Learning from Unincentivized and Incentivized Communication: A Randomized Controlled Trial in India*

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Abstract

We designed a randomized controlled trial on willingness to pay (WTP) for a type of off-grid solar technology to understand the extent of information barriers in adopting such household products. We gave high-quality solar lanterns to randomly selected seed households in a non-electrified part of rural India. We randomly assigned three friends of the seed to treatments that led them to different exposure to their peer. We also introduced a second treatment to investigate whether the seed's gender identity impacts the magnitude of peer effects. We show that, while unincentivized communication increases WTP by 90% and incentivized communication by 145%, gender seems not to matter. We also show that learning from others is the mechanism that drives the increase in WTP.

JEL: D83, O33, Q21, Q42

Keywords: Peer Effects; Social Networks; Communication; Solar Lanterns

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1 Introduction

Theories of economic growth hold technological progress as the main engine of economic development. In particular, endogenous growth models highlight the important role of social learning in technology diffusion: profit- or utility-maximizing agents invest, learn by doing and learn from each other through knowledge spillovers (Acemoglu, 2009; Aghion and Howitt, 1997; Barro and SalaiMartin, 2004; Lucas, 1988; Romer, 1986). This phenomenon has been especially documented for the diffusion of agricultural technologies in developing countries (Bandiera and Rasul, 2006; Bardhan and Udry, 1999; Conley and Udry, 2010; Foster and Rosenzweig, 1995). But peers, or broadly speaking of one's social network, also influence a host of other individual outcomes such as those related to education (e.g., Angrist and Lang, 2002; Figlio, 2005; Hoxby, 2000; Sacerdote, 2001; Zimmerman, 2003), health (e.g., Kling and Liebman, 2007; Munshi, 2003), labor productivity and consumption (e.g., Mas and Moretti, 2009; Mobius, Niehaus, and Rosenblat, 2005).

In this paper, we investigate and quantify the magnitude of peer effects for an example of off-grid solar technology: a high-quality solar lantern featuring a USB port charger. Billions of people around the world still use kerosene lamps to fulfil their lighting needs. Not only is kerosene associated with high risks of burns, fires and poisoning, but burning it contributes to indoor air pollution (which is linked to 3.8 million deaths worldwide annually[1]) and to climate change (Lam, Smith, Gauthier, and Bates, 2012).[2] Although not directly productivity-enhancing, solar lanterns are cleaner and safer alternatives that can have a significant impact on health and educational outcomes, which in turn can enhance well-being. Households' willingness to pay for solar lanterns, however, has remained low. Several reasons have been put forward such as tight household budget constraints, poor product quality and little local expertise in solar technologies (Karakaya and Sriwannawit, 2015). This paper investigates the existence and extent of another channel: information barriers.

We interviewed and offered solar lanterns to 200 randomly selected "seed" individuals in a non-electrified region of India. We asked each seed household to provide the name of three peers whom they regularly interact with. We then randomly assigned these names to a control group, an "unincentivized" communication treatment, and an "incentivized" communication treatment. We interviewed and elicited willingness to pay (WTP) for solar lanterns using the Becker-Degroot-Marschak (BDM) method (Becker, Degroot, and Marschak, 1964) with all three friends but at different points in time. We elicited WTP for the control group immediately after interviewing the seed household. This allows us to capture WTP when there is no prior

[1]Source: World Health Organization https://www.who.int/airpollution/household/en/

[2]UNEP (2013) estimated that the substitution of solar lighting for all traditional lighting in India would save about 34 million tonnes of carbon dioxide annually. Roughly this represented about 1% of India energy-related emissions in 2013.

knowledge of what lanterns are and how to use them. We elicited WTP for both the unincentivized and incentivized groups thirty days after the seed received the lantern. Friends in the incentivized group were invited to a ”tea meeting” during which the seed presented the solar lantern and shared his or her experience. We elicited WTP for lanterns right after the tea meeting.

Our experimental design exploits time lags to instrument for the possibility that peers exchange information about solar lanterns. Within thirty days, peers in the “unincentivized” have likely talked to their seed friend which may have mentioned or even demonstrated using the lantern. We also introduce a second treatment to instrument for the identity of the peer, mainly the gender of the original seed: out of the 200 individuals, half of them are male and half of them female. Recent empirical research has documented that the social identity of the person that carries and diffuses information can have a critical influence on how such information is understood or interpreted. In the context of technology adoption, this means that potential adopters are more susceptible to information and advice from some communicators rather than others (BenYishay and Mobarak, 2018). A key determinant seems to be whether communicators and receivers share a common group identity. In India, gender roles structure a large part of social life, and we investigate whether women may stand as less effective communicators or influencers, especially as it comes to diffusing information about new technologies.

Our results indicate that both the “unincentivized” an “incentivized” treatment effects are large, while the gender treatment is not significant (although the point estimate is negative). Specifically, we find that, on average, the unincentivized group is willing to pay INR 120 more than the control group, and the incentivized group INR 190 more. This corresponds to proportional treatment effects of 90% and 145% increases, respectively. It is notable that the unincentivized effect almost doubled WTP, whereas incentivized communication added another 55 percentage points increase to the treatment effect.

The major challenge in identifying the impact of peers on the adoption of new technologies, even after tackling identification issues through a randomized assignment, is understanding the mechanisms that drive the observed results. It may be that peers imitate each other rather than learning from each other about the benefits of the new technology or learning how to operate the technology (Oster and Thornton, 2012). We collected detailed information about respondents’ perception of the solar lanterns as well as gender norms. In particular, we find evidence that the increase in WTP is driven by learning both how to operate the technology and learning about its benefits. We also document that households in our sample appeared to give women some say in purchasing decisions, as well as when it comes to using new products. In particular, most respondents thought that women were as able as men to use new technologies. Consequently, despite their lower overall social status, women may still be perceived as a legitimate communicator when it comes to demonstrating the pros and cons of a household product such as solar lanterns.

This paper contributes to the literature on the role of peer effects in technology adoption in developing countries. As noted above, most of this literature focuses on agricultural technologies, with notable exceptions such as the study of the adoption of menstrual cups by school girls in Nepal (Oster and Thornton, 2012). This paper is the first in this literature to focus on off-grid solar technologies and the first to investigate gender as a type of group or social identity that may impact the magnitude of peer effects on technology adoption. This paper, therefore, also speaks to the emerging field of "envirodevonomics" (Greenstone and Jack, 2015) which attempts to shed light on why marginal willingness to pay for environmental improvements in developing countries is so low given environmental quality is low and health burdens high. In particular, part of this literature examines the causes and consequences of energy poverty. For example, some studies have investigated barriers in adopting cleaner cookstoves, a type of household technology also related to indoor air pollution (Levine, Beltramo, Blalock, and Cotterman, 2012; Miller and Mobarak, 2013).

More than one billion people around the world live without electricity access, and many more without reliable electricity supply.[3] Extending the grid (or decreasing the number of outages) requires high levels of investment that are often difficult to secure by governments. Poor households, therefore, will likely continue fulfilling their energy needs through other means, and in particular using kerosene for lighting. In rural areas in India, for example, about one out of every person use kerosene for lighting (Jain, Tripathi, Mani, Patnaik, Shahidi, and Ganesan, 2018). Beyond impacting health outcomes and emitting greenhouse gases, kerosene use also has a significant impact on the country's public finances. Indeed, kerosene has a long history of generous subsidies, and some estimates indicate that the government could save around INR 600 per year for every consumer switching from kerosene to solar (Jain and Ramji, 2016).

The rest of the paper is organized as follows. Section 2 lays out the conceptual framework and our key hypotheses about willingness to pay for solar lanterns. Section 3 describes the design and procedure of the randomized controlled trial, with results of the randomization checks. In Section 4, we present our empirical results, robustness checks and evidence for the mechanisms at play. Section 5 draws on broader implications and concludes the paper.

