Journal of Behavioral and Experimental Economics 53 (2014) 1–9

Contents lists available at ScienceDirect

Journal of Behavioral and Experimental Economics

journal homepage: www.elsevier.com/locate/jbee

# The effect of social fragmentation on public good provision: An experimental study☆

Surajeet Chakravarty, Miguel A. Fonseca*

*University of Exeter, United Kingdom*

ARTICLE INFO

*Article history:*
Received 10 February 2014
Received in revised form 24 July 2014
Accepted 25 July 2014
Available online 4 August 2014

*JEL classification:*
C92
D02
D03
H41

*Keywords:*
Social identity
Public goods
Social fragmentation
Experiments

ABSTRACT

We study the role of social identity in determining the impact of social fragmentation on public good provision using laboratory experiments. We find that as long as there is some degree of social fragmentation, increasing it leads to lower public good provision by majority group members. This is mainly because the share of those in the majority group who contribute fully to the public good diminishes with social fragmentation, while the share of free-riders is unchanged. This suggests social identity preferences drive our result, as opposed to self-interest. Importantly, we find no difference in contribution between homogeneous and maximally-fragmented treatments, reinforcing our finding that majority groups contribute most in the presence of some diversity.



## 1. Introduction

We live in an ever increasingly diverse world, whether measured in terms of ethnicity, religion or language. For instance, in the US there has been an increase in the proportion of ethnic minorities: while currently accounting for roughly one third of the population, they are expected to become the majority in 2042 (US Census, 2008). Increasing social and ethnic diversity in societies may have important economic consequences, namely on public good provision. Ethnic or social fragmentation has emerged as a potential explanation for low public good provision in settings as diverse as African countries (Easterly and Levine, 1997) and US cities (Alesina, Baqir, and Easterly, 1999). A fundamental question is why this is the case. The literature on the effect of social fragmentation on economic performance has identified two main causes for the negative relationship between higher fragmentation and public good provision. On one hand, different social or ethnic groups may prefer different public goods (Poterba, 1998). On the other hand, different social groups may dislike sharing a public good with one another (Luttmer, 2001).

Our paper investigates, using laboratory experiments, whether higher social fragmentation leads to lower public good provision and to what extent identity-based discrimination can explain such behaviour. We eliminate the possibility that different groups may prefer alternative public goods by allowing for only one public good to which members of both groups may contribute. We generate two artificial groups in the lab, and we exogenously change the degree of fragmentation by varying the relative size of each group playing the public good game. This allows us to measure the interaction between social identity and fragmentation on public good provision cleanly.

Theories of inter-group relations in social sciences have argued that discriminatory behaviour across ethnic or religious lines stem from competition for resources (Allport, 1954; Sherif et al., 1988). Economists have broadly taken two approaches to model the role

☆ We gratefully acknowledge financial support from the University of Exeter Economics Department and ESRC grant RES-000-22-3941. We thank Tim Miller for his excellent assistance with programming the software and help with running the sessions. We are also grateful to Yan Chen, Dirk Engelmann, Gareth Myles, Lise Vesterlund and Daniel Zizzo; participants at the 2009 European ESA, the 2010 World ESA, the 2012 RES, the 2012 European Econometric Society conferences; and participants at seminars at the University of Exeter, ETH Zurich and the University of Pittsburgh for their comments and suggestions. An earlier version of this paper circulated under the title "Social Identity, Group Composition and Public Good Provision: An Experimental Study." The usual disclaimer applies.

* Corresponding author. Tel.: +44 1392722584.
*E-mail addresses:* s.chakravarty@exeter.ac.uk (S. Chakravarty), m.a.fonseca@exeter.ac.uk (M.A. Fonseca).

2214-8043/$ – see front matter © 2014 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.socec.2014.07.002

of social affiliation. The first approach emphasizes that group affiliation is an important tool to overcome market imperfections by promoting trust among members of a given social group and therefore be able to overcome moral hazard problems (e.g. Bowles and Gintis, 2004). At the core of this approach is a game-theoretic argument based on repeated interaction, in that more identical groups should be able to achieve and sustain cooperative outcomes as equilibria via internal mechanisms of monitoring and social norm enforcement. The second is to assume that a sense of group identity enters individual preferences. In this sense, individuals define themselves as a function of the group(s) to which they belong.[1] As such, an individual may shape his behaviour as a function of group norms (Akerlof and Kranton, 2000); or care not only about his well-being, but also about the well-being of his fellow group members (Alesina and La Ferrara, 2000). This approach is in the spirit of social identity theory, which explains the basis for discriminatory behaviour across groups (Tajfel and Turner, 1979).

In the spirit of the minimal group paradigm (Tajfel et al., 1971), subjects in our experiment selected their social group based on their preferences for paintings by two artists (Klee or Kandinsky).[2] We then randomly assigned subjects to six-player public good games, who then played in a fixed matching protocol for twenty periods. The main treatment condition was the degree of social fragmentation, which ranged from fully homogenous (e.g. six 'Klee' players) to the fully fragmented case (e.g. three 'Klee' players and three 'Kandinsky' players). We find that a higher degree of social fragmentation leads to significantly lower contribution levels by members of the majority group and the highest contribution levels by the majority are observed in the treatment with the lowest level of fragmentation. Interestingly, this result comes from a drop in the share of players who contribute maximally, rather than an increase in the fraction of free-riders, which remains roughly constant across treatments. However, subjects in the fully homogenous treatment do not contribute more than subjects in highly fragmented treatments and contribute less than the majority group members in treatments with minimal levels of fragmentation. This implies that an in-group affiliation is a powerful driver for cooperation, such that some diversity may be beneficial; however, such an affiliation only works in the presence of an out-group.

The remainder of the paper is organized as follows. The following section briefly reviews the empirical literature on fragmentation, as well as the experimental literature on social identity. Section 3 outlines the experimental design and procedures and Section 4 presents the results. Section 5 concludes the paper.

