EFFECT OF AN AUDIENCE IN PUBLIC GOODS PROVISION[*]

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April 2013

Abstract. This paper investigates a novel public goods game where contributions to the public goods require effort that is observable. When the players are observed, they exert more effort to contribute to the public goods, and free-riding diminishes significantly compared to the no observer case. These effects are absent when no effort is required in order to contribute to the public goods. Furthermore, in the presence of an audience, the contributions to the public goods do not diminish when the game is repeated in the effort-required environment. Being observed does not affect the performance of the players if there is no strategic aspect of the game, in other words, when they play a private goods game. These results indicate that an individual wants to avoid a lazy image when her effort helps the society.

Keywords: Public goods; observable effort; experiment; social image.

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[*] We would like to thank Rachel Croson, Elif Incekara Hafalir, Lise Vesterlund, and seminar participants at the University of Pittsburgh for many useful comments and feedback. We thank Ozlem Tonguc and Danyan Zha for their competent research assistance.

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1. Introduction

Provision of public goods may be accomplished either via donating money or exerting physical effort. For example, when the walls of a community center need to be painted, the town can collect money to hire someone or work together to paint the walls. In either method of provision of the public goods, the contributions may be observable. In this paper, we study the interaction between being observed and how the public goods are generated (through donating money vs. exerting effort). We show that the contributors want to signal to the audience only how hard-working they are when their effort helps society. However, making only monetary contributions does not have signaling value.

The pressure that the audience creates on contributors may depend on the exact role of the audience in the game. When an individual is observed by the other group members, she may act pro-socially in order to avoid the pain of telling the observers that she did not care about them or to motivate the others to contribute as well. To isolate such effects, in our study only independent third parties observe the players of the public goods games. Indeed in real life, the contributions may be observable by the other contributors, such as the other members using the community center or independent third parties such as people passing by the center in the example above. While cycling for a benefit, a cyclist's performance is observed by the audience watching the event, or when a volunteer gift wraps at a store to collect money for a charity, she is observed by all the individuals in the store. In these examples, the contributors are observed by a third party.

The contribution of this paper is two-fold: (i) it introduces a novel public goods game where provision of public goods requires physical effort; (ii) it studies the effect of a third-party audience when provision of public goods is done only through monetary donations and when it is done through exerting effort. In a standard public goods experiment, the subjects are asked to divide an endowment between public and private accounts. The parameters are selected so that the marginal return of the contribution to the public account is lower than its marginal cost, and therefore there are monetary incentives to free ride. We modify this game to accommodate the provision via effort such that the subjects need to perform costly tasks in order to contribute to the public good. After completing the public goods game, subjects are asked to solve the costly tasks for their private benefit (private goods game). The performance of subjects in the private goods game provides a measure of the capacity of the subjects in this task. As will be explained in detail later, we use this measure to evaluate how generous their contributions were in the public goods game part of a treatment. To study the effect of an audience, in some treatments, the performing subjects are watched by some observing subjects who are not part of the public goods game.

Our results show that presence of an audience increases the contribution to the public good significantly only when the effort is required for the provision of the public good. When no effort is required, the generosity of subjects is not affected by being observed. When effort is involved, the performers may have different motivations to work hard besides generosity: i) not wanting to look lazy when they perform for the benefit of the society, ii) wanting to show that they are good at performing the task, independent of who benefits from their performance and the size of benefit. We rule out the second motive by showing that the subjects' productivity is the same with or without an audience when they perform for their own benefit in a control treatment with weak monetary incentives.

Additionally, we check whether the observers' effect on the contributions is persistent by conducting repeated game versions of our treatments. When effort is required, we find that the contribution rates do not diminish over time in the presence of observers, although they decrease in later periods of the game without observers. In the repeated public goods games without effort, both with and without observers the contributions decrease over time and the trend is very similar in both cases. Therefore, also in repeated plays, the observer effect differs depending on how public goods are produced.

Related Literature:

The existence of an audience may trigger the need for a social approval on the part of a contributor and may promote pro-social behavior (see e.g. Hollander (1990); Rege (2004); Rege and Telle (2004); Dana, Cain, and Dawes (2006); Tadelis (2008); Ekstrom (2011); also Chaudhuri (2011) for a survey of the literature). In the public good experiments that study identifiability, the contributions are made observable mostly either by other contributors who benefits from the public good (see e.g. Andreoni and Petrie, 2004, and the internal cause treatment of Soetevent, 2005) or by other contributors who do not benefit from the public good (see e.g. the external cause treatment of Soetevent, 2005, and Ariely, Bracha, and Meier, 2009). There are few exceptions: Ekstrom (2011) finds no effect of showing a picture of eyes on donating to charity. In two field studies on door-to-door fund raising, DellaVigna, List, and Malmendier (2012) and Soetevent (2011) show that social pressure plays an important role in solicited donations. The picture of eyes in Ekstrom's study and the solicitors in the field experiments are similar to having a third party observer. Similar to Ekstrom (2011) but unlike DellaVigna, List, and Malmendier (2012) and Soetevent (2011), we find no effect of third party observers in our no-effort treatments. Perhaps, the solicitors are perceived by donors as "other benefactors" since they invest their time in going from door-to-door.