2 Conceptual Framework

Drawing on Bandiera and Rasul (2006); Bardhan and Udry (1999); BenYishay and Mobarak (2018); Conley and Udry (2010); Foster and Rosenzweig (1995), we lay out a brief motivating framework for interpreting

[3]Source: https://www.iea.org/energyaccess/database/

the main results from our randomized controlled trial. We begin by defining the following treatments:

- In the *unincentivized* group, subjects observe the use ofthe new technology by others without incentivized and tailored communication. Thus, learning from others is a result of the natural interaction through social networks, and in particular with the seed household.
- In the *incentivized* group, subjects both observe the use of new technology by others and receive direct communication about the properties of the new technology just before WTP is elicited. Thus, learning from others is the result of incentivized interactions with the seed household.

To test the presence of social learning in agriculture, studies typically make use of the "target-input" model proposed by Wilson (1975) and Jovanovic and Nyarko (1994). According to this model, farmers know the basic form of the new technology with certainty (e.g., an improved seed), but does not know the target level, which is assumed to be random. Farm profits are inversely related to the difference between the actual level of input applied and the target level. Farmers realize what the actual level of input should be only after the input is applied and output realized. As a result, the farmer learns about the new technology over time through learning-by-doing. In this model, individuals can also learn from each other's experience when they share a similar distribution of the input target. Assume that two farmers belong to the same social network and share information or costlessly observe each other's input choice. In each period, farmers use Bayes' rule to update their prior belief on the variance of the optimal input level, making use of information from their own experience and the experience of their network members. Thus, the adoption of new technologies in this model is a social process because its adoption by an individual generates information spillover to all her peers, which increases their expected welfare in the future (Bardhan and Udry, 1999).

Diffusion of solar lanterns can be modelled using an extended version social learning framework because, through their interactions with the solar lantern owners, peers learn about the service provided by the lanterns and update their belief about the quality of the lanterns. Consequently, these individuals would be willing to pay more than those who did not have prior information about the lanterns. Our experimental design allows for a period of one month for information to diffuse, that is for households in the unincentivized group to learn about the solar lantern.[4] In our context, one month seems sufficient because; 1) the technology is easily observable, and 2) we offer the technology to one of their closest friends who is expected to interact with them regularly. We will show later that, indeed, all unincentivized households report knowing what a solar lantern is, indicating that one month was sufficient to ensure respondents in the treatment groups were

[4] Allowing for longer than a month would increase the probability of other confounders.

exposed to solar lanterns through their friend. Hence, we formulate Hypothesis 1 below.

Hypothesis 1. *The unincentivized treatment increases willingness to pay.*

An important extension of the "target-input" model by BenYishay and Mobarak (2018) is that the member of the social network who communicates information about the new technology, i.e., the "communicator" knows the optimal level of the technology. However, it would be costly to transfer her knowledge about the new technology to other farmers. If there is an intervention that rewards the information communicator based on what proportion of farmers adopted the new technology as a result of the communicator's efforts, diffusion of the technology may occur much faster. As a result, others will learn about the new technology and adopt it much more quickly than the case of unincentivized communication through ordinary social networks. In our case, rewarding seed households to invite one of their randomly selected peers for a tea meeting after the seed household used the solar lantern for a month is expected to increase the saliency of the product and transmission of more accurate information than in the case of unincentivized regular interactions. As a result, peers who have been provided detailed information about the attributes of the solar lanterns are likely to pay more for the lanterns than peers who were not invited for the tea meeting. Hence, we formulate Hypothesis 2 below.

Hypothesis 2. *The incentivized communication treatment increases willingness to pay more than the unincentivized treatment.*

Finally, BenYishay and Mobarak (2018) show that, when it comes to adopting a new technology, farmers appear most convinced by communicators who share a group identity with them. In our study, the social identity we focus on is gender because gender norms in India assign women to a particularly low social status. The knowledge externalities they generate through their experience with solar lanterns may then be less effectively captured by their peers. The idea that women are less influential than men has empirically been documented. Although in a context very different from ours, Aral and Walker (2012) show, using randomized experiments on 1.3 million of Facebook users, that men are more influential than women and that women influence men more than they influence other women.

In India, women's lower social status is apparent in the overall lower levels of educational attainment and lower participation in labour markets. Gender inequalities are also pervasive inside the household where women display lower bargaining power over many of the household's decision (e.g., purchase of durable goods). For example, recent studies show that improved cookstoves, which enhance the quality of life of all household members, are valued at significantly higher levels by women than men, but could not be adopted optimally because women have low decision-making power (Alem, Hassen, and Köhlin, 2017; Miller and Mobarak, 2013). Hence, inside or outside the households, women lack social prestige. We, therefore, hypothesize that when they communicate about a new household technology, receivers of the information are likely to place less attention or discount the information they receive. Hence, we hypothesize that the effect of our communication treatments on their WTP would be weaker when the seed is female.

Hypothesis 3. *Learning through male social networks increases willingness to pay by a greater amount than learning through female social networks.*

3 Experimental Design

To test our hypotheses, we collaborated with a local organization to distribute solar lanterns and conduct an experiment[5] in 200 non-electrified habitations[6] in India, in Gonda district in the state of Uttar Pradesh. At the time of the experiment, the study area was still non-electrified and households did not know of solar lanterns.

Solar lanterns are small lamps (about thirty-five centimeters high) powered by a battery that can be charged when exposed to solar radiation. The solar lanterns we used sold for INR 1,200 in Lucknow, the capital of Uttar Pradesh state.[7][8] Notably, these lanterns had a USB-port feature which allowed users to charge a mobile phone. As a point of comparison, in our sample, households spent on average about INR 42 on lighting needs per month per lamp (typically on kerosene), corresponding to about INR 500 per year. Hence, if households paid the market price of the solar lantern, they would amortize it in about two years and a half. We chose the product based on a review of solar lanterns available among Uttar Pradesh distributors. We confirmed the performance of the lanterns in terms of lighting quality and duration and charging power by using them with the survey team for about a week. This way, we selected the model to be durable, multipurpose, and convenient to use.

In our experiment, the subjects were given an opportunity to purchase a solar lantern in a BDM game. The experiment was conducted in two rounds between the end of July and the beginning of October 2015. The study area was chosen because it had a low electricity access rate, with many non-electrified habitations close to Gonda City, the district capital. To avoid data mining and bias from multiple comparisons, a detailed pre-analysis plan (PAP) listing all research hypotheses and our key empirical specifications was registered

[5]Before implementation, the experiment was reviewed and approved by the internal review board (IRB) of Columbia University.

[6]Habitations (also called sub-villages or hamlets) are the lowest administrative units in India.

[7]This was equivalent to about USD 18.5 at the time of the time of the fieldwork (Fall, 2015). The products had a 3-watt solar panel, a 6V 4.5Ah battery, a 3-watt, 24-piece surface-mounted-device LED, and a mobile-charging socket.

[8]Photos of the lantern can be found in the supporting online materials.

with Evidence in the Governance and Politics website.[9]

The primary specification equation can be written as follows:

$$WTP_{ij} = \alpha + \beta_1 U_i + \beta_2 U_i F_i + \gamma_1 I_i + \gamma_2 I_i F_i + \mu_j + \epsilon_{ij}, \tag{1}$$

where WTP_{ij} is the willingness to pay for a solar lantern by household i in habitation j; U_i is a dummy variable coding for whether household i is in the unincentivized group; F_i is a dummy variable coding for whether the lantern was seeded to a female (i.e., if 1, then household i is a friend of a female seed); I_i is a dummy variable coding for whether the household is in the incentivized group (i.e., household i attended a tea meeting with the seed); μ_j is a vector of habitation fixed effects ($N = 200$); ϵ_{ij} is a random error term. A term for F_i does not appear in the equation because, by design, habitation fixed effects accounts for it. Our objective is to estimate $\beta_1, \beta_2, \gamma_1, \gamma_2$. Throughout, we cluster standard errors by habitations. In this empirical framework, the hypotheses can be expressed as follows. Hypothesis 1 is equivalent to $\beta_1 > 0$ and $\beta_1 + \beta_2 > 0$; Hypothesis 2 to $\gamma_1 > 0$ and $\gamma_1 + \gamma_2 > 0$; Hypothesis 3 to $\beta_2 < 0$ and $\gamma_2 < 0$.

