Examining the Behavior in Public Good Games: An Application of Prisoner's Dilemma

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Abstract

This study is an attempt to mimic a real-life scenario in which individuals have a choice to opt between personal benefits and communal benefits. The purpose of the study is to analyze the patterns in charitable giving under different scenarios, i.e., as an individual and as a member of a social group. The study employs a modified version of the standard "Public Good Game"; it offers novelty in terms of the addition of the role of social pressure on charitable giving. The study dichotomized the game design into two settings: the first one was when an individual was made to play the game and contributions were anonymous, while the second set was the case when group size was fixed, and intragroup communication was allowed. The magnitude of contributions was significantly lower in solo settings as compared to group settings. As the game progressed, contributions toward public goods decreased in solo settings, while an opposite pattern was observed in group settings. Results show that wherein free ridership is not a dominant strategy, its presence further weakens with the introduction of social pressure. The uniqueness of the current study lies in the fact that the game design used in this study reflects an interdisciplinary perspective encompassing sociology, psychology, and economics.

Keywords: Free-rider; public good provision; social pressure; groups; experiment.

JEL Classification: H30, H41

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1. Introduction

Human decision-making has two distinct systems: system I, which makes split-second decisions in emergencies, and system II, which is reserved for situations that require the complex and thoughtful activity of the human brain. Closely linked with the idea of irrationality is the idea of free ridership in group behaviour; the "free-rider hypothesis" (FRH) is the belief that some individuals in a population will tend to consume more than their fair share of a common resource, or that they will pay less than their fair share of the cost of the common resource (Stein et al., 2021). The FRH purports to explain the inability of rational economic agents to set aside their self-interested motivations in the face of mutually beneficial gain. This problem has cropped up under various headings in several different disciplines of social science, but what it ultimately comes down to is the problem of collective action.

The collective action problem refers to a situation where two or more agents face two courses of action: coordination or defection. Defecting is believed to be the individually rationalistic option i.e. if the individual chooses to defect, he can expect to maximize his returns. However, joint coordination of actions can result in greater gains that are mutual to all. Coordination is the socially optimal option; however, it is not rationally individualistic because of the lower private returns it offers and this causes conflict to arise. The conflict is primarily between individual and group interests, and it leads to a collective failure that is termed the collective action problem. Thus, the collective action problem can be summed up as the failure to achieve the outcome everyone would prefer over the outcome. This is because each individual prefers to enjoy the benefits of a socially optimal result without having to endure the costs of it; the resultant overall situation is, consequently, one that is socially inferior. The lack of interest in participation in collective action problems often leads to free ridership; once provided, the good is available to all regardless of their participation. The problem of collective action was best illustrated by Olsen (1965). Before that, the consensus was that there was a natural tendency for people with shared interests to come together in the pursuit of those interests, i.e., there was an unproblematic convergence between individual and group interests, with which Olsen (1965) disagreed.

Today, the FRH can be divided between two approaches: one purported by Samuelson (1954) and the other by Brubaker (1975). Samuelson (1954) provided the weak version of the FRH where sub-optimal provision will occur; Even if some members contribute towards the good because of their interests, there will be members present that free ride off others' contributions. Brubaker (1975) provided the strong FRH: under ideal-typical conditions, no agent should be contributing towards the provision of the public good, i.e., the total contribution by the group should be zero. The conflict an individual face is similar to that illustrated in the prisoner dilemma game; regardless of others' behaviour, the individual is better off not contributing, but if everyone behaves in such a manner, all are made worse off. This scenario has been termed the "Tragedy of the Commons" by researchers (Almeida et

al., 2020; Wilson et al., 2020). The tragedy of the commons implies that generally, people are motivated to work for personal gains more than the communal gains. Hence, in a situation where benefits can be mutually dispersed among all, theory frequently highlights the individual's tendency to contribute as little as possible – and in the process diminish the benefits not only for himself but the entire group he belongs to (Wilson et al., 2020). Proponents of the "Tragedy of the Commons" and the FRH argue that people can reap the benefits of the public good without contributing to it, so non-cooperation is the dominant strategy (Schreck et al., 2019). Yet at the same time, more contributions to the public good would collectively yield a greater payoff to all, so in such a case, individual self-interest is at odds with the combined interest of the group (Ledyard et al., 2020).

Despite economic theory frequently asserting free ridership as a dominating phenomenon in the public good provision, experimental work has questioned this assertion. The most influential paper on this topic (Marwell & Ames, 1979) found that tests of the hypotheses derived more or less directly from the economic theory showed a very weak free-rider hypothesis. Around 57% of available resources endowed to participants were found to be invested in the public good. Ironically enough, the strongest support for the free-rider hypothesis emerged when participants were economists themselves suggesting that such behaviour could very well be learnt rather than naturally occurring. Furthermore, free-rider tendency was shown to be situational, with a significant lack of free-rider problems in the voluntary provision of public goods when any of the "invalidating factors" were present (Kim & Walker, 1984). Moreover, voluntary contributions to public goods can be increased if a stochastic funding policy is followed by the central authority (Huck & Kubler, 2000). Later research was able to expand and move beyond free riding to include the intricacies of human behaviour.