## 2. Summary of the literature

Recently, economists have started to study the broader economic impact of social and ethnic fragmentation on economic performance see Alesina and La Ferrara, 2005 for an extensive review). Alesina, Baqir, and Easterly (1999) find the provision of public goods on a cross-section of U.S municipalities is inversely related to ethnic fragmentation. Khwaja (2009) finds that there is a negative relationship between social heterogeneity and successful maintenance of public projects in rural Pakistan. Finally Miguel and Gugerty (2005) find that schools in Kenya from fully homogeneous communities have 20% higher funding levels than schools in communities with the highest degree of heterogeneity. They attribute this finding to the fact that social sanctioning of free-riders in those communities is easier *within* a social group, rather than *across* groups. Other papers analyzing social fragmentation and economic outcomes include La Porta et al. (1999) and Alesina et al. (2003) which find that ethnic fragmentation is negatively correlated with infrastructure quality, literacy and positively correlated with child mortality. Easterly and Levine (1997) find a negative correlation between growth and ethnic fragmentation.

Tajfel and Turner (1979) first demonstrated the effect of group affiliation on behaviour using experimental data. They showed that subjects playing simple distribution games as a third-party, neutral dictator would discriminate in favour of in-group members (and thus violating basic norms of equality), even when the basis for the existence of the group was quite minimal – in this case, it was based on subjects' preferences over paintings from two artists.

Most economics experiments focusing on the impact of group identity on cooperation have looked at pure in-group/out-group differences in two-player cooperation games, where a subject either plays against an in-group member or an out-group member.[3] Notable exceptions are Eckel and Grossman (2005), Smith (2011) and Drouvelis and Nosenzo (2013). Eckel and Grossman (2005) looked at a team production experiment with groups of five. Their research question was whether eliciting a common identity within a group would raise effort levels. They found identity matters most when there is inter-group competition, i.e. when an out-group is made salient. Drouvelis and Nosenzo (2013) look at a three-person public goods game in which one player contributes first and the other two make their decision knowing what the first player has contributed. A common identity between the leader and the two followers results in significant increases in contributions vis-à-vis the case where no identity is present. Like our paper, Smith (2011) looks at the impact of diversity in a six-player public good games, ranging from low levels of diversity (five players from one social group and one of the other) to high (three players from each group). Smith (2011) however does not include a treatment with full homogeneity, or a treatment where group identity is absent. Moreover, this experiment is implemented in a within-subjects design, where all subjects play in all diversity conditions, while ours which is implemented in a between-subjects design. Smith (2011) experiment also directly measures beliefs about the contributions by the other players in the public goods game. He finds players in the majority group contribute more than those in the minority group, but that beliefs about in-group members are the principal driver of contributions, rather than majority or minority status.

We note there is a parallel literature focusing on homophily as a potential explanation for in-group biases. Homophily differs from social identity theory in that it assumes individuals have an intrinsic preference to interact with similar people, as opposed to those preferences emerging through group processes. Currarini, Jackson, and Pin (2009) study the effects of homophily preferences in the context of racial bias in friendship formation using survey data from US high schools. They find that members of larger groups tend to form more friendships per capita; members of larger groups tend to form more same-type friendships and fewer other-type friendships than people in smaller groups. Finally they find that although all groups are biased towards making inward looking friendship ties, the most biased groups are the intermediate-sized groups. Currarini and Mengel (2013) propose an experiment where

[1] Tajfel (1970) argued that membership of social groups had an effect on individual behaviour even if such membership had no survival benefit.

[2] Note that in Tajfel et al. (1971), unlike our experiment, the decisions subjects made had no material consequences to themselves.

[3] In the experimental economics literature on social identity, group affiliation is induced using either pre-existing identities such as gender (Brown-Kruse and Hummels, 1993; Cadsby and Maynes, 1998; Croson, Marks, and Snyder, 2008), membership of social groups (Solow and Kirkwood, 2002; Goette, Huffman, and Meier, 2006), or artificially-induced identities (Kramer and Brewer, 1984; Wit and Wilke, 1992; Eckel and Grossman, 2005; Charness, Rigotti, and Rustichini, 2007).

subjects are first assigned to two groups, and then they play a series of games with another person of either their own group or another group. The main treatment variable is the nature of the matching protocol: it is either exogenously determined by the experimenters or endogenously determined by the subjects themselves. When matching is exogenous, subjects exhibit in-group biases in their behaviour in the games; when subjects choose their partners, they mainly select to play with in-group members, although the degree of in-group bias is attenuated. Regarding the effect of ethnic diversity, Espinosa and Garza (1985) and Cox, Lobel, and McLeod (1991) found that individuals from minority groups cooperated more with fellow minority participants than with those from the majority groups. Habyarimana et al. (2007) combined experimental methods with survey data and found public good provision was highest in areas when group composition was homogenous along ethnic lines.

## 3. Experimental design and procedures

As stated earlier, we wish to test the impact of social identity preferences on public good contributions as a function of the relative size of two groups that must share a single public good. We now construct the hypotheses for our experiment. Our experimental design, described in detail below, consists of a six-player linear public good game, with players belonging to one of two identity categories. We vary the relative size of the groups, from one extreme where all players belong to same group, to the case where half of the players belong to one group and the other half belong to the other group. This allows us to vary the level of fragmentation among players in the game and measure the levels of contribution to the public good as a function of fragmentation.

Our first hypothesis concerns the relevance of identity-driven preferences when players are homogeneous. Social identity theory describes the effect of group affiliation on behaviour when there are multiple social groups. If all players belong to the same social group, it is unclear why there should be any degree of affinity to that particular group. In the context of our experiment, this means that behaviour in the treatment in which identity is not induced should not be any different from behaviour in the treatment in which identity is induced and all subjects belong to the same group. This constitutes the first hypothesis.

**Hypothesis 1.** Contributions to the public good by subjects in homogenous groups (*6-0*) are no different than contributions by subjects in anonymous groups (*Control*).

Next, we set up the two main hypotheses of the paper. They address how social identity preferences may determine the relationship between social fragmentation (as measured by the relative proportion of each group) and contributions to the public good. We are interested in the effect of fragmentation per se, as well as the comparative static effect of increasing the level of fragmentation on behaviour.

