differ with respect to the timing of the B/C choices and the magnitude of the payoff that the unchosen player obtains. In our CC-90 condition subjects in the role of B and C made their choice before they knew whether they had been chosen by A and the unchosen B/C player obtained a payoff of 90. This choice procedure for B and C yields more information than a sequential choice set-up and also allows us to compare the behavior of matched and unmatched players. Subjects' information depended

on the role they were in: In each round, player A was only informed about the choice of the selected player and the B or C player was only informed of A's choice if he had been selected. In our view, this information structure is quite natural since in many economic exchange situations the terms of the implicit contract are typically not revealed to third parties. The outside payoff of 90 is dominated by the payoffs that a B or C player can obtain if he is chosen by A and chooses 0. At the same time, it is higher than what he gets if he chooses 10 and A chooses 0.

It is conceivable that the choice procedure used in CC-90 could have a separate effect on behavior, perhaps eliciting a very studied, non-spontaneous reaction by B and C. To explore this possibility we changed, in the condition denoted by CC-90DC (where DC refers to direct choice), the choice procedure, while leaving everything else as in CC-90. In CC-90DC the A player first selects whether he will play with B or C, the chosen B or C partner is then informed about this and then the two players make their choices between 0 and 10.

In our CC-10 condition we used the same choice procedure as in CC-90, but lowered the payment of the unchosen player to 10. An intuitive conjecture is that this will lead to more cooperation by B/C players, as being left out is now very costly to them.

In our design the presence or absence of competition is an exogenously given feature, which facilitates the analysis of the effects of competition as such. The fact that there is only one player on the short side of the exchange relation is an additional advantage of our environment, for the following reason. At all times, it is transparent to all three players in a triad whether B or C is unmatched. If after a period of interaction an A player switches away from, say, the B player then the latter player will be unmatched with certainty in the next round.[4] If there were more than two players on the long side, then the issue would arise whether to inform unmatched players about which of the players had been matched. This information could have an influence on behavior, a possibility that for simplicity we want to avoid.

In our setting the advantageous position of the A player is obvious. Actually, the B and C players can be seen as being at A's mercy, since they do not have a proper refusal possibility. This is precisely the kind of situations we want to study. Examples of such situations are the competition between workers for being selected by a superior for a promotion or cases of procurement where several firms compete offering similar inputs. One might also think of situations in smaller towns or at the workplace, where turning down a work-related or business proposal is socially very difficult.

[4]Note, that being able to substitute someone else for someone, or the possibility to be dumped for someone else, is an important aspect of real competition. Actually, for the CCs the whole situation strongly evokes the notion of unemployment being used as a disciplining device; see Shapiro and Stiglitz (1984).

The game-theoretic predictions based on the standard assumption of (common knowledge of) rationality and narrow material self-interest differ across the conditions. For the NCC the unique prediction is straightforward. Since the stage game has the incentive structure of a prisoners' dilemma game, both players choose 0 in the unique Nash equilibrium. Consequently, the repeated game has also only one Nash equilibrium, which is subgame-perfect: both players choose 0 in each round.

For the CCs the standard predictions are rather different. The stage-game now has two Nash equilibria in pure strategies in which all three players involved choose action 0. The only difference between them is whether A chooses B or C as partner. Importantly, however, the two equilibria are not payoff-equivalent. As a consequence, our finitely repeated CC games also have multiple Nash equilibria and some of them are subgame-perfect. One subgame-perfect equilibrium involves all three players choosing the non-cooperative choice in every round. However, there are also numerous other subgame-perfect equilibria involving different levels of stable relations between player A and his partners and different degrees of gains from cooperation for players. The equilibria for CC-90 and CC-90DC are the same. Lowering of the outside payoff to 10 in CC-10 slightly enlarges the set of subgame-perfect equilibria with cooperation.[5] What we wish to highlight here is that under the standard game theoretic assumptions there are subgame perfect Nash equilibria that imply considerable cooperation in the different competition condition, but not in the NCC.

The theoretical prediction of multiple equilibria with and without gains from cooperation in our CCs is akin to the findings of MacLeod and Malcomson (1989). They show that in repeated labor relations without contractually complete effort enforcement many equilibria

[5]For illustration, consider the following set of subgame perfect equilibria all involving one of the players on the long side, say C, always defecting and A choosing B as a partner. In the first k_1 rounds A and B both cooperate, in the second k_2 rounds A defects and B cooperates and in final k_3 rounds both A and B defect, where $k_1 < k_2 < k_3, k_1 + k_2 + k_3 = 30$. In case of a deviation by A, B changes to defection in all remaining rounds. In case of a deviation by B, A switches to choosing C as partner and defects in all subsequent rounds. (We are grateful to Aljaž Ule for providing us with this example.) The punishment corresponding to switching to the other player is credible. Indeed, the described strategies prescribe that after any deviation all players follow the non-cooperative Nash equilibrium strategy. Note, that all of these equilibria involve all three players choosing the non-cooperative action 0 in the last two rounds for an outside payoff of 90 and in the last round for an outside payoff of 10. To see this, observe that if, say, B is chosen in the last round he will earn 160, because all players choose the non-cooperative action in that round, implying a gain of 70 (150) relative to the exclusion payoff of 90 (10). This loss of 70 is smaller (of 150 is larger) than the gain from a deviation in the previous round, $410 - 290 = 120$. Considering the last two rounds (the last round), however, it is clear that the one-time deviation gain of 120 can not compensate for twice (once) foregoing earnings of 70 (150). This kind of analysis is akin to the one suggested by Friedman (1985), Frayssé and Moreau (1985) and Benoit and Krishna (1985).

exist. Some of them involve cooperation with rent extraction whereas others are equivalent to the competitive Walrasian outcome without any rents.

The differences in predictions between the NCC and the CCs can also be compared to those for an analogous pair of situations with a fixed surplus to be divided. The Nash demand game can, due to its symmetry, be seen as the fixed surplus game parallel to the NCC stage game. Although, any division of the surplus is a Nash equilibrium in the demand game, the equal split seems to be a reasonable prediction, and this is what was found in the experiments reported in Nydegger and Owen (1975). The same situation involving two buyers is an auction with secret reserve price where the only Nash equilibrium implies the whole surplus going to the seller. Here competition clearly favors the short side of the market. Güth, Marchand and Rulliere (forthcoming) present experimental evidence from an ultimatum game with responder competition in which the proposer actually obtains almost all the surplus. Roth, Prasnikar, Okuwo-Fujiwara and Zamir (1991) find similar results in a Bertrand-type auction.

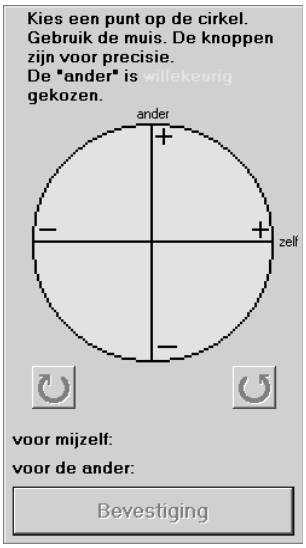
Social or other-regarding preferences can transform the social dilemma games into coordination games in all conditions and can therefore lead to cooperation in the CCs as well as the NCC. For instance, with the type of distributional preferences posited by Fehr, Kirchsteiger and Riedl (1998), Fehr and Schmidt (1999) or Bolton and Ockenfels (2000) both our stage games can have an equilibrium without cooperation, but also have equilibria in which some subjects cooperate while others defect.[6] The possibility of cooperation in the repeated versions of the NCC game follows straightforwardly. In the repeated game with competition the pattern of cooperation may depend on whether players only care about the distribution of payoffs between themselves and their chosen partners, or whether they also take into account the unmatched player. In the first case, equilibrium cooperation could involve a stable relation between player A and one of the other two, whereas in the case in which third party payoffs are also relevant some degree of switching between the two players would be involved.[7]

Part 1 - Initial disposition towards others: In part 1, prior to the interaction phase just described, we recorded participants' decisions in the circle test, which is a modified version of the ring-test (Liebrand, 1984) and was successfully applied by Sonnemans, van Dijk and van Winden (2006). It is a task which allows for a quantification of people's disposition towards others by determining the readiness of individuals to help or hurt others at some cost to themselves.

