When the two ends meet: an experiment on cooperation and social capital

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Abstract

We study the behaviour of individuals from different regions of Italy interacting in a same public good game. In line with the existing literature, we find that Southern citizens cooperate less than Northern citizens when facing the same incentives and experimental conditions. This is explained by a different impact of coordination opportunities, such as communication, as we demonstrate by manipulating them. Most importantly, we provide original evidence that groups where subjects have different geographic origins contribute less than homogeneous groups. This confirms that, rather than being explained just by the differences in institutions and economic opportunities, the Italian South-North divide embeds elements of distrust, prejudice and a consequent path dependence in the level of social capital. More in general, our results point towards integration as a crucial aspect for the economic development of intercultural societies.

Keywords: public good, cooperation, social capital, cultural differences, lab experiment.
JEL classification: A13, C71, C92, H41.

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1 Introduction

Almost since the dawn of experimental economics, researchers have looked with growing interest at what experiments ran in different locations and contexts could reveal concerning the characteristics of specific cultures and societies. This is particularly true for experiments focusing on traits related to *social capital*, such as trust (Croson and Buchan, 1999), cooperation (Cason et al., 2002) and fairness (Oosterbeek et al., 2004), given the fundamental role that social capital bears in explaining variations in institutional organisation and economic outcomes (Knack and Keefer, 1997; Buonanno et al., 2009; Hoyman et al., 2016).

Some countries have been shown to exhibit important *internal* differences in social capital across regions: apart from the case of Italy, which will be discussed in detail in what follows, notable examples are represented by West and East Germany, also analyzed in the experimental literature (Ockenfels and Weimann, 1999; Brosig-Koch et al., 2011), and by heterogeneities across American States (Putnam, 2001).

In Italy, profound internal differences in terms of social capital and cooperation have since long been identified as one of the causes of the North-South economic divide that has characterised the country since its unification and has widened in the last decades (Helliwell and Putnam, 1995; Leonardi, 1995; Guiso et al., 2004). Although the historical origins of the gap remain a matter of debate, empirical evidence on its existence is overwhelming. Strong differences can be found not only in the values of economic indicators (GDP per capita, unemployment rate, internal migrations), but also looking at measures of quality of institutions (timeliness of budgets, legislative innovation, citizen satisfaction) and at individual level indicators (frequency of blood donations, number of associations, voters turnout at elections, newspaper readership).[1]

While such differences are often explained on the ground of disparities in economic opportunities and quality of institutions, a stream of literature, which can be traced back to the seminal work of Banfield (1967), focuses instead on the individual determinants of the propensity to cooperate. Ichino and Maggi (2000), for instance, exploit the phenomenon of on-the-job movers inside a large Italian bank to compare individuals facing the same incentives

[1]The empirical literature on the *"Questione meridionale"*, i.e. the North-South gap, is vast: see Helliwell and Putnam (1995); Ichino and Maggi (2000); Felice (2013); Bigoni et al. (2016) for a more comprehensive view.

but having different geographic backgrounds. Bigoni et al. (2016) instead run a "laboratory-in-the-field" experiment in two cities located in the North and two located in the South of Italy, with experimental subjects being presented the exact same incentives and experimental conditions. Their results confirm that observed disparities in behaviour cannot be explained just by differences in the economic context, but rather are *"likely to derive from persistent differences in social norms"*.

In this paper, through an artefactual field experiment, we study the propensity of individuals from both North and South of Italy to contribute in a *same* public good game. Compared to the experimental literature mentioned so far, the crucial novelty is therefore our ability to observe the interaction between individuals characterised by different geographic backgrounds. Aside from the experimental literature, a growing stream of research focuses on the comparison of migrants and on-the-job movers to local populations (Ichino and Maggi, 2000; Gibson et al., 2015; Algan et al., 2016); however, our setting is unique in the fact that it abstracts from the determinants and effects of migration and integration (or segregation). In fact, our subjects were living in different cities *at the time of the experiment*, they moved to the location were the experiment took place only for few days, and except for the geographic background they shared similar characteristics (such as age and education). In the experiment, we manipulate both the composition of the groups and the available coordination opportunities. Thus, we further improve upon the existing literature by exploring the effect that such opportunities have on contributions, and hence by shedding light on what determines differences in contributions between Northern and Southern citizens.

Our results confirm differences in reactions to identical incentives: specifically, lower contributions on behalf of Southern citizens. In a closely related study, Bigoni et al. (2017) separately elicit contributions, conditional contributions (i.e. as functions of their peers' ones) and expectations regarding peers' contributions. This allows them to demonstrate that individuals from the South *do expect* lower contributions from their peers - while they do not exhibit a lower level of conditional cooperation. Relatedly, in our experiment, the difference in cooperation only emerges in the presence of identification and communication: indeed, the behaviour of individuals from the South is less affected by these coordination opportunities, which can play a crucial role in shaping individual expectations.

The aforementioned evidence emphasises the importance of behavioural

aspects in explaining the North-South divide in Italy: even though behavioural traits might have certainly evolved as an adaptation to institutional characteristics (as already suggested by Putnam et al., 1993), it can be misleading to expect that changing such characteristics will have an immediate positive effect on cooperation levels. This argument can partly explain the failure of past measures adopted by policymakers in order to close the North-South gap, and must be taken into account when planning further actions in this direction - as currently attempted, for instance, by policies aimed at improving the competitiveness of universities located in the South of Italy, e.g. by attracting winners of ERC grants (ANSA, 2016).

The comparison of individuals in mixed and homogeneous groups reveals that, once they get to know the composition of their group, the latter contribute more. The negative performance of mixed groups is in contrast with the experimental literature on cooperation and ethnic diversity (Cox et al., 1991; McLeod and Lobel, 1992; Levine et al., 2014): it is worth emphasizing that, differently from such literature, our subjects live in geographically separated areas and, on the other hand, are not typically considered as "ethnically diverse"; moreover, they have belonged to the same nation for the past 150 years, sharing the same system of rights and laws. Compared to the literature on (absence of) anonymity in public good games (Gächter and Fehr, 1999; Andreoni and Petrie, 2004; Rege and Telle, 2004; Chaudhuri, 2011; Savikhin Samek and Sheremeta, 2014; Gaudeul and Giannetti, 2015), the novelty of our approach lies then in the analysis of within-subject behaviour *across* rounds of a same game. Group composition and coordination opportunities are crucial aspects for the debate on economic inequalities across regions, since they highlight the possible role of prejudice and, more in general, lack of integration. In areas where social capital is scarce, economic development may be also hindered by the relatively difficult interactions with other regions: in absence of measures overcoming regional disparities, these might spontaneously deteriorate over time.

