Revisiting the Impact of Impure Public Goods on Consumers' Prosocial Behavior: A Lab Experiment in Shanghai

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November 5, 2018

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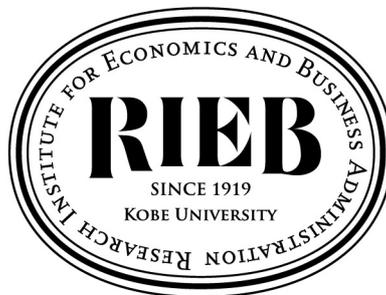
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Abstract

In this study, we implemented a dictator game experiment to examine how the increase of the public characteristic in an impure public good affects individuals' prosocial behavior. A within-subject design was used in the experiment. The dictator game was repeated six times with an impure public good introduced in four of them. We observe that the increase of the public characteristic in an impure public good partly crowds out individuals' subsequent donations, which could be explained by a seemingly "mental accounting" mental process. In addition, we also find that the selfish behavior of individuals in dictator games with impure public goods, to some extent, has an inertia influence on their subsequent donations when the impure public good is removed.

Keywords: Impure public goods; Dictator game; Multiple dictators; Mental accounting

JEL Classification: C91, D64, H41

1. Introduction

Environmental issues have always been critical problems discussed by environmental economists. The externality is known as the basic cause inducing environmental problems from the perspective of standard economic theory. To eliminate the externality, "Top-down" governance (e.g., an environment tax) that refers to policies and regulations implemented by a government is commonly regarded as an effective means to deal with environmental issues. However, it might encounter the risk of rent-seeking (Damania, 1999; Helm, 2010) or harm social welfare considerably. To avoid this dilemma, green consumption and production, especially green consumption as a "bottom-up" measure, have become prevalent in recent years. Instead of compelling consumers to behave environmentally friendly, green consumption, which involves green products and services, could conveniently enable us to contribute to the environment. A great deal of previous literature focused on the factors impacting green consumption through empirical methods (e.g., Laroche et al., 2001; Albayrak et al., 2012; Panzone et al., 2016; Amatulli et al., 2017). Nevertheless, they rarely defined green consumption appropriately to describe how the factors affect the purchase of green products and theorize how green consumption influences consumers' behaviors after purchasing green products.

Green consumption could be treated as a means of private provision of a public good called "impure public good." Cornes and Sandler (1994) first attempted to model characteristic of an impure public good in which they imagined consumers could acquire joint characteristics–both private characteristic and public characteristic in one commodity. Applications of this model have been studied in various fields, such as warm-glow giving (Andreoni, 1989; 1990), military alliances (Sandler and Murdoch, 1990), household refuse collection (Dubin and Navarro, 1988), agricultural research (Khanna et al., 1994), pollution abatement (Rübbelke, 2003), and environmentally friendly consumption (Kotchen, 2005; 2006). Kotchen (2005; 2006) followed the steps of Cornes and Sandler whilst improving the model so that it could explain more issues. Kotchen (2005) separated an impure public good into a

conventional commodity as well as direct donation and applied comparative statics to capture how market prices, green production technologies, and social pressure impact the demand for an impure public good and its public characteristic. Kotchen (2006) eliminated the numeraire in Kotchen's (2005) model and demonstrated that according to heterogeneous preferences and endowments, the impure public good could have either a beneficial or a detrimental effect on environmental quality and social welfare.

Instead of utilizing the traditional methodology to reveal the relationship between an impure public good and direct donation, Munro and Valente (2016) implemented a within-subject dictator game experiment, wherein the impure public good was set as the combination of a private good and a public good. The counterintuitive result shown in this study was that the impure public good more or less decreased the activity of consumers' donation in specific green production technology. This study also found that a self-interested impure public good (i.e., one whose proportion of private characteristic is larger than that of its public characteristic) seems able to influence direct donation, whereas an altruistic impure public good does not. Munro explained that impure public goods gave individuals an excuse for decreasing their prosocial behavior without guilt. Engelmann et al. (2017) combined a real product (i.e., a box of chocolates) with a specific amount given to charity to represent the impure public good and produced results similar to those discussed in Munro's paper (Munro and Valente, 2016). The framed impure public good in Engelmann's paper (Engelmann et al., 2017), to some extent, was a self-interested impure public good as defined in Munro's paper (Munro and Valente, 2016) and the real product-based impure public good seemed to possess the identical characteristic of discouraging consumers' altruistic behavior. This implies that a self-interested impure public good needs to be discovered delicately. Nonetheless, both papers mentioned above fixed an invariant proportion between private characteristic and public characteristic for a self-interested impure public good, which suggests the potential of investigating the influence of changes in the proportions of private and public characteristics of the impure public good on individuals' prosocial behavior.

Furthermore, in the aforementioned dictator game experiments, participants needed to purchase impure public goods with their endowments. This design might affect the participants' donation behaviors after purchasing the impure public goods. The current study aims to eliminate this influence and let participants merely purchase the private part of the impure public good, with the public part being donated by the experimenter. Hence the experimenter here could be regarded as another dictator besides the participants, which forms a multiple dictator game as shown in Dana et al. (2007). Their experiment demonstrated that the existence of multiple dictators would incur dictators to become selfish. A bulk of research has proved that behaviors of participants in a multiple dictator game are different from their behaviors in a traditional dictator game (Dana et al., 2007; Ottone, 2008; Panchanathan et al., 2013). Dictators in the multiple dictator games made their own decisions and behaved more selfishly.