3.1 Outcome Variable

The outcome variable is the subject's WTP measured in the BDM game. As Becker, Degroot, and Marschak (1964) show, the BDM game recovers the subject's true preference by removing incentives to misrepresent WTP for strategic reasons. In the game, the subject is requested to provide his or her highest WTP for an item, and the price of the item is then drawn from a random distribution. If the price is below the stated WTP, the subject pays the *randomly drawn price*, not the stated WTP[10]. Therefore, the subject has no incentive to understate WTP to obtain a better bargain. This method has been widely applied in development economics to measure WTP (e.g., Guiteras, Levine, Polley, and Quistorff, 2013; Hoffmann, 2009; Levine et al., 2012) because it is incentive-compatible and provides a more continuous demand curve, as opposed to demand estimates for a discrete number of price points (as is the case in a typical randomized-price WTP measurement)[11].

The game was played in the field as follows. We ask households to announce their maximal willingness to pay on a 0-1,200 scale (in INR). Then, the actual price is determined by a random draw from a bag which contains 21 balls, each one of them with a number written on it. The number goes from INR 0 to INR 1,200

[9] The PAP is publicly available at `http://egap.org/registration/1420`.

[10] The game is in fact setting up a real purchasing experience, and in that sense, our WTP elicitation is done through revealed preferences.

[11] In practice, prices are drawn from a distribution of discrete numbers so the demand curve is defined on these numbers only.

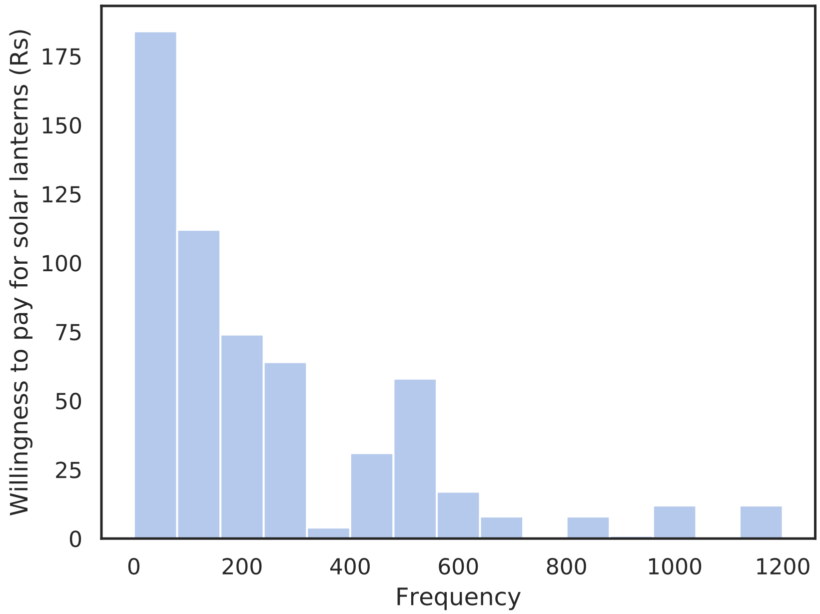

Figure 1: Histogram of bids for solar lanterns. Summary statistics are as follows: minimum = INR 0; maximum = INR 1200; mean = INR 239; standard deviation = INR 266.

in increments of INR 100.[12] The respondent first makes a bid and then randomly draws a ball. If the price on the ball is higher than the bid, the respondent is not allowed to purchase the lantern. If the price on the ball is lower than the bid, the respondent must purchase the lantern at the price that was drawn. As a result, when the respondent makes a bid, she or he must make sure to have access to money. The respondent has only one chance to play, and he cannot change his bid after drawing a ball. Before playing for 'real', we did a practice round with a bar of soap to make sure the respondent fully understood the rules.

Figure 1 displays the distribution of the bids: we see that most subjects made a positive bid, but no subject offered the full market price of the lantern. We also note that the willingness to pay displays important variation across individuals, spanning from 0 to 1200, with mean 239 and standard deviation 266. At the end, a total of 160 respondents (42 in the control group, 55 in the unincentivized group and 63 in incentivized group) ended up purchasing the lantern because their bid was higher or equal to their draw.

In measuring WTP, we paid particular attention to training the enumerators so that they explained the procedure to the subjects carefully and always conducted the practice round with soap. Based on our observation of the WTP measurement, the subjects understood the rules of the game. No subject complained afterwards or refused to pay when they won the solar lantern. The subjects were sometimes disappointed if

[12]The game is therefore incentive-compatible across increments of INR 100.

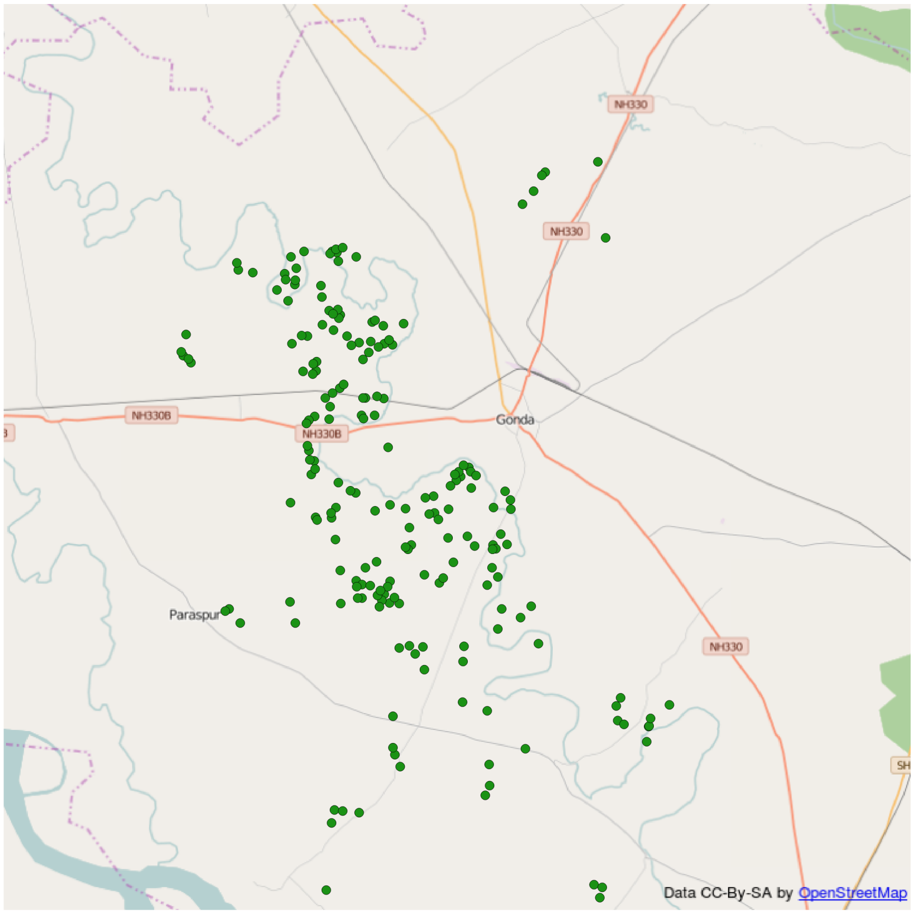

Figure 2: Map of study area around Gonda City. Green dots indicate the habitations included in the experiment.

they did not win the lantern, but in that case they also did not have to give any money.

3.2 Sampling and Treatments

The data collection began with a mapping of 200 primary habitations and 25 replacement habitations around Gonda City. The enumerators approached the habitations in expanding circles, with habitations near Gonda City visited first and those further away visited later. If a habitation was excluded because of safety concerns or because it had access to grid electricity, a randomly drawn replacement habitation was used instead. Overall, we had to exclude and replace five habitations. The map of the study area and habitations is shown in Figure 2.