Andreoni and Petrie (2004) study repeated public goods games without effort where either subjects' pictures or contribution amounts or both are revealed to the other contributors. They find that being identifiable increases contributions, but in our repeated games without effort, the presence of observers does not change the contributions. They explain this increase through the value of setting an example to the other contributors in order to motivate them to contribute. This kind of motivation is effective in their study because the contributors observe each other's contributions, but we have third-party observers. Soetevent (2005) studies identifiability in a natural context where subjects donate in church sequentially. Being observable does not affect behavior when the cause is internal which contrasts with Andreoni and Petrie (2004). However, Soetevent (2005) finds an initial increase in contributions when subjects see each other's donations and the funds are being collected for an external cause, but the effect peters out over time. Ariely, Bracha, and Meier (2009) examine the interaction between extrinsic motives and social image (via identifiability) in provision of a public good where effort is required.[1] Similar to Andreoni and Petrie (2004), here subjects are identified by the other contributing subjects after the contributions are made, but this time the free-riding behavior of a contributor does not affect the monetary payoff of the observing ones. They find evidence for the "crowding out" hypothesis, that is, extrinsic incentives decrease the signaling value of pro-social behavior. In their "good cause treatment", Ariely, Bracha, and Meier (2009) find no significant difference between identifiable and unidentifiable treatments in absolute level when extrinsic motives are involved (see their Figure 1, Panel A, page 549). However, in their "bad cause treatment", being identifiable decreases contributions when there are extrinsic motives (see their Figure 2, Panel A, page 550). It is important to note that the extrinsic motives are introduced by paying subjects an amount equivalent to their charity contributions. Therefore, in their design, the marginal monetary cost of contributing does not necessarily exceed its marginal monetary benefit.

Pro-social behavior promoted by intrinsic motives (e.g. the moral constraints by Sugden, (1984); the "warm-glow" by Andreoni (1989, 1990); the "Kantian" rule by Bilodeau and Gravel (2004)) and heterogeneity in the strength of those motives have been extensively studied in the literature. As argued earlier, individuals are more likely to engage in a pro-social behavior when it becomes more visible. The theoretical models of pro-social behavior due to image concern typically introduce a signaling game

[1] Some other public good experiments have an effort component. For example, in Kroll, Cherry, and Shogren (2005) and Ekstrom (2011), subjects, after earning their endowments, decide how much of their endowment to contribute to a public account; in Stoop, Noussair, and van Soest (2009), not contributing to the public good requires effort; and in Ariely, Bracha, and Meier (2009) subjects press specific keys for a certain amount of time on a keyboard in order to contribute to a charity.

between an observer and a decision maker (see Bernheim (1994), Glazer and Konrad (1996), Bernheim and Serverinov (2003), Bénabou and Tirole (2006), Andreoni and Bernheim (2009)). Bénabou and Tirole (2006) introduce a model where an agent acts to signal her preference for intrinsic and extrinsic motivations. In this model, the pro-social actions, indeed, reflect a variable mix of intrinsic motives, material self-interest, and social or self-image concerns. Grossman (2010) investigates the relative importance of self-signaling versus social-signaling in driving giving behavior and finds little evidence of self-signaling but stronger evidence of social-signaling. In a dictator game context, Andreoni and Bernheim (2009) theorize that people are fair-minded to various degrees, and they like others to perceive them as fair.

Our experimental results are in line with these theories where social image concern is "switched on" by the presence of observers. By showing that the observer effect depends on the way public goods are generated (whether a contributor's physical effort is required or not), we argue that the form of contribution has to be taken into account when applying any of these theoretical models. Our results indicate that the subjects are trying to be perceived as hard-workers in the act of generating public goods when observed by a third-party. Individuals may have other intrinsic motives for giving besides not being lazy but based on our no-effort treatments, they do not signal those intrinsic motives by monetary contributions.

The paper proceeds as follows: In section 2, we describe our experimental design and discuss our hypotheses. In Section 3, we present our results. Section 4 concludes.

2. Experiment

The experiment was run at the Experimental Economics Laboratory at the University of Maryland (EEL-UMD). The experiment was programmed in z-Tree (Fischbacher, 2007). 528 undergraduate students from UMD were recruited via our online recruitment system. Sessions with single round games took about 30 minutes; and sessions with multiple round games took about 80 minutes. In each session, only one of the ten treatments was administered, and no subject participated in more than one session. Table 1 provides a summary of our treatments. The main treatments differed from one another in three aspects: (i) Whether or not effort was required in order to generate public goods. (ii) Whether or not an observer was watching while a contributor was making a decision. (iii) Whether the subjects played single shot or repeated public goods games. Additionally, two control treatments of private goods games with weak incentives (with and without an observer) were conducted.[2]

TABLE 1

SUMMARY OF TREATMENTS

Treatment	Effort	Observer	# of Rounds	# of Subjects
EOS	Yes	Yes	1	80
ES	Yes	No	1	44
OS	No	Yes	1	80
S	No	No	1	40
EOR	Yes	Yes	8	64
ER	Yes	No	8	28
OR	No	Yes	8	64
R	No	No	8	32
O-Weak	Yes	Yes	1	64
Weak	Yes	No	1	32

In treatment names, E indicates effort is required, O indicates there is an observer, S indicates it is only a one-shot game, and R indicates there are multiple rounds of public goods game. O-Weak and Weak are private goods games with weak incentives.

