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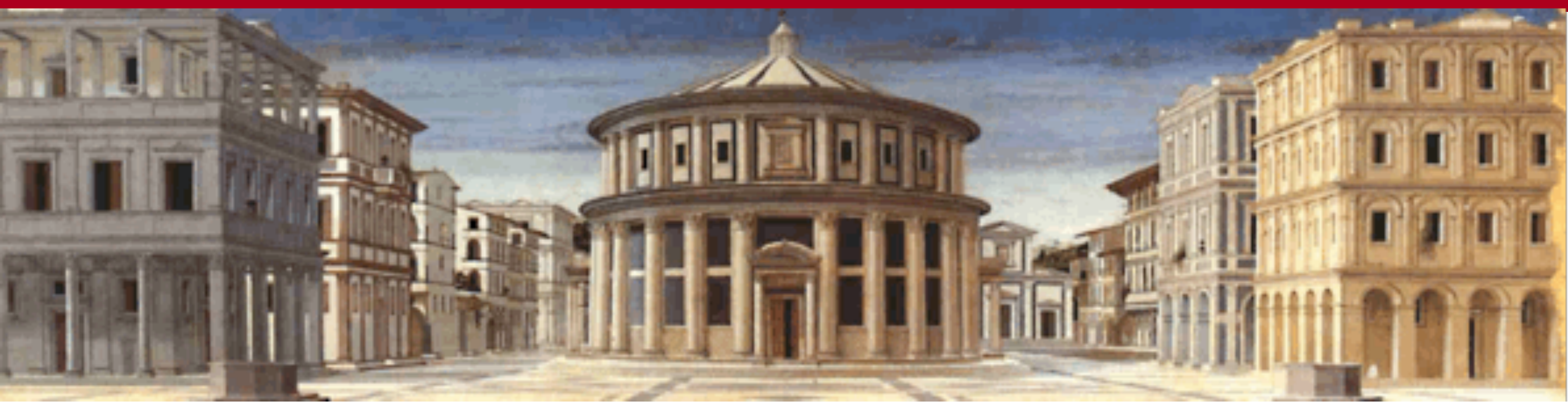

Common reason to believe and framing effect in the team reasoning theory: an experimental approach

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Abstract

The present paper is aimed at empirically verifying the role of the "common reason to believe" (Sugden 2003) and of framing (Bacharach 1999 and 2006) within the theory of team reasoning. The analysis draws on data collected trough a Traveler's Dilemma experiment. To study the role of the common reason to believe, players' belief in their counterpart's choice are elicited and the correlation between the endorsement of team reasoning and beliefs is considered. With respect to the idea of frame proposed by Bacharach, we study the effect of the reduction of social distance on the probability that the "we-frame" comes to players' mind. Social distance is decreased by introducing a meeting between the two players after the game. It is shown that the common reason to believe appropriately explains the internal logic of team reasoning and that the reduction of social distance makes the "we-frame" more likely.

Keywords: Team Reasoning, Common Reason to Believe, Framing, Traveler's Dilemma; Social Distance.
JEL numbers: C72; C91, A13

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1. Introduction

Evidence from laboratory experiments often provides findings which dispute the predictions of theories of decision which assume that player are perfectly rational and purely self-interested. This is the case, in particular of experimental social dilemmas where a significant level of cooperation is observed not only in repeated games, but also when games are one-shot (e.g. Ladyard 1995; Goeree and Holt 2001; Camerer 2003).

An example of social dilemma game in which both the full rationality hypothesis and the purely self-interest hypothesis have been disputed is the Traveler's Dilemma, introduced by Kaushik Basu in 1994. The parable associated with the game concerns two travelers returning from a remote island who lose their luggage, containing the same type of souvenir, because of the airline company. In order to be reimbursed, they have to write down on a piece of paper the value of the souvenir which may range between 2 and 100 (in the original Basu 1994 paper). If the travelers write a different number, they are reimbursed with the minimum amount declared. Moreover, a reward equal to 2 is paid to the traveler who declares the lower value, while a penalty of the same amount is paid by the traveler who writes the higher value. In case the two claims are exactly the same, the two travelers receive the declared value without reward or penalty. Given game characteristics, if both of them want to maximize their monetary payoffs, the (2,2) outcome is the only Nash equilibrium of the game and this is true independently of the size of the penalty or reward (hereafter also P|R).

Basu (1994) rises the problem of the implausibility of the Nash solution - far below the (100,100) cooperative outcome - and suggests that a more plausible result is the one in which each player declares a large number, in the belief that the other does the same. The scarce predictive capacity of the Nash equilibrium in the Traveler's Dilemma has been confirmed by experimental contributions which also emphasized the role of the severity of the punishment in determining the Nash solution. Goeree and Holt (2001) and Capra et al. (1999) showed that the less severe is the punishment the less likely is the Nash equilibrium solution in one-shot (Goeree and Holt 2001) and in repeated (Capra et al. 1999) Traveler's Dilemma. Rubinstein (2007) showed that around 50 percent of more than 4.500 subjects who played an online version of the Traveler's Dilemma (henceforth also TD) opted for the maximum choice (the minimum and maximum choice allowed were 180$ and 300$ respectively and P|R was 5$).[1]

The payoff structure of the Traveler's Dilemma – which is characterized by a large sub-optimality of the Nash equilibrium with respect to the cooperative outcome - makes it a suitable game to experimentally approach the idea of team reasoning, that has been proposed in different terms by David Hodgson (1967), Donald Regan (1980), Margaret Gilbert (1989), Susan Hurley (1989), Robert Sugden (1993, 2000, 2003), Martin Hollis (1998) and Michael Bacharach (1997, 1999, 2006). The aim of this paper is not to present the various approaches to team reasoning (to this aim see Gold and Sugden 2008). Our analysis is aimed at empirically verifying the role of "common reason to believe" (Sugden 2003) and of framing (Bacharach 1999 and 2006) within the theory of team reasoning. We provide an original empirical test of disputed theoretical questions related to the internal logic of team reasoning and to the reason explaining its endorsement by the members of a group.