The following section describes the characteristics and design of the experiment, Section 3 presents our hypotheses, Section 4 the results and Section 5 concludes.

2 Experimental design

The experiment was ran on October 3, 2015, in Volterra (Italy), as part of a more general project organised by Sant'Anna School of Advanced Studies (Nuti and Ghio, 2017), and it involved students from 13 high schools located in 7 different cities, part of 5 different Italian regions. All students were in their last year of school, hence 17 or 18 years old. They shared an average social background (which might make them more representative of the Italian population than samples of university students typically involved in experiments) and a track record of relatively good grades.[2] Most importantly, the *geographic* representativeness of our sample is an exception in the experimental literature, in particular when considering that experimental subjects were, *at the time of the experiment*, living in the 7 cities of origin.[3] In total, the experiment involved 78 subjects (49 females and 29 males): 42 subjects came from schools in the South of Italy and 36 from schools in the Center-North.[4]

Four experimental sessions were ran, each lasting around 20 minutes. Each session involved 19 or 20 participants, who were regrouped into four groups. Of such groups, one was composed only by students coming from the schools in the South, one only by students coming from the schools in the Center-North, while the other two had mixed composition: *"being member of a homogeneous group"* is our main treatment variable. The groups were

[2]Our subjects all had a mother not holding a university degree. The general project was related to curriculum counselling and social mobility: this explains the sample selection criterion which encompassed both merit and social background - the literature on intergenerational transmission on education points at the mother's level of education as particularly relevant (Black et al., 2005; Pronzato, 2012).

[3]Bigoni et al. (2017), for instance, look at a sample of students originating from a large number of cities of both the North and the South of Italy, but all enrolled at University of Bologna.

[4]The seven cities involved in the experiment were Cagliari, Napoli, Palermo, Partinico for the South, and Massa, Milano, Prato for the Center-North. Participants from the Center are pooled with those from the North in light of the characteristics of their cities of origin, both located in Toscana. Bigoni et al. (2016), in their selection procedure, classify Toscana in the North based on its latitude. Such choice is reinforced by a look at socioeconomic variables they adopt as proxies for social capital: when compared to the average for Northern Italy, Toscana has higher association density (68.44 per 100,000 inhabitants vs. 36.57, South is at 23.97) and electoral participation (86.7% vs. 86.0%, South is at 70.2%), while it is close to the North for blood donations (42.5 every 1000 inhabitants vs. 47.9, South is at 23.5).

formed ex ante randomly, with the condition that no group would contain any students from the same school, and that the sizes of the groups were as homogeneous as possible, given the requirement defined above.[5] For the later interpretation of the results, it is worth mentioning that participants had been involved in group activities for the previous two days, and hence knew each other at least superficially, while it is improbable that subjects coming from different schools knew each other before then. At the same time, subjects knew they would spend two more days together, and keep in contact for longer as part of the project, something which might have mitigated the "absence of future" inherent in typical laboratory experiments (Gächter and Fehr, 1999). It is also worth mentioning that, to Italian speakers, Southern and Northern accents are very easily distinguishable. Thus, it is highly plausible that, at the time our experiment was run, participants were broadly aware of each other's origin. On the other hand, at no time during the experiment was any reference to geographic origin, or to the North-South divide, made.

In each session, six rounds of a linear public good game were played. At each round, each participant was given four playing cards, which only she or he could observe. Two of them were red, and were worth one point each; the other two were black, and were worth zero points. Two cards were then collected, covered, from each participant, who could therefore secretly decide to give zero, one or two points (red cards). The total amount of points collected within each group was multiplied by 2 and subdivided between participants of that group. Such points were then added to each participant's "private earnings" - the number of red cards she or he had decided to keep - so that total earnings for an individual i in a given round t would be:

$$\pi_{i,t} = \underbrace{2 - x_{i,t}}_{\text{Private earnings}} + \underbrace{\frac{2}{\mathcal{N}} \sum_{j=1}^{\mathcal{N}} x_{j,t}}_{\text{Public earnings}}$$

with $x_{i,t}$ being the individual contribution to the public good and $\mathcal{N}$ the group size.

[5] All groups were designed to have five or six members, but five groups out of sixteen had only four members due to absences. No group had more than three members from a same city (the algorithm used for creating the groups is described in detail in Appendix A).

After contributions were recorded, each participant received back her two cards,[6] still hidden from the view of others participants, and the next round began. Earnings were summed across all rounds,[7] and prizes were assigned, in each session, to the three players who had accumulated most points after the six rounds.

These rules were explained in advance to participants, who were invited to ask questions in case any aspect was unclear. Participants were also told that information available to them would change across the rounds of game, but without providing further details, except for the fact that individual contributions would remain anonymous across all rounds

2.1 Information and coordination

Information and coordination opportunities available to participants across the six rounds of the game are described below, and summarised in Figure 1.

- Initially, the students were sitting in circle in an order, previously determined by the experimenters, satisfying the condition that neighbours were not in the same group. Students were told they had been subdivided in four groups of roughly equal size, which would have stayed unchanged for the six rounds of the game, but they did not know who their groupmates were.

- After round 2, the names of members of each group were made public, ensuring, by asking them to raise their hands, that participants of each group had identified each other visually. Participants were then asked not to communicate in any way among them, until further notice.

- After round 4, participants were instructed to sit together with their groupmates, with each group in a different corner of the room, and

[6]The mapping between cards and participants was fixed since the beginning, allowing the experimenters both to record private earnings, and to return to each player the contributed cards after each round. For practicality, each participant was assigned four cards with the same number or face, two from a black suit and two from a red suit: for instance, "10 of clubs and diamonds".