[6]Other models of social preferences like Dufwenberg and Kirchsteiger (2004), Falk and Fischbacher (2006) and Charness and Rabin (2002) predict similar patterns.

[7]We also note that the reputation formation model of Kreps, Milgrom, Roberts and Wilson (1982) can also explain cooperation in both the NCC and the CCs.

In the circle-test a person's disposition towards another person is measured by a decision which consists in the selection of a point on a circle. Figure 2 shows the circle test used in part 1 of all conditions. Each point on the circle represents an allocation of points to the person who makes the choice (S) and to another person (O). The amounts allocated can be positive or negative, with $S^2 + O^2 = 1000^2$. Each point on the circle also corresponds to a certain angle. It is possible to choose $S = 1000$ and $O = 0$. Other choices of O lead to $S < 1000$.[8,9] Importantly, in the experiment these numbers translate into money earnings at the exchange rate of 1000 points equal to € 2,30. Hence, decisions in the circle-test have pecuniary consequences.



Translation:
Choose a point on the circle.
Use the mouse. The buttons are for precision.
The "other" is arbitrarily chosen.

for myself:
for the other:
Confirmation

Figure 2: The circle test in part 1

In all conditions subjects had to make circle-test decisions with respect to other subjects. Before the interactive phase of part 2 began and before even knowing the content of this phase, thus also not knowing whether they were in the NCC or the relevant competition condition, each subject chose an angle with respect to one anonymously and randomly chosen other subject. These initial angles towards a stranger measure the 'social value orientation' or the disposition towards generalized others. Subjects were not informed about the decision of 'their' strangers in the circle test until the very end of the session.

[8]The circle test has the advantages of allowing subjects to subtract from others payoffs in a symmetric way, in the sense that giving, e.g., 10 points has the same material costs as taking away 10 points. Especially, in our context where negative and positive emotions may come into play this seems to be an advantage over the use of the more standard dictator game for eliciting social dispositions.

[9]The circle appeared on subjects' computer screen. Subjects received computerized instructions about how to make the decision and had ample opportunity to practice.

Part 3 - Post-interaction well-being and disposition towards others: In part 3 of the experiment we measured the effects of the interaction in the game on subjects' subjective well-being and emotions as well as - as in part 1 - their dispositions towards others.

After the last round of the interactive game, and without knowing beforehand, subjects had to respond to a computerized questionnaire designed to elicit participants' subjective well-being. They were asked to rate themselves with respect to a general subjective well-being indicator as well as with respect to thirteen specific emotions.[10] The questionnaire used has previously successfully been applied by Bosman and van Winden (2002). We will explain the general measure of subjective well-being and the emotions questionnaire in detail when we present the results on subjective well-being in Section 3.2.

Right after answering the questionnaires subjects had to make two new circle-test decisions. In the CCs each subject chose angles regarding each of the two other subjects in the triad. In the NCC each subject made one choice relative to his partner and - to keep the number of decisions constant across conditions - another choice regarding a randomly chosen third anonymous subject, a stranger.

In summary, our discussion leads us to the following main working hypotheses. First, in the interactive game, theory predicts rather more cooperation/efficiency in treatments with competition and an earnings advantage of the A player being on the short side of the interaction; the results pertaining to this hypothesis are presented in Section 3.1. Second, we hypothesize that experience of competition has a negative effect on subjective well-being and on disposition towards others of the B/C players who can be excluded from the interaction; this is analyzed in Sections 3.2 and 3.3. Third, we expect that interaction success in terms of monetary earnings, the presence of competition and the player role together with the subjective well-being and emotions interact in affecting players social post-game disposition towards others; this is what we study in Section 3.4.

3 Results

We collected data for 293 subjects. Each subject participated in only one session. For the NCC 72 subjects participated in 36 dyads in four NCC sessions. We conducted four sessions

[10]For more general discussions about the role and importance of feelings and emotions in economic contexts see Loewenstein (2000), Lawler and Thye (1999) and Elster (1998). According to Robinson and Clore (2002), self-reports are the most common and potentially the best way to measure a person's emotional experience. Alesina, Di Tella and MacCulloch (2004), Blanchflower and Oswald (2004), and Ferrer-i-Carbonell (2005) are examples of recent studies of well-being that use self-reports. A recent account of the usefulness of such measures of subjective well-being for policy evaluation is provided by Krueger (2005). For an experimental study using self-reported happiness measures, see Charness and Grosskopf (2001).

with each of the three CCs. We had 81 subjects in CC-90, 75 in CC-90DC and 66 in CC-10. We have, therefore, 26 [36][11], 27, 25 and 22 statistically independent observations for the different conditions. All sessions were run computerized at the CREED laboratory at the University of Amsterdam. The average (net of show-up fee) earnings per subject was € 23,–. A typical session lasted approximately 90 minutes. The instructions of the experiment can be downloaded from 'http://www.fee.uva.nl/creed/pdffiles/instr2compwellbe.pdf'.

We first present the results from the different parts of our design separately. In Section 3.1 we present the results pertaining to the social dilemma games, concentrating on questions of efficiency and earnings. In Sections 3.2 and 3.3 we report the results concerning subjects' experienced well-being and emotions and their disposition towards others, respectively. In Section 3.4 we relate the data generated in the different parts of the experiment to each other. Particularly, we explain how post-interaction well-being and disposition towards others depend on earnings and other features of the interaction phase. We formulate our main findings in terms of a number of specific results.

3.1 Competition, efficiency and earnings

In this section we study whether competition leads to higher efficiency levels and whether A players are able to benefit from their position. Figure 3 shows for all four treatments the development of average cooperation rates over actual plays, i.e., actually played games, ignoring decisions of non-chosen B/C players in the CCs. This also represents attained efficiency levels in terms of earnings. Recall that 10 is the cooperative choice and 0 the non-cooperative one.

For all four series no large variations across rounds are observed, except for a rather stark end-game effect, common to all conditions.[12] Result 1 summarizes the comparisons of cooperation levels across conditions as well as earnings across conditions and player types.

Result 1

A. *There is no significant difference between cooperation levels in the NCC and in the actual plays in each of the three CCs.*

B. *There is no significant difference in earnings between players in the NCC and A players in the CCs. The same holds for earnings of NCC players and the selected B or C players in each of the CCs.*

[11]For the NCC we have complete data for only 52 participants (26 pairs). For the other 20 participants we have all information except the decisions in the first circle test. This was due to computer problems in one of the NCC sessions.

[12]Such an end-game effect has been found in many other experiments on public goods and social dilemma games. It does not affect our main results.

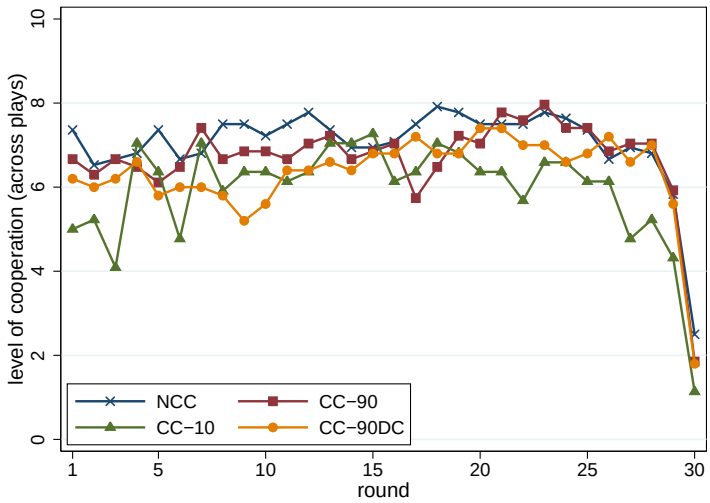


Figure 3: Development of the level of cooperation (efficiency)
in the NCC and the three Competition Conditions

C. *In each of the three CCs the variation (across rounds) in earnings of A players is significantly larger than for players in the NCC.*

Part A of Result 1 states that in our experiment competition does not lead to efficiency gains in terms of earnings. For the NCC the cooperation level and dynamics are in keeping with those observed in similar social dilemma games (see, e.g., Andreoni and Miller, 1993; Keser and van Winden, 2000; Fehr and Gächter, 2000); the average level of cooperation is 7.04 and the standard deviation is 3.39. For the CC-90 these figures are 6.71 and 3.06, for the CC-10 5.92 and 3.15 and for the CC-90DC 6.33 and 3.07. A Kruskal-Wallis test does not reject equality of the four populations ($p = .1379$).[13] All results remain qualitatively the same when the last two rounds are excluded.