In section 2, after having stressed the common thread characterizing the theory of team reasoning, we: a) discuss the idea of common reason to believe within this theory (Sugden 2003); b) discuss the role of framing in prompting the endorsement of team reasoning according to the Bacharach's approach; c) present in detail our empirical aims connected to these two theoretical issues. In section 3, we illustrate the rationale of our experiment and describe its design. In section 4 and 5 we empirically analyze the ideas of common reason to believe and framing within the theory of team reasoning respectively. Section 6 concludes.

[1] Subjects who participated in the online experiment were not paid. However, Rubinstein stresses that the distribution of answers given by these subjects is similar to that of Goeree and Holt (2001) when they use the low P|R.

2. Theoretical Background and Aims

2.1. Team reasoning and common reason to believe.

Team reasoning literature considers the possibility that individuals may identify in team and may use modes of team reasoning ("we-mode") in which decisions are taken by individuals as if they were not distinct from the team. The difference between team reasoning (we also will refer to the theory by saying we-thinking) and the classic individual rationality is that the former lead to say: "It would be good for us if we did…". In other words, when a decision has to be taken, an agent who reasons according to the we-mode wonders "What should we do" instead of "what should I do". Team reasoning is an explanation of the widely observed deviation from Nash solution in games such as Public Good Games and the Prisoners Dilemma (see Sugden 2003 for a theoretical application of team reasoning to this game).

The concept of "reason to believe" (Lewis 1969 and Cubitt and Sugden 2003) has been used by Sugden (2003) to tackle what he called the internal (to the logic of team reasoning) problem of the team reasoning theory. "The internal problem is that, from the viewpoint of any individual, the validity or acceptability of team reasoning, narrowly defined, may be conditional on his confidence that other members of the team are reasoning in a similar way"[2] (Sugden 2003, p.168). Two examples are used by Sugden to explain this concept. The Footballers' Problem considers two players (A and B) in the same football team. A has to pass the ball to B since a player in the opposing team is converging on him. A can pass the ball rightwards or leftwards. Correspondingly, there are two directions (left and right) in which B can run to catch the ball. If A chooses left and B chooses left too, there is a 10% chance to score a goal for the team. If both choose right the chance is 11%. Otherwise, there is no chance to score. The two players act simultaneously without possibility of communication.

Suppose that the two players reason as members of the same team and they want to score a goal. Suppose also that A thinks that B, for whatever reason, is going to choose left. In this case, even

[2] A footnote specifies that "team reasoning, narrowly defined" means "a mode of reasoning, followed by one individual, which prescribes that he should perform his part of whichever profile is best for the team" (Sugden 2003, p.168).

though (*right, right*) is the best solution for the team, it does not justify A in choosing right given her belief in B's choice. It seems, then, that belief in other's behavior has a fundamental role in the logic of team reasoning. This role may be better understood by considering the Prisoners Dilemma which highlights a second form of the internal problem of the team reasoning theory (Sugden 2003). In fact, in the Footballers' Problem the lack of confidence in B does not undermine A's commitment to obtain the best objective for the team. It only generates a particular kind of joint action as the mean of achieving this object. On the contrary, Prisoners' Dilemma represents a case in which lack of confidence in other members of a team eliminates commitment to the aim of the team itself. The payoff matrix of a standard Prisoners' Dilemma is reported in table 1.

Table 1. The Prisoners' Dilemma

		Player 2	
		Cooperate	***Defect***
Player 1	***Cooperate***	3,3	-1,4
	Defect	4,-1	0,0