When we replace a player in the homogeneous treatment (*6-0*) with an out-group member to construct our *5-1* treatment, we expect that identity-based biases will become salient. The presence of one outsider will therefore introduce a positive in-group bias on the majority group members. In addition, it is also possible that introducing an out-group may lead to a separate negative out-group bias. However, both Allport (1954) and Brewer (1999) argue that a positive in-group bias does not necessarily lead to an out-group bias.[4] These biases could take the form of differential other-regarding preferences towards other players, depending on their group membership. Chen and Li (2009) find that introducing group identity leads to subjects exhibiting greater degree of aversion to advantageous inequality (i.e. charity) towards in-group members than out-group members and greater aversion to disadvantageous inequality (i.e. envy) towards out-group members than in-group members. All else equal, positive other-regarding concerns should lead to higher contribution levels, while negative other-regarding concerns should lead to lower contribution levels.

Since there is just one out-group member the negative bias, if present, should be weak. Hence, we expect that the net effect will be an increase in average contributions, which is our second hypothesis.[5]

**Hypothesis 2.** Increasing the number of out-group members from zero to one will lead to an increase in contributions to the public good.

We now move to the main research question of the paper: the effect of changes in social fragmentation on public good provision. Based on the empirical evidence outlined in Section 2, particularly the findings of Smith (2011), we expect that increasing fragmentation will have a negative effect on public good contributions. This conjecture is also supported by social identity theory: Brewer (1991) postulates that in-group identification is the product of two opposing needs. On one hand, individuals have a distinct need for inclusion. As such, if a person is isolated from any social group, she feels the need to identify herself with a collective unit. On the other hand, people also have a need for distinctiveness: if a person is a member of an excessively large group, she feels the need to search for differentiation. Therefore, individuals' affinity for their in-group should be lowest when fragmentation is low, which equates to our *5-1* treatment, and highest when fragmentation is high, which is when both groups have three members (*3-3*).

As fragmentation increases, the number of in-group members of the majority declines and the number of out-group members increases, while the opposite is true of the minority group. As the size of the majority group decreases, a majority group member should feel less of a need for distinctiveness, and as such membership of the majority group should become more salient. Therefore, majority members will exhibit higher concerns for the welfare of their fellow in-group members. The overall size of the net effect is ambiguous: for there to be a positive effect of diversity on contributions, the average concern for in-group members must increase with in-group size. In addition, the majority group players will potentially exhibit a greater dislike for the increasingly high number of out-group members. This will unambiguously lead to a drop in contribution levels.

From the point of view of the minority group, as it increases in size with fragmentation, the stronger the concern its members will have for the financial welfare of their fellow in-group members, and the weaker the concerns for the financial welfare of the (shrinking majority) out-group members. While the direction of the latter effect is ambiguous, the former effect should lead to higher contributions to the public good.

The net effect of changes in fragmentation in terms of total contributions is unclear: it will depend on the strength of other-regarding preferences by members of both groups and how they change as fragmentation changes. As such, we will state our next hypothesis as follows.

[4] Morita and Servátka (2013) find no evidence of out-group discrimination in a hold-up game.

[5] Note that this is a prediction that is different from the data presented by Miguel and Gugerty (2005). However, we reiterate that the authors attribute higher contributions by homogeneous groups to easier punishment of in-group free-riders. Peer punishment technology is not available in our experiment.

**Hypothesis 3.** Contributions to the public good game will not change as social fragmentation increases.

Let us turn to the issue of how minorities will differ from majorities in terms of their contributions to the public good. As argued above, as fragmentation increases, both the positive in-group biases and negative out-group biases by both groups will become more salient. Whether or not the majority players will contribute on average more than the minority players will depend on what the net effect on positive in-group and/or negative out-group biases for each of the two groups is. We do not have a theoretical reason as to how these net effects should be, so we state our last hypothesis as follows.

**Hypothesis 4.** There will be no difference in contributions to the public good between majority and minority players.

### 3.1. Experimental procedures

Before proceeding, a methodological note is warranted. To tackle our research question, unlike field studies which draw on real forms of identity such as language (Easterly and Levine, 1997; Alesina, Baqir, and Easterly, 1999), we rely upon artificially induced identities, following the minimal group paradigm of Tajfel et al. (1971). We induce identity via participants' choices of paintings – an arbitrary task which is completely unrelated to the main focus of the experiment. While an arbitrary identity has the drawback of artificiality, it also allows the experimenter to study the relevance of social identity on behaviour, while isolating the effect of individual preferences from the effect of a previous history of interaction. This is often not possible in the field. Furthermore, individuals may have multiple identities, each of whom may become salient depending on context. For instance, an individual may identify himself through his nationality, ethnicity or gender. By combining an artificial identity with strict anonymity in choices, the experimenter can ensure that this is the only salient factor which influences choices. We can then study the effect of identity while teasing out repeated interaction effects. While studying the effect of particular types of identity such as gender or race is very important, we feel that working with a generic identity fits the purpose of this study best.

Our experimental procedure encompasses three stages. Stage 1 assigns participants to two different groups by eliciting their preferences over two artists' paintings. Stage 2 is a problem solving stage designed to reinforce participants' sense of affiliation to their group. Stage 3 is the actual public good game. We elaborate on each stage below.

#### 3.1.1. Stage 1: Group formation and assignment

We induced social identity by employing a similar design to Chen and Li (2009). In the beginning of each session, participants saw five pairs of paintings; in each pair, one painting was done by Gustav Klee and the other by Wassily Kandinsky.[6] Participants had to state their preference for one of the paintings in each pair. If participants preferred three or more Klee paintings, they were assigned to the Klee group. Otherwise they would be assigned to the Kandinsky group. This meant that we could not guarantee that exactly half the participants in a given session would go to one of the groups. However, the variation in group size across sessions was small.[7]

[6] The paintings were chosen to be as similar as possible.

[7] We opted for the assignment to groups to be endogenous in order to maximize the saliency of the groups, an issue which was raised by Eckel and Grossman (2005).