Part B of Result 1 summarizes our finding that the A players in the different CCs can not use their apparently powerful position to earn more than players in the NCC. When competition is absent, earnings per player pair per round are 252.2. With competition the A players' average earnings per round are 251.6 in CC-90, 257.8 in CC-10 and 249.24 in CC-90DC. A Kruskal-Wallis test does not reject the hypothesis that these earnings are equal in all four treatments ($p = .6020$). Similar comparisons can be made between the NCC earnings and the earnings of actually chosen B/C players in the CCs. Interestingly, the average per

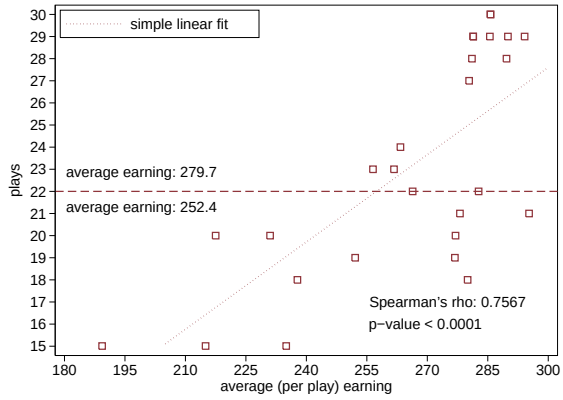
[13]The Kruskal-Wallis test tests the hypothesis that the four independent samples are drawn from the same populations. Where appropriate we use the Mann-Whitney (Wilcoxon signed-ranks) test for independent samples (matched pairs) (Siegel and Castellan, 1988). If not otherwise indicated all test statistics are two-sided (corrected for ties) and the unit of observation is the group (average). In all cases, the alternative - but because of the required normality assumption problematic - t-test gives qualitatively the same results. To save on space we do not report these t-test statistics.

round earnings of the chosen B/C players are in all CCs lower than in the NCC (CC-90: 242.9; CC-10: 216.3; CC-90DC: 235.4), though a Kruskal-Wallis test does not reject the null hypothesis of equality of populations ($p = .2096$). Overall, across conditions, differences in earnings are minor and statistically insignificant.

Part C of Result 1 documents a surprising feature of the interaction under competition. In each competition treatment the (across rounds) standard deviation of earnings of A players is larger than the (across rounds) standard deviation for both players in the NCC (NCC: 65.43 (n=72); CC-90: 89.59 (n=27); CC-10: 94.95 (n=22); CC-90DC: 93.08 (n=25)). A Kruskal-Wallis test indicates that at least one of the differences is statistically significant ($p = .0005$). Subsequent pair-wise Mann-Whitney test reject the hypothesis of no difference between NCC and any of the three CCs ($p \leq .0008$).

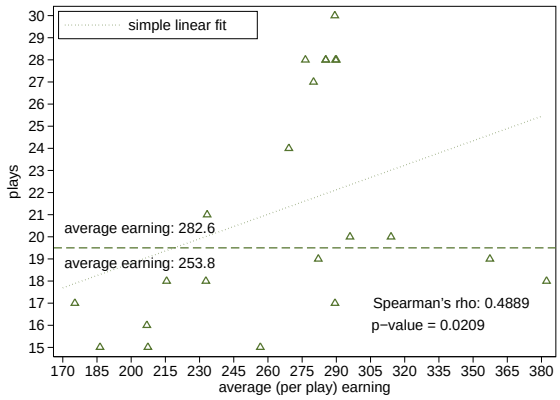
One can interpret Result 1 as showing that competition has at least no positive implications for the allocation of resources. The fact that in many exchange environments the short side obtains a large part of the available surplus is usually considered to have the allocative virtue of attracting resources to that side. This incentive seems not to be present in our environment, if one compares the short side's earnings with that of the NCC. In addition, the fact that the standard deviation of earnings is higher for the A players in any of the CCs in comparison to the NCC shows that being on the short side in the CCs is not such a favorable position as one might expect, intuitively and theoretically. In fact, competition leads to more income uncertainty for agents on the short side of the exchange relation, without experiencing an income increase.

Up to this point we have documented the fact that from a material perspective competition does not increase efficiency nor does it favor the short side. We have not yet studied whether player A's actual use of the possibility of changing his partner affects A's earnings. We now look at the relation between the stability of the relations between the A players in the three CCs and the A players' earnings. Figure 4 shows for the three competition conditions the earnings per play of the A players with the more often chosen B/C players against the actual number of plays. The median number of plays with the more often chosen partner are 22 for the CC-90, 19.5 for the CC-10 and 21 for the CC-90DC. For all three CCs, the Spearman rank order statistics, ρ, yield significantly positive correlations between A's earnings per play with the more often chosen partner and the number of plays with that partner (CC-90: $\rho = .7567$; CC-10: $\rho = .4889$; CC-90DC: $\rho = .6403$ with $p < .0210$ in all three conditions). We find similar results for the correlation of the more often chosen B/C player's earnings per play



(a) CC-90

(b) CC-90DC



(c) CC-10

Figure 4: Earnings (per play) of A-players as a function of the number of plays in all Competition Conditions

with the number of plays (CC-90: $\rho = .7122$; CC-10: $\rho = .6883$; CC-90DC: $\rho = .5066$ with $p < .0099$ in all three conditions).[14]

To further characterize the relationship between earnings per play and the number of plays we calculate the average earnings above and below (or equal) the median number of plays between A players and more often chosen B/C players. In turns out that for all three CCs, A players with strictly above median length relationships earn more than those with relationships shorter than the median length. For each CC, Mann-Whitney tests reject the hypothesis that above and below median length earnings come from the same population ($p < .0410$ in each CC). A similar pattern is found for the more often chosen B/C player ($p < .0062$ for each CC).

[14]Interestingly, these correlations are different for the less often chosen partner ($\rho = -.3999, p = .0476$ for CC-90, $\rho = -.2619, p = .2514$ for CC-10, and $\rho = -.5246, p = .0085$ for the CC-90DC).

Result 2

A. *The number of times an A player chooses the same partner correlates positively with A's earnings in those plays in all three Competition Conditions.*

B. *Similarly, for those B/C players who are chosen more often, the number of times they are chosen correlates positively with their earnings in those plays in all three Competition Conditions.*

Our evidence shows that in all CCs, for A players, relying on a more bilateral relation is the most promising way to behave. However, even the relatively successful group of A-players with above median stable relations does not earn significantly more than subjects in the NCC ($p > .5800$ for all pair wise comparisons between NCC and the CCs; Mann-Whitney tests). That is, compared to the situation without competition, in the competition conditions players on the short-side do not profit from choosing one of the players for a long-term relation. Interestingly, for the A players with less than the median number of plays with the same partner, the result that they earn less than subjects in NCC is marginally statistically significant for CC-90 and CC-90DC ($p = .0630$ and $p = .0513$, respectively), but insignificant for the CC-10 ($p = .5801$).[15]

An important question emerging from the above results is, why does the A player not profit from the rivalry between B and C? An answer may be found in A's punishment behavior, in general, and partner choice behavior, in particular. If A could commit to always changing his interaction partner after the partner having chosen 0 and never switching after the partner having chosen 10, then he might be able to capitalize on his advantageous position. However, since such a commitment is not possible, uncertainty about A's future behavior may lead the B/C players to act opportunistically; i.e., choosing 0 even after successful cooperation in a round. In consonance with this, A may sometimes switch away from a partner who chose 10. Together, this could lead to a dilution of A's apparently advantageous situation.