Obviously, the best solution for the team made by the two players in the Prisoner's Dilemma is the couple of choices (*Cooperate, Cooperate*). Suppose that Player 1 believes that Player 2 will choose *Defect*. If Player 1 follows the team reasoning, she should play *Cooperate* even though players 2 plays *Defect*. In fact, (*Cooperate, Defect*) generates a total payoff equal to 3 which is higher that the payoff generated by (*Defect, Defect*). It means that, given the payoff structure reported in table 1, team reasoning prescribes to cooperate regardless of other player's choice. However, the belief that 2 will defect raises doubts about the appropriateness of team reasoning for player 1. "In part, this is a matter of moral psychology: a person may be willing to play her part in a joint activity which benefits all parties, but not to pay for someone else's free rides. There is also a conceptual issue. It is difficult to make sense of the idea that one person reasons 'as a member of a team' without presupposing that she believes that there *is* a team of which she *is* a member. But, one might think, a two-person team is not something that one person can create unilaterally: for C [*C and D are the two players in Sugden's explanation*] to conceive of {C, D} as a team, she has to conceive of D conceiving of {C, D} as a team. D's choice of *defect* might be construed as asserting that, for her, {C, D} is not a team at all. Construing D's expected choice in this way, C may conclude that there is no call for team reasoning, since there is no team to activate it." (Sugden 2003, p.168). A risk of infinite regress arises: team reasoning may be valid or acceptable for a player (a member of a team) only if it is valid or acceptable for the others. Sugden tackles this problem by developing and applying to team reasoning the idea of common reason to believe which is defined as follows: "there is *common reason to believe* a proposition *p* in a set of individuals *T* if: (i) for all individuals *i* in *T, i* has reason to believe *p*; (ii) for all individuals *i* and *j* in *T, i* has reason to believe that *j* has reason to believe *p*; (iii) for all individuals *i, j*, and *k* in *T, i* has reason to believe that *j* has reason to believe that *k* has reason to believe *p*; and so on. (Gold and Sugden 2008, p. 302). Essentially, members of groups are not committed to reason as a team unless there is a common reason to believe that other members are doing the same (Smerilli 2008).

The first goal of the present paper is to empirically verify the role of the common reason to believe in the theory of team reasoning. We elicited players' belief in their counterpart's choice and verified if the adoption of team reasoning is correlated with the belief that also the other member of the group (the counterpart in the Traveler's Dilemma) is doing the same. We will show that this is the case.

2.2. Team Reasoning, Framing and Reduction of Social Distance

With respect to the Bacharach's approach to team reasoning, we are in particular interested in his interpretation of the role that framing may have in prompting the endorsement of we-thinking in the members of a group. According to Bacharach, the possibility that we-thinking is implemented by agents is strictly connected with the idea of frames. Subjects who are part of a group will endorse team reasoning if the "we-frame" comes to their mind. A frame is intended as a set of concepts agents use when they think about a decision problem. Some situations may be more likely to stimulate the we-frame. For example, Bacharach (2006) states that the we-frame is normally induced by the Hi-Lo game[3] (see also Gold and Sugden 2008) and, even though less reliably, by the Prisoners' Dilemma. The central question to understand this point is: how does we-frame come to mind? In his 1997 and 1999 contributions, Bacharach says that we-frame is based on the concept of "scope for cooperation" and to the "harmony of interests". Essentially, in this perspective, the probability of we-thinking is moderated by the temptation to reason as an individual, and varies with the strategic incentives to defect from the team. This temptation to avoid cooperation may be dictated by the underlying game harmony structure of the game (Tan and Zizzo 2008). Tan and Zizzo (2008) tackle this issue empirically. They define game harmony "as a generic property describing how harmonious or disharmonious the interests of players are, as embodied in the payoffs, capturing in a formal sense an aspect of how 'cooperative' we should consider a game to be" (Tan and Zizzo 2008, p.3) and show that game harmony is positively correlated with cooperation. In the book edited by Gold and Sugden, Bacharach (2006) introduces the concept of "strong interdependence" and proposes the idea that perceived interdependence promotes team identification and endorsement of team reasoning. In a two player context, perceived interdependence depends on three factors.

1. *Common interest*: assuming that s* and s are possible state of affairs, or outcomes of a game, subjects have common interest in s* over s, if both prefer s* to s.
2. *Copower*: subjects cannot reach s* alone, but they can together.
3. *Solution of the game in standard game theory realizes s.*

[3] A Hi-Lo game is a game where each player (suppose a two player game) has to choose one element from the same set of labels. Players' payoffs are (a_i, a_i) if the two players choose the same label i and (0,0) otherwise (with $a_i > 0$). Moreover, there is one label k such that a_k is strictly greater than every other a_i. If you suppose only two labels, the normal form of a Hi-Lo game may be:

		Player 2	
Player 1		High	Low
	High	*a,a*	*0,0*
	Low	*0,0*	*b,b*

a>b>0

That is, group identification is stimulated if a possible outcome (s) which would be reached by endorsing individual standard rationality is strictly Pareto-dominated by another outcome (s*) which is preferred by both the players and which may be achieved if they act according to the team reasoning.

Strong interdependence may prompt team reasoning but it does not imply that we-thinking is endorsed by all the subjects. "In a Prisoner's Dilemma, players might see only, or most powerfully, the feature of common interest and reciprocal dependence which lie in the payoffs on the main diagonal. But they might see the problem in other ways. For example, someone might be struck by the thought that her coplayer is in a position to double-cross her by playing D [*defect*] in the expectation that she will play C [*cooperate*]. This perceived feature might inhibit group identification. (2006, p.86)". Both the Prisoners' Dilemma and the Traveler's Dilemma share the property of strong interdependence. They may be interpreted in terms of I-frame or we-frame by different players, depending on psychological processes, in the same way the drawing used in *Gestalt* psychology can be seen as a duck or a rabbit by different subjects (Gold and Sugden 2008).

The second aim of the present paper is linked with the psychological processes which may induce we-thinking to arise. Without having the ambition to clarify the mechanism behind these processes, we want to investigate if reducing social distance (as it is commonly intended in behavioral economics, see in the following pages)[4] in a standard Travelers' Dilemma increases the likelihood that we-frame comes to mind of players. To the best of our knowledge, this is the first attempt to explicitly consider the effect of the reduction of social distance within the context of the theory of team reasoning. Social distance is decreased by introducing a meeting between the two players after the game. Its effect on the endorsement of team reasoning should be related to the fact that the idea of the team may become more salient when a meeting after the game is introduced.