[7]By allowing for potential carry-over effects, we are able to study intertemporal group dynamics more in depth, and in a more natural setting. This design choice is consistent with studies on repeated public good games against which we compare our results (Andreoni, 1988; Andreoni and Petrie, 2004).

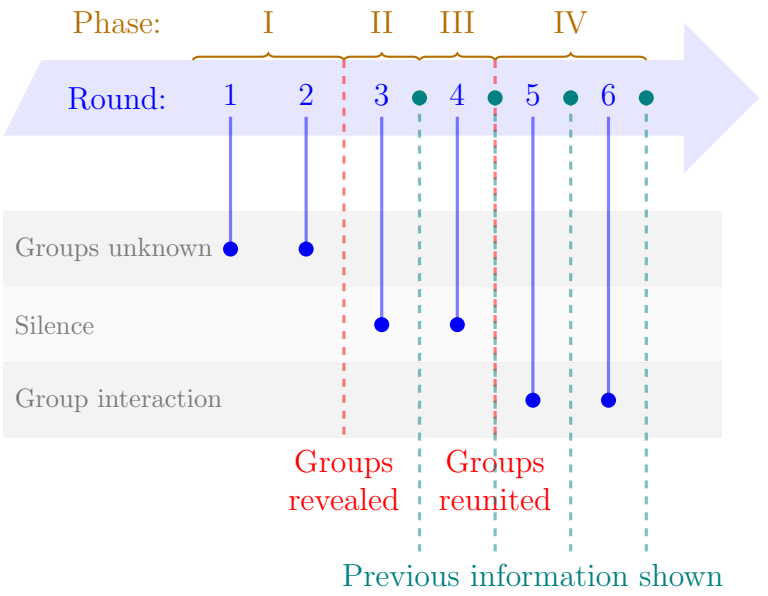


Figure 1: Timeline of the experiment

were given two minutes to discuss among them. The same happened after round 5.

Moreover, after each round starting from the third, information about past contributions was released to participants in two ways: individual contributions from the previous round were read aloud but anonymously, i.e. by referring to the cards owned by each individual rather than to her name, and past results for each group were shown graphically to participants (for an example, see Figure 3 in Appendix B).[8]

These changes in design allow us to investigate the issues of information, anonymity and coordination.

[8]This procedure incidentally allowed participants to verify that their contributions were recorded correctly: they were not allowed instead to reveal their cards to anybody else, hence preventing them from providing hard evidence concerning their contributions. Information during the first two rounds was actually more scarce than in most studies on anonymity in public games, in which participants know the composition of their group (Rege and Telle, 2004) or total contributions of their group in previous rounds (Gächter and Fehr, 1999).

2.2 Theoretical analysis

In what follows, we present a game-theoretical analysis of our experimental design. We start with the one-shot version to focus on the effect of the tournament scheme (i.e. the fact that individuals from different groups compete for a limited number of prizes): in this respect, it is a simplified version of the design implemented by Markussen et al. (2014), who study a public good game where competition between groups takes the form of a bonus which is proportional to the standing in the groups ranking. The authors show that, while with a large enough bonus full contribution is a Nash equilibrium, for smaller values of the bonus (but larger than 0 - the "no competition" case), there are no pure Nash equilibria. Our design is simpler in the fact that participants are rewarded according to the *individual*, rather than group, ranking. Hence, the tradeoff between improving the group standing and increasing private earnings disappears: contributing is always a dominated strategy. Additionally, in our implementation, contributions are restricted to the set {0, 1, 2} rather than being continuous, neutralising the possibility of infinitesimal deviations, which is crucial in the proof of absence of Nash equilibria. Summing up, in the one-shot version of our experiment, complete deception is the only Nash equilibrium. This also applies to a repeated game in which participants receive no information concerning past contributions (i.e. as in the first three rounds of our experiment).

Looking at the repeated version, we can first observe that communication is non-binding, and hence irrelevant from a game-theoretical perspective. What must be considered is the fact that groups are kept unchanged across all rounds, and that information on previous rounds is provided to participants starting from round 4, providing the conditions for the Folk theorem to hold.

Compared to a standard repeated public good game, repeated equilibria would be unaffected by a "linear" tournament scheme as described above (that is, in which the ranking bonus is proportional to the individual ranking). This is true, again, because the tournament scheme *at the individual level* introduces no tradeoff, just like in the one-shot case previously described. What could make our design different from a linear tournament scheme, and hence from a standard repeated public good game, is the decision to award prizes *only to the three participants with the highest gains* in the session. This introduces a strong non-linearity in the incentives scheme: for members of underperforming groups, rational individual behaviour is not sufficient to guarantee any level, albeit small, of effective payoff.

In fact, of the three payoffs characterizing the proof of the Folk theorem (cooperation, individual deception, non-cooperation), the result of our scheme is to shift the third payoff towards zero (it becomes exactly zero, under the assumption that other groups are cooperating): hence punishment (non-cooperation) is harsher, making cooperation relatively more appealing. That is, the proof of the Folk theorem holds *a fortiori* for our design: cooperative symmetric equilibria are qualitatively analogous to the standard public good game.

3 Hypotheses

We first analyse the effect of design changes on contribution levels: for this, we need to consider separately the different rounds of the game. Rounds 1 and 2 present the same information setting, and will be analysed together; the same can be said for rounds 5 and 6. Instead, rounds 3 and 4 differ, since before round 4 (but not before round 3) individuals were given aggregated information on their group's contributions history (and they knew that this information would be communicated after each of the following rounds). Hence, we will refer to rounds 1 and 2 as "phase I", round 3 as "phase II", round 4 as "phase III" and rounds 5 and 6 as "phase IV": each phase coincides with a different level of information/coordination opportunities.

In order to test the effect of such changes of setting, we estimate the following model:

$$\begin{aligned} x_{i,t} =& \alpha^f F_i + \alpha_I T_{t,I} + \alpha_{II} T_{t,II} + \alpha_{III} T_{t,III} + \alpha_{IV} T_{t,IV} + \epsilon_{i,t} \\ =& \alpha^f F_i + \sum_{P=I}^{IV} T_{t,P} \alpha_P + \epsilon_{i,t}, \end{aligned} \tag{1}$$

where each phase dummy $T_{t,P}$ takes value 1 if t is in phase P,[9] and F_i takes value 1 if individual i is a female.