In treatments with observers, subjects were separated at random into equal groups of contributors (actual players of the public goods game) and observers in a session. In treatments without observers, all the subjects were contributors. The contributing subjects were seated in isolated computers. In a given session if there were observing subjects, each of them was randomly matched with a contributing subject, and each observer stood behind the assigned contributor and watched the computer screen while the

[2] We thank the editor and an anonymous reviewer for pointing the need for these control treatments.

contributor played the game. In single-round treatments (EOS, ES, OS, and S), all subjects played a one-shot public goods game; and in multi-round treatments (EOR, ER, OR, and R), each subject played 8 rounds of public goods game with the same group of people. Each group of players was randomly formed by the computer at the beginning of a session. There were four contributing subjects in a group, and a subject did not know the identity of the other group members.

Treatments EOS and ES:

These treatments had two parts: a public goods game and a private goods game.[3] In the public goods game, each subject was initially endowed with $5.00, and she was asked whether she wanted to complete a task for her group. If she said *yes,* she paid $0.50 to see a task that was defined as adding up five two-digit integers that were randomly generated by the computer and presented on the contributing subjects' screens.[4] Each correctly completed task generated $1 in the group's public account. The four group members equally shared the amount that was accumulated in the public account. Therefore, $0.25 was earned by each group member for each correct answer from the group.[5] After completing a task, each subject was asked whether she wanted to see another task by paying $0.50, and the same procedure continued for five minutes. After completing each task, the computer reported whether the answer was correct. At the end of the public goods game, each subject learned how many tasks she completed correctly and how many tasks her group completed correctly.

After completing the public goods game, the private goods game started.[6] With $5.00 initial endowment, the contributing subjects were asked to complete the tasks to earn money only for themselves. They were no longer group members. They again decided whether to see a costly task or not, and this time they earned money only from their own correctly completed tasks. In this part, seeing each task cost $0.50, and each correctly answered task earned $0.75, i.e. for each correct answer, the subjects earned $0.25.

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[3] In the instructions, we did not call them public/private goods games; instead they were named as Parts I and II.

[4] This task was introduced by Niederle and Vesterlund (2007) in private goods settings.

[5] Subjects could attempt as any many tasks as they wanted; nevertheless, none of the subjects bankrupted.

[6] In this paper, we compared the effect of observers in public and private goods games, separately. We ensure that order effect (if any) is the same across treatments since in both treatments the order was fixed. Furthermore, since the behavior in the public goods games is of utmost importance, the subjects played it first to avoid (if any) spillover effects.

The role and payoff calculation of contributors in Treatments EOS and ES were identical. In Treatment EOS, each observer was provided a pen and a piece of paper and asked to report whether the contributor completed each task correctly or not. The observers were paid according to how accurately they reported the performance of the contributors.[7] The contributing subjects knew the payment schemes of the observers; therefore, they were aware that the observers received no benefit from the public goods game.

In the experiment, we did not identify how much a subject earned, and we did our best to convince subjects that the experimenters did not monitor or observe the decisions of any subject. In order to do this, in each session, we had two experimenters: one in the laboratory and one in a different room. The one in the laboratory did not see the decisions of the subjects. The subjects were assigned random ID numbers, and the server collected data under the ID numbers. The experimenter who stayed in a different room saw the data collected in the server and prepared the payment envelopes. She sealed the envelopes and wrote the ID numbers on them. At the end of each session, the experimenter in the laboratory took the envelopes from the other room and distributed them to the subjects. We explained this procedure to the subjects before the experiment started.

Treatments OS and S:

The public goods games in these two treatments did not require any effort to generate the public goods. The games were similar to the standard public goods game experiments in the literature. As in the Treatments EOS and ES, here each contributing subject played a single-round public goods game with three other players. At the beginning of the game, each contributor was endowed with $5, and she was asked to distribute this amount between her private account and the group account. The amount collected in the group account (the sum of the amounts that were put in the group account by each member of the group) was doubled, and then the four group members equally shared the amount. Therefore, similar to Treatments EOS and ES, for each $0.50 contributed to the public account, a subject gets back $0.25.[8] The role of observers in Treatment OS was to report the amount of contribution of the assigned contributor.

[7] All the reports were 100% accurate, and hence all the observers earned $10.

[8] Here, we only equalize the monetary cost and benefit of contribution in effort and no-effort treatments.

Treatments EOR, ER, OR, and R:

Treatments EOR, ER, OR, and R were repeated versions of Treatments EOS, ES, OS, and S, respectively. Four contributing subjects were matched at the beginning and played eight rounds of public goods game. After finishing the repeated public goods game, in Treatments EOR and ER, they played the private goods game which was identical to the private goods game played in Treatments EOS and ES. Subjects were paid what they earned in two randomly selected rounds of the repeated public goods game in addition to what they earned in the private goods game in EOR and ER; in OR and R, they were paid based on one randomly selected round.

Treatments O-Weak and Weak:

Treatments O-Weak and Weak were private goods games with weak incentives. They were similar to the private goods game parts of Treatments EOS and ES, respectively. The only difference was that the payment parameters were scaled down by dividing by 10. In other words, the cost of seeing a task was \$0.05 and solving it correctly paid off \$0.075, i.e. for each correct answer, the subjects earned \$0.025.