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[4] The reduction of social distance is related with the conditions illustrated by Bacharach (2006) which tend to promote a sense of identity such as "falling within the same natural social boundary (such as all being students, or elderly, or resident of the same town), or the same artificial category (such as being overestimators of the number of dots on a screen), meeting, having a common interests […]" Bacharach (2006, p.82).

A growing experimental literature on other regarding behavior shows that the probability of observing deviations from pure self-interest increases as the distance among subjects decreases. According to some authors this evidence can be explained in terms of a negative correlation between the social distance and the degree of empathy among subjects (Bohnet and Frey 1999a,b). An alternative explanation is based on the idea that the reduction of the social distance among the subjects allows for a social norm of cooperation or fairness to become effective (Roth 1995, Hoffman, McCabe and Smith 1996, Bohnet and Frey 1999a). Manipulations of social distance include: face to face interaction (Isaac and Walker 1991, Ladyard 1995, Buchan, Croson and Johnson 2006), impersonal communication (Frohlich and Oppenheimer 1998), silent identification (Bohnet and Frey 1999b and Scharlemann et al. 2001), information about personal characteristics (Charness, Haruvy and Sonsino, 2007; Charness and Gneezy, 2008), and manipulation of language (Hoffman, McCabe and Smith 1996).

Our analysis differs from these approaches in two respects. First, in our experiment anonymity is removed after the game, without introducing any form of pre-play communication. Second, the reduction of social distance has never been used in the Travelers' Dilemma, a game characterized by the property of strong interdependence and particularly capable of prompting the we-frame.

Our aim is to understand if also in a setting which seems to have all the characteristics to stimulate the we-frame because of its payoff structure, the reduction of social distance increases the probability that we-frame comes to mind of players.

3. Experimental Design and Procedure

The experiment is based on a two-player Traveler's Dilemma in which each player is asked to choose a number between 20 and 200 and the size of the penalty or reward is 20.[5] Let us call n_1 and n_2 the numbers chosen by player 1 and player 2 respectively. Following the standard game rules, if $n_1 = n_2$, both players receive n_1 tokens (1 token = 0.05 euro); if $n_1 > n_2$, player 1 receives n_2-20

[5] The instructions of the experiment are available from the authors upon request.

tokens and player 2 receives $n_2 + 20$ tokens; finally, if $n_1 < n_2$, player 1 receives $n_1 + 20$ tokens and player 2 receives $n_1 - 20$ tokens. The unique Nash equilibrium in pure strategies of this game is $n_1 = n_2 = 20$.

We compare subjects' choices under three treatments: Baseline Treatment (BT), Compulsory Encounter Treatment (CET) and Voluntary Encounter Treatment (VET). Each subject participates in only one treatment. In the BT subjects play the standard Traveler's Dilemma. In the CET subjects play the game after having been informed that they would meet their counterpart at the end of the experiment (see Appendix 1 for the timing of the experiment). The meeting consists simply in the presentation of the two players after the game and does not involve any post-play activity. In the VET, before playing the game, subjects are asked to choose whether they want to meet or not their counterpart at the end of the experiment and they are informed that the encounter takes place only if both the participants choose to meet the counterpart. In this treatment, after being instructed about the game but before playing it, subjects are handed a form with the following question: "Do you want to meet, at the end of the experiment, the person you are going to play with?" They are informed of the fact that the meeting would take place only if both players replied with a "Yes" and they are informed of the counterpart's decision about the meeting only at the end of the game.

The CET and the VET introduce a reduction of social distance among players and they were implemented in order to study their effect on the adoption of team reasoning in a game characterized by the property of strong interdependence.

In all our treatments, at the end of the game, beliefs about the opponent's choice are elicited by using monetary incentives. In particular, each subject is asked to guess the number chosen by her opponent and she is paid 1 euro if the distance between her guess and their opponent's actual choice is less then 10.[6] Finally, subjects are asked to answer a set of socio-demographic and attitudinal questions.

[6] We believe that, in our kind of experiment, a prize exclusively given to the correct guess could be considered too difficult to achieve, thereby discouraging players and increasing the likelihood of casual answers. At the same time, eliciting procedures based on quadratic scoring rules (Davis and Holt 1993) are useless for a game - like our version of

The experiment was run both at the Experimental Economics Laboratory (EELAB) of the University of Milan Bicocca and at the Laboratory of Experimental Economics (LES) of the University of Forlì [7]. We ran 2 sessions for the BT (1 in Milan and 1 in Forlì), 2 sessions for the CET (1 in Milan and 1 in Forlì), 3 sessions for the VET (1 in Milan and 2 in Forlì). A total of 140 undergraduate students – 76 in Milan and 64 in Forlì – participated in the experiment. Players were given a show – up fee of 3 euro.