#### 3.1.2. Stage 2: Identity reinforcement

Once the Klee and Kandinsky groups were established, to reinforce their sense of identity, subjects were given a team-building exercise. This exercise consisted of identifying the authorship of two further paintings, one of which was painted by Klee and the other by Kandinsky. Participants were allowed to confer with fellow group members through a chat box for ten minutes. Communication was almost unrestricted; participants were not allowed to use abusive language and they were not allowed to identify themselves. Members of the Klee group could only see their own fellow group members' comments and vice-versa. Participants received an individual payment for each painting they correctly identified. Subjects were shown the payoffs from the painting stage before proceeding to the following stage. 139 out of 144 subjects (96.5%) got both answers correct, so this will not have had a differential impact on subsequent behaviour.

#### 3.1.3. Stage 3: Public Good Game

Following the painting identification stage, subjects were randomly allocated to six-player public goods games. Subjects knew the composition of their own game, but they were not told of the composition of the other games in the session.

The composition of the six-player public good game is the main treatment variable. As described above, we considered four different treatments: homogeneous games with six players of the same type (*6-0*), and a further three treatments varying the degree of heterogeneity (*5-1, 4-2, 3-3.*) In addition, we ran a control treatment where we did not induce identity, which consisted only of Stage 3 (*Control.*) This treatment therefore did not include Stages 1 and 2. We chose this design feature since it may have been confusing to subjects to engage in tasks which had no further bearing in the remainder of the session. However, it is possible that by omitting the group formation and identity reinforcement stages, contribution levels in the *Control* treatment are lower than they could have been otherwise.

All subjects played a standard Voluntary Contribution Game over twenty rounds with fixed matching. Subjects had twenty tokens that they had to allocate between a private and a public account. Payoffs were determined by the following equation, with the same parameters as Fehr and Gächter (2000).

$$\pi_i = 20 - c_i + 0.4\sum_{j=1}^{6} c_j \tag{1}$$

At the end of each round, a screen displayed that subject's contribution in that round, as well as the total contribution to the public good by the other five players. Each session consisted of eighteen participants. At the end of the experiment, subjects were paid individually in cash. The experimental software was z-Tree (Fischbacher, 2007). A total of 180 undergraduate students participated in the experiment. Average payments were £10.30 ($14.89). A copy of the instruction set is in Appendix.

## 4. Results

We begin by looking at aggregate level treatment effects which establish our main result. We then proceed by investigating the effect fragmentation has on the distribution of contributions. We finalize the section by looking at individual level effects – in particular we measure how strength of group affiliation affects contributions.

**Table 1**
Tobit regression estimates.

| Dep. var.: Contribution | (1) | (2) | (3) |
|---|---|---|---|
| *Control* | 9.582*** | 9.581*** | 4.364*** |
| | (0.955) | (0.955) | (1.026) |
| *6-0* | 9.067*** | 9.068*** | 3.650*** |
| | (0.530) | (0.530) | (0.926) |
| *5-1* | 11.334*** | 11.671*** | 5.215*** |
| | (1.506) | (1.288) | (1.580) |
| *4-2* | 8.728*** | 8.474*** | 3.164*** |
| | (1.033) | (1.006) | (1.026) |
| *3-3* | 8.735*** | 8.735*** | 3.562*** |
| | (1.555) | (1.555) | (1.290) |
| *5-1* × *Min* | | −2.115 | −2.094 |
| | | (2.015) | (2.149) |
| *4-2* × *Min* | | 0.777 | 0.824 |
| | | (1.068) | (1.133) |
| $OtherC_{t-1}$ | | | 0.119*** |
| | | | (0.019) |
| Period | −0.446*** | −0.446*** | −0.268*** |
| | (0.047) | (0.047) | (0.045) |
| Observations | 3,600 | 3,600 | 3,420 |
| Pseudo $R^2$ | 0.02 | 0.02 | 0.03 |

Clustered standard errors at group level in parentheses.
*** Significant at 1%.

### 4.1. Aggregate effects of fragmentation

Table 1 displays Tobit estimates of treatment effects on average contribution levels across 20 periods. For ease of analysis, since all coefficients are treatment dummies, we express coefficients directly, rather than as deviations from an omitted category. Regression (1) looks at average treatment effects, as well as a time trend variable. We find no significant difference between the control treatment where group identity is absent and the *6-0* treatment ($F(1, 3594) = 0.33$, $p = 0.564$). This confirms our first hypothesis that in the absence of an out-group, a sense of identity is not relevant, and as such average contributions would not differ. This is our first result.

**Result 1.** There is no difference in contribution levels between a homogeneous treatment and an identity-free treatment.

However, we do not find any significant difference between the coefficients on *6-0* and *5-1* ($F(1, 3594) = 2.26$, $p = 0.133$) as well as the coefficients on *5-1* and *4-2* ($F(1, 3594) = 2.05$, $p = 0.152$). We also find no significant difference in average contributions between the homogeneous group, *6-0*, and the maximally fragmented group, *3-3* ($F(1, 3594) = 0.05$, $p = 0.830$). We note also a negative and significant coefficient on the time trend, indicative of the usual trend in public goods experiments towards non-cooperation. This trend is represented visually in Fig. 1, which plots average contribution levels for each treatment. Note that for the majority of periods (particularly period 7 onwards) the average contribution level is highest for the *5-1* treatment, despite the fact that that difference diminishes with time.

In order to account for the potentially different behavioural responses of the two different groups playing the public good game, regression (2) in Table 1 adds to the econometric specification interaction dummies between the *5-1* and *4-2* dummies with a variable that equals one if the subject belongs to the minority group and zero otherwise. This econometric specification therefore allows for the possibility that minority and majority groups in a given treatment may on average contribute different amounts. While we still observe no difference in the coefficients on *Control* and *6-0* ($F(1, 3592) = 0.33$, $p = 0.565$), we now find a significant difference between the coefficients on *6-0* and *5-1* ($F(1, 3592) = 4.15$, $p = 0.042$), as well as the coefficients on *5-1* and *4-2* ($F(1, 3592) = 3.91$, $p = 0.048$). In other words, individuals in the majority group in the *5-1* condition contribute more than either the homogeneous case, or the majority group in the *4-2* treatment. This is our second result.