Discussion of the Treatments and Hypotheses:

Andreoni and Petrie (2004) argue that identifiability in a public good game may trigger desire to set a reference point to the others to influence other contributors' actions (see also Bazerman et al., 1992, Loewenstein et al., 1989, Berkowitz, 1972), or image concerns such as prestige (see also Harbaugh, 1998a,b), pride (see also Nathanson, 1987), and shame (Broucek, 1991). Their findings are more in line with the "setting a reference" motivation; however, this cannot be effective if the identifying individuals are not potential contributors as in our setup. According to social image theories, in the context of a public goods game, people want the audience to perceive them as having high intrinsic motives (for example Benabou and Tirole, 2006). Our experimental design (comparing EOS with ES and OS with S) is tailored to identify those intrinsic motives that people would like to signal to observers.

The marketing and psychology literatures have established that giving money and giving time (or volunteering) correspond to different mind sets of the donors (Liu and Aaker, 2008). People's representation of giving time is more closely associated with concepts of emotional meaning (Carstensen, Isaacowitz, and Charles 1999; Van Boven and Gilovich 2003). In contrast, the representation of money is more closely associated with concepts of economic utility (Loewenstein, Read, and Baumeister 2003;

Vohs, Mead, and Goode 2006). Liu and Aaker (2008) claim that when asked to volunteer time, the association between charitable contribution and emotional well-being is likely to become more salient. On the other hand, when monetary donations are asked, people consider the implication of contributing to charity in light of a value-maximizing goal. Society seems to appreciate volunteering type of giving more than monetary donations. Microsoft advises its employees to donate to charity through volunteering their expertise rather than their money (Yao 2006), Mother Teresa[9] teaches that "Charity and love are the same -- with charity you give love, so don't just give money but reach out your hand instead". Given that social norms promote volunteering over donating money, we argue that one seek for prestige through exerting effort but not just giving money for the provision of public goods. Our treatments are motivated from testing a possible difference between the social image content of the act of giving when it is in the form of money and when it is in the form of exerting effort to improve the efficiency in the society.

Hypothesis 1a: *People attempt more tasks to contribute to the public goods when they are observed by a third-party.*

Hypothesis 1b: *People contribute the same amount of money to the public goods when they are observed by a third-party and when they are not.*

Rejection of Hypothesis 1b means that individuals would like to use monetary contributions as a signal regarding their intrinsic motives to the third party. Rejection of Hypotheses 1a means rejection of individuals seeking for the image of being hard workers when their effort benefits the society.

While searching for an instrument that boosts the provision of the public good, it is important not only to identify the type of games where it is effective (as in Hypotheses 1a and 1b), but also to see whether the effect is persistent. To the best of our knowledge, social image theories have been written for static games. If pro-social behavior due to the presence of an observer is due to confusion or contributors transmitting their message to the audience by behaving pro-socially only once, then this kind of identifiability will not lead to higher contributions in the long run. On the other hand, if people want to be perceived as willing to work hard for the benefit of the society, they should exert effort repeatedly and send a consistent message to their audience. The next research questions that we ask are whether the effect of audience, when it exists, is persistent over time and whether the time trend of the effect depends on the nature of contribution (money vs. effort). If subjects are not concerned with image the contribution

[9] Mother Teresa, *A Simple Path,* page 85.

rate should decline over time, as in any standard public goods game. The repeated nature of Treatments EOR, ER, OR, and R allows us to test the following hypothesis.

Hypothesis 2a: *The number of tasks attempted stays the same across different periods when subjects are observed by a third-party but declines when they are not observed.*

Hypothesis 2b: *The contribution amounts decline over time when effort is not required in generating public goods.*

An alternative explanation that is consistent with being more pro-social when observed only in effort-required public goods games might be that the performers want to show off their ability to the audience. To rule out this explanation, we conducted Treatments O-Weak and Weak. In these treatments, since the subjects play only the private goods games, we can test the audience effect on performance apart from its effect on generosity. Moreover, the monetary incentives in those treatments are quite weak ($0.025 per correct answer) so the performers may not be motivated to work at their full capacity as in the private goods games following the public goods games with effort. Therefore, there might be some room to solve more tasks in five minutes when the observers watch if indeed the audience makes the performers more productive. Rejection of Hypothesis 3 below would imply a rejection of explanation that subjects want to show off to the observers regarding how well they can add up numbers. Therefore, the "show-off" motive is not the driving force of higher public goods provision in effort-required games with observers.

Hypothesis 3: *The number of attempted tasks for the private benefit changes when individuals are observed.*

In ES and EOS, a private goods game follows the public goods games but we do not use them solely to test Hypothesis 3. They are designed to provide a measure of the capacity of a subject in the addition task when she is observed and not. We believe that paying $0.25 per correctly solved task in the private goods games provides our subjects with a strong enough motivation to perform at capacity. The performance in these games is indeed close to what Niederle and Vesterlund (2007) find in a comparable game.

3. Results

In our single-round public goods games, the observations are independent, as the subjects do not get any feedback before or at the time of the decision making. In our repeated games, the observations are independent at the group level due to fixed matching. Using these independent data points, we perform Mann-Whitney tests in our analyses unless noted otherwise. Table 2 summarizes our results.