Experiments showed that marginal per capita returns to an individual could play a more impactful role regarding free-riding behaviour as opposed to group size (Issac et al., 1994, Carpenter, 2007), and that familiarity between contributors could encourage contributions (Keser & Winden, 2000). Increases in group size failed to aggravate free ridership; thus, going against conventional wisdom (Lipford, 1995; Haan & Kooreman, 2002). There is strong evidence for the role conditional cooperation plays in determining contribution rates, with papers going so far as to identify a "type" of an agent who models his contributions based on the contributions of others (Frey & Meier, 2004).

The novelty of the current study lies in the fact that it takes an interdisciplinary perspective by employing ideas from sociology, psychology, and economics. It aims to delineate the intricacies of human behaviour with an angle on how social influences can play a role in determining contribution rates. This paper attempts to examine how well economic theory translates into reality via a public good game. Specifically, the research objective of the current study are as follows:

[1] To determine the individual's willingness to pay for public goods; to check the presence of free ridership after implementing social pressure.
[2] To compare the willingness to pay for public goods across two settings: with social pressure and without it.

2. Literature Review

Several studies show how social pressure does, in one way or another, affect an individual's behaviour. People want others to perceive them as fair (Andreoni & Bernheim, 2009). Therefore, they are more generous towards in-group members (Chen & Li, 2009). Generosity and giving behaviour in the face of social pressure, surprisingly, leads to people feeling more positively perceived by others, which influences their perception of themselves.

Social desirability is also relevant in the context of public good games (Fleming & Zizzo, 2011). Social influences can affect an individual's willingness to contribute towards public goods (Carman, 2003). When an individual is assured that his actions will be unobservable, he chooses to act in a manner that is optimal (yields maximum utility) and utilizes the full information available to him. However, when his behaviour becomes observable, he distorts it in order to improve other's perception of him. This increases the contribution to public goods, but at the expense of the giver's disutility and an increased social cost (Daughety & Rainganum, 2010). On the other hand, total contributions may also increase under social pressure with the intention of equalizing income redistribution.

Social pressure has been seen as an impactful way of motivating peers towards more pro-social behaviour, as individuals who are unwilling to contribute to door-to-door campaigns would avoid saying no because of social pressure (DellVigna et al., 2012). Hanes (2012) highlighted a telling trend: there was a noticeable rise in volunteer work among the younger generation. Despite many influencing factors, the study could single out influence from the behaviour of one's colleagues as particularly prominent, i.e., 75.9% of those who volunteered had friends that were involved in social work. Podjed (2014) analyzed the same impact through a different perspective and looked at how observation, either by a friend or an acquaintance, could affect an individual's driving habits. Furthermore, not only external but also self-surveillance had a significant impact on an individual's habits. Such initiatives have illustrated the many ways social influences can impact individual behaviour and how harnessing such a motivator can induce cooperative pro-social behaviour. An example of such an initiative is the 'Ice Bucket Challenge. The challenge was a way to collect donations for the Amyotrophic Lateral Sclerosis (ALS) Association and involved dumping a bucket of ice water over one's head or giving $100 to the association. Interestingly, people not only dumped water on their heads but would also willingly donate.

Various factors, like gender differences, status-seeking motives, envy, and even age differences, once compounded with social pressure, could affect the degree of willingness to pay. However, it was observed that social influences at a personal level have a greater effect on behaviour and charitable giving as opposed to impersonal methods such as television ads (Long, 1976). Besides these factors, group identity can also impact social preferences and thus affect social welfare maximization. There exists strong evidence of linkages between-group favouritism and the extent of charity (Chen & Li, 2009). Thus, as a potent inducer of cooperative, pro-social behaviour, researchers have relied on controlled environments to ascertain more precisely the effect social pressure can have on an individual's willingness to pay, and that the experimental studies have a greater capacity to shed light on free-rider tendencies than other empirical methods (McCaleb & Wagner, 1985). Though the literature is extensive, donations to charities/fundraisers have been used as a proxy for an individual's willingness to pay for public goods, and social pressure has been incorporated into experiments in a variety of ways, including through pins signalling support for a charity (Kessler, 2011) or more overt behaviour such as verbal solicitation (Andreoni et al., 2017). Generally, the findings indicate a strong positive link between the presence of social pressure and charitable conduct.

Literature review allowed us to understand that practical tests of the free-rider problem have shown that, at the very least, there is little support for the problem's existence unless experiments have been aided by some facilitating constraints. Human behaviour is dynamic enough in nature to not be as simplistically explained away as economic theory has done. Behaviour is actually peppered with nuances and has a tendency to vary from theory. Meanwhile, the impact of pressurizing tactics has been seen to have a significant influence. Observation, as well as experimentation, has illustrated that though the direction of the results may not be predictable, social pressure is indeed a motivating factor; and when correctly harnessed, it can assist in bringing about desirable results.