In principle, a positive value for phases coefficients could be a spurious consequence of learning effects. However, this is categorically and consistently ruled out by a stylised fact coming from the literature on repeated

[9] We insert a dummy variable for *each* phase, including the first: coherently, we do not insert in the model a constant term, which would be collinear with them. This choice clearly does not affect the results (we will look at comparisons between coefficients α_P rather than at their individual values, and run significance tests in accordance), and it significantly simplifies the exposition of our hypotheses and results.

public goods games: when subjects are informed about the length of the game, *"provision of the public good 'decays' toward the free riding level with each repetition"* (Andreoni, 1988).[10] Hence, any significant increase in contributions across phases can be considered as (a lower bound to) the effect of the changes in design. Formally, we test the hypothesis

$$\mathcal{H}_0 : \alpha_P = \alpha_{P-1} \tag{HcP}$$

with $P = II, III, IV$.

Group composition

Concerning the treatment variable "belonging to a homogeneous group", denoted as HOM_i, we first test whether members of homogeneous groups exhibit a higher propensity to contribute to the public good: we denote such hypothesis as (Hh).[11]

We then analyse the treatment effect across the different settings by interacting it with phase dummies:

$$x_{i,t} = \beta^f F_i + \sum_{P=I}^{IV} T_{t,P}(\beta_P + \beta_P^h HOM_i) + \epsilon_{i,t}. \tag{2}$$

Importantly, during phase I subjects do not have any information on their group, and so a treatment effect can be excluded. For each phase P from II to IV, instead, we can first check the effect of design changes on contributions, for mixed groups:

$$\mathcal{H}_0 : \beta_P = \beta_{P-1}, \tag{HmP}$$

and for homogeneous groups:

$$\mathcal{H}_0 : \beta_P + \beta_P^h = \beta_{P-1} + \beta_{P-1}^h. \tag{HhP}$$

We can then check whether phase P features a higher level of contributions in homogeneous compared to mixed groups:

$$\mathcal{H}_0 : \beta_P^h = 0. \tag{HdP}$$

[10] Consistent results, with and without anonymity, are provided by Andreoni and Petrie (2004); Savikhin Samek and Sheremeta (2014).

[11] In this test, we will exclude observations from phase I, when the groups composition is still unknown to participants.

Geographic origin

We want to test whether, in line with the existing literature, the propensity to contribute to the public good is related to the geographic origin. To this aim, we test the hypothesis that the average contribution of individuals from the North and from the South differ. We refer to such hypothesis as (Hn).

In the spirit of phase-treatment interactions presented in Equation (2), we now look at interactions between phases and geographic origin:

$$x_{i,t} = \gamma^f F_i + \sum_{P=I}^{IV} T_{t,P}(\gamma_P + \gamma_P^n N_i) + \epsilon_{i,t}. \tag{3}$$

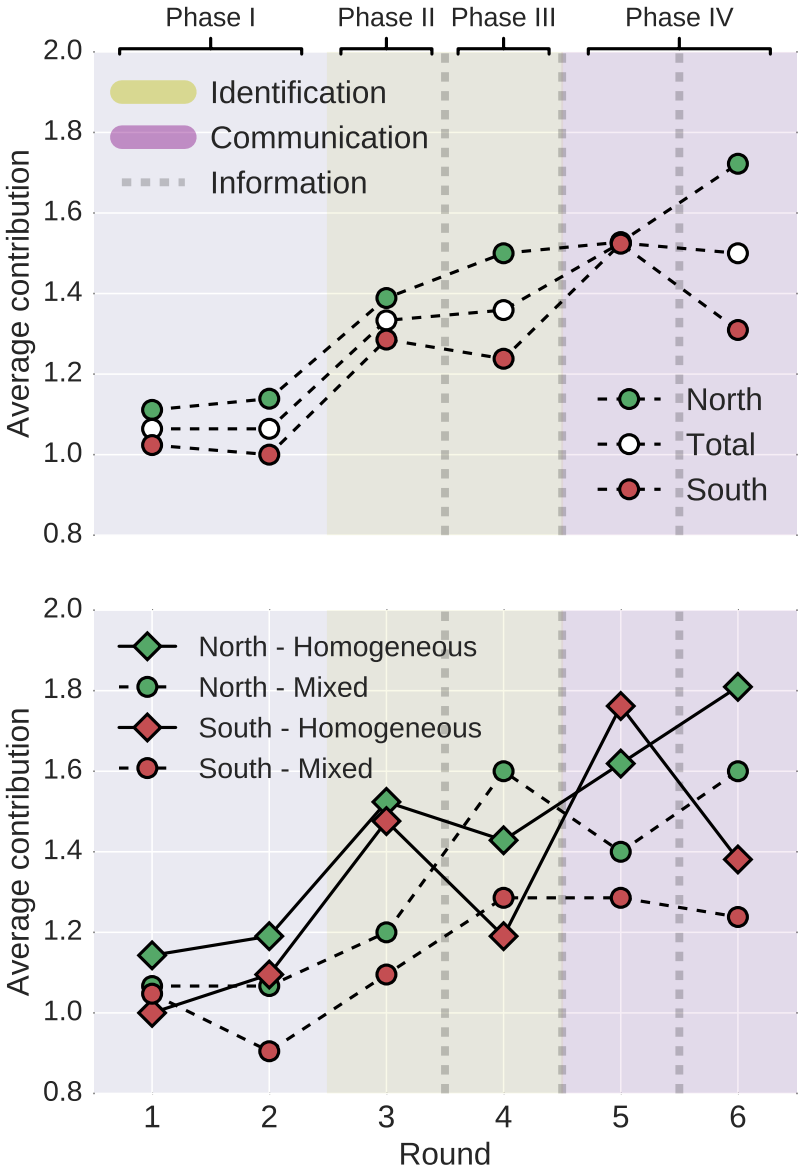
where the dummy N_i takes value 1 if subject i is from the North. Equation (3) allows us to test the hypothesis $\mathcal{H}_0 : \gamma_P^n = 0$, denoted as (HnP), answering the question of whether the effect of coordination opportunities is heterogeneous across geographic origins.

