Cooperation through Communication:
Teams and Individuals in a Finitely Repeated Prisoners' Dilemma Game

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7/4/2017

Abstract

For both two person teams and individuals unrestricted communication between opponents in a finitely repeated prisoner dilemma game results in stage-one cooperation rates of between 95-100%. Content analysis of between opponent communication focuses on the increased earnings cooperation can achieve, with minimal discussion of punishment for failing to cooperate. Restoring cooperation after an early stage-game defection typically requires compensating the aggrieved player. Between opponent discussions underlying cooperation focus on the mutual benefit from cooperation (earning more money and fairer than competing), with threats for failing to live up to agreements coming in a distant third.

Key words: finitely repeated prisoners' dilemma game, cheap talk, teams compared to individuals.

JEL classification: D03, C92, C73

*Research support from national Science Foundation grants SES-1226460 and SES- 1630288 are gratefully acknowledged. We thank seminar participants at the University of Pittsburgh and the University of Michigan for comments that have improved the paper substantially and discussions with Tim Wildschut. Valuable research support was provided by Puja Bhattacharya, Dimity Mezhvinsky and Kirby Nielson. Opinions, findings, conclusions, or recommendations offered here are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Results are reported for an experiment investigating behavior in a finitely repeated prisoners' dilemma game (FRPD) where opponents can talk to each other between stage-games, but cannot make binding agreements (cheap talk).[1] Communication of this sort is a central element underlying cooperation in a variety of repeated games outside the laboratory: It is a common element to collusive arrangements within cartels (e.g., Genosove and Mullin, 2001), collaboration with colleagues, and coordination games, to name but a few. Laboratory studies of the role of communication between agents in conflict situations has been drawing increased attention lately (Fonseca and Norman, 2012; Cooper and Kühn, 2014; Arechar et al., 2016).

We study the effect of cheap talk for both teams and individuals as many economic decisions are made in teams. As such it is important to extend laboratory studies of economic behavior to teams, in order to identify what if any differences there are compared to individuals. In addition, analysis of within team discussions provides an opportunity to understand what motivates team behavior. Further, to the extent that between opponent communications are similar between teams and individuals, provides some assurance that the motivation underlying team behavior extends to individuals.

Focusing on cooperation rates in the first stage-game of a sequence of FRPD games, there are large and consistent increases in cooperation rates compared to the absence of communication for both individuals and teams: Average cooperation rates across super-games of 92.9% with communication compared to 62.2% without for teams, and 97.9% with communication compared to 57.4% for individuals. For both teams and individuals, between agent discussions prior to each stage-game focus on the increased earnings from cooperation, with fairness coming in second, and punishment for failure to cooperate coming in a distant third. Restoration of cooperation following breakdowns in early stage-game cooperation are almost always associated with explicit compensation for the agent earning the sucker payoff. For both teams and individuals, unilateral defections over the last several stage-games are most often met with no comment, or mild upset, consistent with the notion that end game defections were, in most cases, anticipated.

The remainder of the paper is organized as follows: Section I describes the experimental design and procedures. Section II briefly discusses what might be anticipated as a result of

[1] Cheap talk refers to the fact that there are no formal mechanisms in place to enforce agreements between opponents.

communication in both the economics and psychology literature. The experimental results are reported in Section III. Section IV briefly contrasts the results reported here with prisoner dilemma games with cheap talk reported in the psychology literature, which report much lower cooperation rates for teams than reported here. Section V summarizes the main results along with some of their implications.

I. Experimental Design and Procedures:

Procedures are first described for the cheap talk sessions. They were essentially the same for games without cheap talk, with the differences described briefly at the end of this section.

The team treatment consisted of two-person teams, with subjects randomly matched with a partner at the beginning of an experimental session, and partners remaining the same throughout the session. Teams played against teams, and individuals played against individuals. In what follows we will use the term agent or player to refer to either a two person team or an individual. Following each FRPD game, agents were randomly re-matched under the restriction that no two agents would be re-matched in consecutive super-games. All teams played in seven FRPD super-games which were about all we could squeeze in a two hour session. All individuals played in ten FRPD games. Agents in both treatments were told they would play between 7 and 10 super-games.

Agents played a ten stage, simultaneous move, FRPD with stage-game payoffs reported in Figure 1. Payoffs were denominated in experimental currency units (ECUs) which were converted into dollars at the rate of $1 = 250 ECUs. Payoffs were computed over all plays of all super-games and paid in cash at the end of an experimental session along with a $6.00 participation fee. Each member of a team received his team's total earnings.