3. Methodology

3.1 Theoretical Framework

The theoretical model was conceptualized by Olson (1965). This study assumes that a group is made up of N number of individuals; where each individual possesses the capacity to produce a non-negative amount of a collective good. Hence, i □ N where the ith individual's contribution is characterized as $\delta \geq 0$. The summation of all agents contributions will result in the total amount of the collective good available for consumption, $\tau = \Sigma i\ \delta i$. Each agent gains utility from consuming the collective good – $\mu i\ (\tau)$ where $\mu i' > 0$ and $\mu i'' \leq 0$ - so implicitly, the group's utility is a result of summation of all individual utilities i.e. $\mu(\tau) = \Sigma i\ \mu i(\tau)$. Each agent also incurs a cost from contributing to the production of the good; ci (δi) where $c' > 0$ and $ci'' > 0$. Hence, we arrive at the maximization problem:

$$\text{Max } \mu_i(\tau) - C_i(\delta_i) = \mu_i(\delta_i + \Sigma_{i \neq j} \delta_j) - c(\delta_i) \quad (1)$$

Where the individual will only contribute if $\mu_i(\tau) > C_i(\delta_i)$ and it is assumed that the individual will produce the collective good up till the point that MU = MC. However, each individual values the collective good differently. And no individual takes into account the impact their production capability has on the utility of others in the group. This leads to a sub-optimal amount of the group being produced. What distinguishes Olson's illustration is first, the identification of collective goods possessing a public good characteristic and hence highlighting how prevalent the free-rider problem is in one's society. Secondly, an important result is an impact that group size may have on the provision of the collective good: as the group grows, undersupply of the good is believed to be inevitable.

Hardin (1971) identified the strategic structure of the collective action as the N-prisoner dilemma game where if N > 2 collective actions are essentially assumed to be similar to a large number exchange model. Since each member needs to exchange efforts/resources in order to benefit from the collective provision, there is room for individuals to free-ride off others contributions. Current methodology chooses to implement a 4-person prisoner dilemma game:

Table 1:
Returns for Player per Token in 4-person Game

Player 4		**Contribute**				**Don't Contribute**			
Player 3		Contribute		Don't Contribute		Contribute		Don't Contribute	
Player 2		Contribute	Don't Contribute	Contribute	Don't Contribute	Contribute	Don't Contribute	Contribute	Don't Contribute
Player 1	Contribute	(230, 230, 230, 230)	(170,280, 170,170)	(170,170, 280, 170)	(110, 220, 220,110)	(170,170, 170,280)	(110,220, 110,220)	(110,110, 220,220)	(50,160, 160,160)
	Don't Contribute	(280, 170, 170, 170)	(220, 220, 110, 110)	(220, 110, 220, 110)	(160, 160, 160, 50)	(220, 110, 110, 220)	(160, 160, 50, 160)	(160, 50, 160, 160)	(100, 100, 100, 100)

In the game, there are 4 players endowed with 50 tokens each; which they have to distribute between public good and private good. If a player 'contributes' he invests his token in the public good, if he 'does not contribute' he invests the token in the private good. Each token is worth Rs.100. The private good yields a private benefit of 100% (Rs. 100) on each token invested in it. The public good yields a private return of 50% (Rs. 50) to the investor and a public return of 60% (Rs.60) to group members i.e., the remaining players[1]. The remaining players will reap this 60% benefit regardless of whether or not they have contributed towards the public good.

[1] Net gain from investing in a public good exceeds that of a private good.

For example, considering Table 1, in the bolded scenario (Rs. 280, Rs. 170, Rs. 170, Rs. 170), player 1 does not contribute whereas players 2, 3 and 4 contribute towards the public good. The maximum benefit is hence yielded by the free-rider, player 1 i.e., 280. This occurs as a result of player 1 obtaining the full return of investing the token in the private good (Rs. 100) combined with the additional 60% benefit reaped by the public investments of his group members (60+60+60).

In the game, it is in the player's interest to free-ride because the private benefit of the private good is greater than the private benefit of the public good (Rs. 100 > Rs. 50). However, the socially optimal result is for everyone else to invest in the public good because the social benefit of the public good is greater than the private benefit of the private good (Rs. 230[2] > Rs. 100)2. For this result to occur, communication and cooperation must be present between group members.

Though there is a possibility that cooperation will occur by chance, economic theory predicts that each individual possesses a strong dominant strategy to defect i.e., not contribute (Bowles & Gintis, 2013). Rationally, the individual benefits of not contributing are greater, no matter what any other agent does. This strict preference impedes the ability of rational agents from achieving the social optimum.

3.2 Experiment

To obtain the relevant data, we conducted a standard Public Good Experiment (Maxwell & Ames, 1981). As a variant to the typical public good game, in this experiment, the variable of social pressure is added. Not only will the experiment capture the individuals' natural willingness to pay, but it will also find out how contribution decisions vary when social pressure is introduced. This way, the experiment differs from the standard Randomized Control Trials (RCT) as, instead of having separate control and treatment groups, in our experiment, the same individual is subjected to both control and treatment situations, with the variations in responses being analyzed for this research.