4 Results

The average contribution across all sessions and rounds was 1.308. Figure 2 (top, white dots) plots average contributions in each round: the effect of changes in coordination possibilities is evident between phases I and II, and between phases III and IV. Instead, no evident change can be detected between phases II and III, possibly because the effect of information about group contributions presumably depend on such contributions (e.g. due to conditional cooperation or, conversely, incentives to free ride). In fact, the disaggregation by geographic origin shows that, when moving to phase III, the behaviour differs between individuals from the North and from the South (red and green dots), while the disaggregation by treatment status (Figure 2, bottom) shows an even more pronounced difference: contributions increase in mixed groups and decrease in homogeneous ones.

In what follows, we systematically analyse hypotheses formulated in Section 3. Estimated coefficients for equations (1), (2) and (3) are presented in Table 1.

Figure 2: Average contributions per round



Note: Top: average contributions by geographic origin. Bottom: average contributions by geographic origin and group composition.

4.1 Treatment effect

We start by testing the treatment effect (Hh) on individual averages over rounds ($\bar{x}_i$)[12] with a Mann-Whitney test. We find that $\{\bar{x}_i\}_{HOM_i=1} > \{\bar{x}_i\}_{HOM_i=0}$ (participants in homogeneous groups contribute more), and that the difference is significant ($p = 0.040$).

> **Result 1** *Groups composed by members sharing the same geographic origin contribute to the public good more than mixed groups.*

The already mentioned increase in contributions across phases, which is evident in Figure 2, is *per se* a nontrivial finding, given the decay in contributions over time consistently observed by the experimental literature (Andreoni, 1988). Hence, we can infer that changes of setting have an effect in increasing contributions: we now proceed to a more formal analysis of such effect.

What follows is the summary of results concerning the identification of groupmates, which happens in phase II.

- From Equation (1):
  - (HcII): $\alpha_{II} > \alpha_I$ ($p = 0.015$)
- From Equation (2):
  - (HmII): $\beta_{II} = \beta_I$ not rejected ($p = 0.450$)
  - (HhII): $\beta_{II} + \beta^h_{II} > \beta_I + \beta^h_I$ ($p = 0.001$)
  - (HdII): $\beta^h_{II} > 0$ ($p = 0.048$)

Identification of group members has a positive and significant effect on contributions (HcII): this is driven by subjects in homogeneous groups (HhII), who contribute significantly more than subjects in mixed groups (HdII), for which no significant change is observed (HmII). Notice that, in mixed groups, the identification of groupmates does not reveal, at an aggregate level, new information concerning the group composition: on average, the group has

[12] We exclude from this test phase I, when participants did not know the composition of their group: we analyse this phase in Section 4.4 as a robustness test on the randomisation process.

Table 1: Main results

		Eq. (1) (α)	Eq. (2) (β)	Eq. (3) (γ)
	Female	0.133	0.082	0.149
		(0.089)	(0.081)	(0.086)
Phase	I	0.981***	0.977***	0.913***
		(0.095)	(0.118)	(0.097)
	II	1.250***	0.102***	1.186***
		(0.112)	(0.144)	(0.123)
	III	1.275***	1.380***	1.139***
		(0.098)	(0.103)	(0.107)
	IV	1.429***	1.324***	1.317***
		(0.094)	(0.140)	(0.111)
Phase interacted with treatment	h,I		0.065	
			(0.117)	
	h,II		0.333**	
			(0.155)	
	h,III		-0.135	
			(0.148)	
	h,IV		0.254	
			(0.157)	
Phase interacted with North	n,I			0.126
				(0.081)
	n,II			0.116
				(0.152)
	n,III			0.274*
				(0.131)
	n,IV			0.221**
				(0.102)
	N	468	468	468

Note: The dependent variable in each model is individual contributions $x_{i,t}$. Row labels indicate coefficients subscripts: phase dummies are in the first block, phase-treatment interactions in the second block, phase-origin interactions in the third block. E.g. the bottom right estimate refers to of γ^n_{IV}, relative to the interaction of dummy variables $T_{t,IV}$ (fourth phase) and N_i (North) in Equation 3. Group-level clustered standard errors in parentheses.

***p< 0.01, **p< 0.05, *p< 0.10.

the same share of participants from the South and from the North as the entire session. This can partly explain why the transition from phase I to phase II does not affect mixed groups.

> **Result 2** *Identification of groupmates significantly increases contributions only in groups composed by members sharing the same geographic origin.*

What follows is the summary of results concerning the transition from phase II to phase III, when information on previous contributions is provided.

- From Equation (1):
  - (HcIII): $\alpha_{III} = \alpha_{II}$ not rejected ($p = 0.818$)
- From Equation (2):
  - (HmIII): $\beta_{III} > \beta_{II}$ ($p = 0.075$)
  - (HhIII): $\beta_{III} + \beta^h_{III} = \beta_{II} + \beta^h_{II}$ not rejected ($p = 0.126$)
  - (HdIII): $\beta^h_{III} = 0$ not rejected ($p = 0.374$)

As already suggested by Figure 2 (top, white dots), observing past group performance does not significantly affect *average* contributions (HcIII). In the bottom plot of the figure, we can however observe a sort of rebound effect: contributions in round 4 decrease for homogeneous groups, which were the best performers in round 3, while the opposite stands for mixed groups. Indeed, while contributions in homogeneous groups decrease, although not significantly (HhIII), they increase significantly for mixed groups (HmIII), reversing the gap between the two, which changes sign and is now not significant (HdIII): this evidence is coherent with a rebound effect.[13]

We finally verify how the transition to phase IV (characterised by the possibility to communicate) affects contributions.

- From Equation (1):

[13]Since participants observed past group performance, they could at this stage exhibit conditional cooperation. On the other hand, since they observed the performance of *all* groups and they knew that prizes would go to the three best performers in the session, they could decide to increase free riding in order to capitalise on a good group standing, or to limit it in order to catch up.

