Chapter 7
Deviations from Equilibrium in an Experiment on Signaling Games: First Results [1]

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Introduction

In this paper we provide a summary of results concerning two series of experiments we ran based on a modified signalling game, which was presented graphically to subjects on a screen. The game for the initial experiment was selected by Reinhard Selten in coordination with the first named author. It has the interesting property that the strategically stable outcome (Kohlberg and Mertens 1986) does not coincide with the outcome of the Harsanyi-Selten solution (Harsanyi and Selten 1988). However, it is a complex game insofar as standard refinement concepts like the intuitive criterion, or the never-a-weak-best-response criterion, do not help to refine among the equilibria. The second motive for the design was to analyse, how the change in the reward at a particular terminal node would affect behaviour.

For the experiments we ran it turned out that the strategically stable equilibrium is never a good description of the data. While behaviour in some of the sessions converged to the Harsanyi-Selten outcome, there were systematic deviations from the equilibrium behaviour. Casual observations and discussions with participants suggested that a "collective reputation" effect might be at work within the random matching framework in which our basic games were played. [2] By this we mean that the subjects in the role of one player would abstain from a certain action which is in their short run interest, but would harm their opponent, in order to allow for

[1]We would like to thank Reinhard Selten for the design of the game used in the initial set of experiments; the staff working at the Bonn Laboratory of Experimental Economics and the Finance and Economics Experimental Laboratory in Exeter (FEELE), for their support while conducting the experiments; and Karim Sadrieh for the organisation of the "Scientific Excursions with Reinhard Selten" which motivated us to conduct the new experiments.

[2]The term is due to Reinhard Selten.

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coordination on a mutually beneficial outcome. Moreover, in the experiments we had given subjects information not only on the results of their own plays, but of all plays of the games that were simultaneously conducted. A reduction of this information should make it harder to build up a collective reputation. We hence conducted a new series of experiments where we made the mutually beneficial outcome even more attractive and hence gave a stronger incentive to build a collective reputation, while we varied the information on past outcomes given to subjects. We conjectured that more information would result in more coordination on the mutually beneficial outcome.

We did not find evidence for this hypothesis, but we did find systematic violations from equilibrium behaviour, very similar to those in the initial series of experiments. The purpose of the paper is to describe these. Due to time and space constraints the presentation of these observations must remain somewhat impressionistic; a more thorough quantitative and econometric analysis is planned for the future.

Previous experimental work on signalling games concentrated on the predictive power of refinement concepts (Brandts and Holt 1992, 1993; Banks et al. 1994). For an excellent survey see Camerer 2003. The analysis in these papers concentrated on pure strategy equilibria, but in our case the strategically stable equilibrium is mixed. More recent experiments study how changing a game or deciding in teams affects behaviour in signalling games (Cooper and Kagel 2003, 2005).

In section "Model and Experimental Design", we describe in more detail the extensive form games we are using and their normative solutions, as well as the experimental design. In section "Data Analysis and Results", we describe our findings. We conclude with a brief discussion in section "Discussion and Conclusions".

Model and Experimental Design

The experiments are based on the two signalling games shown in Figs. 7.1 and 7.2. Both signalling games have the following structure: Players always have to choose between a strategically safe and a strategically risky option. The game is one of incomplete information in which Player 1 can be of two possible types, 1a and 1b, which have equal probability. Player 1 chooses first, followed by Player 2. Player 1 can either end the game (the strategically safe option) or give the move to Player 2 (the strategically risky option). Player 2 can then choose between a strategically safe option which gives type independent payoffs and a strategically risky option, which gives type dependent payoffs. Player 1 only wants to use the strategically risky option, when Player 2 does so as well. For Player 2 it depends. The strategically risky option is better only when she faces type 1a. She is better off taking the strategically safe option against type 1b. The two games S and T have in common, that type 1a has a higher gain from both players taking the strategically risky option than type 1b. In the first experiment we varied the payoff "x" of type 1a at the terminal node following the play where both players chose the strategically risky strategy. x could be 4, 5 or 6.