[Insert Figure 1 here]

For teams, each stage-game began with a brief period of within team discussions, followed by a period for between team discussions, with both team members able to communicate with their common opponent. This was followed by a brief period for within team chat during which teams decided whether to defect or cooperate. All communication, both within and across teams, was done anonymously through computers, with subjects sitting at their own computer terminals. For individuals, each stage-game began with communication between opponents, after which decisions were made. Here too all communication was done

anonymously through computers. The time available for each of these stages is detailed in the instructions, along with the default options if teams failed to reach agreement (which was rare).

Following the end of each stage-game agents had up to 30 seconds to view their own results before moving on to the next stage-game, where again teammates first had an opportunity to talk to each other, followed by between team discussions, and ending with within team discussions deciding what action to take.[2] Following the last stage-game agents were notified that their match had ended and that they would start another match with another randomly chosen agent. Neutral language was used throughout; e.g. agents chose between option A or B in each stage-game, and were told they would be "paired with the same other team (individual) for a set of 10 repeated choices."

With cheap talk there were three team sessions with between 8 and 10 teams in each for a total of 28 teams and three individual subject sessions with between 10 and 12 subjects for a total of 34 individuals. Sessions without cheap talk were essentially the same except for doing away with the cheap talk between opponents. There were 5 sessions with teams and 5 with individuals absent cheap talk with between 8 and 12 individuals/teams in each session.[3] Detailed results from these sessions were previously reported (Kagel and McGee, 2016). Their main function here is to calibrate the effect of communication under otherwise identical conditions to the games with cheap talk.

II. Theoretical predictions

Assuming common knowledge of rationality in FRPD games, the standard theoretical prediction is that there will be no cooperation between agents using a backward induction argument. However, this virtually never happens for super-games of any length which are typically characterized by some early stage-game cooperation only to trial off as the last stage-game approaches. Explanations for the failure of the backward induction argument are based on an absence of common knowledge of rationality so that fully rational players will respond to early stage game cooperation (or the belief that there will be early stage game cooperation), only to defect in later stage games as the end game draws near (Kreps et al., 1982; Reny, 1992). Given these initial tendencies to cooperate in early stage-games, following Farell and Rabin

[2] Procedures were the same for individuals absent the need for within team discussions.
[3] One these team sessions used a student assistant to ensure an even number of teams. The assistant informed his teammate that he was part of the experimental team and would agree to whatever his partner did. Data for this "team" is dropped from the analysis.

(1996) communication may aid in achieving cooperation in early stage-games via self-signaling (when the sender prefers the receiver to play the message sent if the sender truly intends to play the signaled action). As such we would predict increased cooperation in early stage-games with communication than without for both individuals and teams in repeated PD games.

However there are reasons to believe there may be differences between teams and individuals. One relatively unambiguous prediction would be that, to the extent there are relatively high levels of early stage game cooperation, teams will start defecting earlier, and at higher rates, than individuals. The reason for this is that teams, having two heads to work with, will be more "rational" than individuals (as defined in standard economic theory), recognizing the end game effect earlier and more often (Bornstein, Kugler, and Ziegelmeyer, 2004). This same line of thinking would suggest lower early stage game cooperation rates, albeit to a lesser extent than any differential in end game cooperation rates. However, it is not exactly clear how sensible this would be, as it implies giving up higher payoffs, while risking very little from adopting a Grim strategy.

III.1 Cheap Talk Results:

Figure 2 compares cooperation rates within and across super-games for individuals with and without communication. The most striking result is the huge increase in early stage-game cooperation with communication. Further, outside of the first super-game, stage one cooperation rates are 100% with communication, which almost always persists through the first several stage-games, only to trial off as the end game draws near. Noticeably, with communication end game cooperation rates start out high in the first super-game and never get below 26% in subsequent super-games. In contrast, absent communication, the maximum frequency of end game was 13.5% in the first super-game, and 0% in the last two super-games.

Figure 3 reports the corresponding results for teams. Here too there is a huge increase in stage one cooperation rates with communication than without. However, except for super-game six, average stage-one cooperation rates are always a bit lower than 100%. Further, after the first super-game, end game cooperation rates are close to, or equal to, zero with communication both with and without cheap talk.