As suggested in the previous paragraph, in all three competition conditions, A's rewarding and punishment behavior is indeed not fully consistent. Table 9 in the Appendix summarizes the following discussion. In CC-90, if both the A player and the chosen partner make the cooperative choice 10 in a round $t-1$ the A player does not reward the partner in 59 out of 455 cases. In 39 instances the A player switches partner and in the other 20 cases he stays

[15]Kollock (1994) and Brown, Falk and Fehr (2004) also find that in stylized situations without formal contracting people tend to create bilateral relations. In accordance with our findings, the latter also find that longer relations generate larger rents and that early round behavior is an important determinant of the length of the relation. These authors, however, do not investigate the impact of competition, i.e. they do not study whether bilateral relations in the presence of competition lead to different outcomes than in the absence of competition.

with the partner but changes to the defective choice 0. That is, in 13% of all instances player A does not stay and cooperate with a cooperative partner. Similarly, if the chosen B/C player does not cooperate in a round $t-1$ while A does cooperate, the A player does not punish this behavior in 14 out of 74 cases. That is, in 19% of all instances A players do not sanction defecting partners by also defecting or switching to the other B/C player. Together, this gives an overall inconsistency measure of (59+14)/(455+74), which amounts to 13.8%.

In CC-10 and CC-90DC, we observe similar inconsistencies in A players' rewarding and punishment behavior. In CC-10, if both the A player and the chosen partner make the cooperative choice 10 in a round $t-1$ the A player does not reward the partner in 66 out of 300 cases. In 45 instances the A player switches partner and in the other 21 cases the A player stays with the partner but changes to defection. Hence, in 22% of all instances A players do not stay and cooperate with a cooperative partner. Similarly, if the chosen B/C player does not cooperate in a round $t-1$ while the A player does cooperate, the latter does not punish this behavior (neither by defecting himself nor by switching partners) in 4 out of 53 cases (7.5%). In CC-10 overall inconsistency amounts to (66+4)/(300+53), that is 19.8%. The corresponding figures for the CC-90DC treatment are, that in (39+24)/387 cases (16%) the A player does not reward cooperative behavior and in 16/69 (23%) he does not sanction defective behavior, leading to an overall inconsistency measure of 17.3%.

Another mode of behavior that is likely to increase efficiency and earnings is conditional cooperative behavior (Keser and van Winden, 2000; Fischbacher, Gächter, and Fehr, 2001). With conditional cooperative behavior we mean that a player responses with the (non) cooperative choice (0) 10 in t to a (non) cooperative choice of (0) 10 by the partner in $t-1$. We find that compared to the NCC the behavior of the A players in the CCs is less conditionally cooperative, especially regarding cooperative choices. A choice of 10 by player A in a round t following the partner's choice of 10 in round $t-1$ is significantly less likely in the CCs than in the NCC. The frequencies of such choices in NCC, CC-90, CC-10, and CC-90DC are .926, .828, .689, and .794, respectively. χ^2-tests indicate that the differences between NCC and the CCs are highly significant ($p < .001$). Uncooperative responses of A players after uncooperative choices of B/C players are also less frequent in the CCs than in the NCC, however, mostly insignificantly so. For detailed results see Table 10 in the appendix.

Interestingly, B/C players in the CCs also tend to behave less conditionally cooperative than players (with label B) in the NCC. However, in contrast to A players who are less positively cooperative, B/C players are less negatively cooperative. A choice of 0 in t by a B/C player in response to a 0 choice in $t-1$ by an A player is significantly less frequent in each CC treatment than in the NCC. The frequencies of such choices in the NCC, CC-90, CC-10, and CC-90DC are .854, .701, .583, and .732, respectively. χ^2-tests indicate that the

differences between the NCC and each of the CCs are highly significant ($p < .001$). In the CCs, B/C players are also weakly less positively conditional cooperative than players in the NCC. The differences are mostly not significant, however. Table 10 in the appendix provides the detailed results.

The results on conditional cooperation are consistent with the idea that A players are indeed in a relatively strong position in the CCs. However, since they are not consistently sanctioning defecting behavior and rewarding cooperative behavior of their chosen partners they can not benefit from this structural advantage. In consequence, competition does neither increase efficiency nor materially favor the short side of the exchange relation.

In the next two sections we will discuss our subjects' experienced well-being and their behavioral disposition towards others. In Section 3.4 we will relate these results with the results from the interactive game just discussed.

3.2 Subjective well-being after the interaction

We use both a general measure as well as a list of specific emotions to elicit subjects' subjective (experienced) well-being. For measuring general subjective well-being we used Figure 5. After the interaction phase, subjects were asked to indicate the number below the little figures that best corresponded to their general mood in relation to the facial expressions of the so-called Self-Assessment Manikin.[16]

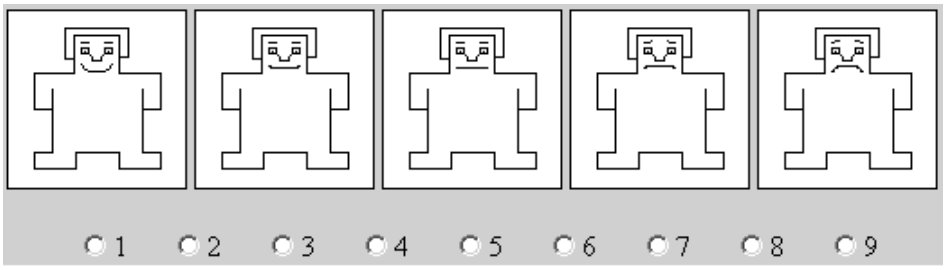


Figure 5: General measure of subjective well-being

In the figure, a "1" clearly corresponds to the highest level and a "9" to the lowest level of subjective well-being. For a better comparison with the emotions scores reported below, we have inverted the score obtained from subjects' decisions in Figure 5, so that "1" reflects the worst and "9" the best mood. Table 2 shows the average values of the general well-being measure for the NCC and the CCs, pooled as well as separately. Result 3 summarizes the results of these comparisons for the pooled CCs.

[16]These figures, developed by Lang (1980), are reprinted from Sonnemans (1991).

Result 3

A. *For players in the NCC general subjective well-being is lower than for A players, higher than for less often chosen B/C players and not different from more often chosen B/C players, in the Competition Conditions.*

B. *In the Competition Conditions, for A players general subjective well-being is higher than for both more and less often chosen B/C players.*

C. *In the Competition Conditions, for more often chosen B/C players general subjective well-being is higher than for less often chosen B/C players.*

Support for this result can be found in Table 2. In the table the superscripts indicate significant differences of pairwise comparisons across player situations and conditions, as explained in the note to the table. For the pooled data all pairwise comparisons are significant (at least at the 2.5 percent level, 1-sided tests), with the only exception of the difference between players in the NCC and the more often chosen B/C players in the CCs. For CC-90 and CC-10 the same pairwise comparisons as for the pooled data appear to be significant. Note, that for these two conditions the levels of our general measure of subjective well-being are different between all three player situations. Being on the short or long side does make a difference for subjective well-being, independent of the earnings obtained outside the relation. Those on the long side feel significantly worse than players on the short side. Moreover, being mostly excluded on the long side has an additional negative impact on subjective well-being. Observe also that, in comparison to the NCC, the reported scores of our general measure in the CC-90 and CC-10 conditions are at a higher, a lower and a similar level, depending on the position of the players. Hence, competition has led to an inequality in subjective well-being without generating material efficiency gains. For the CC-90DC the results are slightly different as the comparison between CC-A and both CC-B/C m.o. and NCC are not significant, while all other differences stay significant also in this condition.

