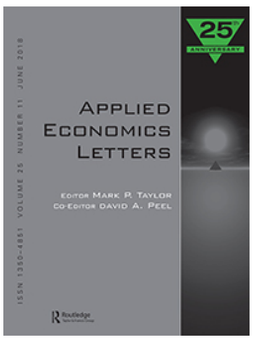

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ARTICLE



# Facebook-to-Facebook: online communication and economic cooperation

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**ABSTRACT**

Direct face-to-face communication has traditionally been found to be more effective for fostering economic cooperation than any form of indirect, mediated communication. We inquire whether this is still the case since most young adults routinely use texting and online social media to communicate with each other. We find that young adults in our laboratory public goods experiment are just as adept at finding and sustaining cooperative agreements when communicating within a Facebook group and through online chat as they are in person.

**KEYWORDS**

Laboratory experiments; communication; public good; voluntary contribution mechanism

**JEL CLASSIFICATION**

C91; D83; H41

## I. Introduction

Communication between agents is critical for fostering economic cooperation in many settings (Ledyard 1995). Experimental research has traditionally found that direct face-to-face (FTF) communication is far more effective in achieving cooperation than any kind of indirect, mediated communication (Dawes, McTavish, and Shaklee 1977; Isaac and Walker 1988; Davis and Holt 1992). Roth (1995) suggests that FTF communication is the most effective for at least two reasons: First, it triggers social utility by 'call[ing] into play all of the social training we are endowed with' (295). Second, it has the richest set of communication channels, including nonlinguistic channels such as facial expressions, tone of voice and body language (295–296).

The recent revolution in online communication has resulted in radical changes in the way people communicate with each other. According to the Pew Research Center, 95% of young American adults own a cell phone and 97% of these cell owners use text messaging (Smith 2011). Furthermore, 90% of young adults use social networking sites (Perrin 2015), and Facebook (FB) remains by far the most popular platform, engaging 87% of young adult and 71% of all adult Internet users (Duggan et al. 2015).

Given the now commonplace use of online communication media, does FTF still remain more effective than online media for achieving cooperative goals? Or do online media now allow for levels of cooperation comparable to FTF? We investigate this question in the context of a voluntary contribution mechanism (VCM) for public goods provision, a setting commonly used to study economic cooperation. A number of recent experimental studies comparing FTF with alternative media indicate that the gap is narrowing (Brosig, Weimann, and Ockenfels 2003; Bochet et al. 2006).[1] In particular, Bochet et al. (2006) compare contributions under VCM after the subjects engage in FTF or online chat room discussions, and find that both media lead to significant increases in contributions as compared to the no-communication (NC) baseline. However, online chat remains significantly less effective than FTF communication. Further, Bochet et al. (2006) allow for more frequent communication in the chat room treatment than in the FTF treatment, potentially boosting the effect of online chat compared to FTF. It is important to establish the effectiveness of online media compared to FTF communication under identical design conditions. We address this issue here. We focus on two online communication media most commonly used in everyday life – specifically online chat and FB – as alternatives to FTF. Whereas online chat has been studied before, the use of FB as a communication media is another novel contribution.

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[1]See also Fiedler and Haruvy (2009), Bicchieri and Lev-On (2011), Greiner, Güth, and Zultan (2012), Greiner, Caravella, and Roth (2014).

The supplemental material for this article can be accessed here.

We test whether these commonly used online communication media are now as effective in achieving cooperation among young adults as traditional FTF communication.

## II. Experimental design and hypotheses

We conducted the following VCM laboratory experiment with students at a U.S. university. Each session involves 8–12 participants and is divided into three parts. In Part 1, 'Before Communication', participants are divided into groups of four and play 10 periods of the VCM with the same group members. In each period of the VCM, a participant belonging to a four-person group has 10 tokens to allocate between a private and a public fund. The payoff function of person $i$ contributing $x_i$ tokens to the public fund is given by $\pi_i(x) = 10 - x_i + 0.5\sum_{j=1}^{4} x_j$, where $\sum_{j=1}^{4} x_j$ is the total group contribution to the public fund. This part is used to familiarize the participants with the VCM.