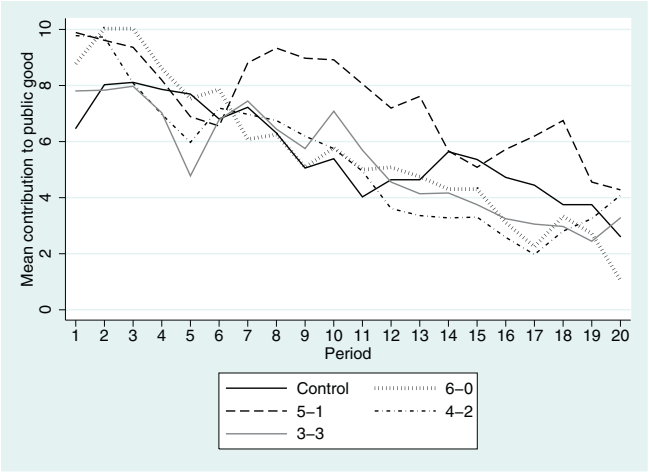


**Fig. 1.** Time series of average contributions to public good by treatment.

**Result 2.** Average public good contributions by the majority group are highest when there is a single out-group member.

We find no significant difference in the coefficients on the *4-2* and *3-3* dummies ($F(1, 3592) = 0.06$, $p = 0.804$), which suggests a flat relationship between social fragmentation and average contributions after the initial increase in social fragmentation from *5-1* to *4-2*. Furthermore, we find no significant difference between the coefficients on *6-0* and *3-3* in the second specification ($F(1, 3592) = 0.55$, $p = 0.459$).

**Result 3.** Average public good contributions are highest when fragmentation is lowest. However, there is no difference in contributions between maximum fragmentation and full homogeneity. We find no significant difference in average contributions between the majority and minority groups either in the *5-1* or in the *4-2* treatments, but that is likely due to the large variance in the coefficient on the minority interaction dummies, which denotes large heterogeneity in behaviour.

**Result 4.** There is no significant difference in average contributions by majority and minority players. This is driven by high variance in behaviour by minority players.

We conclude our analysis by introducing some dynamic considerations, in particular the previous contributions of the other five players in the previous period, $OtherC_{t-1}$. While the sign and significance of the group dummies remain the same, we observe a positive and significant coefficient on $OtherC_{t-1}$. This is consistent with the strategic complementarity inherent to the public good game: the higher the contribution levels by other subjects, the more player *i* will contribute in the following period.[8]

Looking at average contribution levels omits the heterogeneity in contributions which is present in public good experiments. Fig. 2 displays histograms of contributions to the public good by treatment. Note that in all identity treatments, the fraction of observations registering zero contributions remains relatively constant,

[8] We estimated an additional model in which we interacted $OtherC_{t-1}$ with each treatment dummy, but we did not find any significant differences in the coefficients. We therefore omit the results from this estimation.

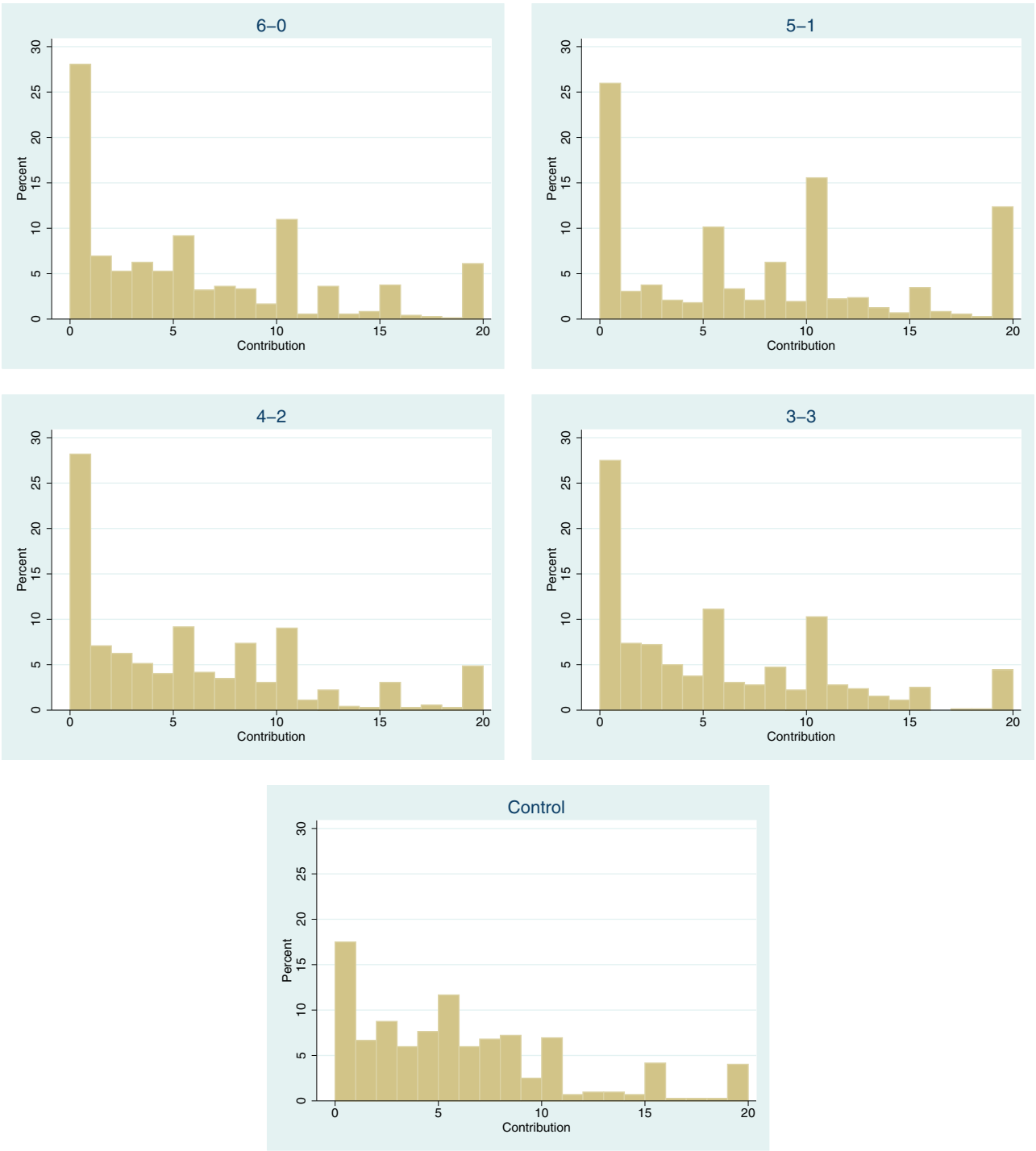


**Fig. 2.** Histograms of contributions by treatment.

accounting for 27% of observations. However, we observe a significant change in the opposite end of the distribution as a function of fragmentation: in the *5-1* treatment, there is a noticeable increase in full contributions relative to either the *6-0* or *4-2* conditions.[9]