TABLE 2

Treatment	Game	Attempts	Attempts conditional on positive attempts	Correct answers	Contribution rates*
EOS (N=40)	Public Goods Game	7.95 (0.496)	8.15 (0.464)	7.15 (0.48)	0.72 (0.033)
	Private Goods Game	10.85 (0.44)	10.85 (0.44)	9.65 (0.47)	
ES (N=44)	Public Goods Game	4.25 (0.497)	5.34 (0.471)	3.86 (0.46)	0.38 (0.042)
	Private Goods Game	11.05 (0.52)	11.05 (0.52)	9.52 (0.48)	
EOR (N=32)	Public Goods Game	8.25 (0.24)	9.06 (0.194)	7.05 (0.22)	0.72 (0.02)
	Private Goods Game	11.62 (0.14)	11.62 (0.14)	9.28 (0.165)	
ER (N=28)	Public Goods Game	4.37 (0.314)	6.43 (0.355)	3.91 (0.288)	0.37 (0.024)
	Private Goods Game	11.75 (0.22)	11.75 (0.22)	9.43 (0.263)	
OS (N=40)	Public Goods Game	-	-	-	0.53 (0.054)
S (N=40)	Public Goods Game	-	-	-	0.52 (0.051)
OR (N=32)	Public Goods Game	-	-	-	0.44 (0.017)
R (N=32)	Public Goods Game	-	-	-	0.42 (0.023)
O-Weak (N=32)	Private Goods Game	8.03 (0.621)	8.29 (0.583)	6.97 (0.628)	-
Weak (N=32)	Private Goods Game	8.44 (0.623)	8.71 (0.58)	7.66 (0.61)	-

Averages with standard errors in parentheses.
*(correct/attempt when # of attempts>0)

Result 1: *Being observed increases the contributions to the public goods and decreases free riding when effort is required. Furthermore, this effect is upheld in repeated public goods games.*

Result 1 shows that the social image concerns are present in effort-required public goods settings. When we compare Treatments EOS and ES, we find that attempts and correct answers (contributions to the public goods) in two public goods games are significantly different at the $p<0.001$ level. In EOS, 1 out of 40 subjects contributes zero; however, without an observer, the free-riding rate increases to 20.45% (9 out of 44 subjects). Fisher's exact test yields that free-riding decision is significantly affected by being observed ($p=0.011$). Not only free-riding decreases with observers but also the contributions of non-free riders increase. We find that attempts conditional on not free riding in these two treatments are significantly different ($p<0.001$). Finally, there is no significant difference between correct answer rates (# of correct answers/ # of attempts) for non-zero attempts in public goods games with and without observers ($p=0.121$).

Figure 1 shows the cumulative distribution of contributions in the two public goods games with and without observers. A first order stochastic dominance exists between these two distributions.

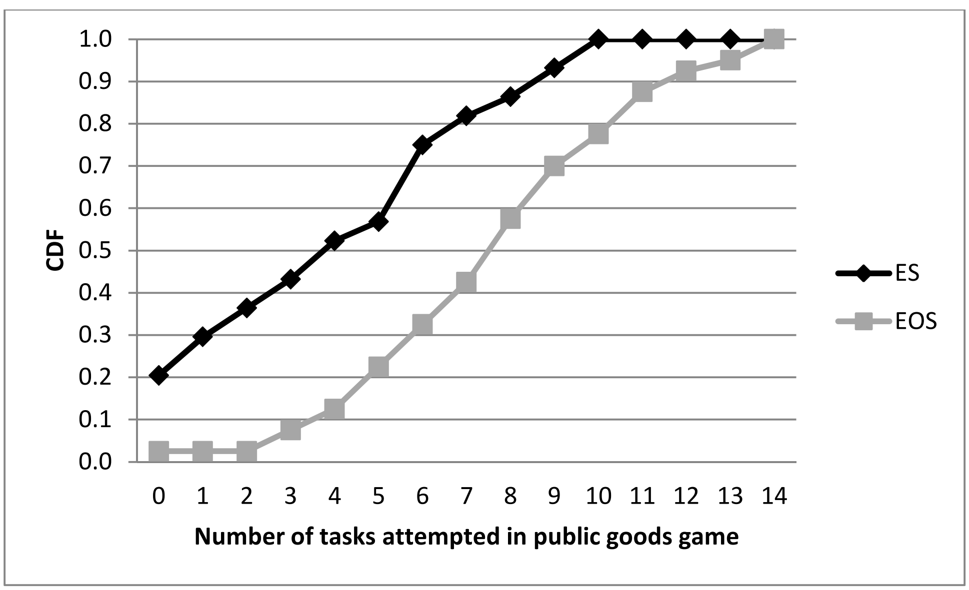

Figure 1: Cumulative distribution functions of number of tasks attempted in public goods provision with and without observer.

Furthermore, the observer effect exists in repeated plays as well. When we compare Treatments EOR and ER at the aggregate level, the attempts, correct answers, and attempts conditional on not free riding are still higher when observers are present (p<0.001). Similar to our treatments with single-round public goods games, there is a significant difference between the percentages of free-riding in Treatments ER and EOR (32.1% and 9%, respectively, with p<0.001 by Fisher's exact test). There is a significant difference between correct answer rates (# of correct answers/ # of attempts) for non-zero attempts in public goods games with and without observers (p<0.001).

Another way of measuring the effect of observer is to consider the contribution rate. Contribution rate in a public goods game is the ratio of actual contribution to the public goods over the maximum contribution one can make. In a standard public goods game, as in our OS, S, OR, and R treatments, contribution to the public goods does not require effort, and the initial endowment is taken as the maximum possible contribution level. The literature finds contribution rates between 0.4 and 0.6. When effort is required, the number of attempts in private goods games may be used as the maximum potential contribution level. When the subjects are motivated by the monetary incentives, they may exert their highest effort in the private goods game to maximize their own payoffs.[10] It is worth noting that, although our private goods games were played after the public goods games, the performance of our subjects was not different from that found by Niederle and Vesterlund (2007).[11] Therefore, we use this capacity measure in calculation of contribution rates to provide alternative support for Result 1.