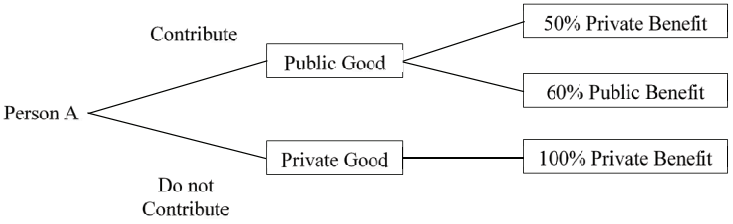

Figure 1: N-person Prisoner Dilemma Game

[2] In order to obtain the optimum benefit of 230: All players contribute towards the public good. Hence, each player's private benefit is Rs.50 per token combined with Rs.180 (60+60+60) that they get from the remaining players contributing towards the public good as well. Hence, each players returns = 50+60+60+60 i.e. 230

The public good game was repeated over six rounds; however, the total number of rounds were not communicated to the participants at the start of the experiment. In each round, subjects were provided with 50 tokens, and they had to allow them to either Good A or Good B. Good A characterized a public good, with the marginal per capita return (MPCR) to the contributor being 0.5 for every 1 token contributed and 0.6 to the rest of the society. Similarly, Good B represented a private good where only the contributor reaps the return of a hundred per cent on each token contributed (whether the good represented a public good or a private good was not communicated to the participant, the participants made their contributions based solely on MPCR). For the first three rounds, group size was not defined and there was no inclusion of social pressure; individuals were not allowed to communicate or reveal their contribution decisions. From round four, groups consisting of four participants each were formed, and social pressure was introduced in the form of mandatory revealing of contribution decisions to fellow members, and allowing communication. It is important to note that only intra-group communication was permitted, with no inter-group communication permitted. The participants were given instruction sheets that aided their understanding of the experiment and provided everyone with a uniform format to write down their contribution decisions. A copy of the instruction sheet is added in the Appendix.

The sample consists of 208 university students[3]. The students were selected from different departments (engineering, social sciences etc.) and different years (first, second, third etc.) to ensure maximum possible generalization of sample results.

3.3 Research Variables

In the current experiment, the dependent variables are the contributions made to Good A (a public good) in the three rounds of control and treatment, whereas the independent variables are social pressure and group size. The analysis reveals whether the interaction of these independent variables affects the dependent variables and whether free ridership emerges as the dominant strategy in the conducted public good game.

4. Results

From the data collected, some basic information can be deduced to infer the behaviour of individuals when it comes to contributing to public goods.

[3] All participants were students of National University of Sciences and Technology, Islamabad.

4.1 Willingness to Pay for Public Goods across rounds

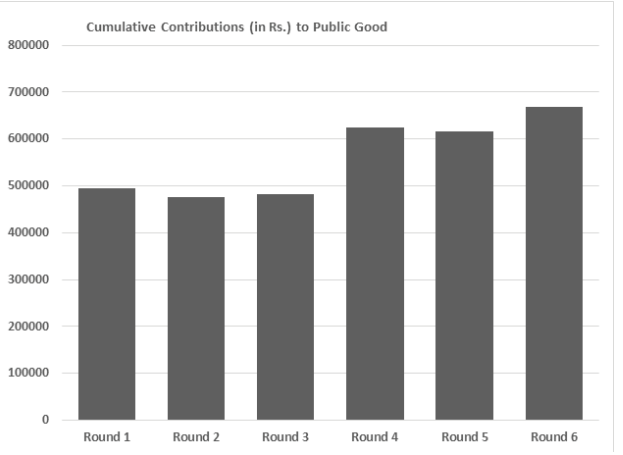

Figure 2: Cumulative Contributions (in Rupees) towards a Public Good.

From Figure 2, it is apparent that individuals do exhibit a tendency to contribute to public goods, even though in literature. This tendency to contribute to public goods is seen to amplify once social pressure is introduced in the experiment (Round 4 onwards) (Reyniers & Bhalla, 2013).

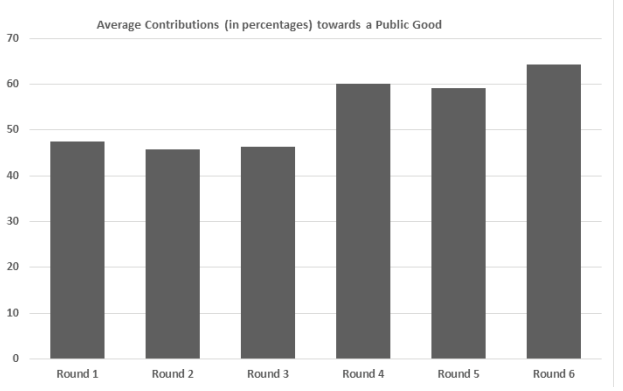

Figure 3: Average Contributions (in Percentage) towards a Public Good.

It can be seen, in Figure 3, that even in Round 1, with undefined group size and no social pressure, individuals on average contribute more than 40% of their tokens to public goods, showing that individuals have an altruistic tendency. Andreoni (1988) states that when public good games are repeated over a finite number of times, the contributions of individuals 'decay' as they realize that free riding is the dominant strategy. However, in this experiment, no such constant decay is witnessed. Even though the average amount contributed decreased

in the second round, the amount is seen to slightly increasing again in Round 3. This indicates that individuals do not adhere to a specific strategy, but rather contribute differently to each round. However, in many experiments from literature, (Isaac & Walker, 1988; Kim & Walker, 1984), this decay is normally apparent in the end rounds of the game. This variation of current findings from the ones done in the past can be attributed to the number of rounds played. Most experiments have more than 10 experimental rounds, in some cases as many as 25 games with 10 rounds each played back-to-back (Selten & Stoecker, 1986), so it could mean that the 'decay' is experienced over a longer time period (increased number of rounds) than the one in the current experiment. Furthermore, the presence of social pressure and smaller group size in the later rounds could also be deterring the decay in contributions.