To investigate this issue further, we conducted a set of Probit regressions, reported in Table 2, using as a dependent variable a dummy variable which equals one if subject $i$ in period $t$ contributed his full endowment to the public good and zero

[9] We note that the histogram for the *Control* condition has a lower frequency of zero contributions. We conducted a Probit regression whose dependent variable was a dummy variable equaling 1 if subject $i$ in period $t$ contributed nothing and zero otherwise, and the regressors were treatment dummies plus a time trend. We find a significant difference in the likelihood of no contribution between *6-0* and *Control* ($p = 0.018$), and a marginally significant difference between *3-3* and *Control* ($p = 0.081$). No other pairwise comparison yielded significant differences (*Control* vs *5-1*: $p = 0.190$; *Control* vs *4-2*: $p = 0.196$). This may have been due to the procedural differences between *Control* and the main treatments, although any difference should be in the opposite direction (i.e. more free-riding in *Control*).

**Table 2**
Probit regression estimates.

| Dep. var.: Max Contribution | (1) | (2) | (3) |
|---|---|---|---|
| *Control* | −1.376*** | −1.376*** | −1.542*** |
| | (0.310) | (0.310) | (0.284) |
| *6-0* | −1.125*** | −1.125*** | −1.318*** |
| | (0.176) | (0.176) | (0.249) |
| *5-1* | −0.715*** | −0.707*** | −0.946*** |
| | (0.152) | (0.122) | (0.249) |
| *4-2* | −1.241*** | −1.375*** | −1.538*** |
| | (0.138) | (0.230) | (0.325) |
| *3-3* | −1.299*** | −1.299*** | −1.483*** |
| | (0.197) | (0.197) | (0.214) |
| *4-2* × Min | | 0.338 | 0.278 |
| | | (0.458) | (0.495) |
| *5-1* × Min | | −0.049 | −0.036 |
| | | (0.482) | (0.472) |
| $\text{Other}C_{t-1}$ | | | 0.004 |
| | | | (0.004) |
| Period | −0.046*** | −0.046*** | −0.040*** |
| | (0.007) | (0.007) | (0.008) |
| Observations | 3,600 | 3,600 | 3,420 |

Clustered standard errors at group level in parentheses.
*** Significant at 1%.

otherwise. To facilitate the interpretation of the results, we again report coefficients on treatment dummies directly, as opposed to deviations from an omitted category. The first specification only accounts for the different treatments plus a time trend. The results are consistent with our visual inspection of Fig. 2, in that there is a significant difference in the likelihood of full contribution between *5-1* and *6-0* ($\chi^2(1)=3.85$, $p=0.0496$), as well as *5-1* and *4-2* ($\chi^2(1)=6.63$, $p=0.010$). Allowing for minority dummies does not change the main effect of fragmentation: the likelihood of full compliance is significantly higher for the majority group members in the *5-1* treatment than either subjects in the *6-0* treatment ($\chi^2(1)=5.24$, $p=0.022$) or majority members in the *4-2* treatment ($\chi^2(1)=6.37$, $p=0.012$). Our third specification studies the effect of previous period contributions by the other five players on the likelihood of full contribution in the present period. Interestingly, we find no significant coefficient on $\text{Other}C_{t-1}$: unlike average contribution, the likelihood of full contribution is not affected by the behaviour of the other five players.

**Result 5.** The likelihood of full contribution is highest in the treatment with minimal fragmentation. It is independent of past total contributions by the other five players.

## 5. Discussion and conclusion

Social fragmentation, along ethnic, linguistic or religious lines has been identified as the cause for low public good provision in settings as diverse as U.S cities (Alesina, Baqir, and Easterly, 1999) and rural Pakistan (Khwaja, 2009). However, the existing research on social fragmentation has been unable to identify the underlying mechanism which causes societies with higher levels of fragmentation to under-perform. Is this caused by discriminatory preferences based on a sense of affiliation towards a social group, or is it instead caused by the fact that different social groups may prefer different types of public goods?

The present paper seeks to understand the extent to which the former explanation is at the heart of this problem. We conducted an experiment where two artificial social groups could contribute to a single public good. Keeping the total number of players constant, we systematically varied the relative size of the two groups as a proxy for social fragmentation. In one extreme, we minimized fragmentation by having all players belong to the same group. In the other extreme, we maximized fragmentation by having one half of players belong to one group, and the other half belong to the other group.

The experimental evidence to some extent qualifies the results from the existing literature. In the context of our experiment, in the absence of outsiders a sense of identity is irrelevant with respect to the contributions to the public good. Indeed, our data found that the average contribution by subjects in games where everyone was from the same group were no different from the average contribution by those subjects who played the same game in an identity-free condition. This suggests that one's sense of belonging to a particular group is a function of how salient that group is. Once everyone is a member of the same group, membership of that group ceases to have meaning, and this is consistent with behaviour in the experiment.