First, we find that the average contribution rate without observers (in ES) is 0.38 which is close to the lower bound found in the literature. However, in EOS with the presence of observers, this rate jumps to 0.71. Mann-Whitney test shows that the contribution rates with and without observers are significantly different in games where effort is required (p<0.001).

Figure 2 shows the average contribution rates per period in two repeated public goods games. In Treatment ER, the contribution rates diminish over time. However, the observer effect is persistent in Treatment EOR. Moreover, the contribution rate in any period of Treatment ER is significantly smaller than the contribution rate in the corresponding period of Treatment EOR (p<0.05).

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[10] Additionally, in private goods games with strong incentives, there was no subject with zero attempts as it can be seen in Table 2.

[11] In any of the effort required treatments, there are no significant correlations between the payoffs in public goods game and the number of attempts in the subsequent private goods game.

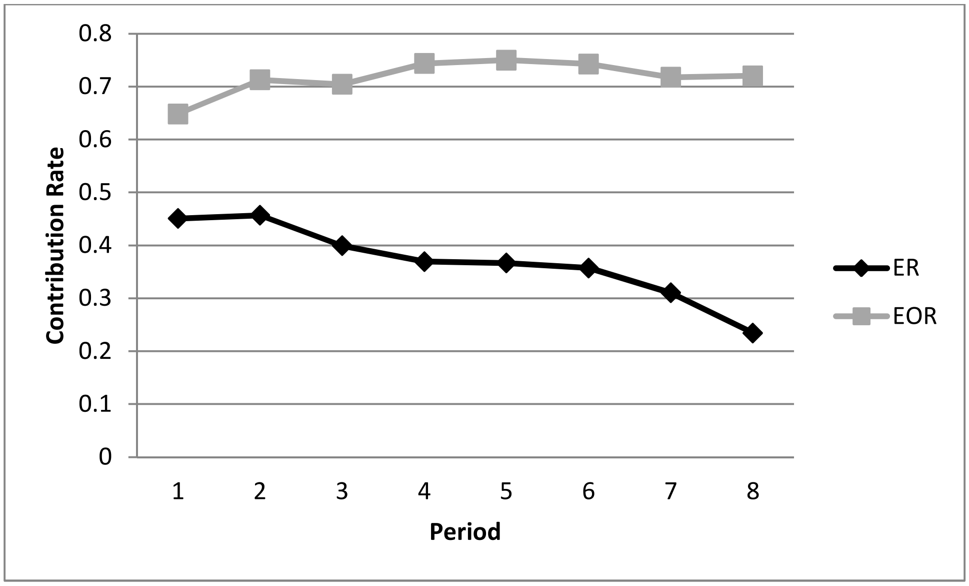

Figure 2: Average contribution rates per period in Treatments ER and EOR.

Result 2: *When effort is not required, there is no observer effect.*

To see whether the effect of observers on contribution levels is specific to the public goods games with effort, we need to look at our results from Treatments OS, S, OR and R, given in Table 2. The contribution rates in Treatments S and OS are not significantly different (p=0.842). Moreover, in both S and OS, only 5 out of 40 subjects put zero toward the public account, which contrasts with the significant difference between the number of free-riders in Treatments ES and EOS. Likewise, in the repeated versions, the contribution rates in Treatments OR and R are not significantly different (p=0.600). Hence, Result 2 suggests that the individuals do not use monetary contributions to signal their intrinsic motivtions.

Similar to the findings of other experiments where subjects played repeated public goods games without effort (see e.g. Andreoni (1988), Croson (1996)), in Treatment R the contribution rates diminish over time. The same declining pattern is observed in OR as well (as in Andreoni and Petrie (2004)). As can be seen in Figure 3, the contribution rates decline in both treatments. However, unlike Andreoni and Petrie (2004), the contribution rate is not always higher in one treatment than the other treatment. Putting our results together with those of Andreoni and Petrie (2004), when other contributors observe individuals behave pro-socially to set an example but when a third-party observes, monetary donations do not have a signaling value to gain a social image.