Next to the general measure of subjective well-being subjects also reported the experienced intensity of a number of specific emotions. As expected, negative emotions (sadness, envy, anger, irritation, contempt) are negatively correlated with general well-being while positive emotions (happiness, pride, joy, relief) correlate positively with this measure ($p < .025$ for all mentioned emotions, using the pooled data from the Competition Conditions; for details see Table 8 in the appendix). These results supports the interpretation that our general measure indeed indicates how people feel and demonstrates the close relation between subjective well-being in a more general sense and the intensity of experienced specific emotions.

In summary, the evidence presented in this section documents that there exists a clear relation between people's subjective well-being and their position in the interactive game. In

Table 2: Averages of general measure
of subjective well-being across conditions and roles

		condition-role			
	well-being/emotion	CC-A	CC-B/C m.o.	CC-B/C l.o.	NCC
All CC	general well-being^{a,b,c,d,f}	7.53	6.35	3.83	6.40
	no. of obs	74	73†	74	72
CC-90	general well-being^{a,b,c,d,f}	7.85	6.09	3.50	
CC-10	general well-being^{a,b,c,d,f}	7.72	5.81	3.73	
CC-90DC	general well-being^{b,c,f}	7.00	7.08	4.28	
	no. of obs	22	22†	27	

Note: Scores for well-being range from 1 (feel "very bad") to 9 (feel "very good"). "m.o." ("l.o.") stands for "more (less) often chosen". ^{a} significant difference between CC-A and CC-B/C m.o., ^{b} significant difference between CC-A and CC-B/C l.o., ^{c} significant difference between CC-B/C m.o. and CC-B/C l.o., ^{d} significant difference between CC-A and NCC, ^{e} significant difference between CC-B/C m.o. and NCC, ^{f} significant difference between CC-BC l.o. and NCC; all significances at least at 2.5 percent level, Mann-Whitney rank sum tests, one-sided; † $n = 21$ in CC-10 due to one missing observation.

particular, being on the long side in the CC tends to reduce their subjective well-being, which is reinforced for those often excluded from the interaction.

3.3 Disposition towards others before and after the interaction

Table 3 presents the averages and standard deviations of the angles observed in the circle tests of parts 1 and 3, for the NCC and the CCs, pooled as well as separately. For the CCs we distinguish between player types and, for the B/C players, between more (m.o.) and less (l.o.) often chosen ones.

Previous use of social value orientation tests in economic experiments, as for instance in Offerman, Sonnemans, and Schram (1996), has shown that a large fraction of people give positive amounts to anonymous others. We find a similar pattern when looking at the initial angles chosen by our subjects in the circle test. These choices were recorded before subjects were informed about the content of any of the remaining parts of the experiment and, therefore, can not be affected by behavior or even by expectations about behavior in the interactive game. As expected the initial angles do not significantly differ between treatments. On average the angles are 15.37 degrees in the NCC and 14.01, 15.75, and 18.54 in the three CCs[17] (cf. left part of Table 3). A Kruskal-Wallis test does not reject the hypothesis that the angles come from the same population ($p = .3937$). There is also no statistically significant difference in initial angles between those subjects who became an A player and those who

[17] An angle of 15 degrees implies a transfer of 259 points to the other person, whereas 966 points are kept.

Table 3: Disposition towards others - average angles in the circle tests

	initial angle of					final angle of							
	all	A	B/C (all)	B/C-m.o.	B/C-l.o.	all towards partner	all towards third party	A towards B/C-m.o.	A towards B/C-l.o.	B/C-m.o. towards A	B/C-m.o. towards B/C-l.o.	B/C-l.o. towards A	B/C-l.o. towards B/C-m.o.
NCC	15.37					10.67	9.68						
	(18.40)					(24.17)	(15.49)						
	[n=52][a]					[n=52][c]	[n=52][c]						
All CC	16.07	16.02	16.10	18.38	13.81			16.92	10.17	9.98	11.74	-2.97	6.38
	(21.84)	(18.73)	(23.28)	(18.85)	(26.66)			(19.64)	(18.71)	(20.39)	(18.16)	(27.48)	(16.51)
	[n=221][b]	[n=73][b]	[n=148]	[n=74]	[n=74]			[n=73][d]	[n=73][d]	[n=74]	[n=74]	[n=74]	[n=74]
CC-90	14.01	14.90	13.58	19.20	7.96			14.54	6.93	12.49	12.59	-4.19	5.95
	(26.03)	(19.43)	(28.83)	(21.99)	(33.81)			(20.14)	(14.40)	(19.24)	(16.79)	(27.03)	(13.61)
	[n=80][b]	[n=26][b]	[n=54]	[n=27]	[n=27]			[n=26][d]	[n=26][d]	[n=27]	[n=27]	[n=27]	[n=27]
CC-10	15.75	15.60	15.84	18.75	12.93			16.28	12.36	10.80	11.13	-2.84	7.69
	(19.48)	(20.17)	(19.36)	(17.94)	(20.48)			(18.77)	(17.94)	(19.75)	(16.49)	(20.45)	(13.72)
	[n=66]	[n=22]	[n=44]	[n=22]	[n=22]			[n=22]	[n=22]	[n=22]	[n=22]	[n=22]	[n=22]
CC-90DC	18.54	17.56	19.03	17.18	20.89			19.97	11.60	6.55	11.36	-1.77	5.68
	(18.73)	(17.29)	(19.56)	(16.50)	(21.57)			(20.25)	(23.11)	(22.41)	(21.42)	(33.70)	(21.50)
	[n=75]	[n=25]	[n=50]	[n=25]	[n=25]			[n=25]	[n=25]	[n=25]	[n=25]	[n=25]	[n=25]

Note: "m.o." ("l.o.") stands for "more (less) often chosen; [a] observations of one session are missing due to technical problems; [b] one missing observation in CC-90; [c] without observations that correspond to the missing observations in the first circle test (see [a]); [d] without observation that corresponds to the missing observation in the first circle test (see [b]); in cases where both B/C players are chosen exactly 15 times the average angles of the two players is used when calculating the angles for the "more often" and "less often" chosen players. Standard deviations in parentheses.

became a B or C player in the three CCs ($p \geq .6333$, Mann-Whitney test). If during the interactive game sorting out of initially more selfish B/C players has taken place this should be reflected in differences of the initial angles between more and less often chosen B/C players. Indeed, in CC-90 and CC-10 the initial angles of less often chosen B/C players are smaller than those of their more often chosen counterparts. However, the differences are statistically not significant ($p \geq .1729$, Wilcoxon signed-rank test) for any Competition Condition.

Next consider the final angles shown on the right part of Table 3. These angles were measured after the interaction phase and, hence are payoff relevant expressions of post-interaction disposition towards others. Our main interest is in whether and how competition and experience during the interaction phase affect people's disposition towards others. We, therefore, focus here on changes relative to the initial angles. With the notable exception of A players behavior towards more often chosen B/C players we observe a general tendency for angles to decrease from the pre-game to the post-game situation, in all conditions. Such a general 'decay' is in keeping with the results of van Dijk, Sonnemans and van Winden (2002). Importantly, however, the observed changes clearly differ between the NCC and the CCs as well as between player roles. The pattern of these differences is summarized in the following result.[18]

Result 4 *In comparison to the disposition towards others measured before the interactive game:*

A. *In the NCC, players' disposition towards their partners do not significantly change, whereas it exhibits a significant decrease towards third parties.*

B. *In the CCs, A players' disposition towards the more often chosen partner does not significantly change, but significantly decreases towards the less often chosen partner.*

C. *In the CCs, the more often chosen B/C players' disposition towards A players and less often chosen B/C players significantly decreases.*

D. *In the CCs, the less often chosen B/C players' disposition towards A players and more often chosen B/C players significantly decreases.*

In the NCC, a Wilcoxon signed-ranks test does not reject the hypothesis of equality of distributions ($p = .1775$) of initial angles and final angles towards the partner. In contrast, when comparing initial angles with final angles towards the third party (average: 9.68) the null hypothesis of equality is rejected ($p = .0132$, Wilcoxon signed-ranks test).