4. I-rational and we-rational behavior: an empirical test of the role of common reason to believe within the theory of team reasoning

By considering different pairs of choices and beliefs in the Traveler's Dilemma we define two types of players' behavior:

1) ***Individually rational behavior****:* a player *i* behaves as individually rational (IR_i) if $C_i<B_{i(j)}$ or $C_i = B_{i(j)} = \underline{B} = \underline{C}$, where C_i is the choice of player *i*, $B_{i(j)}$ is the expectation of player *i* on the choice of her opponent *j*, $\underline{C}$ is the smallest number that a player can declare and $\underline{B}$ is the player's belief that her opponent will declare the smallest number. The individually rational player (i.e., in the Bacharach's perspective, a player who frames the situation according to the I-frame) aims at maximizing her payoff and therefore chooses at least one unit below her belief on the counterpart choice ($C_i<B_{i(j)}$).[8] Obviously, she is also individually rational if she expects the counterpart to play

the Traveler's Dilemma - characterized by a large number of possible strategies. The use of tolerance thresholds for subjects' guesses is used in the literature as a valid method for eliciting beliefs (see for example Charness and Dufwemberg 2006; Croson 2000).

[7] Subjects were recruited by email. They were students included in the mailing list of the two laboratories. Two weeks before the experiment they received an email in which the staff invited them to visit the Laboratory's website for information about the experiment and subscriptions.

[8] Since the belief is not necessarily a point estimate but may be a distribution of expected choices, we choose a broader concept of individual rationality where a individually rational player may choose not only $C_i=B_{i(j)}-1$ but also $C_i<B_{i(j)}-1$. To understand this point imagine a car driver who drives on a one lane road and respects the rules. He knows that he needs extra care to take into account the possibility of crazy driver coming from the other direction that, when overtaking another car, enter his lane. The possibility of meeting this type of drivers will lead him to take a little bit extra care in driving.

lowest and she does the same ($C_i = B_{i(j)} = \underline{B} = \underline{C}$). Beliefs are strategically used by players who follow I-rationality in order to obtain the reward by undercutting the counterpart's choice.

ii) ***We-rational behavior:*** a player *i* behaves as we-rational (WR_i) (i.e. she follows team reasoning) if $C_i=B_{i(j)}$ when $B_{i(j)} = \overline{B} = \overline{C}$, where $\overline{C}$ is the largest number that a player can declare and $\overline{B}$ is the player's belief that her opponent will declare the largest number.

Moreover, we could wonder if a player may behave according to team reasoning in case her belief is not $\overline{B}$. This is the first aspect we want to empirically test in our contribution. According to the idea of common reason to believe, there is no way for team reasoning to arise if the belief in the counterpart's choice is different from the maximum. This is because, as in the case of the Prisoners' Dilemma, also in the Traveler's Dilemma a team may not be created unilaterally. If the choice which maximizes the team's payoff (i.e. $C_i=B_{i(j)}$)[9] is not observed when players believe that the counterpart is not going to choose the maximum bid while it is commonly endorsed when the beliefs are equal to the maximum, we will conclude that the common reason to believe has a central role in team reasoning.

To test this idea, let us start by considering the possible {choice, belief} outcomes which stem from the existence of Individually rational behavior and We-rational behavior. There are three cases:

a) $\{IR_i, E_i[IR_j]$[10]$\}$ and $\{IR_i, E_i[WR_j]\} \rightarrow \{C_i < B_{i(j)}$ and $C_i = \underline{C}$ if $B_{i(j)} = \underline{B}\}$[11]

If player *i* frames the situation according to the I-frame, irrespectively of her expectation on the counterparts' type, she will try to obtain the prize by undercutting the other player's choice, i.e. she will play $C_i < B_{i(j)}$. Obviously, in case player *i* believes that the counterpart is going to choose the minimum bid she will opt for the minimum too ($C_i = \underline{C}$ if $B_{i(j)} = \underline{B}$).

[9] In the Traveler's Dilemma, a player who endorses team reasoning and has a belief $B_{i(j)} \neq \overline{B}$, will maximize the joint outcome by choosing $C_i=B_{i(j)} \neq \overline{B}$.
[10] E_i is the player i's expectation about the type of her opponent.
[11] See footnote 7 for the motivation of our decision not to restrict individual rationality to C=B-1.

b) $\{\mathbf{WR_i}, \mathbf{E_i}[\mathbf{WR_j}]\} \rightarrow \{\mathbf{C_i} = \overline{C}, \boldsymbol{B_{i(j)}} = \overline{B}\}$

If player *i* expects that the counterpart will frame the situation in terms of we-frame and she does the same, she will play highest under the expectation that the counterpart will play highest.

c) $\{\mathbf{WR_i}, \mathbf{E_i}[\mathbf{IR_j}]\} \rightarrow \{\mathbf{C_i} = \boldsymbol{B_{i(j)}} \neq \overline{B}\}$ (only if common reason to believe does not have a relevant role in team reasoning theory).

If players who choose a number equal to their belief even when $\mathbf{B_{i(j)}} \neq \overline{B}$ do exist, we should conclude that the common reason to believe does not have a relevant role in team reasoning theory. Otherwise, we should conclude that the confidence in the counterpart's behavior is fundamental to allow team reasoning.

Table 2 summarizes the experimental data from our Traveler's Dilemma by considering the previous analysis in terms of choice and belief.