[Insert Figures 2 and 3 here]

Table 1 reports average stage one cooperation rates for each super-game with and without communication. The focus is on stage-one cooperation rates, as cooperation in later stage games

is dependent on what happens in the first stage-game, which is difficult to account for. Further, once two or more stage-games have been completed in which one of the agents has defected, in the overwhelming number of cases, both agents defect for the remainder of the super game.

[Insert Table 1 here]

With communication, average stage-one cooperation rates for teams in super-game one are lower than for individuals, but the difference is relatively small and not statistically significant (75.0% for teams versus 83.5% for individuals; $p > 0.10$, Fisher's exact test).[4] This is smaller than the difference without communication (41.2% for teams versus 61.5% for individuals; $p < 0.05$, Fisher's exact test). Looking beyond the first super-game, the fact that with communication stage-one cooperation rates are 100% in all subsequent super-games for individuals and, with one exception, less than 100% for teams, assuming independence across super-games (a highly questionable assumption) the average difference - 92.9% versus 97.9% - is statistically significant ($p < 0.01$), but obviously quite small.[5] In contrast, without communication, on average teams are *more* cooperative, 62.2% versus 57.4%, which is marginally significant ($p < 0.10$) after controlling for interdependencies across super-games.

Conclusion 1: For both teams and individuals, the *primary* impact of introducing unrestricted cheap talk in FRPD games is a large and significant increase in stage-one cooperation rates. As to the effect of communication on differences in early stage game cooperation rates between teams and individuals, the differences are smaller, both in the first super-game, and on average after that.

Fully rational, own income maximizing agents should never cooperate in the last stage-game as it is a dominant strategy to defect. In this respect, with communication teams are much more rational (and/or self-interested) than individuals as 32.1% of all teams cooperated in the last stage game at least once compared to 79.4% for individuals ($Z = 3.75$, $p < 0.01$).[6] These high

[4] Unless noted otherwise, all proportion tests use Fisher's exact text.

[5] $P < 0.01$ based on an exact binomial test statistic. The 100% cooperation rate for individuals after the first super-game with communication precludes more complicated regression specification controlling for interdependencies between super games such as the one reported in Dál Bo and Fréchette (2011). This shows that initial tendencies to cooperate, and whether their opponent cooperated or not in stage-one of the previous super-game, affect the current probability of cooperating. That is to say, the assumption that outcomes are independent across super-games fails to be satisfied. Unfortunately this specification cannot be employed here since, after accounting for initial tendencies as measure in the first super-game, the 100% cooperation for individuals generates a singularity.

[6] For both treatments end game cooperation rates were highest in the first super-game.

end game cooperation rates contrast with the substantially lower rates without communication: 26.9% for individuals verses 9.8% of the teams. So that looking at end game cooperation rates in isolation, there is a larger difference between teams and individuals with communication (a 47.3% difference) than without (a 17.1% difference).

Conclusion 2: With communication there is significantly less cooperation in the last stage-game for teams than for individuals. This declines over time as individual cooperation rates are half as likely to be repeated after being met with defection, as opposed to cooperation, at the end of the previous super-game.

Cooperation unravels at about the same rate with and without communication for both teams and individuals, conditional on being on a cooperative path at the start of a super-game. Further, in both cases it unravels further and faster for teams than for individuals. To measure this we identify the stage-game in which an agent first defects, conditional on being on a cooperative path at the start of a super-game. The latter is defined as sustained cooperation over rounds 1-4, typically with both agents cooperating in all rounds.[7] Table 2 reports the median, and average, stage-game in which these first defections occurred across super-games both with and without communication. In both cases the median in the first super-game is the last stage-game (10) for individuals versus the next-to-last stage-game (9) for teams.[8] There is slow, and far from complete, unraveling across super-games in both cases, with the median for teams always one step ahead of individuals until the next to last super-game, where it is two steps ahead (stage-game 7 versus 9). Comparing counts across teams and individuals, the difference in medians in the last super-game is significant ($p < 0.01$ using a Mann-Whitney test statistic).

Conclusion 3: The pattern of unraveling over time is essentially the same both with and without communication. Cooperation unravels further and faster for teams than individuals.

[Insert Tables 2 and 3 here]

[7] There are exceptions to this criterion discussed below.
[8] A unilateral defection counts as one observation in Table 2, with mutual defection counting as two observations.