Overall, it can be seen that once social pressure was introduced in Round 4 (onwards) and groups of four individuals were created, a clear increase was observed in the average contributions. This shows that individuals are susceptible to pressure and show a desire to portray 'good' behaviour (Reyniers & Bhalla, 2013). The maximum average contributions were noted in Round 6.

4.2 Effect of Social Pressure on Group Contributions

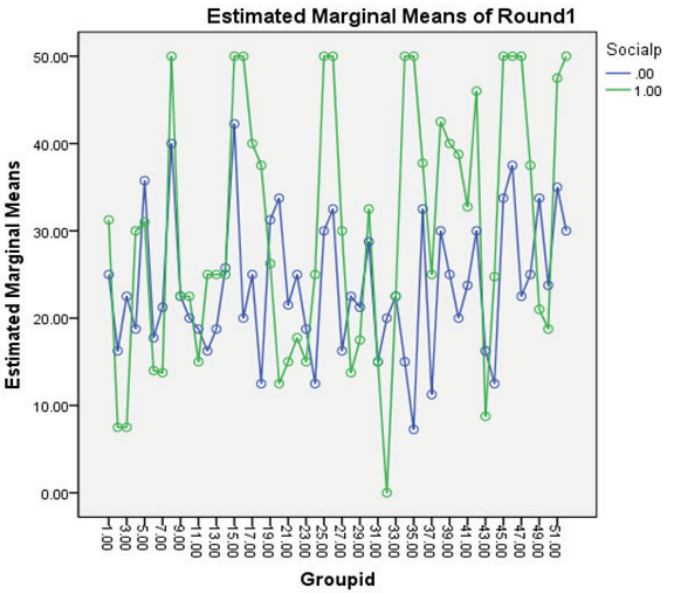

Figure 4: Estimated Marginal Means of Round 1(with and without social pressure)

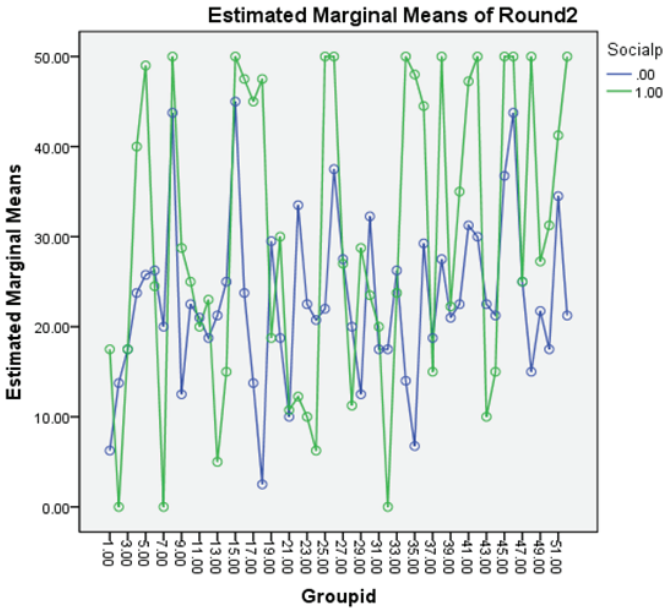

Figure 5: Estimated Marginal Means of Round 2 (with and without social pressure).

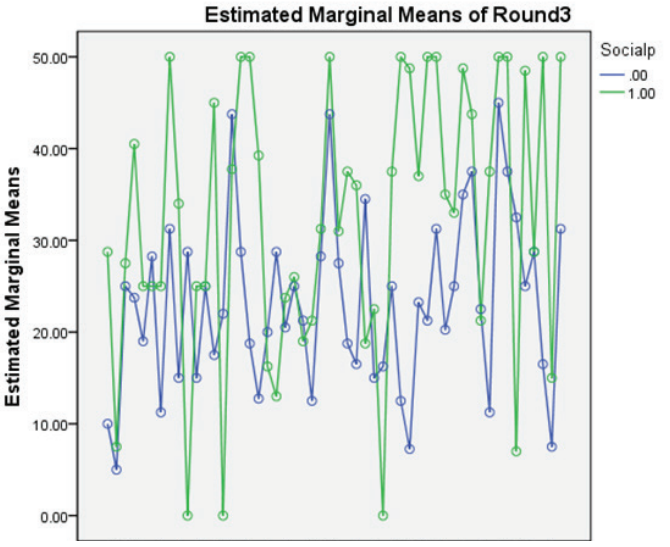

Figure 6: Estimated Marginal Means of Round 3 (with and without social pressure).