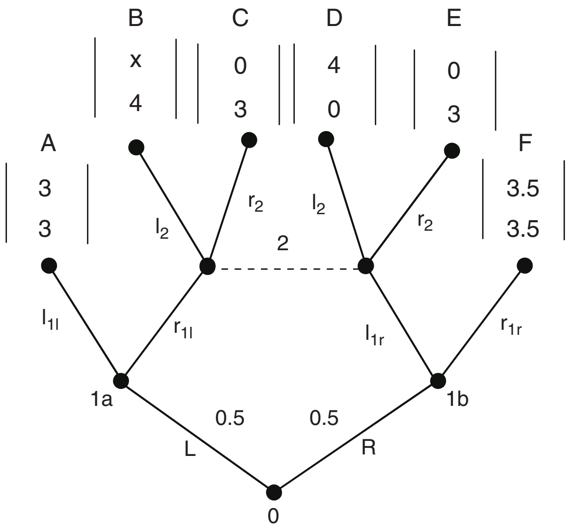

Fig. 7.1 Basic game experiment S (where x = 4, 5, or 6)

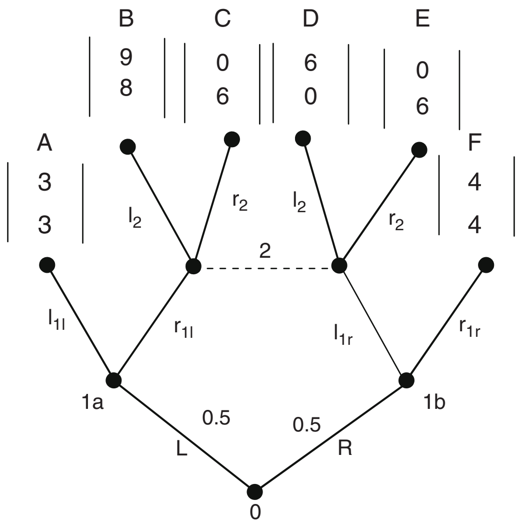

Fig. 7.2 Basic game experiment T

Normative Analysis

We work exclusively with behaviour strategies. Both games have two Nash equilibrium components. The first component consists of Nash equilibria where both types of Player 1 take the strategically safe option and Player 2 chooses the strategically safe option with a sufficiently high probability, namely at least with probability (x−3)/x in Game S (with x = 4, 5, 6) and at least probability 2/3 in Game T. This component contains, in particular, the Nash equilibrium where all players and types take their strategically safe option with certainty. The latter is uniformly stable and can be shown to be the equilibrium selected by the theory of Harsanyi and Selten (1988).

The second component consists of a single equilibrium where Player 1a takes the strategically risky option with certainty, while type Ib and Player 2 randomise. Namely, in Game S type 1b chooses the strategically safe option with probability 2/3 and Player 2 chooses the strategically safe option with probability 1/8. In Game T type 1b chooses the strategically safe option with probability 2/3 and Player 2 chooses the strategically safe option with probability 1/3.[3] Conditional on her information set being reached, Player 2 believes to face type 1b with probability 1/4. This equilibrium component can be shown to be the only strategically stable component of Nash equilibria in the sense of Kohlberg and Mertens (1986).

The purpose of the first set of experiments (Game S) was to test the two equilibrium refinements against each other. We expected the Harsanyi-Selten solution to arise for the parameter value x = 4, but did not rule out that terminal node B would be reached more often if x was increased.

In the new version (Game T), we made it more attractive to choose the strategically risky choice, but we made it more attractive for type 1a than for type 1b. We hence expected that Player 2's information set would be reached substantially more often in the new experiment.

The Extended Games

For most part of the experiments we used the extended models, S′ and T′ (See Figs. 7.3 and 7.4), which modified the basic games, S and T, as described above.

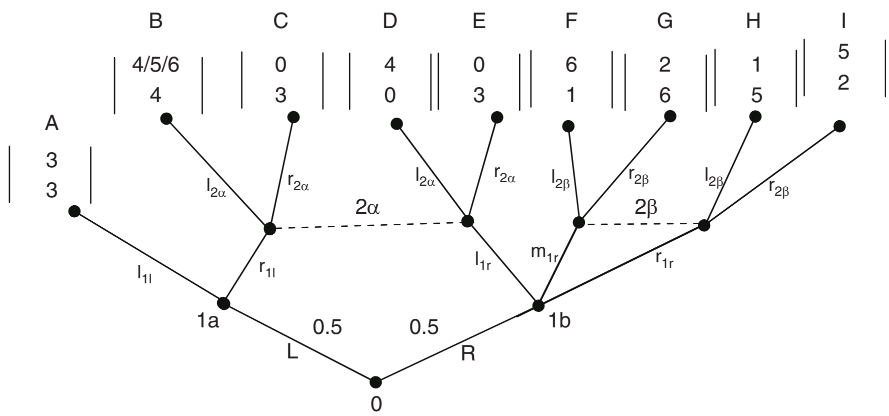

Fig. 7.3 The game S′

[3]Detailed proofs are available on request.