Table 2. Choice and belief in the Traveler's Dilemma (Total Sample)

Type of behavior	Combination of {choice,belief} solutions compatible with the defined types	Conditions	Number of players choosing the outcome	Percent of total sample
Minimum bid		$C_i = \underline{C}$	3	2.14
Maximum bid		$C_i = \overline{C}$	35	25.00
Individually rational behavior, ruling out the possibility of "strategic" beliefs which exploit the +/- 10 tolerance*	$\{IR_i,E_i[IR_j]\}$ and $\{IR_i,E_i[WR_j]\}$	$\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$ or $\{C_i < B_{i(j)}, B_{i(j)} > \underline{B}\}$	52 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	37.14
We-rationality being common knowledge, ruling out the possibility of "strategic" beliefs which exploit the +/- 10 tolerance**	$\{WR_i,E_i[WR_j]\}$	$\{C_i = \overline{C}, B_{i(j)} = \overline{B}\}$	15	10.71
Individually rational behavior including "strategic" beliefs which exploit the +/- 10 tolerance*	$\{IR_i,E_i[IR_j]\}$ and $\{IR_i,E_i[WR_j]\}$ adjusted for the +/- 10 belief prize tolerance	$\{C_i = \underline{C}, B_{i(j)} = \underline{B}$ *or* $B_{i(j)} = \underline{B} + 10\}$ or $\{C_i < B_{i(j)}, B_{i(j)} > \underline{B}\}$	52 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	37.14
We-rationality being common knowledge including "strategic" beliefs which exploit the +/-10 tolerance**	$\{WR_i,E_i[WR_j]\}$ adjusted for the +/- 10 belief prize tolerance	$\{C_i = \overline{C}, B_{i(j)} = \overline{B}$ *or* $B_{i(j)} = \overline{B} - 10\}$	28	20.00
We-rational choice without team preferences being common knowledge when the player does not expect the counterpart to be a we-rational, ruling out the possibility of "strategic" beliefs which exploit the +/- 10 tolerance**	$\{WR_i,E_i[IR_j]\}$	$C_i = B_{i(j)}$ with $B_{i(j)} \neq 190$ and $B_{i(j)} < \overline{B}$ (and $B_{i(j)} \neq \underline{B}$)	4	2.86
We-rational choice without team preferences being common knowledge when the player does not expect the counterpart to be a we-rational including "strategic" beliefs which exploit the +/- 10 tolerance*	$\{WR_i,E_i[IR_j]\}$	$C_i = B_{i(j)}$ with $B_{i(j)} < \overline{B}$ (and $B_{i(j)} \neq \underline{B}$)	9	6.43

* Given the possibility of getting the prize for the belief even in case of a +/- 10 error, we consider that "strategic" players may declare a belief of 30 even though their true belief is lower than 30 (in particular it could be equal to 20). If players declare a belief lower than 30 they are not exploiting this opportunity and therefore we assume that their declared beliefs correspond to the true ones.
** Given the possibility of getting the prize for the belief even in case of a +/- 10 error, we consider that "strategic" players may declare a belief of 190 or higher than 190 even though their true belief is higher than 190 (in particular it could be equal to 200). If players declare a belief higher than 190 they are not exploiting this opportunity and therefore we assume that their declared beliefs correspond to the true ones.

We resume our main findings from Table 2 as follows:

i) ***A significant part of players endorse team reasoning, even though, as a whole, individual rationality is more widespread than we-rationality***

If we do not consider the possibility of "strategic" belief (given the possibility of getting the prize for the belief even in case of a +/- 10 error, players may declare a belief of 190 (30) even though their true belief is equal to 200 (30)) data show that 52 players (37.14% of the total sample) endorsed I-rationality and 15 players (10.71%) endorsed we-rationality by choosing $C_i = \overline{C} = \overline{B}$ (the number of players who endorsed we-rationality by choosing $C_i = \overline{C} = \overline{B}$ increases to 28 (20.00%) if we consider "strategic" belief).

We also note that only 3 players chose the minimum bid and 35 chose the maximum one. In particular, note that only one player followed recursive reasoning believing that the counterpart knows or acts according to it (i.e. there is only one player who declares the minimum believing that her counterpart was doing the same).

ii) ***The undercutting choice largely prevails over we-rationality choice when the expectation on the counterpart choice is not the upper bound one: This supports the idea that the common reason to believe works well within the theory of team reasoning.***

For $B_{i(j)}<\overline{B}$, we find that cases in which $C_i<B_i$ (51 players) are much more than those in which $C_i=B_i$ (9 players if we do not consider the possibility of "strategic" belief and 4 players if we do)[12]. It seems that, outside the "implicit agreement" around the $\{\overline{C}_i, \overline{C}_j\}$ choice, individually rational behavior largely dominates team rational one. This reveals a significant role of common reason to believe in explaining the internal logic of team reasoning. This conclusion is supported by two other empirical results. First, the 60% of players (15 out of 25) with belief equal to the maximum endorsed team reasoning by choosing the maximum number. Second, a significant number of players who choose the maximum (15 out of 35 if we do not consider the possibility of "strategic"

[12] 5 players declared a belief equal to 190 and chose 190. These players may be individually rational players who exploited the possibility of strategic belief (that means that their actual belief was higher than 190). In this case, by choosing 190 they tried to obtain the prize and not to maximize the team output.

belief and 28 out of 35 if we do)[13] believed that their counterpart was going to play $\overline{C}$ (notice that cannot be excluded that belief and the fact that the we-mode comes to mind are reciprocally affected).

iii) There is a large share of players who choose C_i>B $_{i(j)}$. They may be defined "irrational" player, in the sense that they do not endorse either I-rationality, nor we-rationality

Apart from players who reveal to be I-rational and we-rational, there is a large part of players who choose C_i>B $_{i(j)}$. The share of such players is 45.71. The reason behind the behavior of these players is not the aim of this paper. For an explanation of this evidence, see Becchetti, Degli Antoni and Faillo 2009).