Within each habitation, the enumerators approached a randomly chosen seed household and, depending on the treatment, interviewed either a male or female household member. The seed was requested to provide

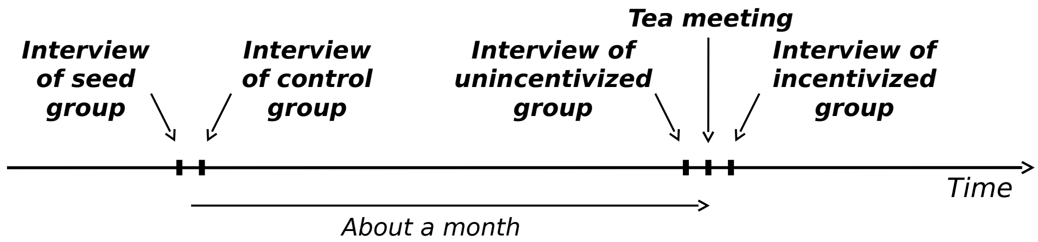

Figure 3: Timeline of the experiment.

names of three friends with whom he or she interacts on a regular basis, and the three friends were then randomly assigned to three groups: control, unincentivized and incentivized communication. The control group was interviewed immediately after the seed household provided names. This way, information about the lantern has no time to diffuse to the friends in the control group. The unincentivized and incentivized groups were interviewed approximately 30 days after the seed. We surveyed these two groups at the same time to avoid treatment spillovers. The timeline of the experiment is summarized in Figure 3. The experiment began with sampling and the interviews of the control group in July-August 2015.

We waited 30 days only because solar lanterns are products simple enough to learn about in a short time. Thirty days appeared to be reasonably long enough for information about the lantern to flow from the seed to the two treatment groups.[13] If the friend chosen was not the household head, we interviewed the head of the household to which that friend belonged to.[14] Households in the three groups were all offered the possibility to buy a solar lantern through a BDM game. Before playing the BDM game with the incentivized household, the seed invited his/her "incentivized" friend over for a tea meeting to discuss his/her experience of the lantern. Table 1 summarizes the size of the different treatment groups. We visited a total of 197 habitations, 98 assigned to the male seed treatment and 99 to the female seed treatment. We dropped three habitations because the unincentivized and incentivized friends had moved away from the village and could no longer be surveyed.

The male-female treatment was randomized at the habitation level. One of the researchers drew a random number for each habitation and assigned the highest 100 numbers to the female treatment. We gave all seed households a solar lantern and INR 100 in exchange for taking part in the survey and inviting one of the three friends for a tea meeting[15]. Our survey team, consisting of enumerators who spoke the local dialect,

[13] We document this in the "Mechanisms" section of the paper.

[14] The person playing the game needs to be able to make purchasing decision. This is why we chose to always interview and play the BDM game with the household head.

[15] This was equivalent to USD 1.54 at the time of the survey.

	Total number of habitations		
	Control	**Unincentivized**	**Incentivized**
Male Seed	98	98	98
Female Seed	99	99	99

Table 1: Size of treatment groups. In all treatments, we interview the household head. We randomize the gender treatment across habitations, and the other treatments within habitations.

attended all tea meetings. They specifically told the seed households that their goal was not to convince their friend to buy a lantern but only to share stories about their experience and the performance of the lanterns.

In order to minimize the likelihood that seeds felt unfairly privileged from receiving a solar lantern plus INR 100, we phrased the experiment to them that they won a lottery which awarded a solar lantern for participating in the study and INR 100 conditional on meeting again with the survey team in the presence of one of their three best friends. We also informed them that their friends would also participate in a lottery, without more information about the nature of the lottery. Hence, the seeds did not know ex-ante that they would be getting INR 100 more than their friends,[16] and they also did not know that their friends would play a BDM game. In this context, seed households likely felt just as lucky and privileged as their friend for participating in a lottery.

3.3 Covariate Balance and Power Analysis

The balance table in Table 2 shows that the treatment groups are balanced across most covariates, with a few exceptions: gender of the respondent, savings and indebtedness. The control group has significantly more female heads of household and about INR 450 less in savings compared to the unincentivized and incentivized groups. This is a potential source for concern given households with more savings would be in a better position to bid higher prices. For this reason, as a robustness check, we include these variables in additional regression analysis.

The balance table across seed genders is shown in Table 3. As could be expected, households referred by female seeds are more likely to be headed by a female, while households referred by male seeds are usually headed by a male. It follows that the groups display significant differences for variables such as education, consumption expenses or literacy.

Standard power analysis shows that the experiment can identify plausible treatment effects. Using the control group's mean and standard deviation (134 and 181 respectively), a standard deviation's uniform increase (to 315, with a standard deviation of 362) would be detected with an $\alpha = 0.95$ probability if the

[16] Their friends also did not know that the seed was getting INR 100 more.

	Con.	Unin.	DIFF	Con.	Ince.	DIFF	Unin.	Ince.	DIFF
1) Individual Characteristics:									
Female respondent	0.355	0.198	0.157***	0.355	0.254	0.102**	0.198	0.254	-0.0558
	(0.480)	(0.399)	(3.54)	(0.480)	(0.436)	(2.20)	(0.399)	(0.436)	(-1.32)
Year of birth	1972.1	1971.8	0.239	1972.1	1970.7	1.345	1971.8	1970.7	1.107
	(14.76)	(14.24)	(0.16)	(14.76)	(12.91)	(0.96)	(14.24)	(12.91)	(0.81)
Education	1.944	2.041	-0.0964	1.944	1.893	0.0508	2.041	1.893	0.147
	(1.352)	(1.435)	(-0.69)	(1.352)	(1.255)	(0.39)	(1.435)	(1.255)	(1.08)
Reads Hindi	0.477	0.487	-0.0102	0.477	0.482	-0.00508	0.487	0.482	0.00508
	(0.501)	(0.501)	(-0.20)	(0.501)	(0.501)	(-0.10)	(0.501)	(0.501)	(0.10)
2) Household Characteristics:									
Number of children	3.693	3.918	-0.225	3.693	4.015	-0.323	3.918	4.015	-0.0979
	(2.106)	(2.032)	(-1.07)	(2.106)	(2.085)	(-1.51)	(2.032)	(2.085)	(-0.47)
Number of children in school	1.370	1.412	-0.0426	1.370	1.649	-0.280*	1.412	1.649	-0.237
	(1.550)	(1.562)	(-0.27)	(1.550)	(1.657)	(-1.71)	(1.562)	(1.657)	(-1.45)
Household size	7.310	7.183	0.127	7.310	7.289	0.0203	7.183	7.289	-0.107
	(3.916)	(3.379)	(0.34)	(3.916)	(3.375)	(0.06)	(3.379)	(3.375)	(-0.31)
3) Wealth-related variables:									
Monthly Expenses	4176.6	4376.6	-200	4176.6	4530.5	-353.8	4376.6	4530.5	-153.8
	(2334.3)	(3412.5)	(-0.68)	(2334.3)	(2810.7)	(-1.36)	(3412.5)	(2810.7)	(-0.49)
Amount of Savings	223.4	682.2	-458.9***	223.4	661.4	-438.1***	682.2	661.4	20.81
	(673.8)	(884.1)	(-5.79)	(673.8)	(1038.3)	(-4.97)	(884.1)	(1038.3)	(0.21)
In debt	0.467	0.609	-0.142***	0.467	0.477	-0.0102	0.609	0.477	0.132***
	(0.500)	(0.489)	(-2.85)	(0.500)	(0.501)	(-0.20)	(0.489)	(0.501)	(2.65)
Owns a business	0.0355	0.0660	-0.0305	0.0355	0.0711	-0.0355	0.0660	0.0711	-0.00508
	(0.186)	(0.249)	(-1.38)	(0.186)	(0.258)	(-1.57)	(0.249)	(0.258)	(-0.20)
Amount of land (acres)	1.310	1.443	-0.134	1.310	1.415	-0.106	1.443	1.415	0.0278
	(1.888)	(1.936)	(-0.69)	(1.888)	(1.426)	(-0.63)	(1.936)	(1.426)	(0.16)
Owns cattle	0.873	0.873	0	0.873	0.929	-0.0558*	0.873	0.929	-0.0558*
	(0.334)	(0.334)	(0.00)	(0.334)	(0.258)	(-1.86)	(0.334)	(0.258)	(-1.86)
Owns a phone	0.853	0.838	0.0152	0.853	0.868	-0.0152	0.838	0.868	-0.0305
	(0.355)	(0.370)	(0.42)	(0.355)	(0.339)	(-0.44)	(0.370)	(0.339)	(-0.85)
4) Lighting-related variables:									
Number of kerosene lamps	2.376	2.421	-0.0457	2.376	2.401	-0.0254	2.421	2.401	0.0203
	(1.266)	(1.229)	(-0.36)	(1.266)	(1.043)	(-0.22)	(1.229)	(1.043)	(0.18)
Hours of lighting	5.178	4.782	0.396*	5.178	5.033	0.145	4.782	5.033	-0.251
	(2.368)	(1.814)	(1.86)	(2.368)	(1.766)	(0.69)	(1.814)	(1.766)	(-1.39)
Monthly spending per lamp	39.65	43.85	-4.196	39.65	43.78	-4.122	43.85	43.78	0.0739
	(26.72)	(23.50)	(-1.62)	(26.72)	(34.85)	(-1.30)	(23.50)	(34.85)	(0.02)