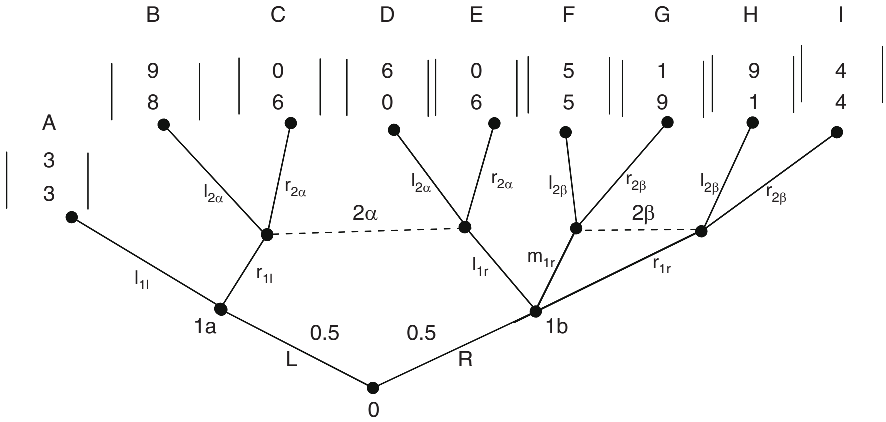

Fig. 7.4 The game T′

Table 7.1 Probabilities in the Nash equilibria

	r_{1l}	m_{1r}	r_{1r}	$r_{2\alpha}$	$r_{2\beta}$
1st component Game S′	0	3/8	5/8	$\geq(x-3)/x$	5/8
2nd component Game S′	1	3/12	5/12	1/8	5/8
1st component Game T′	0	0	1	$\geq 2/3$	1
2nd component Game T′	1	0	2/3	1/3	1

In essence type 1b's strategically safe option was replaced with a 2 × 2 game with a unique equilibrium, having the same expected payoffs as the strategically safe option in the basic game.[4] In the game S′ for the first set of experiments, we used a game with unique mixed strategy equilibrium, where both players have to choose their right strategy with probability 5/8. In the game T′ for the second experiment, we used a prisoner's dilemma game, where the right strategy of both players was the dominant strategy. Since in all Nash equilibria of the basic game S and T the strategically safe choice of type 1b is always reached with positive probability, the Nash equilibria of the extended games are obtained by replacing the strategically safe strategy of type 1b with this equilibrium strategy in the 2 × 2 game and amend player 2's behaviour strategy with her choice at the new information set. See Table 7.1.

Experimental Design

The games above were used in two series of experiments, one conducted at the Bonn Laboratory of Experimental Economics,[5] and one at the Finance and Economics

[4]The 2 × 2 game was added following the strategically safe choice of type 1b, but then moves were coalesced.

[5]These experiments were designed and conducted under the supervision of Reinhard Selten.

Experimental Laboratory in Exeter (FEELE). The extensive games were shown graphically to the subjects on the computer screen. The subjects decided by highlighting the appropriate choice in the extensive form on the screen. Throughout games were repeated in a uniform random matching environment with 6 subjects in the role of player 1 and 6 subjects in the role of player 2. Subjects remained in the same role as long as the game was not changed.

In the first set of experiments conducted in Bonn, the game S' was used in 9 sessions. For each value $x = 4, 5, 6$, three sessions were conducted. After the initial random allocation of roles, subjects played in the main part of the experiment the game S', in strictly sequential order, 50 times. There was a short break after period 25. In the final part of the experiment consisting of 5 rounds, called the Tournament, subjects had to submit strategies for the extensive game. Each strategy of a player was then evaluated against all the strategies of all the players in the opposite role, and would receive the average payoff. Thus, we used the strategy method (Selten 1967), where subjects first learn to play the game sequentially and in the final part submit complete strategies.