5. Reduction of social distance and we-frame

In Table 3 we analyze choices and beliefs when the social distance between players is reduced by introducing a meeting after the game.

The most relevant difference across the three treatments characterizing our Traveler's Dilemma (baseline treatment, compulsory encounter treatment and voluntary encounter treatment) is the rise of the {C_i = $\overline{C}$, $B_{i(j)}$= $\overline{B}$ } belief/choice pair in the compulsory meeting treatment (17.5 percent against 7.5 in the baseline).[14] Essentially, when players know that they will meet after the game, it is more likely that they endorse the we-frame and that they believe that the counterpart is going to do the same. We interpret this result as a positive and significant effect of the reduction of social distance on the probability that the we-frame comes to mind.

[13] 13 players who declared a belief equal to 190 chose a number equal to the maximum (200). As in the case described in the previous footnote, our interpretation is that these 13 players may have used the +/- 10 belief prize tolerance to declare a belief equal to 190 even though their actual belief was 200. In any case, even by excluding the percentage of players who chose the maximum having a belief equal to 200 is much higher that the percentage of players who endorsed team reasoning by having se players, 15 players believed that the counterpart was going to played the maximum percentage of players adopting we-reasoning is significantly higher among players having a belief equal to 200 that If we exclude these players, the number of players who declare the maximum number having the hi If we consider that the out of if we consider that 13 players who choose the maximum and declared a belief equal to 190 could actually have a belief equal to 200 (the decision to declare a belief lower than their actual belief would be due to the). They are 15 out of 33 if we do not consider these 13 players.

[14] This difference (30% against 27.5%) is less evident when strategic beliefs are considered.

By contrast, we do not find a significant effect of the different treatments to the probability to behave as an I-rational player. The effect of the compulsory meeting on the number of we-rational players is due to the reduction of "irrational" players (the ones who choose a number higher than their belief). In fact, the percentage of this kind of players is significantly lower in the compulsory meeting treatment (42.5%) with respect to the baseline (50%).

Finally, the possibility of the meeting introduced in the Voluntary Encounter Treatment does not positively affect the probability of endorsing team reasoning. In this treatment, players are informed of the opponent's decision about the meeting only after the game is ended. Subjects' behavior suggests that the mere option of the encounter is not enough to make the we-frame more likely. A possible explanation is that players anticipate that subjects who do not endorse team reasoning may decide not to meet the counterpart avoiding the encounter and, consequently, avoiding the reduction of social distance. This interpretation is confirmed by data on subjects who decide not to meet the counterpart when the option is available. The percentage of individually rational player among players who refuse to meet the counterpart in the voluntary encounter treatment is much higher than in the other sub-sample. This suggests two possible considerations. First, the I-rational players are more likely to refuse instead of accepting the encounter. Second, while the possibility to agree on a voluntary meeting does not prompt the we-mode, the possibility to refuse a voluntary meeting seems to stimulate the I-mode. This essentially seems to help players to cancel the idea that the game is played by two members of a team.

Table 3. Choice and belief in the Traveler's Dilemma (breakdown by experiment design)

Type of behavior	Combination of {choice,belief} solutions compatible with the defined types	Conditions	Baseline treatment	Compulsory meeting	Voluntary meeting	Voluntary meeting (yes)***	Voluntary meeting (no)
Minimum bid		$C_i = \underline{C}$	2.50	0	3.33	0	6.25
Maximum bid		$C_i = \overline{C}$	27.50	30.00	20.00	25.00	15.63
Individually rational behavior, ruling out the possibility of "strategic" beliefs which exploit the +/- 10 tolerance*	$\{IR_i, E_i[IR_j]\}$ and $\{IR_i, E_i[WR_j]\}$	$\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$ or $\{C_i < B_{i(j)}, B_{i(j)} > \underline{B}\}$	32.50 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	35.00 (among them for no player was $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	38.33 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	35.71 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	43.75 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)
We-rationality being common knowledge, ruling out the possibility of "strategic" beliefs which exploit the +/- 10 tolerance**	$\{WR_i, E_i[WR_j]\}$	$\{C_i = \overline{C}, B_{i(j)} = \overline{B}\}$	7.50	17.50	8.33	7.14	9.38
Individually rational behavior including "strategic" beliefs which exploit the +/- 10 tolerance*	$\{IR_i, E_i[IR_j]\}$ and $\{IR_i, E_i[WR_j]\}$ adjusted for the +/- 10 belief prize tolerance	$\{C_i = \underline{C}, B_{i(j)} = \underline{B}$ *or* $B_{i(j)} = \underline{B} + 10\}$ or $\{C_i < B_{i(j)}, B_{i(j)} > \underline{B}\}$	32.50 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	35.00 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	38.33 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	35.71 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)	43.75 (only in one case $\{C_i = \underline{C}, B_{i(j)} = \underline{B}\}$)
We-rationality being common knowledge including "strategic" beliefs which exploit the +/-10 tolerance**	$\{WR_i, E_i[WR_j]\}$ adjusted for the +/- 10 belief prize tolerance	$\{C_i = \overline{C}, B_{i(j)} = \overline{B}$ *or* $B_{i(j)} = \overline{B} - 10\}$	27.50	30.00	16.67	17.86	27.50
We-rational choice without team preferences being common knowledge when the player does not expect the counterpart to be a we-rational, ruling out the possibility of "strategic" beliefs which exploit the +/- 10 tolerance**	$\{WR_i, E_i[IR_j]\}$	$C_i = B_{i(j)}$ with $B_{i(j)} \neq 190$ and $B_{i(j)} < \overline{B}$ (and $B_{i(j)} \neq \underline{B}$)	2.50	0	6.67	10.71	3.31
We-rational choice without team preferences being common knowledge when the player does not expect the counterpart to be a we-rational including "strategic" beliefs which exploit the +/- 10 tolerance*	$\{WR_i, E_i[IR_j]\}$	$C_i = B_{i(j)}$ with $B_{i(j)} < \overline{B}$ (and $B_{i(j)} \neq \underline{B}$)	7.50	5.00	6.67	10.71	3.13