As evident in Figures 4, 5 and 6, the estimated marginal mean of each group changes once social pressure is introduced i.e., revealing contribution decision becomes mandatory and communication is allowed. The same effect pattern can be observed in all three figures. Group members with social pressure have more extreme values than those without social pressure. This indicates that once group members communicate and reveal their decisions, they develop a level of cooperation between them (as indicated by extreme mean values that show that variations between tokens contributed decreased). Whether groups cooperate to contribute less or more depends on the group dynamics and the members' perception of Good A (public good).

Overall, a high level of cooperation, whether voluntary or involuntary, is observed once social pressure is introduced in the public good game.

4.3 Free Ridership

It is evident from both average contributions and cumulative contributions that individuals do not dominantly free ride. Yet there are some individuals and groups that do display some free-riding tendencies. For the current analysis, two measures have been used to calculate free ridership. The first adheres to conventional economic theory; because an individual gains the greatest return, it is in his self-interest to completely free ride and contributes zero tokens to any public good (Ledyard et al., 1997). In the current study, these types of free riders are termed as the 'Absolute Free Riders'. The second kind of free ridership is analyzed with slightly relaxed assumptions. Any individual that contributes less than 20% of the total token endowment is referred to as the 'Free Rider with the 20% Rule. This assumption is taken from Maxwell and Ames (1981[4]).

Table 2:
Free Riders with the 20% Rule and Absolute Free Riders

Free Riders with the 20% Rule		**Absolute Free Riders**		**Overall Free Ridership**	
Without Social Pressure	18.27%[5]	Without Social Pressure	5.29%	With 20% Rule	4.81%
With Social Pressure	9.62%	With Social Pressure	3.37%	Absolute	0.96%

Once social pressure is introduced, free riding (with the 20% rule) decreases by almost half, meaning that when the actions of individuals become largely observable, individuals generally resist free-riding temptations. With absolute free riders, the same is observed. In Table 2, however, post social pressure decrease in free riders is not as prominent as that seen with

[4] In the paper, six economists and a sociologist were gathered to predict the outcome of the experiments before they were conducted. The average predicted contribution by the gathered 'experts' was found to be 20% of the total tokens.
[5] This value is calculated using the following formula, (no. of free riders/208)*100.

free riders calculated using the 20% rule. When the six rounds are considered altogether, the percentage of free riders is extremely low. This shows that while individuals may free rider in some rounds, it is highly unlikely for them to free ride in all of the rounds consistently.

4.4 MANOVA Results

MANOVA is a statistical technique used to analyze the inter-group differences between more than one continuous random variable; groups are defined according to the same independent variables for each of the dependent variables. A schematic layout of the general setup for the MANOVA model is given in Equation (2).

$$\begin{bmatrix} Y_1 \\ Y_2 \\ . \\ . \\ Y_n \end{bmatrix} = \begin{bmatrix} f\left(X_1, X_2, ...X_n, I\left(X_i, X_j\right)\right) \\ f\left(X_1, X_2, ...X_n, I\left(X_i, X_j\right)\right) \\ . \\ . \\ f\left(X_1, X_2, ...X_n, I\left(X_i, X_j\right)\right) \end{bmatrix}, \; i \neq j, \; I \text{ represents the interaction effect.} \tag{2}$$

Just like its univariate version i.e., Analysis of Variance (ANOVA), the Multivariate Analysis of Variation (MANOVA) partitions the total variation in the dependent variables into two components: variation due to the independent variables, or the treatment sum of squares, and variation due to unpredictable random factors, or the residual sum of squares. Pillai-statistic in MANOVA is the counterpart of the F-statistic in ANONA, this statistic is approximated by the F-distribution (Muller, 1998). A significant Pillai-statistic implies that the group differences are significant for the i^{th} dependent variable, $i = 1, 2, ...n$.

Table 3:
Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.907	1003.538[a]	3.000	310.000	.000	.907
	Wilks' Lambda	.093	1003.538[a]	3.000	310.000	.000	.907
	Hotelling's Trace	9.712	1003.538[a]	3.000	310.000	.000	.907
	Roy's Largest Root	9.712	1003.538[a]	3.000	310.000	.000	.907
Group-ID	Pillai's Trace	.975	2.945	153.000	936.000	.000	.325
	Wilks' Lambda	.279	3.224	153.000	930.141	.000	.346
	Hotelling's Trace	1.746	3.523	153.000	926.000	.000	.368
	Roy's Largest Root	1.142	6.988[b]	51.000	312.000	.000	.533
Social Pressure	Pillai's Trace	.162	20.034[a]	3.000	310.000	.000	.162
	Wilks' Lambda	.838	20.034[a]	3.000	310.000	.000	.162
	Hotelling's Trace	.194	20.034[a]	3.000	310.000	.000	.162
	Roy's Largest Root	.194	20.034[a]	3.000	310.000	.000	.162
Group-ID * Social Pressure	Pillai's Trace	.861	2.463	153.000	936.000	.000	.287
	Wilks' Lambda	.358	2.484	153.000	930.141	.000	.290
	Hotelling's Trace	1.242	2.506	153.000	926.000	.000	.293
	Roy's Largest Root	.588	3.595[b]	51.000	312.000	.000	.370

a. Exact statistic
b. The statistic is an upper bound on F that yields a lower bound on the significance level
c. Design: Intercept + Group-ID + Social Pressure+ Group-ID*Social Pressure