In the second set of experiments conducted in Exeter, subjects played the simpler game T in the first 25 periods, and then switched to the more complex game T' which was played sequentially for the next 25 rounds and the final 5 Tournament rounds. Due to a restriction of the computer software, roles had to be reallocated after Round 25. We stayed as close as possible to the design of the first set of experiments. However, we wanted to see whether it affects the results if subjects were only given the results of the play of their own game, or also the outcomes of the other 5 parallel plays occurring in each period (or respectively, of the other 30 parallel plays in case of the Tournament rounds). In the first set of experiments we had always given information on all plays to the subjects. In the second set of experiments we gave this full information only in five of the ten sessions conducted.[6]

The experimental sessions in Bonn lasted about 3½ hours and about 2½ hours in Exeter. Average payment per subject was about £12 in Exeter.

Data Analysis and Results

Summary Results

- *Player 1 Behaviour at Information Set 1a*

We evaluate how often the strategically safe option was taken by Player 1 at information set 1a. For the old set of experiments, a Mann-Whitney U-test shows that the strategically safe option is taken significantly more often in Rounds 1–50 in

[6]However, we did not see any indication that this difference of information mattered.

the sessions where Player 1's payoff at terminal node B was 4 or 5, as compared to when it was 6. Moreover, in each session of the game where the payoff was 6, Player 1 takes the safe option less often at information set 1a in Rounds 26–50, compared to Rounds 1–25.

As found in many experiments where players have an outside option there is a substantial fraction of subjects who take it (see e.g. Cooper et al. 1990). We see here for Rounds 1–50 that the strategically safe option is taken in at least 15% of the plays. We only find one session (with payoff 6) where the strategically safe option is practically not taken in Rounds 26–50 and Rounds 51–55 of the experiment. In only one session (with payoff 4) the strategically safe option is almost always taken (in 94% of plays), for all the others it ranges between 15–67%. The results are qualitatively the same for the tournament periods 51–55. Thus, behaviour is overall not consistent with either of the two Nash equilibrium components of the game where the strategically safe option is taken either with probability 0 or with probability 1 (Table 7.2).

Table 7.2 How often the strategically safe option is taken at Information Set 1a[7]

	Old experiments		New experiments	
	Avg	Std dev	Avg	Std dev
Rounds 1–25	0.515437	(0.26552)	0.208411	(0.1274)
Rounds 26–50	0.43788	(0.28489)	0.265718	(0.2042)
Rounds 51–55	0.517491	(0.33409)	0.19606	(0.15302)

Comparing the old and new experiments, the strategically safe option is fore-gone significantly more often in the new experiments, as we expected. This is significant by a Mann-Whitney U test conducted separately for Rounds 1–50 and tournament periods 51–55.[8] In the set of new experiments the percentage with which the strategically safe option is taken, is below 50% in each session, and separately for Rounds 1–25, 26–50 and tournament periods 51–55, with just one exception for period 26–50 (always significant by a sign test).

Arguably in the new set of experiments, Player 1 did not take the strategically risky option often enough at his information set 1a. Given the observed frequencies with which Player 2 chose her strategically risky option at information set 2α, he would have made a gain in each session. More precisely, (9*B%) – 3 is positive for each session, where for a given session and Rounds 1–50 or Rounds 51–55, B% is (number of times B is reached)/(number of times B or C are reached). In contrast, this "gain" varies considerably for the sessions in the old experiment.

[7]We calculated the average and standard deviation of the percentage of times Player 1 chose left at information set 1a, relative to the number of times this information set was reached for each session. The following tables are calculated in a similar manner.

[8]The test is highly significant for Rounds 1–25, but not for Rounds 26–50. Thus, the original stronger incentive for Player 1 to take the strategically risky option gets somewhat dampened by experience.

However, players are not simply irrational. The number of times the strategically risky option is taken is highly correlated with the gain to be made. This is significant at a 5% level of significance, using Spearman's Rank Correlation Test for both the new and old experiment sessions.[9]

- *Player 1 Behaviour at information set 1b*

In both the old and the new sets of experiments, Player 1 chose the left option at information set 1b significantly less often than the 33% predicted by the strategically stable (Kohlberg-Mertens) Nash equilibrium. This holds by a sign test for each session, in each part of the experiment (Rounds 1–25, 26–50 and 50–55) separately. In the new set of experiments game T′ was used in Rounds 26–55. Here, Player 1 chose right at information set 1b significantly more often than both left and middle, in each part of the experiment (Rounds 26–50 and 50–55) separately (Table 7.3).