In Part 2, 'Communication', participants are informed that they are randomly rematched into new groups of four, and are asked to communicate for 10 mins within their new group, knowing they will play the same game as Part 1 with this new group. Communication is free-form and varies across treatments only by media, to be discussed next.[2] Participants are monitored by the experimenter in all treatments. We implement four treatments in a between-subjects design:

**NC** – Communication is absent in this baseline. After Part 1, participants are told that they are randomly rematched into new groups, and the experimenter needs a few minutes to set up for the next part of the experiment. During this 10min waiting time, participants are allowed to surf the web but they are not allowed to communicate with each other.

**FTF** – Participants communicate with their new group for 10 mins sitting FTF around a table.

**FB** – Participants, in their new groups, are invited to a specific FB group.[3] They interact with one another via wall posts and post replies. All participants are removed from the FB group immediately after the communication session ends.

**Online chat (Chat)** – Participants, in their new groups of four, interact with one another via the online text messaging option, 'Chat box', provided by z-Tree (Fischbacher 2007).[4]

In Part 3, 'After Communication', participants play another 10 periods of the VCM with the group they just communicated with. At the end of this part, we conducted a short exit survey. The Experimental Instructions and Exit Questionnaire are included in Online Supplementary Materials A and B. Participants were recruited using ORSEE software (Greiner 2015). The game and the Chat part of the experiment were implemented via z-Tree. A standard web browser was used for communication in the FB treatment. A human observer took notes on the contents of the communication sessions of each group under FTF; computer logs were available for communication sessions of both FB and Chat.

**Competing hypotheses** – Before turning to the results, we outline two alternative hypotheses on the effects of different communication media on VCM play. The communication media we study differ in the potential richness of social and communication channels and in the personal information disclosed. FTF is the richest, allowing for ample communication and social interactions (Roth 1995); FB is computer-mediated but still fairly rich, disclosing participants' names, images and the basic information publicly available on their FB profiles; and online chat is fairly anonymous (only subject IDs are displayed) but still allows for unrestricted exchanges.

[2]The communication length, 10 mins, is as in Brosig, Weimann, and Ockenfels (2003). The language of the experimental instructions explaining the communication part is in line with earlier studies on the effect of communication on VCM play (Isaac and Walker 1988). See online Suplementary Materials A and E for experimental instructions and samples of communication logs.

[3]One needs a Facebook (FB) account to join an FB group. As FB does not allow fake accounts, participants' genuine accounts had to be used. In Session 1 of the FB treatment, three participants did not have FB accounts, which had to be created on the spot with the experimenter's help. For later sessions, we requested all of our participants, irrespective of treatment, to have an FB account. Given that around 90% of young American adults use FB (see Section I), the subject pool selection bias introduced by this recruitment restriction is minimal.

[4]Although Bochet et al. (2006) also compared NC, FTF and Chat, our experiment differs in that (1) all our participants played 10 periods of the VCM before communication and (2) only one 10-min communication period was allowed in all our treatments. The former ensures that participants fully understood the game and were better informed during the communication round while the latter ensures that our FTF treatment is comparable to our Chat treatment. In Bochet et al. (2006), FTF communication happened once before the first round of a 10-round VCM while Chat communication happened before the first, fourth and seventh rounds of a 10-round VCM.

Theoretically, with repeated interaction, any form of communication could foster cooperation.[5] Empirically, however, earlier evidence suggests that media with richer communication and social channels, especially FTF, lead to more cooperation (Section I). The hypothesis based on this earlier evidence is:

**Hypothesis 1.** *Media with richer communication and social channels lead to more cooperation in the VCM. That is, FTF > FB > Chat > NC.*

Our alternative hypothesis is based on the now commonplace use of online communication media, suggesting that these online media could be just as effective:

**Hypothesis 2.** *Commonly used online media lead to the same amount of cooperation as face-to-face in the VCM: FTF ∼ FB ∼ Chat > NC.*

We discuss the experimental results in light of these alternative hypotheses.

## III. Experimental results

We conducted 13 experimental sessions, randomizing across the four treatments, with a total of 124 students. Each session had 8–12 students, and there were 6–10 communication groups per treatment (see Table 1).[6] The students were mostly undergraduates from various majors. The gender split was close to 50/50. Out of 124 participants, 117 had FB accounts[7]; 71% of participants reported using FB every day and 84% had more than 100 FB friends. Average earnings were about $21. Tables 3 and 4 in Supplementary Material C provide a more detailed summary by treatment and session.