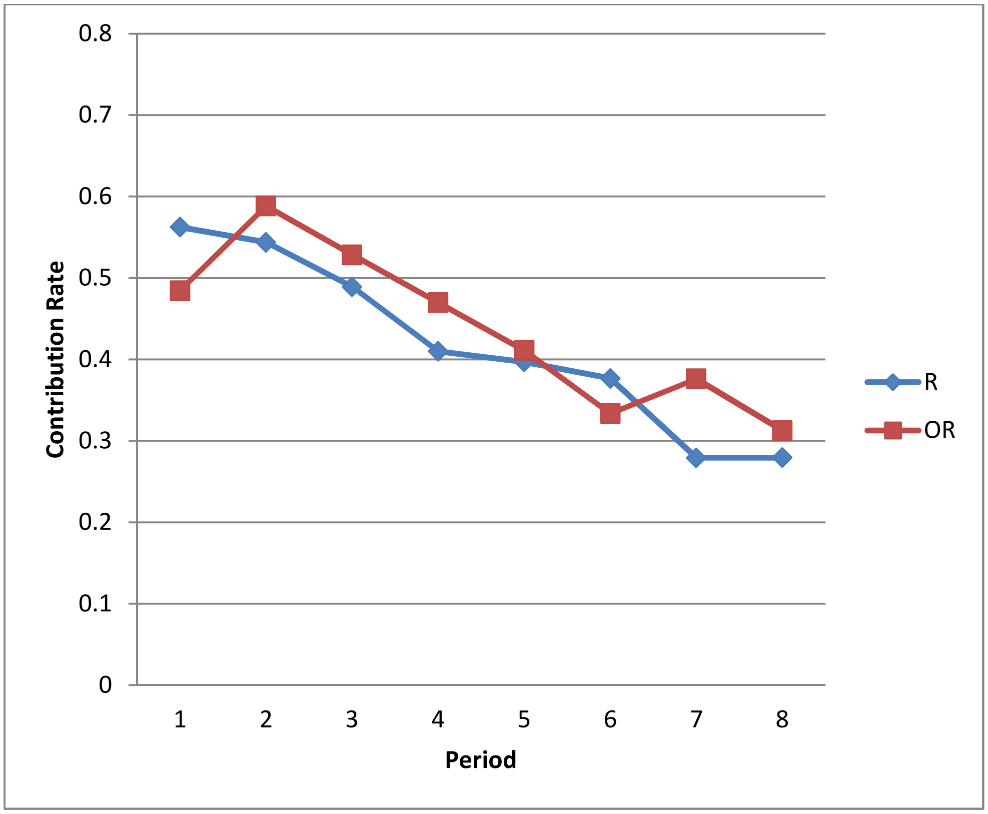

Figure 3: Average contribution rates per period in Treatments R and OR.

Result 3: *The strength of incentives but not the presence of observers affects the performance in the private goods game.*

Unlike the public goods game, the attempts and correct answers do not change in the presence of observers in any private goods games (EOS vs ES: $p=0.871$ and $p=0.732$; EOR vs ER: $p=0.371$ and $p=0.459$; O-Weak vs Weak: $p=0.979$ and $p=0.829$). Changing the incentives affects the attempts in private goods games. The attempts in ES and ER are significantly more than those in Weak ($p<0.001$); also the attempts in EOS and EOR are significantly less than those in O-Weak ($p<0.001$). The same is true for the correct answers. This result implies that showing off one's ability in adding task is not the motive of the performers.

4. Concluding Remarks

In this paper, we experimentally investigate the impact of a third-party audience on contributions in public goods games. By varying the way public goods are generated, we conclude that the subjects do not want to look lazy when their effort helps society. Furthermore, they do not use monetary contributions to gain social image. Finally, they are not trying to "show off" regarding their calculation ability, based on our findings in private goods games with weak incentives where there is a room for show off.

An interesting extension of our study may be an analysis of the observer effect when public goods game is played with earned income rather than laboratory money, and the comparison of the behavior in such circumstances and our effort required games. One may also endogenize the form of contributions, and investigate games where the contributors have the option of choosing between exerting effort and donating money. The observers in our design were randomly selected strangers. A natural question is how the audience effect changes depending on the identity of the observers and their relationships with the contributors. Gender effects, cultural differences and similarity of background are potential relevant social aspects that may be effective. Moreover, examining such factors in the field, where social identities naturally occur, would yield interesting results. Besides using social pressure as a tool to increase voluntary contributions to a charity, one may apply our finding to labor settings to diminish free-riding in the work place by making office space more open.

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Appendix

INSTRUCTIONS:{*public goods with effort*}

Welcome and thank you for coming today to participate in this experiment. Various research foundations have provided funds for this research. The instructions are simple, and if you follow them carefully and make good decisions, you can finish the experiment with a considerable amount of money, which will be paid to you in cash at the end. The exact method of calculating your final payment will be described.

We ask that you do not talk to any other participant in the room. If, at any time, you have a question, please raise your hand, and the experimenter will answer your question. Failure to comply with these instructions means that you will be asked to leave the experiment and all earnings will be forfeited. The experiment will last about 30 minutes.

In this experiment, a random ID number is generated for each computer. You will see this number on your screen. Your name will never be recorded in this study, and you will be known by these ID numbers. Another experimenter in another room will prepare the payment envelopes based on ID numbers without knowing your names. The sealed envelopes will be distributed to you by the experimenter in this room.

You are going to be randomly matched with another participant in this room. That participant is another volunteer, just like you, participating in this experiment. One of you (performer) will be performing several tasks that will be explained below. The other one (observer) will be standing next to the performer while he/she is performing. The observer is only expected to watch the performer and the performer's screen silently. **You are absolutely not allowed to talk to each other.**

If you are sitting in a workstation, then you are a performer. If you are standing, then you are an observer.

Instructions for the performer:

You will be randomly matched with three other performers in this room. Those will be your teammates, and your and their performance will affect your earnings. You will be asked to calculate the sum of five randomly chosen two-digit numbers that will appear on your screen. There is a series of these tasks that you may solve. For your calculations, you may use the scratch paper and pen that we provided you. You cannot use calculators. Each team member has the same role.

When the experiment starts, you and your teammates will be given $5.00 each initially. Depending on your and your teammates' decisions, your final earnings can be more or less than $5.00.