Table 7.3 How often the left option is taken at Information Set 1b

	Old experiments		New experiments	
	Avg	Std dev	Avg	Std dev
Rounds 1–25	0.055979	(0.04221)	0.220375	(0.09273)
Rounds 26–50	0.049949	(0.03563)	0.103184	(0.06487)
Rounds 51–55	0.056884	(0.05144)	0.098769	(0.08681)

In the old set of experiments, left was never chosen in more than 12% of the cases for both Rounds 1–25 and 26–50, and 16% for the tournament periods 51–55. For the new experiments, the corresponding percentages of choosing left are 40, 22 and 27% for Rounds 1–25, 26–50, 51–55, respectively. We calculated various proxies for the gains Player 1 could have made at information set 1b by going left rather than right. These gains were sometimes positive and sometimes negative, varying greatly from session to session. We never found any significant correlation between the percentages of times Player 1b chose left and the gains. Subjects simply seemed to be reluctant to take the left option, which would be consistent with the aim to build up a collective reputation.

- *Observed frequency for Information Set 2α*

Since Player 1 rarely chooses his left option at information set 1b, the relative frequency with which the right node in information set 2α is reached is significantly below 25%. A sign test shows this for Rounds 1–25, 26–50 and 51–55 in the sessions of the old experiment and Rounds 26–50 and 51–55 in the sessions of the new experiment. This is consistent with a collective reputation effect and it would hence be the best for Player 2, in all these cases, to select the strategically

[9]Except for Rounds 51–55 in the new set of experiments which just misses the 5% level of significance.

risky option. Even for Rounds 1–25 in the sessions of the new experiment, the percentages are close to 25% or below (Table 7.4).

Table 7.4 How often the right node is reached at Information Set 2

	Old experiments		New experiments	
	Avg	Std dev	Avg	Std dev
Rounds 1–25	0.108521	(0.06229)	0.213985	(0.0844)
Rounds 26–50	0.082285	(0.06245)	0.126246	(0.08414)
Rounds 51–55	0.118831	(0.0875)	0.094254	(0.08086)

- *Player 2 Behaviour at Information Set 2α*

In the new set of experiments, Player 2 chooses the strategically safe option significantly more often than 33 1/3%, which is the maximal probability in a Nash equilibrium where information set 2α is never reached. This is significant for Rounds 1–25 and 51–55 by a Sign test, for Rounds 26–50 it still holds if we use a Wilcoxon Rank Test, based on the percentage of times left is taken minus 1/3. On average, the strategically risky option is taken in 60% of the cases, well below the 66 2/3% required by the Kohlberg-Mertens strategically stable Nash equilibrium. Given these averages, it makes sense for Player 1 to choose right at both information sets 1a and 1b, which is roughly consistent with actual behaviour. However, we are working here with very crude averages. In some of these sessions the percentage of Player 2 choosing left is well above 66 2/3% and so Player 1 would have an incentive to choose left at information set 1b (Table 7.5).

Table 7.5 How often the strategically risky option is taken at Information Set 2

	Old experiments		New experiments	
	Avg	Std dev	Avg	Std dev
Rounds 1–25	0.519377	(0.29827)	0.601518	(0.09404)
Rounds 26–50	0.653417	(0.1657)	0.577839	(0.20669)
Rounds 51–55	0.631131	(0.20074)	0.580699	(0.11262)

In the old experiments, the information set 2α is reached substantially less often. One may count the first session as one where the Harsanyi-Selten solution is played, because information set 2α is only reached 5 times in Rounds 1–25 and 26–50, and never in the final part. Disregarding this session, it is significant by a sign test that the strategically risky option is chosen in at least 33 1/3% of the cases. However, the percentages are significantly below the 87.5% required by strategic stability (there is only one exception with 93% in Rounds 1–25, and one with 89.5% in Rounds 51–55).

We wanted to see whether Player 2 at information set 2α responded to her experience and did not choose just randomly. For the new set of experiments we hence checked whether a player changed her behaviour more often after a “failure” than after a "success".[10] There are two ways in which Player 2 could make a failure, she may choose right and the left node of information set 2α is reached, resulting in a payoff of 6 instead of 8; or she may go left and the right node of information set 2α is reached, resulting in a payoff of 0 instead of 6.