In addition, Mazar and Zhong (2010) implemented an experiment comprised purchasing conventional or green products and a dictator game to confirm the existence of the aforementioned issue. The results of their experiment were in line with Munro's (2016), but Mazar and Zhong suggested that their results were induced by a "moral licensing effect," which means that individuals behave less pro-environmentally after purchasing environmentally friendly products, as if they have obtained a green license. Momsen and Stoerk (2014) argued that the above phenomenon might be appropriate to interpret through mental accounting. They believed green products or services could be divided into two dimensions (i.e., consumption needs and ethical benefit), so that individuals will classify them into two mental accounts with distinct shadow prices (Thaler, 1985). Since consumers compare their choices between conventional and green products through the above two dimensions, their donations in a dictator game might decrease after ethical spending.

In the current study, a within-subject design was implemented in a dictator game experiment where participants were asked to allocate their endowments between a charity organization and themselves. We aim at investigating whether a multiple

dictator effect and mental accounting exist when impure public goods appear in a dictator game. Our research makes contributes to previous literature in several way. First, we replaced the impure public goods in Munro's design (Munro and Valente, 2016) with a real product (i.e., a ball pen) and made an additional donation as part of the impure public good to a charity organization, as that in Engelmann et al. (2017). This change makes the experiment context closer to a real-world situation. Second, the proportion between private and public characteristics of the impure public good was designed to vary in the experiment. We attempt to reveal whether this change in proportion will have an impact on participants' ethical choices. Moreover, it is worth noting that since the additional donation related to the impure public good was provided by the experimenter, every participant was confronted with the same amount of money when they made the allocation between the charity organization and themselves in each round of the experiment.

The remainder of this paper is organized as follows: The next section describes elements of the experimental design and implementation. Experimental results and discussions are presented in Sections 3 and 4, respectively. The final section offers conclusions and suggestions for further research.

2. Experimental design and implementation

2.1 Experimental design

To explore the above issues, we applied a within-subject design of dictator games according to those used by Munro and Valente (2016) and Engelmann et al. (2017). There were six tasks, including two baseline tasks and four impure public good tasks in our design. The impure public good was specified as a bundle of a private good (i.e., a ball pen) and a public good (i.e., an additional donation to a charity organization), which mimics the setting in Engelmann et al. (2017). The chosen charity organization is Shanghai University Education Development Foundation (SHUEDF)[1] since it is a charity relevant to the participants in our

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[1] SHUEDF was established in February 2014 and certified as a charity. This organization receives donations from either organizations or individuals for Shanghai University and the donations are applied to set up scholarships,

experiments. Thus, participants will feel intense benefits if they donate to this charity. However, in the experiment instructions and during the implementation of the experiment, we did not use any environmental contents, which was an attempt to avoid a potential framing effect of green consumption on participants' choice behavior. Nevertheless, we could still obtain several general results regarding the impact of impure public goods from our specific setting.

Table 1. Features of tasks

Task	Order	Endowment	Impure public good	Constitution of impure public good
BL1	Round 1	60 RMB	No	
IPG1	Round 2	72 RMB	Yes (self-interested)	Private: a ball pen (12 RMB) Donation: to SHUEDF (3 RMB)
IPG2	Round 3	72 RMB	Yes (self-interested)	Private: a ball pen (12 RMB) Donation: to SHUEDF (6 RMB)
IPG3	Round 4	72 RMB	Yes (self-interested)	Private: a ball pen (12 RMB) Donation: to SHUEDF (9 RMB)
IPG4	Round 5	72 RMB	Yes (even-interested)	Private: a ball pen (12 RMB) Donation: to SHUEDF (12 RMB)
BL2	Round 6	60 RMB	No	

Notes: *BL1* and *BL2* refer to the two baseline tasks*; IPG1, IPG2, IPG3,* and *IPG4* refer to the four impure public good tasks*.

The summary of the experimental tasks is presented in Table 1. Each participant was asked to complete six tasks during the experiment; the first and last task (i.e., *BL1* and *BL2*) were baseline tasks (i.e., traditional dictator game without impure public goods being introduced). In the baseline tasks, each participant was given 60 RMB (1 USD≈6.38 RMB) as his/her endowment for this task and was asked to allocate this amount between himself/herself and SHUEDF; the decision needed to be written on

the recording sheet. The contents of the first and last task were the same. The purpose for which we included a baseline task at the beginning and one at the end of the experiments is first to eliminate the possible order effect of the baseline task (Moffatt, 2015) and second to examine subjects' possible behavioral changes after experiencing the impure public good tasks.