At the beginning, a box saying "**Do you want to see the first task?**" will appear on your screen. Seeing a task costs you 50 Cents. If you want to see the task, you need to click on "**Yes**". By clicking on "Yes", you will spend 50 Cents and see five two-digit numbers on your screen. You are going to be asked to calculate the sum of these five numbers. When you finish, you need to enter your answer on your screen where it says "**Sum=**". When you are ready to submit your final answer, just click on "**Submit**". Once you submit your final answer, you cannot go back and change it anymore. The computer will tell you if your answer is correct or wrong. For each correct answer by a team member, your team will gain $1.00, and this amount will be equally shared by all the team members, in other words since there are four members, you will gain 25 Cents for each correct answer by your team. For the wrong answers, your team will not gain any amount.

If you do not want to see the first task, then you need to click on "**No**" when you see "**Do you want to see the first task?**" on your screen. Clicking on "No" does not cost or gain you anything. If you pick "No", then your role finishes.

If you solve the first task and submit your answer, then you will pass to the second task. Again a box will show up and say "**Do you want to see the second task?**" As before, you can click either on "**Yes**" or "**No**". Seeing a task costs you 50 Cents. If you pick "Yes", then you will see another set of five two-digit numbers that you are asked to add. Once you calculate the sum, enter it on your computer screen and click on "**Submit**". The computer will tell you if your answer is correct or wrong. Again, for each correct answer by a team member, your team will gain $1.00, and this amount will be equally shared by all the team members, in other words you will gain 25 Cents for each correct answer by your team. For the wrong answers, your team will not gain any amount. If you do not want to see the second task, then you need to click on "**No**" when you see "**Do you want to see the second task?**" on your screen. Clicking on "No" does not cost or gain you anything. If you pick "No", then your role finishes.

This same exercise will continue. You have 5 minutes to work.

Each team member starts with the first task. The ones who pick “Yes” continue seeing tasks. The ones who pick “No” stop seeing new tasks and their role finishes. When there is no team member left (in other words all team members picked “No”) or 5 minutes pass, we will calculate your earning.

Earning of the performer:

The computer will calculate the number of submitted correct answers by you and your teammates. For each correct answer by your team, your team will earn $1.00. You will gain ¼ of the total earnings of your team in addition to your initial $5.00. From this gain, the computer will subtract the cost of tasks that you have attempted to solve. Remember that seeing a task costs you 50 Cents. The difference will be your earning. This is calculated by the following formula:

$$\text{Earning} = \$5.00 + \frac{\text{Total correct answers of your team}}{4} - 0.50 \times (\text{Number of tasks you saw})$$

For example, let’s say you saw 12 tasks and solved 10 of them correctly, and you and your teammates correctly answered 16 tasks in total. Then, in addition to your initial $5.00, you will gain $4.00 as your share from your team’s $16.00 (which is accumulated by your team by giving 16 correct answers in total). From this gain, $6.00 will be subtracted because you saw 12 tasks and each costs 50 Cents to you:

$$\text{Earning} = \$5.00 + \frac{16}{4} - \$0.50 \times (12) = \$3.00$$

The earnings of your teammates will be calculated by a similar formula for them. Let’s do a similar earning calculation for you in another example. Let’s say, you saw 12 tasks, and answered 10 of them correctly. You and your teammates correctly answered 32 tasks in total. Then your earnings will be

$$\text{Earning} = \$5.00 + \frac{32}{4} - \$0.50 \times (12) = \$7.00$$

Your final screen will show you how many tasks you answered correctly, and your team's total number of correct answers. The computer will also calculate the total amount you made. You will receive this amount in private at the end.

<u>Instructions for the observer:</u>

In this experiment, you are asked to observe your matched performer while he/she is performing his/her tasks. At the beginning, you will be given \$5.00. You are expected to watch the performer's computer screen carefully, and your role is to identify whether the performer completes a task correctly. Use the provided blank page as your report sheet. First, write the ID number of the computer which you are watching on your report sheet.

After completion of each task by the performer, if the computer reports that the task is solved correctly, mark **"C"** next to a task number on your report sheet. If the computer reports that the answer of the performer is wrong, then mark **"W"** next to a task number on your report sheet.

At the end we will collect your report sheet and hand them to the experimenter in the other room. You will earn additional money based on how accurately you reported the performance of the performer:

$$\text{Earning} = \$5.00 + \$5.00 * \frac{\text{number of accurately reported tasks}}{\text{number of solved tasks}}$$

Instructions for Part II: *{given after first part is completed}*

In this part of the experiment, you are not in a team, in other words only your own performance will determine your earnings. Again you will be given \$5.00 initially.

Your task is the same as the first part of the experiment. You will be asked to calculate the sum of 5 randomly chosen two-digit numbers that will appear on your screen. In order to see a task, you need to click on the "OK" button on your screen. You may use the scratch paper and pen that we provided you. You cannot use calculators. This part of the experiment is 5 minutes long.

Earning of the performer:

The cost of seeing a task is 50 Cents, and you earn 75 Cents for each correctly solved task. Therefore, for each task you solved correctly, you will earn 25 Cents. Hence, your earning from this part of the experiment will be calculated by the following formula:

$$\text{Earning} = \$5.00 + 0.75 \times (\text{Total correct answers you solved}) - 0.50 \times (\text{Number of tasks you saw})$$

Your final payment will be the sum of your earnings in parts I and II.