We counted for each subject how often they switched after a failure or a success in Rounds 1–25 and 26–50, if information set 2α was reached. We took the difference of the 2 two percentages. We disregarded individuals for whom the difference was zero, or for whom the information set was never reached. In Rounds 1–25, we found overall 36 individuals who switched more often after failure, 14 who switched more often after success, and 6 who switched equally often. For Rounds 26–50, the corresponding numbers were 34, 8 and 7. Sign tests based on these numbers would indicate that most subjects switch more often after failure than success.

Looking at individual sessions, in Rounds 1–25, we found for eight sessions that the difference was positive for a majority of the subjects. In the other two sessions the number of subjects with a positive difference was equal to the number of subjects with a negative difference. A sign test then indicated that most subjects switch more often after failure than after success. However, with a corresponding analysis for Rounds 26–50 we just miss a significant result.

- *Player Behaviour in the embedded 2×2 game*

In the new experiments, we embedded a Prisoner's Dilemma type of 2×2 game into the signalling game in Rounds 26–50 and 51–55. As was to be expected, both players choose their strictly dominated action much less often than the undominated action. However, the percentages with which the dominated action is chosen are not negligible and can be as high as 23% in Rounds 26–50 and 32% in Rounds 51–55 in individual sessions.[11] Averaged over all sessions, Player 1 chooses the dominated action more often than Player 2, but a Wilcoxon Rank test does not yield significant results. For Rounds 26–50, the percentages of choices of dominated actions of Player 1 and Player 2 are positively correlated (correlation coefficient $= 0.34$), but negatively correlated in the tournament periods 51–55 (correlation coefficient $= -0.25$). It is interesting to observe that there is no significant difference between the number of times Player 1 chose left and the number of times he chose the dominated action middle at information set 1b (Table 7.6).

Table 7.6 How the right option is chosen in the 2×2 game in the New Experiment

	Player 1		Player 2	
	Avg	Std dev	Avg	Std dev
Rounds 26–50	0.899071	(0.08269)	0.937936	(0.0406)
Rounds 51–55	0.866204	(0.11283)	0.921962	(0.06393)

[10] We disregarded the sessions of the old experiments since information set 2α was not reached often enough.

[11] The fractions are calculated relative to the number of times Nature chose right and Player 1 did not choose left.

Table 7.7 How the right option is chosen in the 2 × 2 game in the Old Experiment

	Player 1		Player 2	
	Avg	Std dev	Avg	Std dev
Rounds 1–25	0.530085	(0.09553)	0.713404	(0.08242)
Rounds 26–50	0.578689	(0.06828)	0.663489	(0.07171)
Rounds 51–55	0.525137	(0.13771)	0.708392	(0.10936)

In the set of old experiments, we embedded a 2 × 2 game with a unique mixed-strategy Nash equilibria into the signalling game S, and used the resulting game S′ in all the rounds. The percentages of strategy choices in the nine sessions are roughly comparable with the mixed-strategy equilibrium, but as in many experiments with such 2 × 2 games (see for instance, Selten and Chmura 2008 and the literature they cite), one has strong own-payoff effects. For the main part of the experiment, periods 1–50, the percentages with which right is chosen are significantly below the equilibrium values for Player 1 and above for Player 2 (by a sign test). This finding is consistent with the predictions made by the alternative solution concepts for such 2 × 2 games in Selten and Chmura 2008 (Table 7.7).[12]

Discussion and Conclusions

We conducted an experiment on games in extensive form which had a signalling game with a 2 × 2 game embedded as its basis. The initial set of experiments was conducted with the aim of testing which of two competing theories of equilibrium selection or refinement theories better described behaviour. What we found is that there are systematic deviations from both types of theories. The second set of experiments was conducted in order to test for the appearance of a collective reputation. No statistically significant evidence was found. However, a number of interesting observations about the behaviour in these games could be made.