Table 1. Average contribution and frequency of full contributions before and after communication, by treatment.

| | | | Mean contribution, tokens | | Full contributions frequency, percent | |
|---|---|---|---|---|---|---|
| Treatment | No. subjects | No. groups | Before | After | Before | After |
| NC | 24 | 6 | 3.69 | 3.63 | 7.50 | 6.67 |
| FTF | 40 | 10 | 3.85 | 9.89 | 15.05 | 98.75 |
| FB | 32 | 8 | 3.49 | 9.14 | 5.63 | 87.50 |
| Chat | 28 | 7 | 4.97 | 9.22 | 24.29 | 91.43 |

Figure 1 shows the dynamics of average contributions. Table 1 displays the average contributions and frequencies of full contributions of 10 tokens, before and after communication, by treatment. Figure 1 and Table 1 suggest that the contributions to the public good before communication (periods 1–10) followed the usually observed pattern. After communication (periods 11–20), contributions to the public good increased and reached close to the maximum

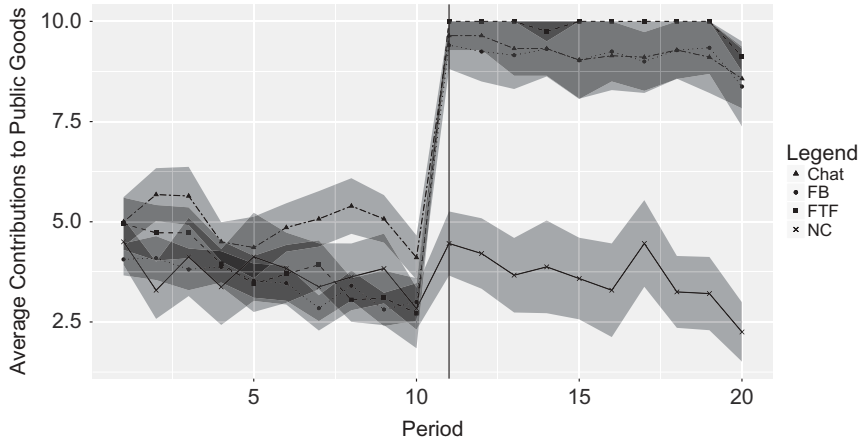


Figure 1. Mean contributions with group-based SEs by treatment.

[5]We are grateful to an anonymous referee for this remark. This ignores end-game effects.
[6]We have fewer groups in the NC treatment since NC serves only as a benchmark. The target number of communication groups was 7 or 8 per treatment. We accidentally conducted one extra session with 2 groups in the FTF treatment, resulting in 10 groups for FTF. We include all data collected in our analysis. The results are not sensitive to exclusion of the extra FTF session.
[7]In spite of the recruitment request that all participants should have a FB account, there were four individuals who participated in non-FB sessions but reported in the post-experiment questionnaire that they did not have FB accounts.

of 10 tokens in all communication treatments; in comparison, the average contributions under NC remained low.

To test for differences across treatments, we conduct regression estimations of contribution $y_{it}$ of individual $i$ in period $t$, using the following differences-in-differences specification:

$$\begin{aligned} y_{it} = {} & \beta_0 + \beta_{\text{After}} D_{\text{After}} + \beta_{\text{FTF}} D_{\text{FTF}} + \beta_{\text{FB}} D_{\text{FB}} \\ & + \beta_{\text{Chat}} D_{\text{Chat}} + \beta_{\text{FTF After}} D_{\text{FTF}} D_{\text{After}} \\ & + \beta_{\text{FB After}} D_{\text{FB}} D_{\text{After}} + \beta_{\text{Chat After}} D_{\text{Chat}} D_{\text{After}} \\ & + \beta_{\text{last period}} D_{\text{last period}} + \beta_{\text{daily use}} D_{\text{daily use}} \\ & + \beta_{\text{many friends}} D_{\text{many friends}} + u_{it} \end{aligned}$$

where $D_{\text{After}}$ is a dummy variable for After Communication (Part 3), while $D_{\text{FTF}}$, $D_{\text{FB}}$ and $D_{\text{Chat}}$ are dummies for the corresponding treatments; the after-treatment interaction terms are included to evaluate treatment effects. In addition, we include a 'last period' dummy $D_{\text{last period}}$, and two FB use dummies: $D_{\text{daily use}}$ for participants who reported to use FB every day, and $D_{\text{many friends}}$ for participants who have more than 100 FB friends. Finally, $u_{it}$ is the error term.