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Balance table across treatments and associated t-tests. we also performed a rank-sum test (Wilcoxon-Mann-Whitney) for the variables that do not approximate a normal distribution. The only difference with the t-tests are as follows: 1) The difference between control and incentivized for the number of children that go to school is significant at the 10% level, 2) The difference between unincentivized and incentivized for hours of lighting is now significant at the 10% level.

	Con. M	Con. F	DIFF	Unin. M	Unin. F	DIFF	Ince. M	Ince. F	DIFF
1) Individual Characteristics:									
Female respondent	0.153	0.556	-0.402***	0.102	0.293	-0.191***	0.153	0.354	-0.200***
	(0.362)	(0.499)	(-6.47)	(0.304)	(0.457)	(-3.45)	(0.362)	(0.480)	(-3.31)
Year of birth	1971.3	1972.8	1.532	1971.6	1972.1	-0.529	1969.7	1971.8	-2.043
	(15.89)	(13.58)	(-0.73)	(15.06)	(13.44)	(-0.26)	(12.82)	(12.97)	(-1.11)
Education	2.051	1.838	.213	2.265	1.818	0.447**	1.980	1.808	0.172
	(1.357)	(1.345)	(1.10)	(1.544)	(1.289)	(2.21)	(1.284)	(1.226)	(0.96)
Reads Hindi	0.541	0.414	0.127*	0.592	0.384	0.208***	0.490	0.475	0.0150
	(0.501)	(0.495)	(1.79)	(0.494)	(0.489)	(2.97)	(0.502)	(0.502)	(0.21)
2) Household Characteristics:									
Number of children	3.543	3.837	-0.294	3.823	4.010	-0.187	3.918	4.113	-0.196
	(2.077)	(2.133)	(-0.97)	(2.026)	(2.043)	(-0.64)	(2.045)	(2.131)	(-0.65)
Number of children in school	1.223	1.510	-0.287	1.417	1.408	0.00850	1.526	1.773	-0.247
	(1.489)	(1.601)	(-1.28)	(1.499)	(1.630)	(0.04)	(1.690)	(1.623)	(-1.04)
Household size	7.357	7.263	0.0945	7.765	6.606	1.159**	7.939	6.646	1.292***
	(3.946)	(3.906)	(0.17)	(3.705)	(2.927)	(2.44)	(3.472)	(3.163)	(2.73)
3) Wealth-related variables:									
Monthly Expenses	3899.0	4451.5	-552.5*	4844.9	3913.1	931.8*	4940.8	4124.2	816.6**
	(2240.9)	(2403.0)	(-1.67)	(4403.4)	(1913.7)	(1.93)	(3206.4)	(2299.6)	(2.06)
Amount of Savings	278.6	168.7	109.9	717.3	647.5	69.87	672.4	650.5	21.94
	(776.2)	(552.7)	(1.15)	(914.5)	(856.1)	(0.55)	(740.3)	(1270.3)	(0.15)
In debt	0.480	0.455	0.0250	0.582	0.636	-0.0547	0.480	0.475	0.00484
	(0.502)	(0.500)	(0.35)	(0.496)	(0.483)	(-0.78)	(0.502)	(0.502)	(0.07)
Owns a business	0.0510	0.0202	0.0308	0.0816	0.0505	0.0311	0.0612	0.0808	-0.0196
	(0.221)	(0.141)	(1.17)	(0.275)	(0.220)	(0.88)	(0.241)	(0.274)	(-0.53)
Amount of land (acres)	1.196	1.422	-0.226	1.431	1.455	-0.0248	1.604	1.228	0.375*
	(1.157)	(2.404)	(-0.84)	(1.678)	(2.170)	(-0.09)	(1.638)	(1.158)	(1.86)
Owns cattle	0.827	0.919	-0.0927*	0.867	0.879	-0.0114	0.918	0.939	-0.0210
	(0.381)	(0.274)	(-1.96)	(0.341)	(0.328)	(-0.24)	(0.275)	(0.240)	(-0.57)
Owns a phone	0.816	0.889	-0.0726	0.806	0.869	-0.0626	0.908	0.828	0.0799*
	(0.389)	(0.316)	(-1.44)	(0.397)	(0.339)	(-1.19)	(0.290)	(0.379)	(1.66)
4) Lighting-related variables:									
Number of kerosene lamps	2.235	2.515	-0.280	2.439	2.404	0.0347	2.541	2.263	0.278*
	(1.250)	(1.273)	(-1.56)	(1.332)	(1.124)	(0.20)	(1.141)	(0.921)	(1.88)
Hours of lighting	5.082	5.273	-0.191	4.806	4.758	0.0485	5.005	5.061	-0.0555
	(2.218)	(2.515)	(-0.57)	(1.892)	(1.743)	(0.19)	(1.709)	(1.828)	(-0.22)
Monthly spending per lamp	38.79	40.48	-1.688	44.92	42.84	2.088	42.30	45.25	-2.952
	(22.00)	(30.64)	(-0.44)	(21.72)	(25.13)	(0.61)	(21.83)	(44.27)	(-0.59)

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Balance table across treatments and seed gender and associated t-tests. we also performed a rank-sum test (Wilcoxon-Mann-Whitney) for the variables that do not approximate a normal distribution. The only difference with the t tests are as follows: 1) The difference in education level is significant at 10% in the control group, 2) The difference in household expenses is not significant in the unincentivized group, 3) The difference in savings of the seeds is significant at 10% in the incentivized group, 4) The difference in irrigated land is not significant in the incentivized group, 5) The difference in the number of kerosene lamps is not significant in the incentivized group.

control and treatment group each had at least 65 participants. In our setting, each group has 200 subjects, and, we cluster standard errors at the habitation level ($N = 200$). We also control for habitation fixed effects, which enables us to estimate the treatment effects more precisely.

4 Results

4.1 Main Estimates

Figure 4 shows the distribution of bids across treatment groups. There is a noticeable change in the distribution between the control group, the unincentivized group, and the incentivized group: distributions become flatter and displays fatter right tails. This likely indicates that our treatments have positive effects on WTP. We hardly notice important differences, however, when comparing the distribution across gender of the seed indicating that our gender treatment is not likely to have any effect.

We display box plots of WTP for the different treatment groups on Figure 5.[17] We find that the mean WTP in the unincentivized and incentivized treatments are significantly higher than in the control, and we find a significant difference between the unincentivized and incentivized treatments when the sample is not split by gender.[18] However, when looking only at the sample with female seeds, there is no significant difference between the means of the unincentivized and incentivized treatments. Box plots on Figure 5 indicate that distributions for the male and female control groups seem to differ, but the difference is not significant with a rank-sum test.