- (HcIV): $\alpha_{IV} = \alpha_{III}$ not rejected ($p = 0.240$)

- From Equation (2):
  - (HmIV): $\beta_{IV} = \beta_{III}$ not rejected ($p = 0.796$)
  - (HhIV): $\beta_{IV} + \beta^h_{IV} > \beta_{III} + \beta^h_{III}$ ($p = 0.012$)
  - (HdIV): $\beta^h_{IV} = 0$ not rejected ($p = 0.127$)

Comparing phase IV with phase III, we do not find a significant increase in average contributions (HcIV). Indeed, we do find a positive variation for homogeneous groups (HhIV), but not for mixed ones (HmIV). The effect of treatment in phase IV is also non significant (HdIV): in fact, if we rerun our analysis by splitting phase IV into rounds 5 and 6, we find a significant difference ($p = 0.005$) for round 5 only.[14] This is also clearly visible in Figure 2 (bottom) where the transition to round 5 compensates the already mentioned rebound effect for round 4. While our estimates do not allow to reach a definitive conclusion, they at least suggest that the increase for homogeneous groups (HhIV) itself might represent the end of the rebound rather than reliable evidence of a communication effect.

4.2 Effect of geographic origin

The average contribution of subjects from the North is 1.398, while it is 1.230 for subjects from the South. By testing (Hn), we ascertain whether this difference is significant. A Mann-Whitney test on average contributions yields $\{\bar{x}_i\}_{N_i=1} > \{\bar{x}_i\}_{N_i=0}$ ($p = 0.010$). While this result clearly evidences that subjects from the North contribute more than subjects from the South to the public good, its interpretation is nontrivial. Indeed, being in a "North-only group" can have a different effect than being in a "South-only group" on the propensity to contribute, and to the extent to which this is true, the result can be affected by the treatment. In order to isolate the individual-level geographic effect, we hence run the same test restricting the sample to mixed groups (members of which are not affected by differences in treatment), again rejecting the null hypothesis ($p = 0.047$). This evidence is in line with the available experimental literature on the North-South gap in Italy (Bigoni et al., 2016).

[14] Results are available upon request.

Result 3 *Subjects from the North contribute to the public good more than subjects from the South.*

Concerning the analysis of the geographic effect across phases (HnP), we find that γ_P^n is (positive and) significantly different from zero in the last two phases only ($p = 0.141, 0.459, 0.054, 0.048$, respectively). We can hence state the following:

Result 4 *The higher level of contributions of subjects from the North is explained by a stronger reaction to the introduction of coordination opportunities rather than by a higher propensity to contribute since the first rounds.*

Interaction coefficients from Equation 3 could again be affected by a potentially asymmetric treatment effect (being part of a South-/North-only group). Disaggregating further the analysis, by combining the two aspects of group homogeneity and geographic origin, would allow us to tackle this issue and also to verify whether the treatment effect itself (Result 1) is to be attributed in larger part to North-only (South-only) groups. We do so in Equation 5, presented in Appendix C; however, the increase in the number of regressors can by itself justify the mostly non-significant results.[15] The two significant interaction coefficients (evidencing higher contributions, in mixed groups, of Northern subjects) are in line with Result 3, and the fact that they refer to the last phases is a confirmation of Result 4.

It might be worth mentioning that the last round taken in isolation features a clear difference ($p = 0.076$) between Northeners and Southeners: the latter feature the typical drop of contribution characterising the last round of public good experiments, where incentives to reputation building disappear (Gächter and Fehr, 1999), while the *opposite* effect can be seen for Northeners. A conclusive interpretation of this difference would require additional data, but it is tempting to relate it to the stronger betrayal aversion measured by Bigoni et al. (2017) for Southerners.

[15] For instance, since there is a significant effect of being assigned to a homogeneous group (results 1 and 2) at the aggregate level, then this must also hold in either North-only or South-only groups (or both).

4.3 Contributions and gender

In the literature on public good games, there is some evidence of a higher propensity to contribute on behalf of females (Nowell and Tinkler, 1994). Estimates reported above have been obtained controlling for a potential gender effect; in the present section, we explicitly verify whether females and males have a different propensity to contribute to the public good, and whether they react differently to the treatment and/or to the changes in information settings.

We can test the presence of a gender effect by running a Mann-Whitney test on average contributions of females versus males: the result is not significant ($p = 0.106$). To control for the possibility of asymmetric treatment effects, we run the same test restricting to mixed groups (like we did for hypothesis (Hn)): the result is again not significant ($p = 0.180$).

For what concerns the gender component *of the treatment effect*, we can estimate the following equation (analogous to Equation 5 in Appendix C, but with geographic origin replaced by gender):

$$x_{i,t} = \sum_{P=I}^{IV} T_{t,P}(\delta_P + \delta_P^h HOM_i + F_{i,P}(\delta_P^f + \delta_P^{hf} HOM_i)) + \epsilon_{i,t}. \qquad (4)$$

See Table 4 in Appendix C for estimation results. By testing $\mathcal{H}_0 : \delta_P^f + \delta_P^{hf} = 0$ for $P = I, II, III, IV$, we verify whether, in homogeneous groups, females behave differently than males. Results are never significant ($p = 0.484, 0.739, 0.604, 0.514$): that is, we find no evidence of a gender difference in the effect of the treatment.

4.4 Robustness

Result 1, concerning the effect of the treatment, is supported by a non-parametric Mann-Whitney test: alternatively, we can test parametrically the joint significance of phase-treatment interaction dummies (excluding phase I) in Equation 2: we do so through a Wald test, and again reject the null hypothesis of no difference ($p = 0.079$). Analogously, Result 3, concerning the effect of geographic origin, is confirmed by looking at the joint significance of phase-origin interaction dummies in Equation 3 ($p = 0.054$).

As already mentioned in Section 3, Equation 2 is not expected to yield interesting insights concerning phase I: at that time, subjects did not know who

their groupmates were, and hence their contribution could not be affected by being in a homogeneous or mixed group. If homogeneous and mixed group members had differed in their contribution levels already before the group composition was made public, this would have represented an alarming signal of ex ante differences among the two samples. However, this is not the case, and the null hypothesis that $\beta_I^h = 0$ cannot be rejected ($p = 0.586$).

Female participants outnumbered male participants in all sessions. We both allowed for a gender effect in our estimates, and explicitly looked at a gender component of the treatment effect in Section 4.3, without finding any. This said, the randomisation algorithm resulted for session 2 in a significantly unbalanced composition of homogeneous groups, which included no male participants (see Appendix B). We hence re-estimate hypothesis (Hh) excluding such groups from the analysis, and still find a significantly positive treatment effect ($p = 0.079$).