To account for possible interdependencies of observations within sessions, and for the finite sample distribution given a relatively small number of independent sessions, we use a block bootstrap method where we define a block as a session. For each estimation, we generate 1000 random samples where we select 13 sessions at random with replacement and then include all of the data from those 13 sessions selected to create each sample. Thus, the sample size of each random sample could be different. We then use these 1000 samples to calculate the bootstrapped confidence intervals (Efron and Tibshirani 1994).

Table 2 displays the results of both linear and ordered logit regressions of individual contribution amounts, as well as logit estimation of the probability of full contribution.[8] All three regression specifications convey qualitatively similar results. First, the differences in contributions between treatments before communication were negligible, as evidenced by the lack of significance on coefficients FTF, FB and Chat (with the exception of a positive and significant coefficient on FTF under logit, indicating that participants in the FTF treatment were more likely to contribute full amounts even before communication). Further, the treatment effects coefficients on 'FTF After', 'FB After', and 'Chat After' are all positive and significant at the 1% or 5% levels. This confirms that the changes in contribution levels and in the probability of making the full contribution after communication are statistically different

**Table 2.** Regression estimation of public good contributions.

| | Contribution amount Linear regression | | | | Contribution amount Ordered logistic regression | | | | Probability of full contribution Logit regression | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contribution | Coeff. | SE | 95% confidence interval | | Coeff. | SE | 95% confidence interval | | Coeff. | SE | 95% confidence interval | |
| Constant | 4.03*** | 1.12 | 1.90 | 5.61 | – | – | – | – | −2.40*** | 0.57 | −3.89 | −1.69 |
| After | −0.07 | 0.81 | −1.13 | 0.99 | −0.04 | 0.36 | −0.59 | 0.45 | −0.13 | 0.37 | −0.75 | 0.21 |
| FTF | 0.18 | 1.08 | −1.52 | 1.94 | −0.04 | 0.60 | −0.96 | 0.94 | 0.81*** | 0.25 | 0.23 | 1.31 |
| FB | −0.19 | 1.04 | −1.62 | 1.38 | −0.07 | 0.60 | −0.96 | 0.92 | −0.27 | 0.51 | −1.09 | 0.63 |
| Chat | 1.33 | 1.26 | −1.43 | 3.43 | 0.63 | 0.64 | −0.57 | 1.70 | 1.44 | 0.68 | −0.12 | 2.37 |
| FTF After | 6.12*** | 0.87 | 4.67 | 7.56 | 6.39*** | 0.97 | 5.46 | 7.96 | 6.37*** | 0.66 | 5.57 | 8.02 |
| FB After | 5.72*** | 1.02 | 3.87 | 7.57 | 3.90*** | 1.68 | 2.37 | 7.69 | 5.00*** | 1.59 | 4.09 | 9.31 |
| Chat After | 4.32*** | 1.44 | 1.98 | 7.66 | 3.65** | 4.67 | 1.56 | 20.18 | 3.73** | 1.84 | 1.54 | 8.29 |
| Last period | −0.94*** | 0.15 | −1.22 | −0.64 | −0.70*** | 0.12 | −0.98 | −0.52 | −0.82 | 0.43 | −2.26 | −0.48 |
| Daily FB use | −0.64** | 0.26 | −1.22 | −0.21 | −0.50** | 0.20 | −1.01 | −0.21 | −0.63* | 0.38 | −1.48 | 0.02 |
| Many friends | 0.22 | 0.40 | −0.47 | 1.16 | 0.11 | 0.33 | −0.30 | 1.07 | 0.39 | 0.60 | −0.38 | 1.87 |
| | Number of Obs. = 2472<br>Wald $\chi^2(10)$ = 9883.16<br>Adjusted $R^2$ = 0.4891 | | | | Number of Obs. = 2472<br>Wald $\chi^2(10)$ = 113.68<br>Pseudo $R^2$ = 0.1991 | | | | Number of Obs. = 2472<br>Wald $\chi^2(10)$ = 840.53<br>Pseudo $R^2$ = 0.5720 | | | |

Notes: Bootstrap replications based on 13 clusters at the session level. Note that confidence intervals are based on bootstrap replications. ***Significant at 1%; **significant at 5% level; *significant at 10% level.