From the second to the fifth task (i.e., *IPG1* to *IPG4*), a specific impure public good was introduced into each task. The contents of the four impure public good tasks were similar. In *IPG1*, each participant received 72 RMB as the endowment and was asked to purchase a ball pen whose retail price is 12 RMB. When the participants purchased the ball pen with 12 RMB, 3 RMB out of the 12 RMB would be donated to SHUEDF by the experimenter. After that, the participants needed to determine how to allocate the remaining 60 RMB (72 RMB subtract 12 RMB) between themselves and SHUEDF, and the decision needed to be written on the recording sheet. The amount of the donation out of the 12 RMB (i.e., the fixed price of the ball pen in every impure public good task) in *IPG2*, *IPG3*, and *IPG4* increased successively; it was 6, 9, and 12 RMB, respectively.[2] In addition, the impure public good in *IPG1*, *IPG2,* and *IPG3* could be regarded as a self-interested impure public good, since the amount of donations offered with the impure public good in these tasks was lower than the retail price of the ball pen. The impure public good in *IPG4* was set as an even-interested impure public good, in which the amount of donation equals the retail price of the ball pen.

2.2 Implementation

Participants were recruited at Shanghai University (SHU) through advertisements posted on the internet, and 137 students took part in the experiment. The demographic characteristics of participants are shown in Table 2. Female students account for 57.66% of the sample, and the average age is 22 years. Of the participants, 67.15%

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[2] There are two reasons for not assigning the amounts of donation out of the 12 RMB in random order. First, we conducted the experiment in paper-and-pencil style and not via a computer, so perfect randomization was hard to achieved Second, the participants might check or correct their decisions in previous tasks because all the decisions were written on the same recording sheet; thus, whether the order was random would not be a possible factor affecting participants' choices.

come from a rural area and 59.12% are postgraduate students. In addition, 54.74% of the participants are students from the School of Economics and most of the participants (64.23%) spend 1500 RMB and above for their living expenses per month, excluding dormitory payments. A total of eleven sessions took place in two classrooms (one for the experiment and the other for payment) at the School of Economics, Shanghai University, on May 19th and 20th, 2018.

Table 2. Demographic characteristics of the participants (n=137)

Demographic characteristics	% in sample
Gender	
Male	42.34%
Female	57.66%
Age（mean=22）	
18-21	36.62%
22-25	61.19%
26 and above	2.19%
Hometown	
Urban area	32.85%
Rural area	67.15%
Grade	
Undergraduate student	40.88%
Postgraduate student	59.12%
Major in economics?	
Yes	54.74%
No	45.26%
Living expenses per month (RMB)	
600-999	5.84%
1000-1499	29.93%
1500 and above	64.23%

In each session, we implemented the same six tasks. Each participant received written experimental instructions (Appendix 1) and a recording sheet (Appendix 2) at the beginning of the experiment. Before starting the experiment, one experimenter first read the instructions loudly to assure the participants understood the whole procedure. Then, each participant was asked to finish the above-explained six tasks in order (i.e., from round 1 to round 6) without any communication with other

participants and was informed that their decisions and earnings would remain anonymous and private. The rewards of each task or round were the amount participants left for themselves in that task or round. The participants were asked to raise their hands to hand over their instructions and recording sheets when they finished their own tasks and one experimenter would approach them with an automatic dice machine containing one die. The participants pushed the button on the machine by themselves, and the number shown on the die (any number from 1 to 6) determined the number of the task or round they could acquire a reward for. When all the participants in this session finished their tasks as well as rolled the die on the machine, they were asked to answer a questionnaire[3], and then took this questionnaire to another classroom to receive their rewards. The sessions lasted from 30 to 40 minutes, and the average earnings were 42.6 RMB, which is above the minimum hourly wage in Shanghai.

3. Results

3.1 Graphical evidence of donation in each task

Figure 1 presents both the voluntary donations and total donations (i.e., donations coming from impure public goods plus donations from participants) in the six tasks. In the baseline tasks (i.e., *BL1* and *BL2*), participants simply needed to make a choice on how to allocate the 60 RMB between themselves and SHUEDF; thus, the participants' voluntary donations equal the total donations, since impure public goods were not involved in these two tasks. In the impure public good tasks (i.e., *IPG1*, *IPG2*, *IPG3*, and *IPG4*), participants were compelled to purchase a symbolical impure public good consisting of a ball pen at a fixed price of 12 RMB and a donation to SHUEDF at a varying amount (i.e., 3 RMB, 6 RMB, 9 RMB, and 12 RMB in *IPG1*, *IPG2*, *IPG3*, and *IPG4*, respectively) donated by the experimenter. The value of the ball pen was then excluded from the endowment of 72 RMB and the participants could make their own determinations on how to allocate the remaining 60 RMB

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[3] The contents of the questionnaire were about choices for mobile payments. None of questions were relevant to the purpose of this study.