* Given the possibility of getting the prize for the belief even in case of a +/- 10 error, we consider that "strategic" players may declare a belief of 30 even though their true belief is lower than 30 (in particular it could be equal to 20). If players declare a belief lower than 30 they are not exploiting this opportunity and therefore we assume that their declared beliefs correspond to the true ones. ** Given the possibility of getting the prize for the belief even in case of a +/- 10 error, we consider that "strategic" players may declare a belief of 190 or higher than 190 even though their true belief is higher than 190 (in particular it could be equal to 200). If players declare a belief higher than 190 they are not exploiting this opportunity and therefore we assume that their declared beliefs correspond to the true ones. *** Players who opted for the meeting in the voluntary encounter treatment.

6. Conclusions

The present paper approached the theory of team reasoning from an empirical point of view in order to verify:

1. the role of the common reason to believe in the theory of team reasoning;
2. the effect of the reduction of social distance on the likelihood that we-frame comes to mind of players involved in a game characterized by the property of strong interdependence.

With respect to the first point, we were interested in analyzing if the belief in the other player's behavior is significantly correlated with the adoption of team reasoning. With respect to the second point, we reduced the social distance between subjects by introducing in a standard Travelers' Dilemma a voluntary and a compulsory meeting between the two paired players and we studied the effect of these two treatments on the probability that team reasoning was endorsed.

Two main findings characterize our empirical analysis. First, the notion of "common reason to believe" used by Sugden (2003) to tackle the so called "internal problem of team reasoning" seems appropriately capture the internal logic of team reasoning. When the belief is lower than the maximum, we find that players who endorse the I-mode are much more than players who follow the team reasoning. It seems that, outside the "implicit agreement" around the $\{\overline{C}_i, \overline{C}_j\}$ choice, individually rational behavior largely dominates team rational one. The role of belief is confirmed by the fact that the majority of players who think that their counterpart is going to play the maximum, endorse the team reasoning. Second, when the meeting is a compulsory characteristic of the game, there is a significant increase of players who endorse team reasoning by choosing the maximum under the belief that also the counterpart is doing the same. This result may be interpreted as a positive and significant effect of the reduction of social distance on the probability that the we-frame comes to mind. Players who know that after the game the members of the team will meet are more likely to adopt team reasoning.

Even though different authors used the idea of team reasoning "in different ways, and applied it to different but overlapping sets of phenomena" (Sugden 2003, p.166) there is a surprisingly lack of experimental study on this concept. The present paper aimed at investigating two theoretical issues related to the theory of team reasoning by considering an original experimental approach. Our empirical findings stimulate further research to verify whether our result on the role of "common reason to believe" and on the effect of the reduction of social distance on the endorsement of team reasoning may be reinforced or confuted by similar experimental analyses on different games.

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APPENDIX 1 - Timing of the experiment

BASELINE TREATMENT (BT)

T_1	T_2	T_3	T_4	T_5
The experimenter reads the instructions about the game	Control questions; checks and corrections by the experimenters	Subjects play the Traveler's dilemma	The experimenter reads the instructions about the survey (beliefs, risk attitude, socio-demographics)	Subjects fill the survey

COMPULSORY ENCOUNTER R TREATMENT (CET)

T_1	T_2	T_3	T_4	T_5	T_6
The experimenter reads the instructions about the game. Subjects are informed about the encounter	Control questions; checks and corrections by the experimenters	Subjects play the Traveler's dilemma	The experimenter reads the instructions about the survey (beliefs, risk attitude, socio-demographics)	Subjects fill the survey	Encounter

VOLUNTARY ENCOUNTER TREATMENT (VET)

T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
The experimenter reads the instructions about the game. Subjects are informed about the encounter option	Control questions; checks and correction by the experimenters	Subjects decide whether to meet or not the counterpart	Subjects play the Traveler's Dilemma	The experimenter reads the instructions about the survey (beliefs, risk attitude, socio-demographics)	Subjects fill the survey	Subject learn the counterpart's decision about encounter	Encounter