However, our data partially replicates the pattern shown by the empirical literature: so long as there is *some* degree of social fragmentation, then increasing social fragmentation decreases public good provision by members of the majority group contributing to the public good. In this sense, our findings confirm the evidence of Smith (2011), who had also analyzed the effect of diversity in linear public games, and had found that increasing diversity decreased public good contributions. However, our findings differ from Smith's in that we do not find a significant difference between majority and minority groups. This may have been due to several differences in our designs: in our experiment, both roles (i.e. minority or majority) and groups were fixed throughout the session, while in Smith (2011), both were randomly reset in every round. Another reason could have been the feedback given to subjects at the end of each round: we provided aggregate contributions, while subjects in Smith (2011) would have received information about group-specific aggregate contributions, through their payoffs on the belief elicitation of the two groups' aggregate contributions. Finally, the differences in our findings could be due to differences in the saliency of the group identity: Eckel and Grossman (2005) find the strength of group identity is critical to increased cooperation. Our experiment and Smith (2011) differ in the sense that group assignment was exogenous in Smith's experiment and endogenous in ours, although both experiments had similar identity-reinforcement stages.

Importantly, our experiment complements and extends Smith (2011) by finding that socially homogeneous treatments do not exhibit higher contributions than maximally fragmented treatments. This result is due to the fact that majority group members respond non-linearly to the presence of diversity. They contribute most when there is an out-group that constitutes a small minority. The mechanism for this result is simple: the fact that different social groups exist triggers a meaning to belonging to a group, and thus a utility from membership of that group. This in turn creates the willingness to contribute to the public good, as it will benefit one's in-group members. So long as the positive in-group biases dominate the negative out-group biases, then the net effect is higher public good provision. This interpretation is substantiated by evidence that the likelihood of full contribution is highest among majority players in the treatment with minimal but positive fragmentation and by the fact that this likelihood is statistically independent of total contributions by other players in the game. This suggests that group identity, rather than strategic considerations guide cooperative behaviour in the experiment. Interestingly, we find this mechanism to be present only among majority players in the public good. This is partially due to high variability in behaviour by minority group members. Investigating the reasons for these differences in behaviour is an important question left for future research.

## Appendix. Instruction sets

*Instruction set*

Welcome to our experiment. Please remain silent during the course of the experiment. If you have any questions, please raise your hand. You will now take part in a decision-making experiment. The amount you will receive for participating will depend on your decisions and the decisions of other participants. There will be 2 parts to this experiment. Before each part of the experiment begins, you will receive a set of instructions explaining the details of that particular part.

Once you complete all the decisions in a given part, we will move to the next part of the experiment. You will only receive information about the outcome of your choices at the end of the experiment. To keep track of your choices, we will provide you with a decision form. Your payoff in this experiment will be equal to the sum of payoffs in each of the individual parts. The payoffs throughout the experiment will be denominated in Experimental Currency Units (ECU); 1 ECU is worth 20 cents. Once the experiment ends, your payoff will be calculated and you will receive your payment in cash.

*Part 1 (All treatments except Control)*

In this part we will show you five pairs of paintings by two artists. For each pair of paintings, you must choose the one you prefer. Once everyone makes their five choices, we will divide participants into two groups according to which artist they preferred.

Once you have been allocated to one of the groups, we will show you a further two paintings. Your task will be to identify which artist painted which painting. You will be allowed to confer with your fellow group members in order to determine the answer to the two questions. To this effect, you will have access to a chat programme, through which you can offer help or get help from your fellow group members.

Messages you post in the chat box will only be visible to members of your own group. You will not be able to see the messages posted by members of the other group and vice-versa. You will be able to communicate with your fellow group members for 10 min before submitting your answers. You are free to post how many messages you like. There are only two restrictions on messages: you may not post messages which identify yourself (e.g. age, gender, location, etc.) and you may not use offensive language. For each correct answer you will earn 10 ECU. Once everyone submits their answers, the experiment will move to the second part. You will only be informed of your payoff in this part of the experiment at the very end of the session.

*Part 2 – only seen after the end of Part 1. Paragraph in italic was not written in Control instructions*

In this part of the experiment you will be matched with five other participants. You will be interacting with the same five participants until the end of the experiment.

There will be 20 rounds in this part of the experiment. At the beginning of each round, each participant will receive 20 ECUs. We will call this your endowment. Your task in each round is to decide how to use your endowment. You must decide how many ECUs you want to contribute to a project and how many you want to keep for yourself. The consequences of your decision are explained in detail below. Your payoff is given by the following formula:

$$\text{Your Payoff} = (20\,\text{ECU} - \text{Your Contribution}) + (0.4 \times \text{Total Contribution})$$

This formula implies that your payoff in every round is based on two parts:

1 The ECUs you kept for yourself: (20 ECU − Your contribution.)
2 The income from the project, which is 40% of the total contribution from you and from the other five participants.

The payoff of each of the six participants is calculated in the same way. This means that the income from the project is the same for everyone.

To fix ideas, let's consider a few numerical examples. Suppose that the total contribution to the project is 60 ECU. In this case, each of the six participants receives an income from the project of $0.4 \times 60 = 24$ ECU. If instead the total contribution to the project is 9 ECU, then each of the six participants will receive an income of $0.4 \times 9 = 3.6$ ECU from the project.

Each ECU you keep to yourself raises your payoff by 1 ECU. Each ECU you contribute to the project raises the total contribution to the project by 1 ECU and causes your income from the project to rise by $0.4 \times 1 = 0.4$ ECU. The income of the other five participants will also rise by 0.4 ECU, so that the total income of the six participants from the project will go up by 2.4 ECU. Your contribution to the project therefore also raises the income of the other participants. Conversely, contributions to the project by other participants also raise your income; for each ECU contributed by another participant, you earn $0.4 \times 1 = 0.4$ ECU.

Remember that ECUs earned in one round do NOT carry over to subsequent rounds. You will start every round with the same endowment of 20 ECUs.

Once all participants have made their decisions, you will be informed about your decision, and the total contribution made by the other 5 participants, the total amount of ECUs contributed to the project and your payoff.

*You will also know how many persons with whom you are playing belong to either the Kandinsky or the Klee group, but not their exact identity.*

Once the 20th round is over, the experiment will be over. The computer will select two rounds at random. Your payoff in those two rounds plus the payoff from part 1 will determine your total earnings in the session.

## References


Akerlof, G.A. and R.E. Kranton, 2000]. Economics and identity. Quarterly Journal of Economics 115(3), 715–753.