With communication, the most common pattern by far for getting on a cooperative path consisted of mutual cooperation over the first four stage-games. However, within the first four stage-games there were a number of unorthodox patterns under which agents were able to sustain cooperation for a large number of stage-games until the defections reported in Table 2. These unorthodox patterns were most common in the first super-game and more common for teams than individuals (see Table 3). One of these unorthodox patterns had agents alternate between defection and cooperation within the first three stage-games, only to restore cooperation for a number of stage-games. Restoring cooperation typically required "evening the score", either explicitly following the initial defection, or explicitly referred to after the cooperating player retaliated: Of 19 super-games with unilateral defection within the first 3 stage-games, 13 "evened the score", trading defection and cooperation, with 10 of these restoring cooperation. Only 1 out of the 6 super-games that failed to even the score returned to cooperation.[9]

III.2 Content Analysis of within Team and Between Agent Discussions

The results reported show a huge increase in initial cooperation rates with communication between players. This section looks at these between opponent discussions to better understand the basis for the increase in cooperation rates, as well as the within team discussions to better understand the factors motivating team play. Further, to the extent that between opponent discussions are similar for teams and individuals, they provide some confidence that similar factors motivate individual subject play, which is not directly observable.

Two students were used to code within and between agent discussions according to pre-specified categories of general interest (e.g., agents' responses to end game defection), and after I read a sample of the chats with these categories in mind. Coders could assign multiple codes to the same stage-game. The coders independently coded a common session, after which we met jointly to refine our common understanding of what the categories were designed to capture. Coders then independently coded the rest of the sessions, after which there was a final meeting to reconcile obvious discrepancies.

[9] One example of explicitly agreeing to settle the score: From the team defected on "Seriously if you choose A (cooperate) we all win". From the team that unilaterally defected "we'll go A now and you guys take B (defect) so its even".

Table 4 reports the between player dialogues for individuals and teams in the first stage-game for super-games 1, 3 and 6. The goal here is to identify the principle arguments for cooperating – fairness, way to make the most money, and threats should their opponent fail to cooperate. Between opponents chat had declined substantially by super-game 6, with brief discussions largely limited to agreeing to cooperate, with most codes assigned in super-game 1, and 3 to a lesser extent, trailing off after that. The numbers report the frequency with which at least one coder coded the category in question.[10] Snippets of discussions for each category are reported at the bottom of the table.

The most frequently coded category consisted of cooperating to get the most money for both players, accounting for a little over 50% for both teams and individuals. Fairness followed a close second at 30-40%, with threatening their opponent, should they not cooperate, coming in a distant third at 8%. While the high frequency of appealing to the mutual benefits of cooperation is not surprising given previous results reported, the relatively low level of threats to retaliate for cheating is less common. For example, Cooper and Kühn (2014) in their treatment with unconstrained communication in a coordination game report appeals to mutual benefits just shy of 30%, with threats of punishment for defecting to an outcome where one player would be better off, at just under 20%.[11]

[Insert Table 4 here]

We also coded within team chats *after* the between team discussions, when teams were deciding whether to cooperate or not. The extant psychology literature argues that major concerns underlying the failure of cooperation for teams is "distrust" and/or "safety" considerations (Wildschut and Insko, 2007), which we coded for, along with any discussions of retaliation if the other team failed to cooperate. This too was coded for the first stage-game of super-games 1, 3 and 6, with multiple codes permitted for a given stage-game. Table 5 reports these frequencies. Distrust regarding their opponent's intention to cooperate is the most frequently coded category by far, at just shy of 74%, with most of these discussions occurring in

[10] Agreement rates for coders summed over the three categories was 75% for teams and 68% for individuals. The agreement rates for the most frequently coded category, "making the most money", were 90% for teams and 85% for individuals.

[11] Important differences between that experiment and the present one is that the former used a cross-over design, going from no communication to communication, with effectively zero cooperation prior to the introduction of communication, and they employed only individuals.

super-game 1. However, teams typically did not act on these concerns, as evidenced by the high stage 1 cooperation rates in the first super-game (75%). Here too, discussions of retaliating should the other team not cooperate were minimal, perhaps because of an implicit understanding that cheating would result in retaliation, which almost always happened.

[Insert Table 5 here]

Conclusion 4: Between decision maker discussions for teams and individuals both focused on cooperating to make the most money, along with fairness considerations. Threats if their opponent failed to cooperate came in a distant third. Within team discussions prior to choice focused on "distrust" as to whether their opponent would follow through on cooperating. Most of the latter discussions occurred in stage-one of super-game one and, as the data shows, did *not* result in wholesale defections.