In the CCs we need to distinguish between A players and more and less often chosen B/C players. In the following we present the test results for the pooled data of all CCs and mention the results for an individual Competition Condition only if it differs from the pooled pattern.

[18]To save on space for the CCs the result refers to the pooled data. The few differences between the CCs are discussed after the result.

Part B of the above result captures the A players' changes in dispositions towards interaction partners. Compared to their initial disposition, A players do not significantly modify their disposition towards the more often chosen partner ($p = .7734$, Wilcoxon signed rank test). In stark contrast, concerning the less often chosen partner the final angles decrease significantly ($p = .0005$, Wilcoxon signed rank test). For CC-90DC this decrease is large in absolute terms, but statistically not significant ($p = .1523$, Wilcoxon signed rank test).

For the more often chosen B/C players (part C) a Wilcoxon signed-rank test rejects equality of distributions of initial angles and final angles towards A players ($p = .0009$). For CC-10 the decrease is marginally significant ($p = .0593$) and insignificant for CC-90 ($p = .1650$). When comparing the initial angle of B/C players with the final angle regarding the less often chosen B/C fellow player a Wilcoxon signed-ranks test rejects equality of distribution ($p = .0019$). On the individual CC level Wilcoxon signed rank tests show only marginally significant (CC-90: $p = .0552$; CC-10: $p = .0856$) or marginally insignificant differences (CC-90DC: $p = .1171$).

For the less often chosen B/C players equality of distributions for the initial angle and the final angle regarding the A-player is rejected by a Wilcoxon signed-rank test ($p < .0001$). Note, that the negative angles (average: -2.97) implies that less often chosen B/C players actually gave up money in order to reduce the earnings of A-players. When comparing the initial angle with the final angle towards more often chosen B/C fellow players we also observe a significant decrease ($p = .0018$, Wilcoxon signed-rank test). Among the individual CCs the observed decrease is statistically not significant in CC-90 ($p = .4178$).

A general insight from the findings of this and the previous section is that subjective well-being and dispositions towards others are strongly influenced by the interaction institution and the role in which a person participates in the interactive game. In particular, being on the long side of the exchange situation has a strong negative effect on players' subjective well-being and their disposition towards other players, especially those on the short side.

3.4 The relation of interaction experience, post-interaction well-being and disposition towards others

We have seen that both subjective well-being and disposition towards others are affected by people's position in the interaction phase. In this section we use regression analysis to study how well-being, experienced emotions and interaction success are related to the post-game disposition towards others. We presume the following relations: (i) well-being and emotions are influenced by experience in the game, that is, by both, the interaction success in monetary terms and the position a player is put in; (ii) the disposition towards others after the interaction is affected by interaction success but also by emotional factors, which allows

for an indirect - via interaction success - as well as direct effect of emotions on the disposition towards others.[19] In the following we concentrate on the NCC and the pooled data of all three Competition Conditions.

For general well-being and each specific emotion we ran separate OLS regressions with interaction success, i.e., total earning across actual plays, as explanatory variable. We briefly report the main results of these estimations. For the NCC players the central result is that general well-being as well as the positive emotions happiness, pride, and joy and the negative emotions sadness, envy, anger, and irritation are strongly significantly related to interaction success, with the expected sign ($p < .01$). In addition, surprise shows a significantly negative sign ($p < .01$). These regression results clearly indicate that the emotional state of NCC players is strongly correlated with their earnings success in the incomplete contract game.

The picture turns out to be different in the Competition Conditions. For the A players general well-being is significantly positively related to interaction success in plays with the more often chosen B/C player ($p < .01$) but marginally negatively related to interaction success with the less often chosen player ($p < .1$).

Of the specific emotions the positive emotions happiness, relief, and joy are positively and the negative emotion anger is negatively correlated with interaction success in plays with the more often chosen B/C player ($p < .01$ for the positive emotions and $p < .01$ for anger). Interaction success in plays with the less often chosen B/C player has no significant effect on any of the specific emotions. Hence, for players on the more powerful side in the CCs interaction success shows a weaker relation with the emotional state and general subjective well-being. While for B/C players interaction success and general well-being are positively correlated and similar for more and less often chosen ones ($p < .01$ and $p < .05$, respectively), the effect for the specific emotions differs strongly. More often chosen B/C players' positive emotions happiness, pride, relief, and joy are significantly positively related to interaction success ($p < .05$) and the negative emotions sadness, envy, anger, irritation, and contempt are significantly negatively related to interaction success ($p < .01$). In stark contrast, for the less often chosen B/C players the negative emotions sadness and anger indicate a significantly negative correlation with interaction success ($p < .05$), while all other specific emotions seem unrelated to this experience.

We now move to studying how emotions and interaction success relate to the disposition towards others. Due to the substantial correlations among the experienced emotions, we

[19]We cannot completely rule out the possibility that post-game dispositions towards others are to some extent ex-post rationalizations of the earlier elicited emotions. However, as will be seen later our results are not invariant between the NCC and the Competition Conditions, indicating that ex-post rationalizations cannot be the most important explanation of the relations we find.

performed a factor analysis to identify the main dimensions for the regression analysis, which follows below. It turns out that for all four player-roles only three factors had eigenvalues larger than 1, and together accounted for more than 60% of the variance of the thirteen emotion items. For the first factor the factor loadings were high for the negative emotions anger, sadness, irritation, and contempt; for the second factor they were high for the positive emotions joy, happiness, and pride; for the third factor they were high for the emotions guilt, shame, and fear. For convenience, we call these three factors the anger factor, the joy factor and the guilt factor, for obvious reasons.[20]

We examined three models of seemingly unrelated regressions for the NCC and the pooled data of the CCs and all player roles. In the regression models the independent variables are the final angles, i.e., the dispositions towards others after the game, and the explanatory variables are the initial angle, i.e., the initial disposition towards others, the total earnings over plays, i.e., interaction success, and the three emotional factors just described.

Table 4 presents regression results pertaining to the players in the NCC. In this condition we need to distinguish between changes of disposition towards the partner in the interactive game and the randomly chosen third player. The (a) equation pertains to the partner in the interactive game and the (b) equation relates to the third player. We estimate three nested models. In all models the initial angles, i.e., *ante*-game disposition towards others, is used as an explanatory variable. In model 1 the sum of earnings measuring interaction success is also included as an explanatory variable. In model 2 the three emotional factors are added as regressors and in model 3 interaction success is dropped as explanatory variable. The results reported in Table 4 show that in the NCC interaction success has in no significant effect, independent of the model specification. In contrast, in models 2 and 3 the disposition towards the interaction partner is significantly negatively affected by the anger factor and significantly positively affected by the guilt factor. The disposition towards the third party is unaffected by emotional factors, indicating that the emotions are directed towards the partner in the interactive game. Likelihood ratio tests show that model 2 provides a better fit than model 1 and that model 2 and model 3 are doing equally well (see, bottom of the table). Hence, adding the emotion factors increases the explanatory power of the regressions whereas adding interaction success does not. Taking also into account the result that the emotions of players in the NCC are correlated with interaction success (cf. discussion above) the overall picture is consistent with the idea that interaction success triggers emotional responses, which in turn, together with the initial disposition, determine people's post-interaction disposition

[20]The criteria we use for selecting the factors are two of the most widely used conventions. There were some minor variations of the factor loadings across player types. The complete list of factor loadings can be obtained from the authors upon request.