5 Conclusions

We run a repeated public good game with participants coming from different Italian cities. Differently from the existing experimental literature on inter-regional gaps in social capital, our analysis focuses on the *interaction* between subjects with different geographic background and *only temporarily* abstracted from their respective cities of origin. By manipulating the composition of groups, we compare the level of cooperation of those composed only by individuals sharing the same origin, on the one side, and mixed ones, on the other. At the same time, we explore the extent to which changes in coordination opportunities can lead an individual to contribute more. Moreover, we compare the contribution patterns of individuals with different geographic backgrounds.

We find that groups composed both by subjects from the North and from the South of Italy perform significantly worse than homogeneous groups (Result 1), mainly because of the different impact of implicit (identification) and explicit (communication) coordination opportunities (Result 2). As already reported in the literature, individuals from the North contribute more than individuals from the South (Result 3): this is explained by a different reaction to information concerning past contributions and to the possibility to communicate (Result 4). Instead, geographic origin does not significantly predict contributions in the first phase of the experiment: hence, there is no

evidence of a difference in the ex ante propensity to contribute. In general, the introduction of coordination opportunities has a strongly positive effect, which more than counterbalances the expected decay of contributions over time. Finally, we find no significant difference between males and females, neither in average contributions nor in their reaction to the treatment.

Our results shed new light on the problem of the North-South divide in Italy. Result 3 reinforces the conclusions of Bigoni et al. (2016) that the gap *"appears to lie in the ability to cooperate"*. In particular, Result 4 points out that the level of contributions crucially depends on the effectiveness of coordination, rather than just on altruism and trust. Since geographic origin is not a significant predictor of contributions *at the beginning* of the experiment (when participants act in isolation), we suggest that prejudices, and more in general mutual trust, play a fundamental role in the North-South divide. At the same time, Results 1 and 2 highlight the difficulty in cooperation *across* the North-South divide: such difficulty could represent a cause of path dependence (historically, the gap in socioeconomic indicators does not seem to vanish over time, rather the opposite) and a further obstacle to economic and social development.

Summing up, our results lie against the view that the North-South gap in social capital can be imputed only to differences in institutions and opportunities, pointing out at the different reactions to the same incentives. Hence, such gap cannot be levelled by only focusing on institutional settings: while, in the long term, behaviour can certainly react to institutions, such reactions might be too slow. Most importantly, institutions themselves are composed of citizens, and any attempt at shaping them must take this into account. Interestingly, like most of the Italian population, the typical participant in our experiment had relatively few occasions to enter in relation with compatriots from the other side of the peninsula: the literature on the positive effect of diversity on group performance (McLeod and Lobel, 1992; Lazear, 1999; Hong and Page, 2001) is well aware of the problem of communication costs, and suggests that policymakers should work in the direction of integration and mutual knowledge. These should be considered among the main objectives when dealing with socioeconomic differences across regions, and as a viable way to increase the level of social capital in countries characterised by strong heterogeneities.

Further studies could analyse more in depth the interaction of the treatment with geographic origin. Indeed, we do not find a significant effect of being in a homogeneous group *conditional* on being from the North/South:

such level of detail might be achieved with additional experimental evidence. This will allow for instance to state whether the worse performance of mixed groups can be imputed more to Northerners or to Southerners, or whether individuals from the North contribute less when they are in mixed groups than when they are in North-only groups. We think that these are important issues to consider for the understanding of the North-South economic divide, and that they are an interesting venue for future research, together with the study of other brackets of the population.

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A Algorithm for the creation of groups

The following algorithm was implemented to subdivide participants of each session in four groups. Importantly, in each session, each school was represented by a maximum of 3 students.

1. Create three empty lists: $\mathcal{S}$(outh) with 6 slots, $\mathcal{N}$(orth) with 6 slots, $\mathcal{M}$(ixed) with 12 slots. A slot is occupied whenever a student is appended to a list.
2. If the session has strictly less participants from the North (South), remove one slot to the $\mathcal{N}$ ($\mathcal{S}$) list, respectively.
3. Let I be the school with the most students among schools still not processed.
4. Let $\mathcal{L}$ be the list $\mathcal{S}$ if the school is from the South, $\mathcal{N}$ otherwise.
5. If $\mathcal{L}$ has a free slot, append a randomly selected student from I to it.
6. If there are still students to be placed from I, append them to $\mathcal{M}$.
7. If there are still schools to be processed, go back to point 3.
8. Create two lists $\mathcal{M}1$ and $\mathcal{M}2$ from elements of $\mathcal{M}$ in odd and even positions, respectively.

The rationale for ordering schools by size was to guarantee that no two students from the same school would end up in the same group (i.e. that schools with more students, and hence more difficult to place, would "choose" - i.e. randomly assign their students - first).

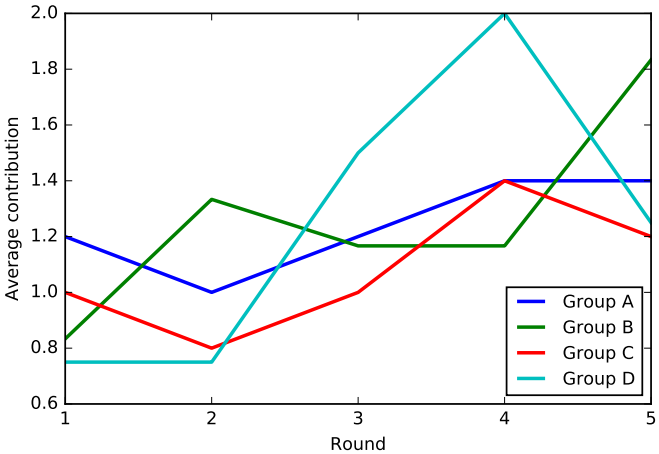
B Additional material

Figure 3 features an example of how information about past group contributions was shown to participants (from round 3 onwards).