Table 3, shows the statistics of each of the four separate multivariate test statistics, which are: Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root. These tests examine the statistical significance of the different effects of the independent (fixed) variables in the model. Keeping in view the guidelines from the literature (Tabachnick et al.,2007; Finch et al.,2011), Pillai's trace statistic is used for determining the significance of the main effect and the interaction effects; it is a robust statistic that performs efficiently in different settings of the MANOVA model (Tabachnick et al .,2007). From the table above, it is evident that for both social pressure and group ID, the p-values are less than 0.05, meaning that the effect of both these variables is statistically significant. However, from the values of Pillai's trace, we assess that overall, the effect of groups is stronger than that of social pressure (as the value of group ID is closer to 0). Secondly, the interaction effect, "group ID* social pressure" explains whether the effect of social pressure is consistent across the various groups. Since Pillai's statistic is significant, it is concluded that the effect is consistent and statistically significant.

The partial "Eta Squared" column denotes the measurement of the size of the interaction effect of the two independent variables on the dependent variable. It portrays the practical significance of each term, based upon the ratio of the variation (sum of squares) accounted for by the term to the sum of the variation accounted for by the term and the variation left to error. Thus, we will focus on the "Group ID*social pressure" row in this case. Larger values of partial Eta square indicate a greater amount of variation accounted for by the model term, to a maximum of 1. The value of partial Eta square corresponding value of Pillai's test shows that nearly 29% of the variability in the contributions made towards Good A can be contributed to the interaction of group ID and social pressure. This means that, aside from the effects being analyzed in the model, other unknown effects also have a significant impact on an individual's willingness to pay for the public good.

Table 4 shows the analysis of the variance. It is reporting the results of the ANOVA tests on the dependent variable i.e., contributions made in Round 1, 2 and 3(with and without social pressure). Initially, we focus on the values of "group ID* social pressure" interaction as this will help us on determining the significance of the results. Keeping this in mind, we once again observe that the results are significant since all the p-values are less than 0.05. This proves the statistically significant differences present between group ID, social pressure, and their interaction.

Furthermore, the value of partial Eta square will guide us to understand the effect size of social pressure and group ID separately as well as collectively on the contributions made towards Good A. As shown in Table 4, the values for partial Eta square for "group ID*social pressure" have varied in all the rounds. In Round 1, the value was 0.26, while in Round 2, it increased to 0.358. This shows that the impact of social pressure and Group ID has increased the number of contributions made towards the public good. However, in Round 3 there was a slight drop from 0.358 to 0.304, but 0.304 is still greater than 0.26, thus showing that the presence of social pressure and group ID does affect one's contributions towards a public or a private good. On the other hand, if we look at the two independent variables separately, we observe that the values of partial Eta square for group ID are much greater than those for social pressure. This shows that group ID has a greater effect on the decision making of the contributors as compared to social pressure. Moreover, the partial Eta squared for social pressure shows an increasing trend from Round 1 to Round 3. This shows that as the rounds progressed, the effect of social pressure became more pronounced, thus making them switch from contributing to the private good to contributing to the public good.

Table 4:
Tests of Between Subject Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Round 1	59927.413[a]	103	581.820	3.426	.000	.531
	Round 2	77633.990[b]	103	753.728	4.856	.000	.616
	Round 3	71800.837[c]	103	697.096	3.899	.000	.563
Intercept	Round 1	300785.087	1	300785.087	1771.077	.000	.850
	Round 2	286755.010	1	286755.010	1847.549	.000	.856
	Round 3	318683.163	1	318683.163	1782.395	.000	.851
Group-ID	Round 1	37186.913	51	729.155	4.293	.000	.412
	Round 2	45965.490	51	901.284	5.807	.000	.487
	Round 3	38985.087	51	764.413	4.275	.000	.411
Social Pressure	Round 1	4087.538	1	4087.538	24.068	.000	.072
	Round 2	4657.846	1	4657.846	30.010	.000	.088
	Round 3	8424.000	1	8424.000	47.115	.000	.131
Group-ID*Social Pressure	Round 1	18652.962	51	365.744	2.154	.000	.260
	Round 2	27010.654	51	529.621	3.412	.000	.358
	Round 3	24391.750	51	478.270	2.675	.000	.304
Error	Round 1	52987.500	312	169.832			
	_Round 2	48425.000	312	155.208			
	Round 3	55784.000	312	178.795			
Total	Round 1	413700.000	416				
	_Round 2	412814.000	416				
	Round 3	446268.000	416				
Corrected Total	Round 1	112914.913	415				
	Round 2	126058.990	415				
	Round 3	127584.837	415				

a. R Squared = .531 (Adjusted R Squared = .376)
b. R Squared = .616 (Adjusted R Squared = .489)
c. R Squared = .563 (Adjusted R Squared = .418)

Overall, the current experiment provides support for three main results. Firstly, that people have altruistic tendencies and do not display profit-maximizing characteristics. This is indicated by the fact that from the first round till the last, each individual on average donated at least 40% of their tokens to the public good. Secondly, social pressure and group settings have a positive and significant impact on the individual contributions made to the public good. This effect is depicted in Figures 2-5. When the treatment effect (inclusion of social pressure) is introduced in Round 4 onwards, both cumulative and meaningful contributions to public goods are generally observed to increase. Furthermore, the FRH is rejected in this experiment, with only less than 5% of participants exhibiting free-riding tendencies in the 6 rounds simultaneously (as evident in Table 2).