- At information set 1a, there tends to be a significant percentage of players who take the strategically safe option even if it would pay well to forego it. This is as observed in other games with outside options and could simply be explained by risk avoidance or low aspiration levels. Otherwise behaviour is fairly consistent with payoff maximization, actions yielding higher average payoffs are taken more often.
- Behaviour in the embedded 2 × 2 games is similar to the experimental results found when similar 2 × 2 games are played in isolation. In the Prisoner's Dilemma type game, the undominated actions were primarily chosen. However,

[12]In the impulse balance equilibrium, right is chosen with probability ½ by Player 1 and with probability 2/3 by Player 2. In the action sampling equilibrium, right is chosen with probability 0.56 by Player 1 and with probability 0.66 by Player 2.

the percentages of times in which the dominated action was chosen were not negligible. For the game with the unique mixed-strategy Nash equilibrium observed frequencies tended to be in a 10% range around the equilibrium. Deviations from the Nash equilibrium tended to be in the direction of behavioural concepts which adjust for the own-payoff effect as, for instance, impulse balance equilibrium or action sampling equilibrium (Selten and Chmura 2008).
- Throughout all sessions of the experiment, the action left at information set 1b is rarely chosen. This holds quite independently of the payoffs and how players behave at the other information sets. In the new set of experiments, it is taken roughly as often as the dominated action middle is chosen. Part of the explanation is presumably that the potential gains from taking this action are not very high. In fact, in many sessions it wouldn't pay given the behaviour of Player 2, but even when it would pay, the action left is not taken. Perhaps the subjects in the role of Player 1 are trying to build up collectively the reputation not to take this action, in order not to destroy a cooperation which leads to outcome B, when information set 1a is reached. Alternatively, the potential threat of a payoff 0 may deter Player 1 from taking the action. Both middle and right always yield non-negative profits. Right guarantees the payoff of 4 in the new set of experiments, while middle secures a payoff 2 in the old experiments.
- The percentage of times with which the right decision node is reached when play reaches information set 2α is systematically below ¼. Thus it would maximise Player 2's payoff if she chose her strategically risky choice.
- At information set 2α, left is typically chosen in at least 1/3 of the cases. Often this percentage is much higher although rarely above 2/3. We found some evidence for learning at this information set, but it isn't strong. Perhaps there is a substantial fraction of subjects who do not understand the strategic situation very well and choose both actions equally often, for instance, by always taking the highlighted choice randomly selected by the computer.[13] Such subjects would bias observed frequencies towards 50–50, and the behaviour of the other players may not fully compensate for this "irrationality".

An equilibrium concept that would lead to some of the behaviour as just described, is the notion of a cursed equilibrium (Eyster and Rabin 2005). This concept is a modification of the Nash equilibrium where players do not correctly Bayesian update based on the information they receive. Specifically for our games S and T, Player 2 would not correctly update the probability with which she is facing type 1a or 1b at information set 2α.

In the fully cursed equilibrium, Player 2 would believe at information set 2α that she is facing both types of Player 1 with equal probability. In a partially cursed equilibrium, her belief would be a weighted average of the former belief and the belief inferred by correctly Bayesian updating. If equal weight is put on both beliefs

[13]Our programme initially highlights each choice at the relevant information set with equal probability. Subject can then change which choice is highlighted with the left and right cursor keys. Once the desired choice is highlighted, subjects decide on it by pressing the Enter key.

there exists a partially cursed equilibrium where Player 1 always chooses right at both his information sets. The correct belief would then assign probability 1 to Player 2 facing type 1a. In the weighted average Player 2 would assign probability $\frac{3}{4}$ on facing type 1a, and thus she would be indifferent between her two options. It would hence be optimal for her to choose her strategically safe option with a probability between 1/3 and 2/3, thus making the choices of Player 1 rational. Thus we can construct a partially cursed equilibrium which fits better with most of our data than any of the Nash equilibria, but only for a highly specific and artificial weighting of beliefs.

A different approach we would like to explore in the future would be uncertainty aversion (See for instance, Eichberger, Kelsey 1996). Recall that it is optimal for Player 1 to choose right in Games S and T at both his information sets, if Player 2 chooses right with a probability between (x−3)/x for game S (x = 4, 5, 6) or 1/3 for game T and 2/3. The paper by Kelsey and Eichberger may explain why Player 2 may prefer to randomise in this way, even though she is not indifferent. Moreover, players without uncertainty aversion would choose left, and those with a high degree of uncertainty aversion would choose right, given the behaviour of Player 1, which could potentially explain the wide diversity of individual behaviour. Also, highly uncertain Player 1s would always choose the strategically safe option. How this and other models of bounded rational behaviour explain our findings, must be left for future research.