between themselves and SHUEDF. Due to this design, the total donations are larger than the voluntary donations of participants in the tasks with an impure public good.
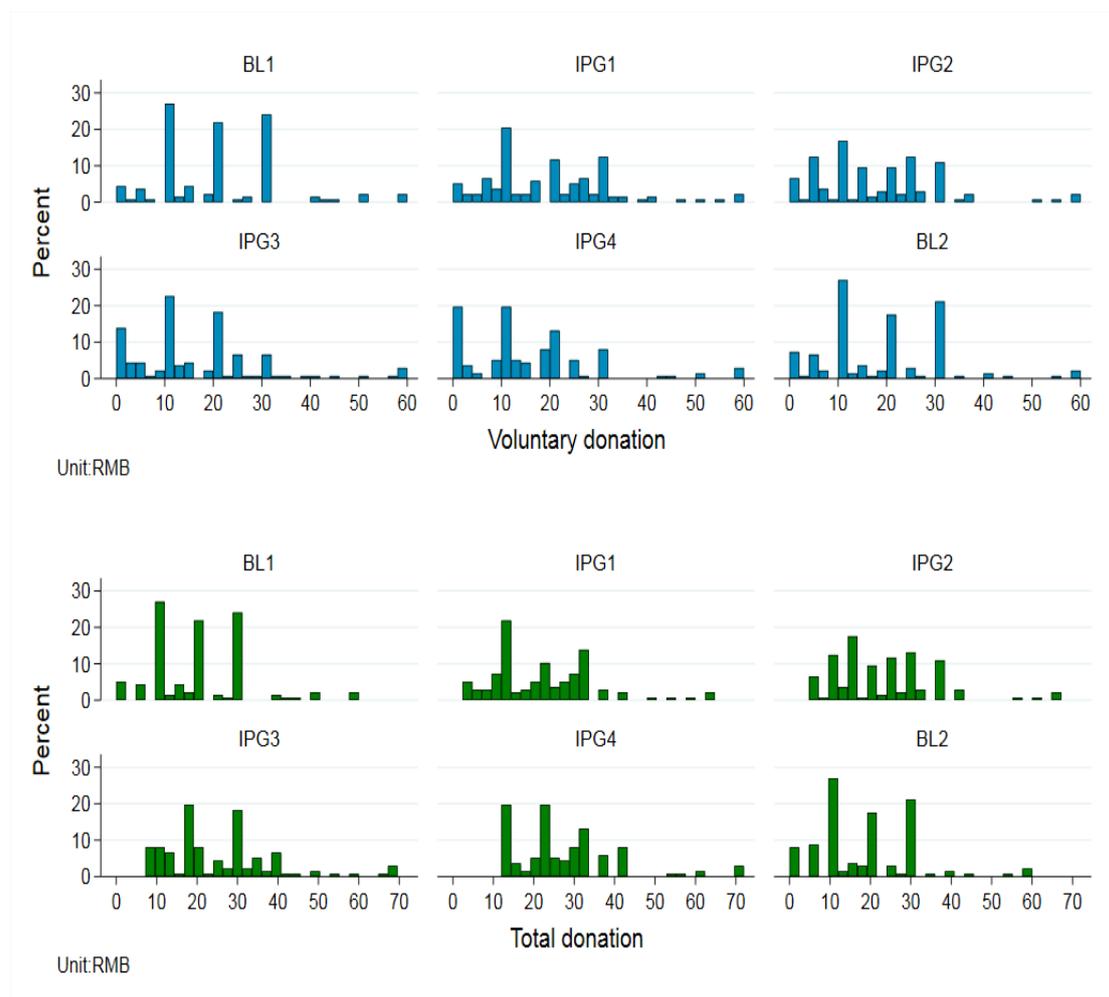

Figure 1. Voluntary donations and total donations

With respect to the voluntary donations of participants in Figure 1, we first look at the two baseline tasks. It is observed that the distributions of voluntary donations in these two tasks are similar. Five out of the 137 participants shared nothing with SHUEDF in *BL1* task, whereas 10 out of the 137 participants donated nothing in the *BL2* task. Two participants donated all their endowments (i.e., 60 RMB) in both the *BL1* and *BL2* tasks. About 27% of participants donated 10 RMB out of the 60 RMB in both the baseline tasks, which accounts for the highest proportion of participants. The second highest proportion of participants in *BL1* and *BL2* appears at 30 RMB

donations, which account for 24.1% and 21.2%, respectively. Nearly 21.9% and 17.5% of participants in the *BL1* and *BL2* tasks, respectively, account for the third highest proportion of participants, who shared 20 RMB to SHUEDF. We were able to discover prominent differences in the voluntary donations in the impure public good tasks and those in the baseline tasks in terms of Figure 1. More participants shared nothing with SHUEDF in the impure public good tasks than in baseline tasks, except for *IPG1* and *IPG2,* in which the number of zero-contributors in these two tasks is less than that in the *BL2* task. The number of full-contributors (i.e., those who donated 60 RMB) in each impure public good task is more than that in the baseline tasks. In addition, Figure 1 shows that the 10 RMB, 20 RMB, and 30 RMB donations are still three critical values in the impure public good tasks. The proportions of participants who donated 10 RMB are 20.4%, 16.8%, 17.5%, and 19.7% in *IPG1*, *IPG2*, *IPG3*, and *IPG4*, respectively. Participants who donated 20 RMB account for 10.2%, 8.8%, 11.7%, and 13.1% in *IPG1*, *IPG2*, *IPG3*, and *IPG4*, respectively. With respect to the participants who donated half of their endowment after purchasing the impure public good, the proportions are 12.4%, 10.2%, 6.6%, and 8.0% for *IPG1*, *IPG2*, *IPG3*, and *IPG4*, respectively.