[8]See Deaton (1998, 91) on the dangers of using nonlinear regressions when the distribution of the error term is unknown. As a robustness check, we present the results of both linear and nonlinear regression estimations. We do not use nonparametric tests because the groups within sessions are not independent, due to the rematching after Part 1.

(higher) in all three communication treatments as compared to the NC baseline. Finally, comparing changes in contributions across the three communication treatments, we find no significant differences among the treatments: the null hypothesis of no difference among 'FTF After', 'FB After', and 'Chat After' coefficients is not rejected based on $\chi^2$ tests ($p>0.1$ for all three regression specifications reported in Table 2).

Why was communication so successful in achieving full contributions? Brosig, Weimann, and Ockenfels (2003) and Bochet et al. (2006) attribute the effectiveness of communication under VCM to the individual's ability to discuss cooperative strategies and to express commitments to these strategies. Accordingly, we analysed group communication logs to see if each group discussed the game and agreed on everyone contributing all 10 tokens to the public fund.

Among the three communication treatments, 24 out of 25 groups discussed the game and agreed on full contributions.[9] Out of these 24 groups, 23 fully contributed until the penultimate period, with only occasional deviations. Specifically, under FTF, all 10 groups agreed on full contributions, and only one individual deviation was observed before the last period. Under FB, seven out of the eight groups agreed on full contributions, and had only one deviation before the last period. Under Chat, all seven groups agreed on full contributions, and in six out of these seven groups, no deviations were observed before the last period. Online Supplementary Material D illustrates individual group contribution dynamics (Figures 2–5), and percentages of participants fully contributing by treatment (Figure 6). We conclude that our data reject Hypothesis 1 in favour of Hypothesis 2:

**Conclusion:** *There were no significant differences in the effectiveness of direct Face-to-Face communication as compared to communication mediated through Facebook or Online Chat. Under all three communication media, one-time communication allowed for full and sustained cooperation in the VCM game. The overwhelming majority of groups discussed the game, agreed to fully contribute to the public good, and followed through with their agreements until the penultimate period.*

## IV. Discussion

Our results suggest that among a population of college students, there is no longer a difference in the effectiveness of direct FTF communication compared to communication mediated through familiar online media (FB and online chat) in sustaining cooperation in a simple VCM game. While the three media differ in the potential richness of communication and social channels (e.g. Roth 1995), we observed that our participants were able to use these media equally effectively in finding and sustaining cooperative agreements. In contrast to early studies that used recurring communications (Isaac and Walker 1988), only one communication session was necessary to sustain full cooperation until the penultimate period in almost all (23 of 25) communication groups.[10]

As our subject pool consists of young adults who are familiar with online media, – 117 out of our 124 participants have FB accounts, – we cannot say if the result would be different had we used a different subject pool for whom texting and Facebooking are less common. However, given the commonplace use of these online media, a subject pool of nonusers would be less representative of the current U.S. population overall and of young adults in particular.

A question motivated by our work is what effect does the use of online social media have on people's cooperative behaviour? Some survey results suggest that FB users are more trusting than others, have closer relationships and get more social support than other people (Hampton et al. 2011). Although we cannot fully explore the connection in this short article, we inquire whether participants who reported to be daily FB users, or those who have more than 100 FB friends, behaved in the VCM any differently than other participants. Our regression estimates reported in Table 2 suggest that the daily FB users contributed to the public good slightly less (0.64 tokens less in the linear regression specification), whereas the effect of having more than 100 FB

[9]Here is a typical example of an agreement: '…Everyone cool with putting in all 10 every time?' 'Sounds good to me.' 'Same here.' 'Yes, sounds like a good idea…' (FB Group 2). More samples of communication logs are provided in online Supplementary Material E.

[10]Observing frequent defections in the last period of the post-communication VCM game validates our results even further, indicating that our participants were fully aware of the strong incentive to defect, but did not act on it until the very last period.

friends was positive but insignificant. A deeper investigation of these effects is warranted. We leave it for future work.

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