Mean comparisons, however, do not control for unobserved heterogeneity across habitations and for correlation between observations within the same habitation. We therefore proceed to using regressions with fixed effects. The main results are shown in Table 4. In all regressions, the standard errors are clustered at the habitation level. Habitation fixed effects are not included in the second column because the gender treatment was randomized across habitations. Results show that the unincentivized treatment increased WTP by almost INR 120 compared to the control group. Given the mean WTP in the control group was INR 134,[19] this corresponds to a 90% increase. Furthermore, compared to the control group, the incentivized treatment increased WTP by INR 195 which corresponds to a 145% increase. Additionally, in column 1, the coefficients for the unincentivized and incentivized treatments are different at the 1% level.

The gender treatment, on the other hand, is not statistically significant. However, the point estimates are negative and correspond to minus INR 34 for the unincentivized group and to minus INR 58 for the

[17] We also show the value of the mean WTP across treatments in the supporting online materials.
[18] We performed both t-tests and rank-sum tests.
[19] Similarly, the value of the intercept in model 1 of Table 4 is INR 134.5.

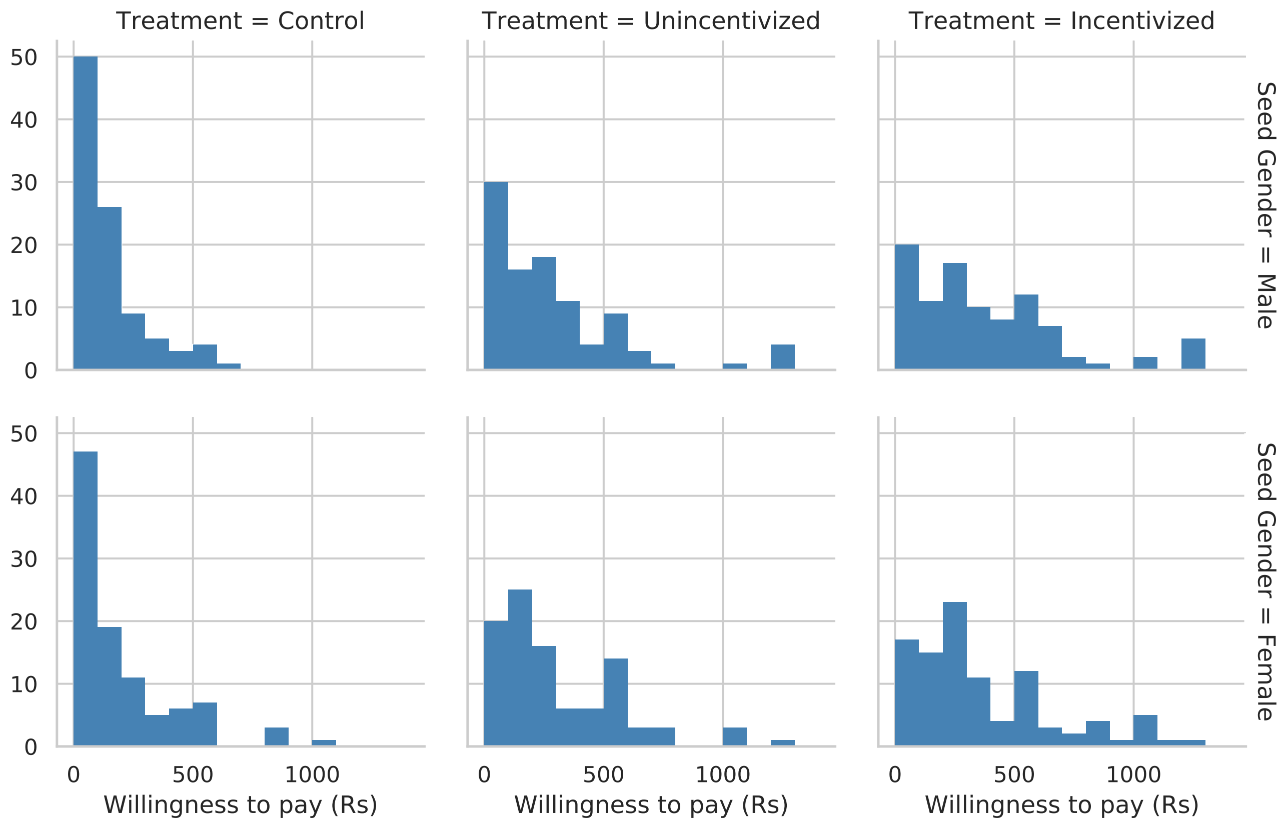

Figure 4: Faceted histogram of bids for solar lanterns across treatment groups.

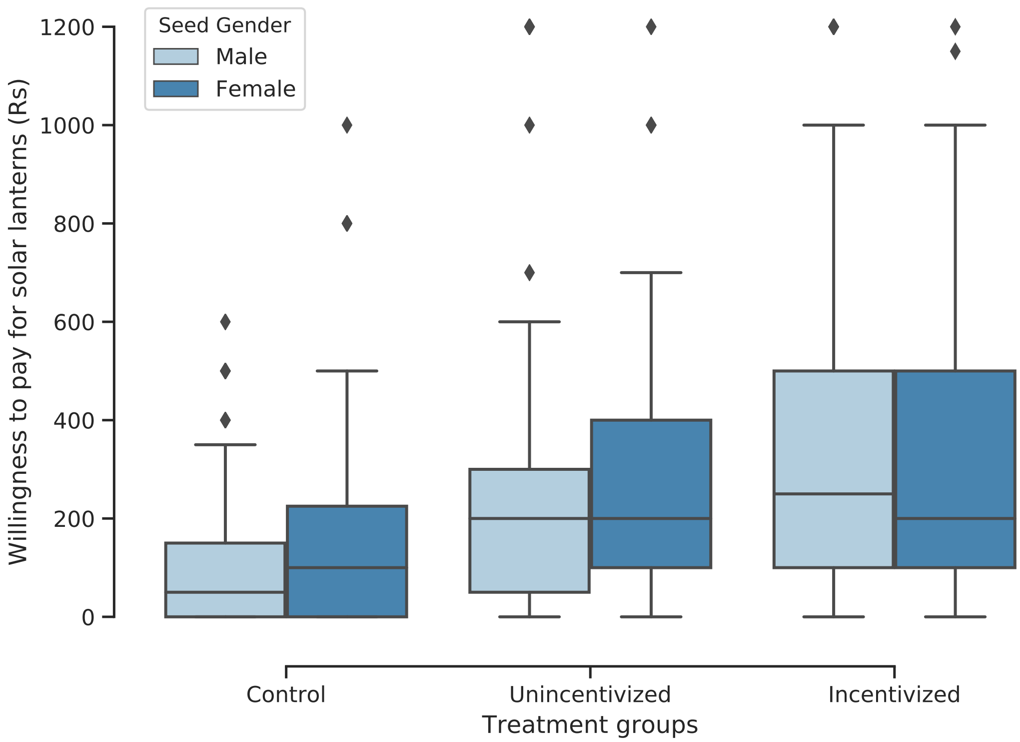

Figure 5: Boxplots of bids for solar lanterns across treatment groups.

	(1) WTP	(2) WTP	(3) Male head only
Unincentivized	119.883***	136.988***	134.586***
	(22.115)	(30.847)	(35.014)
Incentivized	195.078***	224.416***	224.802***
	(22.925)	(32.086)	(36.442)
Unincentivized x Female Seed		-34.067	-10.586
		(44.229)	(62.968)
Incentivized x Female Seed		-57.749	-63.893
		(45.745)	(65.971)
Habitation fixed effects	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes
R-squared	0.157	0.161	0.165
Observations	585	585	426

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Main results.

incentivized group. Some of the friends chosen by the female seed were in fact female household heads. If women identify other women more as belonging to the same social identity than men, then possibly the gender effect that we hypothesized is stronger within the subsample of male household head. In other words, we expect that the female identity of the communicator leads to more discounting of the information for male than for female. In column 3 of Table 4, we run a regression specification similar to column 2 but excluding households headed by women. Although the point estimate is indeed negative, overall, the effect is not statistically significant. We exclude the possibility of not observing a gender effect due to a composition effect. Instead, it indicates that the mechanism we hypothesized and discussed earlier might not be in place.