The details of the participants' total donations are presented at the bottom of Figure 1. In the impure public good tasks, none of the total donations are zero because of the donations by the experimenter for the impure public goods being added. Therefore, the least total donations in *IPG1*, *IPG2*, *IPG3*, and *IPG4* are 3 RMB, 6 RMB, 9 RMB, and 12 RMB, respectively, and the full donations in these tasks are 63 RMB, 66 RMB, 69 RMB, and 72 RMB, respectively. Comparing this to the voluntary donation distribution mentioned above, Figure 1 shows that the distribution of total donations in each impure public good task slightly moves to the right side by the amount of the experimenter's donation in each task.

The mean of the voluntary donations and total donations in the six tasks are shown in Figure 2. With respect to voluntary donations, the mean in *BL1* is higher than that in *BL2* (19.97 versus 18.07 RMB). When comparing to those in the baseline

tasks, the mean donations in the impure public good tasks are almost always lower. Moreover, the mean voluntary donations seem to decrease as the donations provided by experimenter in the impure public good tasks increase (i.e., as the public characteristic in the impure public good increases). Nevertheless, the mean total donations presented in Figure 2 follow the opposite trend, showing a positive relation with the experimenter's donations. The reason for this might be that the increase of the experimenter's donations does not crowd out participants' voluntary donations completely. For instance, the decrease of the mean voluntary donations between *IPG1* and *IPG2* is 1.627 RMB, which is less than the 3 RMB increase in the experimenter's donation. The opposite trend in the mean voluntary donation and mean total donation to some extent probably reflects the participants' specific mind process when they make donations. This issue will be further discussed later.
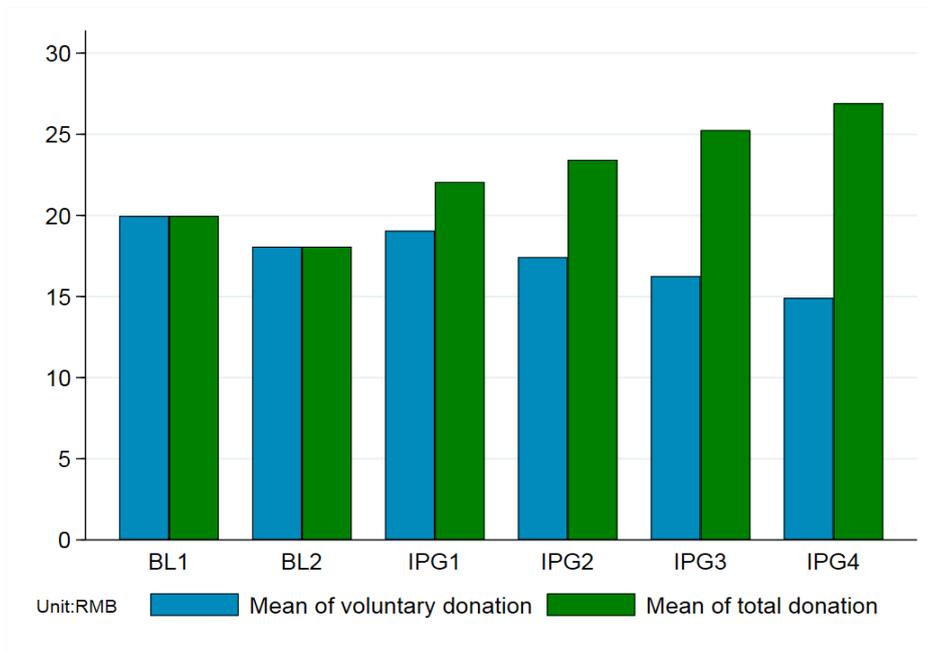

Fig 2. Mean of voluntary donations and total donations

3.2 Regression analysis of voluntary donation and total donation

Table 3 presents the results of two Tobit regressions treating the amount of voluntary donation and the amount of total donation as dependent variables. In both

regressions, we include individual characteristics of participants and the task dummy variables as independent variables. Of five individual characteristics variables, *Female* (i.e., male=0, female=1), *Hometown* (i.e. urban area=0, rural area=1), and *Economics* (not majoring in economics=0, majoring in economics=1) were set as dummy variables, whereas *Age* and *Living expenses* were continuous variables. As regards the tasks, we defined six dummy variables that equal 1 if participants took part in the task and 0 otherwise. The dummy variable for the first baseline task (i.e., *BL1*) was regarded as the reference of the other five task variables.

Table 3. Tobit regression estimation results

	Voluntary donation		Total donation	
Constant	47.203	(4.19)**	43.417	(4.22)**
IPG1	-0.951	(-1.47)	2.217	(3.65)**
IPG2	-2.677	(-4.14)**	3.589	(5.91)**
IPG3	-3.991	(-6.16)**	5.414	(8.91)**
IPG4	-5.717	(-8.75)**	7.152	(11.75)**
BL2	-2.049	(-3.18)**	-1.995	(-3.27)**
Female	2.234	(1.02)	2.418	(1.20)
Age	-0.378	(-0.91)	-0.340	(-0.89)
Hometown	1.531	(0.61)	1.516	(0.66)
Living expenses	-5.386	(-2.72)**	-4.619	(-2.56)*
Economics	-4.674	(-2.15)*	-4.303	(-2.17)*
Log likelihood	-2571.10		-2689.54	
Sample size	137		137	

Notes: ** and * indicate statistical significance at the 1% and 5% levels of confidence, respectively. Z-statistics are reported in parentheses.