5. Discussion

This study is an attempt to mimic a real-life scenario in which individuals have a choice to opt between personal benefits and communal benefits. To create cohorts that can reflect different real-world scenarios, the study dichotomized the game design into two settings: the first one was when an individual was made to play the game and contributions were anonymous, while the second set was the case when people played in a group, group size was fixed, and intragroup communication was allowed. This game design allows one to analyze two real-world scenarios: one is when individual philanthropic behaviours are studied, while the other one is when people do philanthropic practices as a result of campaigns that target social groups, such as friends, members of a club, or colleagues in a workplace. It was observed that the existence of social pressure decreased the likelihood of free ridership. The magnitude of contributions was significantly less in solo settings as compared to group settings; furthermore, as the game progressed contributions toward the public goods decreased.

The solo settings of the game are a good description of human behaviour when they rely on the “quick thinking” or the system-I of the brain that takes on-spot decisions. It depicts the human psyche that they think about personal gains more than the communal gains when they take quick decisions. However, even in such scenarios, they do not totally denounce the benefits of contributing to communal gains. The reflective system-II of the human brain comes into play in group settings because the later outcomes of the game are linked with the earlier ones. In simple words, when people observe that they have been noticed by their peers for a long time then their system-II signals them that it is a time to behave socially desirable.

5.1 Conclusion

The objective of this paper was to evaluate the behaviour of an individual in the context of the public good provision. Even though previous literature has termed 'Collective Action' as irrational, this study finds support for cooperative behaviour as well as a voluntary contribution to public goods. On average an individual willingly donated more than 40% of the endowment towards the public good, even without any additional motivating factors. This tendency was only observed to be amplified once social pressure was introduced and groups consisting of four members were created. Moreover, this experiment provided little to no support for the FRH in both its forms (Free rider with 20% rule and absolute free-rider).

5.2 Implications, Limitations and Avenues for Future Research

The importance of this study is highlighted in post-COVID times when governments worldwide are required to be frugal. Philanthropic practices have the potential to support the government if it succeeds in winning public trust. In the case of Pakistan, the unprecedented mix of public, corporate, and nonprofit activity in the development realm that is growing in Pakistan is profoundly altering the way we approach our most pressing social issues. According to the Pakistan Centre for Philanthropy, the annual amount of charitable giving in Pakistan is 70.538 billion rupees (Pakistan Centre for Philanthropy, 2017). With so much huge potential in the philanthropic channels, there is a need to develop a mechanism to streamline this money for the benefit of the country in such a manner that it strengthens the macroeconomic indicators. This is only possible if the government can win public trust and design charity campaigns effectively. In this context, the current study is an oriel into a newer perspective about using human capital to improve the economy. The findings of this study shall interest those who want to tap into unconventional solutions to boost the economy.

Repeated solo philanthropic campaigns should be designed in such a manner that there is some gap between subsequent calls for charities. This roots out from the results of the current study in a sense that as rounds proceeded (in solo settings), the contributions towards the public goods tapered off. Repeated group philanthropic campaigns may be designed with lesser gaps between subsequent calls for charities. This roots out from the results of the current study in a sense that as rounds proceeded (in group settings), the contributions towards the public goods increased. The study offers interesting insights for the stakeholders who design charity campaigns. It was noticed that contributions are higher in group settings as compared to solo settings; therefore, crowdfunding initiatives are a better option than individual charity solicitations.

Limitations of the current study include its reliance only on students as study participants. There is a need to analyze the role of group composition (such as average age of participants, diversity in terms of socioeconomic background, gender, and educational

qualification). The findings of the study, though relevant, require improvement in terms of generalizability because the study population was restricted in the sense that the participants were university students. To better analyze the complexities of human philanthropic behaviours, there is a need to conduct observational studies or real-time social experiments in which real money is used. Furthermore, even in real-time social experiments, it remains unknown what the difference in giving behaviour is when the money is earned versus when it is an endowment.

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Appendix
Instrument

Instructions

You have been given a total of 50 tokens, and you have to donate them to either Good A or Good B, or both Good A and Good B. You can decide how many tokens you want to donate to each good.

For every 1 token (which is worth Rs.100), donated to Good A, you get a return of 50% (Rs.50) and everyone else gets a return of 60% (Rs.60). Similarly, for every 1 token that everyone else donates to Good A, you get a return of 60%; regardless of whether or not you have given to the good.

For every 1 token (which is worth Rs.100), donated to Good B, you get a return of 100% (Rs.100). On this good, only you earn the return from donating, no one else will earn returns from your donation to Good B.

The rest of the instructions will be communicated to you.

Rounds	Good A	Good B

Thank you for participating in this exercise. Have a Good Day!