4.2 Robustness Checks

In Table 5, we include controls for monthly savings, one of the imbalanced covariates. We see that the treatment effects coefficients slightly decrease from 120 to INR 108 in the unincentivized group and from INR 195 to 184 in the incentivized group. Yet, the effects remain robust. The coefficient for monthly savings is significant at the 5% level but the magnitude is small: every additional Indian Rupee in savings correlates with a WTP increase of INR 0.026. Given the imbalance of savings across treatment groups[20], this represents an average contribution to the WTP of about INR 6 in the control group and about INR 17 to INR 18 in the unincentivized and incentivized groups. The contribution of savings to the WTP is therefore an order of magnitude lower than the contribution of our information treatments. In fact, the raw correlation coefficient between WTP and savings is only 0.15. This can be visualized on the scatter plot of WTP for the entire

[20]On average, the unincentivized and incentivized groups have, respectively, INR 459 and INR 438 more in savings than the control group.

	(1)	(2)	(3)	(4)	(5)
Unincentivized	107.560***	114.829***	103.161***	119.744***	117.944***
	(22.727)	(28.718)	(25.966)	(33.841)	(36.070)
Incentivized	183.525***	201.240***	177.301***	229.662***	214.382***
	(23.902)	(25.510)	(27.383)	(39.679)	(43.535)
Amount of savings (in Rupees)	0.026**	0.066**			
	(0.013)	(0.033)			
Unincentivized x Savings		-0.037			
		(0.039)			
Incentivized x Savings		-0.053*			
		(0.031)			
Savings (log)			5.689	19.353**	
			(4.340)	(7.478)	
Unincentivized x log Savings				-14.007	
				(8.860)	
Incentivized x log Savings				-22.412**	
				(9.470)	
Habitation fixed effects	Yes	Yes	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes	Yes
R-squared	0.165	0.170	0.162	0.173	0.180
Observations	585	585	585	585	315

Standard errors in parentheses
Model57 is for the sub-sample of respondents that declare zero savings.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Main results controlling for amount of savings.

sample, with amount of savings shown in the supporting online materials: those who had the highest amount of savings are not those who revealed the highest WTP.

In regression 2, we interact monthly savings with the treatment dummies. The coefficient for the interaction term is, in fact, negative and significant at the 10% level, indicating that savings and WTP correlate even in this treatment group but than overall more savings is not associated with higher WTP. We also run an analysis using monthly savings in logs instead of levels and find similar results. Specifically, we note that the estimated treatment effects decreases slightly, from INR 120 to INR 103 in the unincentivized group and from INR 195 to INR 177 in the incentivized group, but, overall, the effects remain large and significant at the 1% level. Finally, Regression 5 estimates the treatment effects for the sub-sample of respondents who declared having zero savings, which constitute more than half of our observations. We see that the treatment effects found within this subsample are very similar to those found for the whole sample. This confirms that monthly savings are not the main driver of our treatment effects.

We further test the robustness of our results by adding other control variables in Table 6. Whether the household head was female or male was another unbalanced variable; we therefore control for it in column 1. Treatment effects for both the unincentivized and incentivized groups change little. In column 2, we control for both whether the household head is female and for the amount of monthly savings. The main treatment effects are slightly reduced but remain large and significant at the 1% level. In column 3, we control for the date when the household was surveyed. Harvesting of maize and rice in the study area started at the end of September and early October respectively, and about 20% of our treated households were interviewed after September 25. Hence harvesting partly coincided with our survey of the unincentivized and incentivized groups. If those sampled households began selling their harvest, they would likely have been able to afford greater expenditures, and consequently have a higher WTP for the solar lanterns. We therefore investigate the robustness of our treatment effect to this possible "wealth effect".[21] [22]

To do so, we control in our regression for the date of interview. Specifically, the variable "Date" is the month and day of the month on which the respondent was interviewed. If there is a wealth effect from harvest sales, respondents interviewed toward the end of the experiment are more likely to have access to cash and bid a higher price. The coefficient on 'Date' then should be positive. Results show that the coefficient is not significant and leans toward negative values.[23] This shows that respondents interviewed last were no more likely to bid higher amounts, which provides supporting evidence against a wealth effect from the harvest season. In column 4, our main results remain robust to the inclusion of seven additional control variables. Most variables, such as the level of education, expenditures, whether or not the respondent is in debt, household size and number of kerosene lamps display coefficients that are small and not significant. The number of children going to school shows a slightly larger coefficient; but the variable isn't statistically significant.

4.3 Mechanisms

In this section, we investigate the possible mechanisms to explain why our communication treatments are effective and why the gender treatment was not. Table 7 displays the mean response to various survey questions for each treatment group. The exact phrasing of the questions can be found in the supporting online materials. First, we note that almost every respondent thought that a solar lantern was *definitively* an innovative product, *definitively* a product superior to a kerosene lamp, and would *definitively* recommend

[21] Rice Knowledge Management Portal, maintained by the Indian Council of Agricultural Research (http://www.rkmp.co.in/content/rice-growing-seasons-of-uttar-pradesh) indicates that in Uttar Pradesh summer rice is harvested in April-May and Kharif rice in November-December. On the other hand, wheat is harvested around March-April in the eastern part of Uttar Pradesh, and around mid-April in the western part (see http://www.archive.india.gov.in/citizen/agriculture/index.php?id=11). Our local team, however, indicated that a reasonable estimate for the first day of harvest in the region around Gonda City was September 25 for Maize and October 5 for rice, and we use these more conservative dates for our robustness check.

[22] We also checked for other campaigns promoting solar lanterns in the sample habitations, which are likely to be correlated with our treatments. There were none.

[23] Standard errors and coefficients are very large in this case due to the collinearity between our treatment dummies and the date variable.

	(1)	(2)	(3)	(4)
Unincentivized	115.107***	103.683***	388.290**	107.417***
	(22.469)	(22.937)	(180.316)	(23.648)
Incentivized	191.915***	181.072***	470.514***	180.440***
	(23.112)	(24.064)	(180.690)	(25.392)
Female Head	-31.046	-27.911	-29.942	-23.498
	(27.096)	(26.594)	(26.485)	(29.239)
Amount of savings (in Rupees)		0.026**	0.027**	0.025*
		(0.013)	(0.013)	(0.013)
Interview date			-7.698	
			(4.800)	
Education				4.435
				(11.774)
Monthly Expenses				-0.005
				(0.005)
If in debt				-26.111
				(26.150)
Household size				-2.581
				(3.973)
Number of children to school				11.891
				(7.441)
Number of kerosene lamps				19.689
				(11.929)
Hours of lighting				1.419
				(6.538)
Monthly spending on lighting				0.008
				(0.290)
Habitation fixed effects	Yes	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes
R-squared	0.160	0.167	0.176	0.181
Observations	585	585	584	574

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Main results with additional control variables.