Table 6 reports messages sent to their opponent following unilateral defection in stage-games 7-9.[12] Making no comment or expressing mild upset following defection is coded most often for both teams and individuals (55.3% and 60.0%. respectively). Sarcasm or real upset occurred a bit more than half the time, not slowing down materially with the unraveling of cooperation over time (recall Table 2). The latter is somewhat surprising, since in a voluntary contribution game with stranger matching Masclet et al. (2003) report that giving agents the opportunity to express disapproval of others' decisions consistently increased contribution levels, and early on increased them to levels reported with monetary punishment. However, Mascelt et al. did not provide any opportunity for communication prior to determining contribution levels, so that the only opportunity to promote cooperation in subsequent games was through disapproval after contribution levels were announced.[13]

[Insert Table 6 here]

Teams were coded for the first super-game in which they discussed defecting while cooperating in early stage-games. These discussions occurred primarily in super-games 1 and 2

[12] Again for super-games 1, 3, 6, with frequencies based on coding by either one of the two coders. The agreement rate between coders for teams was 96% and 83% for individuals. There was no opportunity for sending messages after the last stage-game in both cases.

[13] Only individuals were involved in the Masclet et al. experiment.

(67.8% and 25.0%, respectively).[14] In both cases most of these discussions occurred on or before the fourth stage-game (68.4% and 85.7% for super-games 1 and 2, respectively), and with one exception, the proposed round for defection was either the last, or next to last stage-game (83.3% discussing defection in the last stage-game).[15] However, about half of the teams discussing defection in the last stage-game, actually defected in the next to last stage-game, indicating some limited backward induction resulting from further within team discussions.[16] A few of the teams proposing defection in super-games one and two did so just prior to, or during, the stage-game in which they defected (stage-games 8-10), 15.8% and 14.3% respectively.

Conclusion 5: Most teams *first* discussed defection well before the end of super-games 1 or 2, typically planning to defect in the last stage-game. As such, most teams acted as if they were well aware of the dominant strategy for the last stage-game (although none discussed it formally), but engaged in limited, or no, backward induction, accounting for their opponents thinking along the same lines which, in turn, prevented massive unraveling.

IV. Results from Psychology Experiments.

There have been a number of earlier experiments reported in the psychology literature comparing teams and individuals in repeated prisoner dilemma games, with and without communication. These experiments involve financially motivated subjects and repeated interactions as in a super-game. However, there are a number of, potentially important, procedural differences compared to the experiment reported here. I will illustrate this in discussing outcomes in Schopler et al. (2001) which is one of the studies with communication and repeated play.[17]

Procedures in Schopler et al. were similar in a number of dimensions to the ones employed here as there were between opponent discussions prior to each stage game after which

[14] The two coders' achieved100% agreement on the super-game in which defection was first discussed, as well as the other characteristics discussed here. Recall, there were 28 teams.
[15] The one exception proposed defection in the second stage-game after being defected on while cooperating in the first stage-game.
[16] Note, however, that one these teams planning to defect in the last stage-game actually cooperated, and another moved from planning to defect in the next-to-last stage-game, the last stage-game.
[17] There are a number of interesting experiments with one-shot PD games, played only once (see Insko et al., 1993 for example).

decisions were made simultaneously, with outcomes reported after each stage game, and a payoff matrix not that different from the one employed here.[18] There were also a number of major differences in that subjects played a single super-game which, they were told, would have between 1 and 20 stage games, with the number of stage games set at 10. That is, subjects did not know in advance how many stage-games there would be, nor was it a repeated play game with a defined, probabilistic continuation value. Groups consisted of 3 subjects. Communication was face-to-face and, in the case of teams, consisted of a representative from each team meeting face to face and then reporting back to their group.

Results are reported averaged over the 10 stage games measured as follows: 0 if both sides chose to defect, .5 if one side chose to defect and the other chose to cooperate, and 1 if both sides chose to cooperate. Outcomes averaged 0.01 for teams and 0.30 for individuals indicating essentially no mutual cooperation on the part of teams, and cooperating less than half the time for individuals, with these differences statistically significant at the 1% level.[19] Table 1 in the present experiment, scores stage 1 cooperation rates the same way as in Schopler et al. – averaging 0.71 for teams and 0.85 for individuals in super-game 1, with these differences not significant at conventional levels ($p = 0.19$).