Alesina, A. and E. La Ferrara, 2000]. Participation in heterogeneous communities. Quarterly Journal of Economics 115(3), 715–753.

Alesina, A. and E. La Ferrara, 2005]. Ethnic diversity and economic performance. Journal of Economic Literature 43(3), 762–800.

Alesina, A., R. Baqir and W. Easterly, 1999]. Public goods and ethnic divisions. Quarterly Journal of Economics 114(4), 1243–1284.

Alesina, A., A. Devleeschauwer, W. Easterly, S. Kurlat and R. Wacziarg, 2003]. Fractionalization. Journal of Economic Growth 8(2), 155–194.

Allport, G.W., 1954]. The nature of prejudice. Cambrige, MA: Addison-Wesley.

Bowles, S. and H. Gintis, 2004]. Persistent parochialism: Trust and exclusion in ethnic networks. Journal of Economic Behavior and Organization 55(1), 1–23.

Brewer, M.B., 1991]. The social self: On being the same and different at the same time. Personality and Social Psychology Bulletin 17(5), 475–482.

Brewer, M.B., 1999]. The psychology of prejudice: Ingroup love or outgroup hate? Journal of Social Issues 55(3), 429–444.

Brown-Kruse, J. and D. Hummels, 1993]. Gender effects in laboratory public goods contribution: Do individuals put their money where their mouth is? Journal of Economic Behavior and Organization 22(3), 255–267.

Cadsby, C.B. and E. Maynes, 1998]. Gender and free riding in a threshold public goods game: Experimental evidence. Journal of Economic Behavior and Organization 34(4), 603–620.

Charness, G., L. Rigotti and A. Rustichini, 2007]. Individual behavior and group membership. American Economic Review 97(4), 1340–1352.
Chen, Y. and S.X. Li, 2009]. Group identity and social preferences. American Economic Review 99(1), 431–457.
Cox, T.H., S.A. Lobel and P.L. McLeod, 1991]. Effects of ethnic group cultural differences on cooperative and competitive behavior on a group task. Academy of Management Journal 34(4), 827–847.
Croson, R., M. Marks and J. Snyder, 2008]. Groups work for women: Gender and group identity in the provision of public goods. Negotiation Journal 24(4), 411–427.
Currarini, S. and F. Mengel, 2013]. Identity, homophily and in-group bias. Mimeo.
Currarini, S., M.O. Jackson and P. Pin, 2009]. An economic model of friendship: Homophily, minorities and segregation. Econometrica 77(4), 1003–1045.
Drouvelis, M. and D. Nosenzo, 2013]. Group identity and leading-by-example. Journal of Economic Psychology 39, 414–425.
Easterly, W. and R. Levine, 1997]. Africa's growth tragedy: Africa's growth tragedy: Policies and ethnic divisions. Quarterly Journal of Economics 112(4), 1203–1250.
Eckel, C.C. and P.J. Grossman, 2005]. Managing diversity by creating team identity. Journal of Economic Behavior and Organization 58(3), 371–392.
Espinosa, J.A. and R.T. Garza, 1985]. Social group salience and interethnic cooperation. Journal of Experimental Social Psychology 21(4), 380–392.
Fehr, E. and S. Gächter, 2000]. Cooperation and punishment in public goods experiments. American Economic Review 90(4), 980–994.
Fischbacher, U., 2007]. Z-Tree – Zurich toolbox for readymade economic experiments. Experimental Economics 10, 171–178.
Goette, L., D. Huffman and S. Meier, 2006]. The impact of group membership on cooperation and norm enforcement: Evidence using random assignment to real social groups. American Economic Review 96(2), 202–216.
Habyarimana, J., M. Humphreys, D.N. Posner and J. Weinstein, 2007]. Why does ethnic diversity undermine public good provision? American Political Science Review 101(4), 709–725.
Khwaja, A.I., 2009]. Can good projects succeed in bad communities? Journal of Public Economics 93(7-8), 899–916.
Kramer, R.M. and M.B. Brewer, 1984]. Effects of group identity on resource use in a simulated commons' dilemma. Journal of Personality and Social Psychology 46(5), 1044–1057.
La Porta, R., F. Lopez-de-Silanes, A. Schleifer and R.W. Vishny, 1999]. The quality of government. Journal of Law, Economics and Organization 15(1), 222–279.
Luttmer, E.F.P., 2001]. Group loyalty and the taste for redistribution. Journal of Political Economy 109(3), 500–528.
Miguel, E. and M.K. Gugerty, 2005]. Ethnic diversity, social sanctions and public goods in Kenya. Journal of Public Economics 89(11-12), 2325–2368.
Morita, H. and M. Servátka, 2013]. Group identity and relation-specific investment: An experimental investigation. European Economic Review 58, 95–109.
Poterba, J.M., 1998]. Demographic change, intergenerational linkages, and public education. American Economic Review 88(2), 315–320.
Sherif, M., O.J. Harvey, B.J. White, W.R. Hood and C.W. Sherif, 1988]. The robbers' cave experiment: Intergroup conflict and cooperation. Norman, Oklahoma: University Book Exchange.
Smith, A., 2011]. Group composition and conditional cooperation. The Journal of Socio-Economics 40(5), 616–622.
Solow, J.L. and N. Kirkwood, 2002]. Group identity and gender in public goods experiments. Journal of Economic Behavior and Organization 48(4), 403–412.
Tajfel, H. and J.C. Turner, 1979]. An integrative theory of intergroup conflict. In Austin, W.G. and S. Worchel (Eds.), The social psychology of intergroup relations. Monterey, CA: Brooks/Cole.
Tajfel, H., M.G. Billig, R.P. Bundy and C. Flament, 1971]. Social categorization in intergroup behavior. European Journal of Social Psychology 1(2), 149–178.
Tajfel, H., 1970]. Aspects of national and ethnic loyalty. Social Science Information 9(3), 119–144.
U.S. Census Bureau, 2008, August. An older and more diverse nation by Midcentury, U.S. Census Bureau News Release CB08-123.
Wit, A.P. and H.A.M. Wilke, 1992]. The effect of social categorization on cooperation in three types of social dilemmas. Journal of Economic Psychology 13(1), 135–151.