3.2.1 Voluntary donations

As shown in the second column of Table 3, all the estimated parameters of the task dummy variables except that of *IPG1* are statistically significant and have negative signs, implying that the voluntary donations in the latter four tasks are significantly less than those in the reference task (i.e., *BL1*). Furthermore, the magnitudes of *IPG1*, *IPG2*, *IPG3*, and *IPG4*—although *IPG1* is not significant—decrease extras the experimenter's donations increase. This result is consistent with

the mean voluntary donation trend shown in Figure 2, which implies participants prefer to donate less if the impure public good contains more public characteristics (i.e., a higher donation from the experimenter). The statistically insignificant parameter of *IPG1* suggests that the participants may consider *IPG1* to be substantially the same as *BL1*, possibly because the public characteristic part in this task is smaller than those in other impure public good tasks. It is unexpected that the donation in *BL2* is significantly less than that in *BL1*, whereas the smaller parameter in absolute value of *BL2* than those of *IPG2*, *IPG3*, and *IPG4* suggests the donation in *BL2* is still larger than those in these three impure public good tasks. In addition, the incomplete crowding out effect of donations provided by the experimenter, to some extent, could also be captured by these results. For instance, the parameters of *IPG2* and *IPG3* are -2.677 and -3.991, respectively. The difference is 1.314 (=3.991-2.677) RMB, which means the donation in *IPG3* is 1.314 RMB less than that in *IPG2*. This amount is less than the increase of 3 RMB in the experimenter's donation; therefore, it seems that the increase in the public characteristic of the impure public good does not completely crowd out participants' voluntary donations.

With respect to individual characteristics, the parameters of *Female*, *Age*, and *Hometown* are statistically insignificant, which indicates these characteristics do not affect the donation behaviors in our experiment. The parameters of *Living expenses* and *Economics* are both statistically significant and have a negative sign, suggesting that participants who major in economics or spend more on living expenses per month would behave less altruistically and donate less. The result that students majoring in economics are inclined to behave less prosocially is consistent with that found in Marwell and Ames (1981) and Cadsby and Maynes (1998).

3.2.2 Total donations

The results of total donations are presented in the third column of Table 3. All the estimated parameters of the impure public good task variables are statistically significant and have positive signs, implying that the total donations in these tasks are

significantly higher than that in the *IPG1* task. In addition, the magnitudes of *IPG1, IPG2*, *IPG*3, and *IPG4* increase as the experimenter's donations rise, which indeed shows an adverse trend compared to that in the voluntary donations regression. This trend exhibits that total donation will increase if the impure public good contains more public characteristics. In addition, the results of the individual characteristics in this regression are the same as those in the voluntary donations regression.

4. Discussion

4.1 Multiple dictators

The impure public good tasks of our experiment involved impure public goods with specific public characteristics. The impure public goods in *IPG1*, *IPG2*, and *IPG3* could be treated as self-interested impure public goods, since the amounts donated by the experimenter are less than the value of the private characteristic (i.e., the 12 RMB cost of the ball pen), whereas the impure public good in *IPG4* could be treated as an even-interested impure public good because the amount donated by the experimenter is equal to the value of the private characteristic. From the results described in Section 3, we could deduce that the voluntary donations of participants in the impure public good tasks will obviously decrease as the experimenter's donations increase; in other words, participants will behave less altruistically when they face an impure public good with more public characteristics, regardless if it is a self-interested or even-interested impure public good. This could possibly be interpreted through the multiple dictator effect. Our experiment is quite consistent with the "multiple dictator treatment" implemented in Dana's paper (Dana et al., 2007). Their experiment demonstrated that the existence of multiple dictators would incur dictators to become selfish. The experimenter acted like another dictator in our impure public good tasks, which probably gave the participants an excuse to become selfish. This is because the final donations received by SHUEDF are the sum of those from both the experimenter and the participants.

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4.2 Mental accounting

Another interpretation of participants' voluntary donations showing a negative correlation with the experimenter's donations may be that participants set a specific amount for donations to SHUEDF and the experimenter's donations crowd out their voluntary donations. If this is true, the total donations among impure public good tasks should not be statistically different. However, we find out that total donations statistically increase along with the experimenter's donations, but the magnitudes of this increase are less than the increase in the experimenter's donations. We might interpret this behavior as a phenomenon of incomplete "mental accounting," since the participants indeed decreased their voluntary donations to allow room for the experimenter's donations, as shown in the regression results of voluntary donations. Participants might treat the two types of donations as one mental account (i.e., donations to SHUEDF) instead of separating these two donations into distinct mental accounts. This implies that the experimenter's donations might be regarded by participants as their own donations to SHUEDF, since it is their purchases of the impure public goods that induce these donations by the experimenter. This interpretation is to some extent consistent with that of Momsen and Stoerk (2014). Nonetheless, this mental accounting is incomplete because participants' voluntary donations cannot completely crowd out those by the experimenter. The possible implication might be that the participants behave slightly more altruistically to offset the multiple dictator effect, which results in the mental accounting being incomplete.