As noted, we employ data from the first stage game to measure cooperation rates as it is well known that choices in later stage games are affected by outcomes in the first stage game. In contrast, Schopler et al. average over the 10 stage games played. As an exercise we averaged cooperation rates over the first five stage games, before the end game effects really kicked in, resulting in index values of 0.66 and 0.89 for teams and individuals, respectively, significantly different from each other ($p < 0.01$), but still a far cry from the low cooperation rates reported in Schopler et al.[20] Given the many differences in experimental procedures, it would no doubt take a number of careful studies to better understand these differences, which go well beyond the bounds of the present experiment.

V. Discussion

This paper investigates the effect of unrestricted communication on cooperation between opponents in a finitely repeated prisoner dilemma game. For both teams and individuals, the

[18] I am indebted to Tim Wildschut for clarifying these and other procedures. The payoffs were $0.90 for cooperation, $0.60 for mutual defection, with the temptation payoff $1.20 and a sucker payoff of $0.30

[19] Similar differences have been reported in one-shot PD games (Insko et al, 1993).

[20] With experience this difference narrows, averaging 0.92 for teams and 0.99 for individuals.

opportunity to engage in unrestricted pre-play communication increased stage-one cooperation rates substantially comparted to no communication: from 62.2% to 92.9% for teams and from 57.4% to 97.9% for individuals (averaged across all seven super-games). The unrestricted communication employed here resulted in a substantially larger increase in cooperation rates than in a repeated play PD games with more limited communication (Aracher et al. 2016).[21] Between opponent discussions underlying these extremely high cooperation rates focused on the increased earning opportunities and fairness from cooperation, with very limited discussion of retaliation for failure to cooperate. However, the latter typically occurred following unilateral defection, suggesting that retaliation was, at least implicitly, a common understanding among players. Unilateral defection in later stage-games, after agreeing to cooperate, was most often met with no comment or expressing mild upset with the opposing party. Harsher comments following these defections, which occurred 32-38% of the time, had little if any effect on slowing down unraveling over time, compared to games with no between opponent communication indicating they had little, if any, effect on cooperation for both teams and individuals.

Teams were much more likely to defect on or before the last stage-game than individuals, both with and without communication, suggesting better understanding of the dominant strategy and/or stronger self-interest on the part of teams. Teams also ended joint cooperation earlier within super-games. Within team discussions in the communication treatment show that even while cooperating at the start of the first or second super-game, most teams were already planning to defect on, or just before, the last stage-game. This is consistent with one of the main ideas underlying the Kreps et al. (1982) model of early stage game cooperation in FRPD games, namely that players are able to see through to the later stage-games, planning to defect at some point, even while cooperating early on. However, unlike that model, early stage-game cooperation has been shown to develop through a trial and error learning process rather than based on prior beliefs regarding the existence of cooperative types (Kagel and McGee, 2016).

The most striking result reported here is the sharp increase in stage-one cooperation rates with communication compared to without. In anti-trust legislation it is against the law to discuss cooperation between competitors, regardless of whether it results in a collusive outcome or not.

[21] Also see Cooper and Kühn (2014) who compare unrestricted with restricted communication in a closely related game, which shows a large increase in cooperation rates with unrestricted compared to restricted communication.

Although we recognize that there is no direct link between the experiment reported here and anti-trust issues outside the lab, to the extent that the prisoners' dilemma serves as a metaphor for competition between the few, the sharp increase in cooperation rates reported here with cheap talk serves as laboratory support for the prohibition on rivals even discussing cooperation.

This paper also makes a contribution to experimental methodology. One of the aims of comparing teams with individuals in strategic interactions such as the prisoner's dilemma, is to gain insight into players' beliefs and reasoning through within team communication underlying the behavior reported. The similarity in the between opponent communication for teams and individuals, both before and after making choices, is consistent with the idea that the within team discussions provide valid insight into players beliefs and reasoning in strategic interactions.