Table 4: Determinants of post-game disposition towards others - A and B players in NCC

	A and B players towards each other (#a equations) and unrelated third player (#b equations)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Initial angle	.4870**	.4601**	.3158	.3654**	.3226	.3654**
	(.003)	(.000)	(.065)	(.001)	(.058)	(.001)
Sum of earnings	.0549		-.0326			
	(.320)		(.616)			
Anger factor			-7.404*	-1.117	-6.650*	-1.117
			(.016)	(.508)	(.013)	(.508)
Joy factor			4.015	2.825	3.323	2.825
			(.226)	(.136)	(.271)	(.136)
Guilt factor			6.290*	1.903	6.219*	1.903
			(.027)	(.286)	(.028)	(.286)
Constant	-10.43	2.602	13.84	4.056	5.636	4.056
	(.450)	(.264)	(.410)	(.089)	(.138)	(.089)
R^2	.1845	.2986	.3194	.3478	.3203	.3478
N	52	52	52	52	52	52
Model comparisons		Model 1 vs Model 2		Model 2 vs Model 3		
LR χ^2		12.27		.25		
p-value (1-sided)		.0281		.3081		

Note: Seemingly unrelated regressions; ** significant at the 1 percent level, * significant at the 5 percent level; $p-$values (2-sided) between parentheses.

towards their interaction partner. Note, that the effect of earnings on the final disposition towards the interaction partner is only indirect and mediated by the emotions.[21]

Table 5 shows analogous regression results for the A players in the CCs. We use the same model specifications as for the NCC, except that now the (a) equations relate to the more often chosen B/C player and the (b) equations to the less often chosen one. In all model specifications, the initial disposition towards others (initial angle) has a significantly positive effect whereas interaction success (sum of earnings over plays) has no significant effect. In model 2 and 3 the guilt factor is significantly positively related with the disposition towards the less often chosen B/C players. This indicates that on average feelings of guilt, shame, and fear increased the disposition of the A players towards those B/C players they have

[21]This mediator effect of psychological variables (emotions in our case) is well known in social psychology research. For a discussion of the mediator effect see, e.g., Baron and Kenny (1986).

Table 5: Determinants of post-game disposition towards others - A players in the Competition Conditions

	A player towards more often (#a equations) and less often (#b equations) chosen B/C player					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Initial angle	.3137**	.3146**	.2990*	.2491*	.2966*	.2497*
	(.009)	(.006)	(.023)	(.038)	(.024)	(.036)
Sum of earnings	.0006	.0008	.0004	.0014		
	(.554)	(.591)	(.765)	(.369)		
Anger factor			1.526	2.701	1.322	3.045
			(.515)	(.195)	(.554)	(.135)
Joy factor			1.865	1.387	2.028	1.172
			(.433)	(.514)	(.380)	(.577)
Guilt factor			2.335	5.319*	2.463	4.940*
			(.334)	(.017)	(.298)	(.023)
Constant	8.113	3.753	9.941	3.746	12.11**	6.072*
	(.256)	(.328)	(.209)	(.325)	(.000)	(.030)
R^2	.0955	.0989	.1217	.1981	.1180	.1935
N^a	73	73	73	73	73	73
Model comparisons		Model 1 vs Model 2		Model 2 vs Model 3		
LR χ^2		9.60		1.82		
p-value (1-sided)		.0714		.2010		

Note: Seemingly unrelated regressions; ^{a} one missing initial angle observation due to technical problems in one session; ** significant at the 1 percent level, * significant at the 5 percent level; $p-$values (2-sided) between parentheses.

more often excluded from playing the game. The model comparisons show that including the emotional factors weakly improves the estimation but interaction success does not (see bottom of the table). Recall from above that the emotions of A players in the CCs are not affected by interaction success with the less often chosen B/C player. Therefore, the post-game disposition of A players in the CCs are neither directly nor indirectly (via the emotions) influenced by interaction success. Only one of the emotional factors is an important direct determinant for the final disposition towards the interaction partner on the short side of the exchange relation.

Table 6 shows the results for the more often chosen B/C players and Table 7 for the less often chosen one. Here the (a) equations refer to the A player and the (b) equations to the other B/C player, the less often chosen and the more often chosen, respectively. We discuss the regression results for both kinds of B/C players together. Model 1 in Tables 6 and 7

Table 6: Determinants of post-game disposition towards others - more often chosen B/C players in the Competition Conditions

	More often chosen B/C player towards A (#a equations) and less often (#b equations) chosen B/C player					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Initial angle	.3927**	.5601**	.3975**	.5550**	.3929**	.5550**
	(.001)	(.000)	(.000)	(.000)	(.001)	(.000)
Sum of earnings	.0027**		.0017			
	(.004)		(.156)			
Anger factor			-5.115*	.5921	-7.192**	.5921
			(.045)	(.731)	(.001)	(.731)
Joy factor			-1.317	.3572	.3914	.3572
			(.583)	(.835)	(.853)	(.835)
Guilt factor			1.207	-2.875	1.013	-2.875
			(.562)	(.096)	(.631)	(.096)
Constant	-11.98*	1.195	-6.899	1.287	2.423	1.287
	(.039)	(.615)	(.335)	(.589)	(.407)	(.589)
R^2	.2322	.3445	.2872	.3719	.2543	.3719
N^a	73	73	73	73	73	73
Model comparisons		Model 1 vs Model 2		Model 2 vs Model 3		
LR χ^2		10.62		2.04		
p-value (1-sided)		.0504		.0765		

Note: Seemingly unrelated regressions; ^{a} one missing initial angle observation due to technical problems in one session; ** significant at the 1 percent level, * significant at the 5 percent level; $p-$values (2-sided) between parentheses.

shows that the post-game disposition towards the A player is significantly positively related to interaction success for the more often chosen B/C player, whereas such a relation fails to exist for the less often chosen B/C player. Models 2 and 3 show that for both kinds of B/C players the disposition towards the A players is strongly and significantly negatively influenced by the anger factor, indicating that negative feelings strongly decrease their kindness towards the more powerful player on the short side of the interaction but not towards their co-players on the long side. Interestingly, when adding the emotions factors in the regression for the more often chosen B/C player, interaction success ceases to be significant (cf. equations (1a) and (2a) in Table 6). Together with the above established result that the emotions that make up the anger factor are strongly related to interaction success this points to a pronounced mediator effect of this emotion factor. That is, interaction success influences the disposition of more often chosen B/C players towards A players only indirectly via the emotions. For the

Table 7: Determinants of post-game disposition towards others - less often chosen B/C players in the Competition Conditions

	Less often chosen B/C player towards A (#a equations) and more often (#b equations) chosen B/C player					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Initial angle	.5071**	.2463**	.5171**	.2277**	.5179**	.2276
	(.000)	(.000)	(.000)	(.001)	(.000)	(.001)
Sum of earnings	.0026		.0012			
	(.335)		(.625)			
Anger factor			-8.338**	.2199	-8.565**	.2199
			(.002)	(.903)	(.001)	(.592)
Joy factor			1.904	1.990	2.181	1.990
			(.488)	(.284)	(.414)	(.284)
Guilt factor			4.802	-.6343	4.701	-.6343
			(.072)	(.728)	(.075)	(.728)
Constant	-14.05**	2.975	-12.10*	3.233	-10.12**	3.233
	(.008)	(.139)	(.017)	(.115)	(.001)	(.115)
R^2	.2538	.1581	.3809	.1733	.3815	.1733
N	74	74	74	74	74	74
Model comparisons		Model 1 vs Model 2		Model 2 vs Model 3		
LR χ^2		16.66		.2600		
p-value (1-sided)		.0053		.3054		

Note: Seemingly unrelated regressions; ** significant at the 1 percent level, * significant at the 5 percent level; $p-$values (2-sided) between parentheses.

less often chosen B/C players we neither find a significant direct relation between the emotions entering the anger factor and interaction success (see above) nor is there a significant direct effect of interaction success on the disposition towards A players. Together, this shows that the post-game disposition of more often excluded players on the long side is directly negatively affected by their negative emotional feelings.[22]

[22]One might speculate that the desire to reduce earnings inequalities drives the final disposition of the less often chosen B/C players towards their richer A players. To test this we have also run regressions where we included the total earnings across rounds (as well as across plays) of the less often chosen B/C player relative to the earnings of the A player as a measure of interaction success. None of these alternative measures of interaction success is significant, neither when used separately nor when used jointly. In all alternative specifications the anger factor stays significant at the 1% level. Hence, for our results the explanation that less often chosen B/C players punish A players because of earnings inequalities has no bite.