4.3 *BL1* vs. *BL2*

The donations in *BL2* are significantly lower than those in *BL1*, which indicates participants behave more selfishly after experiencing the impure public good tasks. For the sake of determining how individuals donated in *BL1* and *BL2*, we have a closer look at the donations in both *BL1* and *BL2*. About 24.8% (34 out of 137) participants donated less in *BL2* than in *BL1* and the mean difference of these donations is 9.32 RMB. Of the 34 participants, 13 donated 5 RMB less in *BL2,* and 11

donated 10 RMB less in *BL2*. The maximum and minimum difference is 40 RMB and 1 RMB, respectively, and 85.3% of the 34 participants' differences in their donations between *BL1* and *BL2* are at least 5 RMB. We check the voluntary donations in the four impure public good tasks prior to *BL2* to seek a reasonable explanation. We find out that 23 out of these 34 participants' donations decreased continuously, which led us to suspect that their decreased donations in *BL2* might be influenced by the previous tasks. The selfish behavior seemingly exists as a mental inertia that causes participants to act less altruistically even when the experimenter's donations were excluded in *BL2*. Nevertheless, the multiple dictator effect vanished in *BL2;* therefore, the participants' voluntary donations were more or less higher in *BL2* than those in the impure public good tasks.

5. Conclusions

In the current study, we applied a within-subject design in the dictator game experiment in accordance with that in Munro and Valente (2016) and Engelmann et al. (2017). Our results suggest that a multiple dictator effect was induced by the impure public good and an incomplete mental accounting effect could be captured through our experiment. The effect of the impure public good on participants' prosocial behavior shown in our study demonstrates the importance of the public characteristic in the impure public good and suggests that the donations by a third party (e.g., the experimenter in the current study) might be a vital factor affecting individuals' voluntary donations.

Moreover, an impure public good is considered as an alternative path to encourage consumers to contribute more to the public good without being mandatorily required. For instance, green consumption, a prevalent impure public good, could be utilized to address environmental issues. However, our results offer evidence that green consumption alone might not be a sustainable measure to induce consumers to behave more prosocially. Hence, we should be prudent when promoting impure public goods as an instrument to aid contributions to public goods. Engelmann

et al. (2017) proposed that making it mandatory for consumers to purchase a green product would improve contributions to environmental causes. In fact, their research implied that we need to construct an appropriate institution for the impure public goods market that could cultivate consumers to behave in alignment with sustaining prosocial actions. Therefore, producers of impure public goods, as the main participants in the market, should also be considered in future research on impure public goods.

Finally, we designed two baseline tasks, one at the beginning and another at the end of the experiment. The results indicate that participants' behaviors in the impure public good tasks, which took place between the two baseline tasks, might impact their behaviors in the second baseline task. Participants became more selfish as the experimenter's donation increased, and this trend decreased their donations in the last baseline task. This inertia influence should be delicately checked through exploring how opposite settings related to the impure public good tasks (i.e., the continuous decrease of the experimenter's donations) affect participants' voluntary donations and whether this influence has an inertia affecting their behaviors when the impure public good is removed. We leave this issue open and welcome any efforts to further explore this issue in detail.

Acknowledgements

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Appendix 1: Task instructions

I would like to welcome all the participants in today's experiment. This experiment is divided into six rounds of tasks. In each round you will be rewarded based on your decision, whereas the final reward you receive in the experiment will be determined by randomly selecting one of these six rounds. The specific selection method will be explained in detail later. The procedure of the experiment is as follows: First, we introduce the processes of Rounds 1 to 6, and then you will be asked to do the tasks of Rounds 1 through 6. Remember that you cannot speak to other participants during the experiment. If this happens, the experiment will be aborted immediately. If you have any questions, please raise your hand.

We first introduce the process of the Round 1 task.

Instructions for Round 1 task

In Round 1, you will receive 60 RMB. Then, you need to decide how to allocate these between the "Shanghai University Education Development Foundation" (i.e., SHUEDF, a non-profit charity established in February 2014, accepting social donation funds for Shanghai University and utilizing these to support higher education) and yourself. The amount you leave for yourself will be your reward in this round.

In addition to the experiment instructions, you also have a "Recording sheet."

Please look at this sheet. It will be used to record the amount of money you allocate between SHUEDF and yourself. When you have decided how to distribute the money, please fill in the amount allocated to the SHUEDF in the "Donate to SHUEDF"

column in the "Recording sheet" of the Round 1 task; the amount assigned to yourself should be recorded in the "Assign to yourself" column on the sheet of the Round 1 task.

Instructions for Round 2 task

Round 2 will be conducted after the Round 1. In this task, you will receive 72 RMB. You have to buy a 12 RMB ball pen we provide you, whereas we will donate 3 RMB to SHUEDF. Next, you will decide how to allocate the remaining 60 RMB (i.e., 72 RMB minus 12 RMB) between SHUEDF and yourself. The amount you leave for yourself will be your reward in this round.

When you have decided how to distribute the money, please fill in the amount allocated to SHUEDF in the "Donate to the SHUEDF" column in the "Recording sheet" of the Round 2 task; the amount assigned to yourself should be recorded in the "Assign to yourself" column on the sheet of the Round 2 task.

Instructions for Round 3 task

Round 3 will be conducted after Round 2. In this task, you will receive 72 RMB. You are asked to buy a 12 RMB ball pen we provide you, whereas we will donate 6 RMB to SHUEDF. Next, you will decide how to allocate the remaining 60 RMB (i.e., 72 RMB minus 12 RMB) between SHUEDF and yourself. The amount you leave for yourself will be your reward in this round.