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Figure 1

Stage Game Payoffs

(in ECUs)

	A	B
A	105 105	5 175
B	175 5	75 75

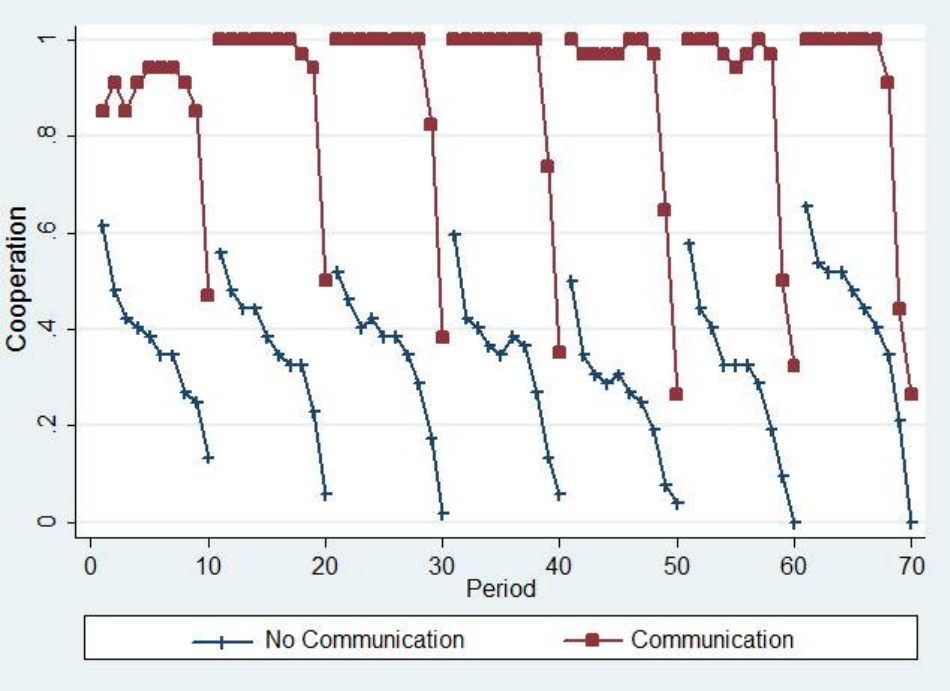

Figure 2. Individuals With and Without Communication.