Table 2 provides some descriptive statistics: for each session, we show the distribution of individual characteristics (geographic origin/gender) based on the assignment of individuals to the treatment. T-tests ran on the each session fail to reject the null of identical distribution between the two categories, with the exception of Session 2 ($p = 0.001$), in which homogeneous groups were composed only of female participants (we take this into account in Section 4.4).

Table 3 provides information about the 12 prize winners (three for each session). In theory, individual earnings could go from 2 to 32 (see Equation (2)). The signs of deviations between the shares of winners and the shares of sample presenting each feature are in line with results presented in the main text (females contribute more, although not significantly, "North-only" groups perform better, although not significantly, homogeneous groups perform better).

Figure 3: Example of past information, as shown to participants



Note: Information shown to participants of session 1 before the last round (labels translated from Italian).

Table 2: Descriptive characteristics

		Female		**North**	
Session	**Treatment**	**0**	**1**	**0**	**1**
1	0	5	4	6	3
	1	3	8	6	5
2	0	6	3	4	5
	1	0	10	4	6
3	0	5	4	6	3
	1	3	8	6	5
4	0	4	5	5	4
	1	3	7	5	5

Table 3: Descriptive characteristics of winners

Session	**Rank**	**Female**	**North**	**Treatment**	**Total gain**
1	1	0	0	1	22
1	2	1	1	1	21.4
1	3	0	1	0	21
2	1	1	0	1	24
2	2	1	1	1	23
2	3	0	1	0	22.5
3	1	0	0	0	23.6
3	2	1	0	1	22.7
3	3	1	0	1	22.7
4	1	1	1	1	22.8
4	2	0	1	1	22.8
4	3	1	0	0	22.5
Winners (share):		**7 (58%)**	**6 (50%)**	**8 (67%)**	
Share of all participants:		63%	46%	54%	

C Supplementary results

In the following, we combine Equations 2 and 3, interacting phase and treatment dummies with the geographic origin of participants.

$$x_{i,t} = \zeta^f F_i + \sum_{P=I}^{IV} T_{t,P}(\zeta_P + \zeta_P^h HOM_i + N_{i,P}(\zeta_P^n + \zeta_P^{hn} HOM_i)) + \epsilon_{i,t}. \quad (5)$$

Hypotheses (HdII), (HdIII) and (HdIV) allowed us to investigate whether being in a homogeneous group (instead of a heterogeneous one) has an effect on contributions. The estimation of Equation (5) can help us verify if there is a treatment effect *conditional on the geographic origin of individuals*. Namely, we can answer such question by running the following joint tests on coefficients presented in Table 4:

- $\mathcal{H}_0 : \zeta_P^h + \zeta_P^{hn} > 0$ for individuals from the North,
- $\mathcal{H}_0 : \zeta_P^h > 0$ for individuals from the South,

for each phase $P = II, III, IV$. From such tests, no significant differences emerge ($p = 0.183, 0.239, 0.259$ for the North, $0.149, 0.517, 0.204$ for the South, respectively).

By exploiting the disaggregation along the dimension of geography, we can also compare North-only and South-only groups between them. This is done by testing $\mathcal{H}_0 : \zeta_P^n + \zeta_P^{hn} > 0$ for each phase $P = II, III, IV$.[16] Results do not suggest that people from the North act differently from people from the South in homogeneous groups ($p = 0.703, 0.191, 0.306$, respectively).

By running the same analysis for mixed groups, we can instead compare the behaviour of Southern and Northern individuals subject to the *same* treatment (i.e. being in a mixed group) in each phase.[17] Namely, we test $\mathcal{H}_0 : \zeta_P^n > 0$ for each phase $P = II, III, IV$: in line with Result 3, in mixed groups we find a higher level of contributions on behalf of Northeners compared to Southeners, for two phases out of three ($p = 0.669, 0.055, 0.087$, respectively).

[16] It is worth stressing the fact that such tests pool together an intrinsic feature (the geographic origin) and a possible treatment effect (being in a North-only or South-only group).

[17] We had already tested Hypothesis (Hn) on such a subsample, but pooling together all phases, that is not looking for an effect of design changes.

Table 4: Additional estimation results

		Eq. (4) (δ)			Eq. (5) (ζ)
				Female	0.104
					(0.076)
Phase	I	0.950***	Phase	I	0.926***
		(0.179)			(0.108)
	II	1.250***		II	1.046***
		(0.195)			(0.195)
	III	1.350***		III	1.236***
		(0.198)			(0.152)
	IV	1.225***		IV	1.212***
		(0.158)			(0.155)
Phase interacted with treatment	h,I	0.272	Phase interacted with treatment	h,I	0.032
		(0.263)			(0.156)
	h,II	0.194		h,II	0.341
		(0.277)			(0.224)
	h,III	-0.128		h,III	-0.135
		(0.312)			(0.203)
	h,IV	0.331		h,IV	0.270
		(0.232)			(0.203)
Phase interacted with Female	f,I	0.144	Phase interacted with North	n,I	0.098
		(0.229)			(0.088)
	f,II	-0.250		n,II	0.113
		(0.227)			(0.258)
	f,III	0.150		n,III	0.322*
		(0.293)			(0.155)
	f,IV	0.306**		n,IV	0.246*
		(0.115)			(0.134)
Phase interacted with F. and t	hf,I	-0.290	Phase interacted with N. and t.	hn,I	0.036
		(0.307)			(0.172))
	hf,II	0.321		hn,II	-0.050
		(0.308)			(0.309)
	hf,III	-0.039		hn,III	-0.069
		(0.361)			(0.244)
	hf,IV	-0.195		hn,IV	-0.088
		(0.202)			(0.201)
	N	468		N	468

Note: The dependent variable in each model is individual contributions $x_{i,t}$. Row labels indicate coefficients subscripts: see the description of each block for the interpretation of the coefficients. Group-level clustered standard errors in parentheses.

***p< 0.01, **p< 0.05, *p< 0.10.

In conclusion, while we confirm the higher level of contributions of Northeners (Result 3) in mixed groups, we find no evidence that the treatment effect is related to the geographic origin of subjects. That is, we cannot explain Results 1 and 2 as the consequence of an interaction between the treatment and the geographic origin. However, we cannot exclude the possibility that such "non-result" is due to the low numerosity of observations in each of the subsamples considered.