When you have decided on how to distribute the money, please fill in the amount allocated to SHUEDF in the "Donate to the SHUEDF" column in the "Recording sheet" of the Round 3 task; the amount assigned to yourself should be recorded in the "Assign to yourself" column on the sheet of the Round 3 task.

Instructions for Round 4 task

Round 4 will be conducted following Round 3. In this task, you will receive 72 RMB. You have to buy a 12 RMB ball pen we provide you, whereas we will donate 9 RMB to SHUEDF. Next, you will decide how to allocate the remaining 60 RMB between SHUEDF and yourself. The amount you leave for yourself will be your reward in this round.

When you have decided how to distribute the money, please fill in the amount allocated to SHUEDF in the "Donate to the SHUEDF" column in the "Recording sheet" of the Round 4 task; the amount assigned to yourself should be recorded in the "Assign to yourself" column on the sheet of the Round 4 task.

Instructions for Round 5 task

Round 5 will be conducted after Round 4. In this task, you will receive 72 RMB. You have to buy a 12 RMB ball pen we provide you, whereas we will donate 12 RMB to SHUEDF. Next, you will decide how to allocate the remaining 60 RMB (i.e., 72 RMB minus 12 RMB) between SHUEDF and yourself. The amount you leave for yourself will be your reward in this round.

When you have made your decision on how to distribute the money, please fill in the amount allocated to SHUEDF in the "Donate to the SHUEDF" column in the "Recording sheet" of the Round 5 task; the amount assigned to yourself should be recorded in the "Assign to yourself" column on the sheet of the Round 5 task.

Instructions for Round 6 task

Round 6 will be conducted after that of Round 5. In this task, you will receive 60 RMB. Then, you need to decide how to allocate this amount between SHUEDF and yourself. The amount you leave for yourself will be your reward in this round. It

should be noted that the task of this round is exactly the same as that of the first round.

When you have decided how to distribute the 60 RMB, please fill in the amount allocated to SHUEDF in the "Donate to the SHUEDF" column in the "Recording sheet" provided in Round 6 task; the amount assigned to yourself should be recorded in the "Assign to yourself" column on the sheet of the Round 6 task.

The above is the content of the six rounds of today's experiment. After making decisions in each round, you can make the next round of decisions on your own without waiting for our instructions. When all the decisions for the six rounds have been completed, and the results have been recorded in the "recording sheet," please raise your hand. We will put an automatic dice machine in front of you, and you need to press the button to roll the dice. The number shown on the die will correspond to which round you will be paid for, namely, 1 corresponds to the first round, 2 to the second round, and so on. For example, if you roll the number 1, you will receive a reward based on your decision in the Round 1 task; if the number is 2, you will receive a reward based on your decision in the Round 2 task, and so on. Furthermore, if you roll a 2, 3, 4, or 5, you will also receive a ball pen with a market price of 12 RMB. At the same time, we will donate the corresponding amount to SHUEDF. In addition, when we prepare your reward, please complete a questionnaire for us.

Appendix 2: Recording sheet

Round 1 task
Now that you have received 60 RMB, you can assign it to yourself or donate it to the Shanghai University Education Development Foundation (i.e., SHUEDF). How will you divide the amount?

Assign to yourself: _____ RMB

Donate to SHUEDF: _____RMB

Round 2 task

Now you have received 72 RMB, with 12 of which you must purchase a ball pen we provide for you. At the same time, we will donate 3 RMB to SHUEDF. Next, you will decide how to allocate 60 RMB (i.e., RMB 72 minus 12 RMB) between yourself and SHUEDF. How will you divide the amount?

Assign to yourself: _____ RMB

Donate to SHUEDF: _____RMB

Round 3 task

Now you have received 72 RMB, with 12 of which you must purchase a ball pen we provide for you. At the same time, we will donate 6 RMB to SHUEDF. Next, you will decide how to allocate 60 RMB (i.e., RMB 72 minus 12 RMB) between yourself and SHUEDF. How will you divide the amount?

Assign to yourself:_____ RMB

Donate to SHUEDF:_____RMB

Round 4 task

Now you have received 72 RMB, out of which you must purchase a ball pen costing 12 RMB. At the same time, we will donate 9 RMB to SHUEDF. Next, you will decide how to allocate the remaining 60 RMB (i.e., RMB 72 minus 12 RMB) between yourself and SHUEDF. How will you divide the amount?

Assign to yourself:_ _____ RMB

Donate to SHUEDF: _____RMB

Round 5 task

Now you have received 72 RMB, out of which you must purchase a ball pen costing 12 RMB. At the same time, we will donate 12 RMB to SHUEDF. Next, you will decide how to allocate the remaining 60 RMB (i.e., RMB 72 minus 12 RMB) between yourself and SHUEDF. How will you divide the amount?

Assign to yourself:_____ RMB

Donate to SHUEDF:_____RMB

Round 6 task

Now you have received 60 RMB, you can either assign it to yourself or donate it to SHUEDF. How will you divide the amount?

Assign to yourself:_____ RMB

Donate to SHUEDF: _____RMB