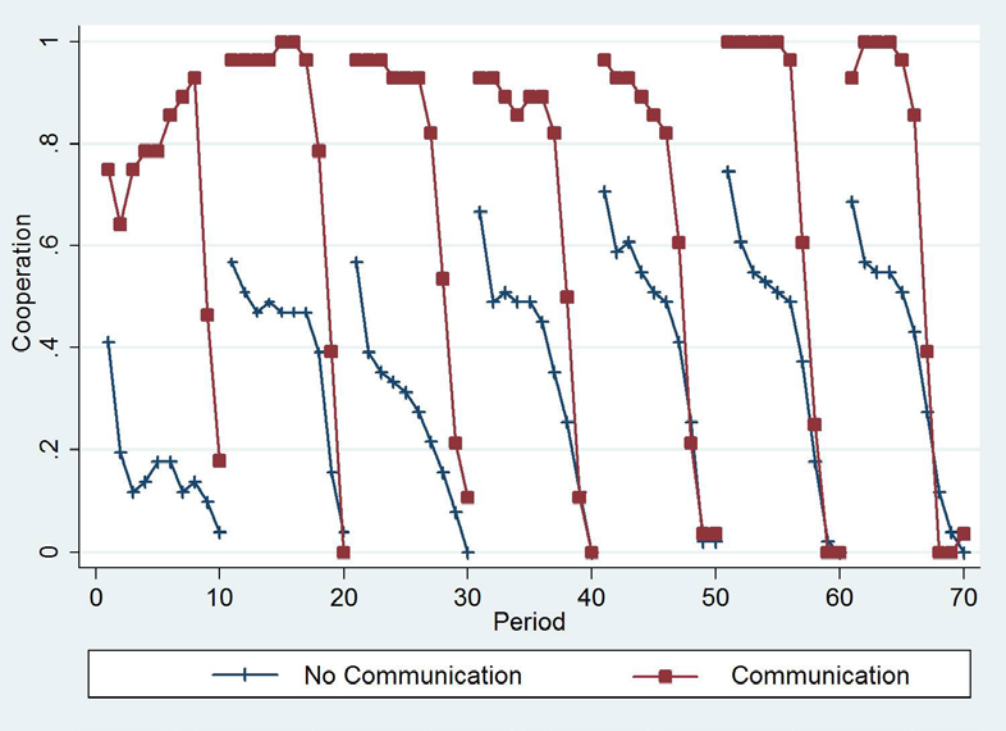

Figure 3. Teams With and Without Communication

Table 1

Average State-One Cooperation Rates

	With Communication			Without Communication		
Super-Game	Individuals	Teams	Diff: Indvds-Teams (test- statistic)[a]	Individuals	Teams	Diff: Indvds-Teams (test-statistic)[a]
1	.850	.750	.130 (0.35)	.615	.412	.203 (< 0.05)
2	1.00	.964	.036 (0.45)	.558	.569	-.011 (> 0.99)
3	1.00	.964	.036 (0.45)	.519	.569	-.050 (.69)
4	1.00	.929	.071 (0.20)	.596	.667	-.071 (.56)
5	1.00	.964	.036 (0.45)	.500	.706	-.206 (<0.05)
6	1.00	1.00	0.00 (> 0.99)	.577	.754	-.168 (< 0.10)
7	1.00	.929	.071 (0.20)	.654	.686	-.032 (.83)

[a] Fisher's exact test, 2-tailed test statistic.

Table 2

Round Defected in Conditional on Being Up on a Cooperative Path:

With and Without Communication[a]

Super-Game Number	Individuals[a]		Teams[a]	
	With Communication	Without Communication	With Communication	Without Communication
	Median (mean)	Median (mean)	Median (mean)	Median (mean)
1	10 (9.8)	10 (9.0)	9 (9.3)	9 (9.4)
2	10 (9.8)	10 (9.3)	9 (9.0)	9 (8.9)
3	10 (9.7)	9 (9.0)	9 (8.4)	8 (7.9)
4	9 (9.4)	9 (8.7)	8 (8.3)	9 (8.2)
5	9 (9.3)	9 (8.7)	8 (7.8)	8 (8.1)
6	9 (9.2)	9 (8.8)	7 (7.5)	8 (7.8)
7	9 (9.1)	9 (8.9)	7 (7.1)	7 (7.0)

[a] In cases where both agents defected in same round, both are counted. In cases where one agent defected first, counted as a single defection.

Table 3

Frequency of Different Cooperative Path Patterns

Pattern	Super-Game 1		Super-Games 2-7	
	Teams	Individuals	Team	Individuals
P_{CC}	10	24	150	200
Other	8	6	6	0
No Coop Path	10	4	12	4

P_{CC} – both players cooperate for the first 4 stage games. Other – see text.

Table 4

Between Opponent Messages Prior to Stage-One Choices*
(percent distribution across categories)

Coding Category	Teams	Individuals
Fairness	36.1%	40.0%
Most money	55.6%	52.0%
Threats	8.3%	8.0%

*Coded for super-games 1, 3 and 6.

Chat examples:

Fairness:

"I say we all just be fair about it and choose A (cooperate)"

"how do we choose?" "A is more mutual"

Most Money:

"yo other team if you trust us we can both choose a (cooperate) and make some hashtag cash"

"listen here. A (cooperate) makes the most money" "makes the most money to pick A" "we wont (sic) the highest earnings"

Threats:

"ok guys here is the thing you can say you dont trust us and go with B but you'll lost 30 pints for each round after that"

Most Money and Fairness:

"I say we all just be fair about it and choose A. That way everyone makes good money" "lets take the experiment people and both choose a"

Table 5
Within Team Discussions Preceding Stage-One Choices
(percent distribution across categories)

Coding Category	Frequency
Distrust	73.7%
Safety	15.8%
Retaliate	10.5%

Chat Examples:

Distrust:

“We going with a (cooperate)?” “I guess so” “hopefully the other team sticks to their word” “That does concern me”

Both Distrust and Safety:

“so the question is do we trust them picking a (cooperate)? If they choose b (defect) and we choose a we’re screwed” “true I don’t know should we?”

Retaliate:

“we decided A (cooperate) right?” “yea” “cool” “if they choose a, too …if not, we probably choose b (defect) from next round”

Table 6

Messages Sent Following Unilateral Defection in Stage Games 7-9.

Coding	Teams	Individuals
No comment or expressing mild upset	55.3%	60.0%
Expecting it to happen	6.4%	8.0%
Expressing real upset or sarcasm	38.3%	32.0%

Chat Examples:

No comment or expressing mild upset:

“ouch”

“I thought you were trusting!?”

“wow that was interesting”

Expecting it to happen:

“I saw that coming”

“I knew it”

Expressing real upset or sarcasm:

“ok be a douche”

“wow was that worth the 75 ur gonna get the rest of the way now”

“well done” “we know your hand must have slipped”