The model comparisons show that model 2 provides a (marginally) significantly better fit for the (more often) less often chosen B/C players. For the more often chosen B/C players it is also the case that the full model including interaction success and emotional factors gives marginally the best fit (see bottom of the tables).

We summarize the main observations concerning the comparison across conditions of how the different variables affect the disposition towards others after the experience in the interactive game in the following result.

Result 5 *In all conditions and for all player roles the final disposition towards others is significantly positively related to the initial disposition. In addition, the following holds for the final disposition towards others:*
A. *For players in the NCC it is related only indirectly to interaction success, mediated by emotional factors.*
B. *For the A players in the CCs it is neither directly nor indirectly related to interaction success, but towards the less often chosen B/C player it is positively related to the guilt factor.*
C. *For the more often chosen B/C players in the CCs the final disposition towards the A is indirectly related to interaction success via the anger emotion factor.*
D. *For the less often chosen B/C players in the CCs the final disposition towards the A players is neither directly nor indirectly related to interaction success but is strongly negatively influenced by the anger emotion factor.*

From Section 3.2 we know that general subjective well-being of players strongly depend on the competitiveness of the institution players are put in as well as their position in the competitive environment. We have also seen that interaction success, measured by earnings, is insufficient to explain these differences. The above result shows that some emotional states rather than pure monetary outcomes are related to behavior after the interaction in the game. We can summarize the results of this section with the following statement. Mediated by the emotional state, the experience with competition as such and the role people are immersed in are important determinants of the disposition towards others, while interaction success plays only a minor role.

4 Final Comments

We find that *competition matters*, but in a very different way than is typically assumed in economics. In our experimental exchange environment without complete contracts competition does neither enhance efficiency nor does it increase the earnings of the short side of the exchange relation. It does have positive effects on the subjective experienced well-being

of people on the short side. However, competition has hidden costs that are related to people's emotional reaction to lack of control and the possibility of exclusion from trade. Being exposed to the competitive environment lowers subjective well-being and triggers negative emotions for those on the long side. Competition has also adverse effects on the behavioral disposition towards those interacted with. Experience with competition appears to decrease the subsequent willingness to help. This effect is strongest for those who are frequently excluded. Importantly, these effects can not be explained by earnings differences generated during the interaction alone. In summary, competition does not show up as a very positive force in our experiment.

One can speculate about potential longer term effects of our findings. The kind of competition we study clearly deteriorates the social relations between interaction partners and considerably depresses the subjective well-being of those on the long side of exchange who are often excluded from interaction. These facts may lead to the obstruction of future cooperation. Note, that the formation of mostly stable bilateral relations can not completely solve this problem. In most competitive situations bilateral relations necessarily imply the exclusion of some parties from materially beneficial interactions. Additionally, in a dynamic society established bilateral relations will not hold forever. When interactions between new partners have to take place, they may bring together parties with a negative disposition towards others. In addition, the subjective well-being of those parties that have previously been frequently excluded from the interaction may be low. This in turn may feed back to individuals' behavior with possibly adverse effects on efficiency. In the related context of coalition formation and bargaining Okada and Riedl (2006) shed light on the connection between exclusion and inefficiency. They find that very frequently exclusion takes place leading to unfair and inefficient outcomes.

In our experiment the interplay between psychological effects and allocative and distributional choices turns out to be significant. Our results indicate that people's motivation and the economic environment they are acting in are not independent from each other. It would be interesting and important to examine if such effects are long lasting and if they indeed spillover to other economic environments. If this turned out to be true, it would affect the very basis of how economists think about competitive interaction. In this respect our study connects with a number of recent papers which yield new perspectives on issues of competition. Brown, Falk and Fehr (2004) examine the emergence of fixed long-term partnerships between workers and firms under incomplete contracting. They find that - due to contract incompleteness - markets resemble a collection of bilateral trading islands rather than a competitive market, in which buyers and sellers establish new trading relations every round. In a related

vein, Kirchsteiger, Niederle and Potters (2005) study how market institutions endogenously emerge.

In a more general sense, our evidence is in favor of the view that socio-psychological influences and those aspects of human interaction mostly related to material welfare and pecuniary incentives can (and should) not always be kept apart or disentangled. Granovetter (1985) refers to this as the embeddedness of economic activity in social relations. The interpersonal rivalry implied by competition can hurt the social relations which are necessary for the successful pursuit of material wealth. Our results add to, but are different from, the criticism of market economies put forward by Lane (1991, 2000). His point is, in essence, that in market economies people are drawn into striving too much for material things at the expense of companionship. Our contribution consists in providing evidence of the social and affective costs of competition as such. In broad terms our results here relate to the work of Bohnet, Frey and Huck (2001), Falk and Fehr (2002), Fehr and Gächter (2002) and Benabou and Tirole (2003).

Clearly, our research does not cast light on every facet of competition. Rather, we study one important aspect of competition - rivalry - but do not touch upon, e.g., the relation between competition and the efficient allocation of resources. Other settings and other institutional environments may lead to other insights. An interesting paper in this respect is Falk, Fehr and Huffman (2008) who show that the successful use of tournaments by firms depends on institutional details like the possibility of sabotage. Therefore, more investigations into the effect of competition on material and non-material well-being under various institutional settings is a promising avenue for future research.

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Appendix

Table 8: Correlation of emotions with general measure of subjective well-being

emotion	correlation coefficient	emotion	correlation coefficient
sadness	-.6392*	anger	-.6868*
	(.0000)		(.0000)
happiness	.7681*	joy	.7564*
	(.0000)		(.0000)
shame	-.0475	guilt	-.0347
	(.4179)		(.5538)
pride	.4079*	irritation	-.6717*
	(.0000)		(.0000)
fear	-.1333*	surprise	-.2228*
	(.0225)		(.0001)
envy	-.5130*	contempt	-.4926*
	(.0000)		(.0000)
relief	.4307*		
	(.0000)		
	$n = 293^{\dagger}$		

Note: * denotes a statistically significant correlation coefficient at 2.5% level, p-values in parentheses, two-sided tests; † ... one missing observation for all emotions; for pride two missing observations.

Table 9: A-players' inconsistency in punishing/rewarding

A cooperates in $t-1$	CC-90			CC-10			CC-90DC		
partner cooperates in $t-1$	A does not reward			A does not reward			A does not reward		
	switch partner	stay but defect	total	switch partner	stay but defect	total	switch partner	stay but defect	total
	39/455	20/455	59/455	45/300	21/300	66/300	39/387	24/387	63/387
partner defects in $t-1$	A does not punish			A does not punish			A does not punish		
	does not switch and not defect			does not switch and not defect			does not switch and not defect		
	14/74			4/53			16/69		

Table 10: Conditional cooperative behavior in the NCC and the Competition Conditions

choice of partner of A in $t-1$	frequency of conditional (un)cooperative choice of A in t			
	NCC	CC-90	CC-10	CC-90DC
0	.797	.723*	.757	.742
		(3.97)	(1.16)	(2.32)
10	.926	.829***	.689***	.794***
		(28.96)	(112.05)	(45.97)
choice of A in $t-1$	frequency of conditional (un)cooperative choice of B/C in t			
	NCC	CC-90	CC-10	CC-90DC
0	.854	.701***	.583***	.732***
		(18.17)	(51.14)	(12.33)
10	.891	.862	.841*	.877
		(2.54)	(5.54)	(0.57)

Note: Pearson's χ^2 statistics for comparison of CC treatments with NCC in parentheses; *** (**) [*] indicates significance at 0.1 (1) [5] percent.