Appendix

Old Experiment, Terminal Nodes Reached in Rounds 1–25[a]

	A	B	C	D	E	F	G	H	I
1 (x = 4)	75	0	4	0	1	11	22	10	27
2 (x = 4)	15	59	5	8	0	12	20	6	25
3 (x = 4)	30	44	8	4	1	7	19	9	28
4 (x = 5)	66	3	10	0	2	9	24	17	19
5 (x = 5)	46	13	14	1	1	10	22	11	32
6 (x = 5)	53	9	20	3	3	10	19	11	22
7 (x = 6)	21	37	21	1	0	4	16	22	28
8 (x = 6)	38	26	18	6	2	4	34	2	20
9 (x = 6)	24	37	21	0	2	9	27	9	21

[a]"x" denotes the payoff of Player 1 at terminal node B

Old Experiment, Terminal Nodes Reached in Rounds 26–50

	A	B	C	D	E	F	G	H	I
1 (x = 4)	72	2	3	0	0	13	26	10	24
2 (x = 4)	51	13	13	4	2	2	21	17	27
3 (x = 4)	27	32	14	3	1	13	15	19	26
4 (x = 5)	32	38	7	1	0	13	16	13	30
5 (x = 5)	28	34	14	3	0	8	24	7	32

(*continued*)

6 (x = 5)	50	10	13	1	3	15	17	10	31
7 (x = 6)	3	54	20	1	1	11	24	18	18
8 (x = 6)	27	33	13	5	0	9	14	19	30
9 (x = 6)	7	55	11	5	4	8	21	11	28

Old Experiment, Terminal Nodes Reached in Rounds 51–55

	A	B	C	D	E	F	G	H	I
1 (x = 4)	91	0	0	0	0	10	26	15	38
2 (x = 4)	72	16	3	4	2	10	51	6	16
3 (x = 4)	69	12	14	3	1	22	25	20	14
4 (x = 5)	15	68	8	0	0	16	26	17	30
5 (x = 5)	50	31	11	1	0	5	20	12	50
6 (x = 5)	62	13	20	2	5	13	20	13	32
7 (x = 6)	0	72	19	3	1	3	24	12	46
8 (x = 6)	58	17	20	1	8	8	32	10	26
9 (x = 6)	16	44	35	7	6	13	25	10	24

New Experiment, Terminal Nodes Reached in Rounds 1–25[a]

	A	B	C	D	E	F	G	H	I
1	17	45	15	7	5	61	0	0	0
2	4	53	27	7	2	57	0	0	0
3	10	32	28	15	7	58	0	0	0
4	26	16	24	7	8	69	0	0	0
5	4	43	25	6	5	67	0	0	0
6*	28	31	23	5	5	58	0	0	0
7*	15	37	17	17	5	59	0	0	0
8*	14	40	26	3	8	59	0	0	0
9*	9	48	25	15	8	45	0	0	0
10*	30	23	26	17	11	43	0	0	0
$\sum$	157	368	236	99	64	576	0	0	0

[a]The * refers to experimental sessions where information on all simultaneous plays was not given to the subjects

New Experiment, Terminal Nodes Reached in Rounds 26–50

	A	B	C	D	E	F	G	H	I
1	2	49	14	5	1	2	16	6	55
2	1	61	12	13	3	0	2	2	56
3	24	29	34	2	0	2	3	5	51
4	33	21	26	0	1	0	1	4	64
5	17	38	23	6	6	0	14	2	44
6*	35	24	17	8	2	1	9	7	47
7*	36	7	33	4	5	0	2	1	62
8*	10	50	19	2	2	0	1	3	63
9*	5	48	16	5	0	1	7	5	63
10*	43	9	23	5	7	0	7	1	55
$\sum$	206	336	217	50	27	6	62	36	560

New Experiment, Terminal Nodes Reached in Rounds 51–55

	A	B	C	D	E	F	G	H	I
1	7	59	23	11	3	2	17	1	57
2	0	64	32	10	6	0	2	3	63
3	19	55	20	0	0	1	9	19	57
4	31	22	27	0	0	0	5	6	89
5	16	38	35	7	2	0	26	2	54
6*	39	35	30	2	5	0	15	3	51
7*	25	24	27	0	0	0	0	7	97
8*	7	45	41	4	3	0	2	11	67
9*	0	59	25	7	4	1	7	2	75
10*	32	28	36	13	9	0	15	6	41
$\sum$	176	429	296	54	32	4	98	60	651

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