	Cont.	Unin.	DIFF	Cont.	Incen.	DIFF	Unin.	Incen.	DIFF
Innovative product	4.939	4.980	-0.0405	4.939	4.970	-0.0305	4.980	4.970	0.0100
	(0.373)	(0.226)	(-1.30)	(0.373)	(0.200)	(-1.01)	(0.226)	(0.200)	(0.47)
Superior to kerosene lamps	4.995	4.980	0.0152	4.995	4.985	0.0101	4.980	4.985	-0.00508
	(0.0714)	(0.174)	(1.13)	(0.0714)	(0.123)	(1.00)	(0.174)	(0.123)	(-0.33)
Will recommend to others	4.995	4.975	0.0203	4.995	4.949	0.0457*	4.975	4.949	0.0254
	(0.0712)	(0.187)	(1.42)	(0.0712)	(0.346)	(1.81)	(0.187)	(0.346)	(0.91)
Seen lantern before	0.244	0.934	-0.690***	0.244	0.949	-0.706***	0.934	0.949	-0.0152
	(0.430)	(0.249)	(-19.49)	(0.430)	(0.220)	(-20.49)	(0.249)	(0.220)	(-0.64)
Know someone with lantern	0.132	0.924	-0.792***	0.132	0.944	-0.812***	0.924	0.944	-0.0203
	(0.339)	(0.266)	(-25.78)	(0.339)	(0.230)	(-27.80)	(0.266)	(0.230)	(-0.81)
Need maintenance function properly	0.533	0.0508	0.482***	0.533	0.0914	0.442***	0.0508	0.0914	-0.0406
	(0.500)	(0.220)	(12.39)	(0.500)	(0.289)	(10.73)	(0.220)	(0.289)	(-1.57)
Cost estimate	627.1	838.7	-211.6***	627.1	736.6	-109.5**	838.7	736.6	102.1*
	(558.7)	(647.9)	(-3.47)	(558.7)	(538.9)	(-1.98)	(647.9)	(538.9)	(1.70)

Table 7: Summary statistics for some key solar lantern related variables highlighting possible mechanisms.

it to others. However, we note that, compared to the control group, respondents in the unincentivized and incentivized groups are much more likely to have seen a solar lantern before and they are much more likely to know someone who owns a lantern. This is fully consistent with our experimental design and provides evidence that our treatments were properly implemented. Furthermore, close to 90% of the respondents in the unincentivized and incentivized groups stated that they had conversations with that person more than three times a week. Hence, the major factor explaining the difference between the unincentivized and the incentivized groups is unlikely to be the level of interactions with a friend who owns a solar lantern.

The last two variables in the table provide some insights as to why WTP has increased. Contrary to the control group, most people in the unincentivized and incentivized groups now believe that, to function properly, a solar lantern needs proper maintenance. They also estimate the cost of such a product at a higher level than the control group. This might seem counterintuitive at first, but perception of higher cost and higher maintenance is consistent with a better appreciation of the technical properties of the product. It supports the ideas that, through interaction with peers, respondents discover how sophisticated the product really is. At first, villagers might expect that solar lanterns are nothing more than basic lamps, like kerosene lanterns. They then observe their friend taking care of it; they note the photovoltaic panel that is connected to the lamp, which allows the battery to be charged. As a result, they perceive the product as a sophisticated item that requires careful maintenance and are therefore willing to pay a higher price.

In one of the survey questions, we asked respondents how much they thought the lantern cost. The mean estimate approximates INR 730 with a standard deviation of about 500. Interestingly, the correlation between

	(1) Estimated cost	(2) Estimated cost
WTP (all seeds all treatments)	0.390***	
	(0.091)	
Unincentivized		211.589***
		(53.725)
Incentivized		109.538**
		(53.985)
Habitation fixed effects	No	Yes
Clustered SE	Yes	Yes
R-squared	0.031	0.036
Observations	585	591

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Results with cost estimate of solar lanterns as dependent variable.

cost estimates and the willingness to pay is small in magnitude. Regression 1 in Table 8 shows that every extra INR 100 in cost estimate correlates with an increase in willingness to pay of only about INR 8. In column 2, we investigate the treatment effects on the estimated cost. We note that both the unincentivized and incentivized groups display higher estimated costs compared to the control group. In particular, respondents in the unincentivized group estimated the lantern at a higher cost than did respondents in the incentivized group. Yet, they bid lower prices in the BDM game on average. This indicates that the main mechanism through which the tea meetings affect willingness to pay is not through increasing respondents' perception of the product's cost. It is rather very likely through improving knowledge about the attributes of the solar lantern technology or through a softer mechanism of peer influence.

Finally, in an attempt to explain why female seeds do not seem to act as ineffective communicators in our setting, Table 9 looks at indicators of women's status. Our survey included a series of questions about gender norms in the villages. The first set of questions reveal gender attitudes consistent with women holding lower social status. For example, we asked respondents whether they believed a woman should ask permission from her husband or a family member before going out. Almost all household heads said that women should ask for permission to go to the health center, to visit a friend or to go to the market. On the other hand, other questions reflect more egalitarian views. Only about 5% of the sample said that they never talked with their spouse about what to spend income on, and about two-thirds of the sample said they often had such discussions. In addition, virtually all households thought that women should have a say in how income is spent. Most respondents thought that it was definitively important that girls go to school. They further expressed the view that beating a woman was rarely justified. Finally, most respondents thought that women were as able as men to use new technologies. It appears that gender norms in our context give

	Male Seed Friends	Female Seed Friends
1. Should ask permission to go the health center	0.963	0.963
	(0.190)	(0.189)
2. Should ask permission to go visit a friend	0.980	0.973
	(0.142)	(0.162)
3. Should ask permission to go to the market	0.980	0.983
	(0.142)	(0.129)
4. Talk about what to spend money on with spouse	1.585	1.613
	(0.600)	(0.583)
5. Women should have a say on how to spend income	0.976	0.966
	(0.174)	(0.199)
6. It is importnat that girls go to school	4.980	4.970
	(0.164)	(0.223)
7. Women should work outside home or own a business	3.524	3.805
	(1.787)	(1.647)
8. Beating justified if she goes out without telling	0.500	0.559
	(0.501)	(0.497)
9. Beating justified if she argues with husband	0.592	0.670
	(0.492)	(0.471)
10. Beating justified if suspected of adultery	0.759	0.754
	(0.429)	(0.431)
11. Men are better able to use new technologies than women	3.299	3.128
	(1.713)	(1.714)

Table 9: Descriptive statistics on women's status. Note: Most variables are binary variables where 0 codes for no, and 1 for yes. Answers to question 4 are coded as follows: 0 for "Never", 1 for "Sometimes", 2 for "Often". Answers to questions 6, 7, and 11 are as follows: 1 for "Definitely not", 2 for "Not really", 3 for "Neutral", 4 for "Somewhat" and 5 for "Definitely".

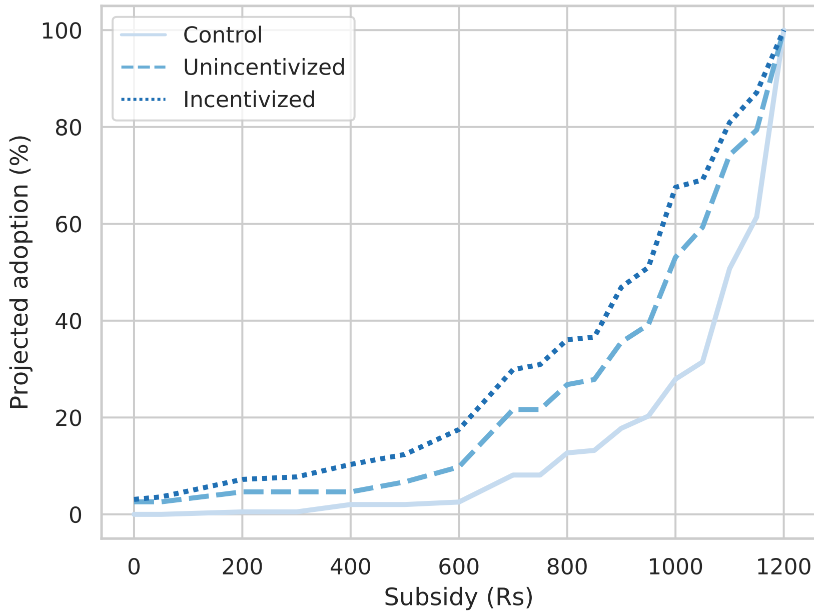

Figure 6: Projected adoption rate as a function of offered subsidy.

women some say in purchasing decisions, as well as when it comes to using new products. Possibly then, gender identity here does not matter when it comes to communicating information about lanterns because women are perceived as legitimate users of the products and holding legitimate opinions and advice about household goods. This may therefore contribute to explain why overall our gender treatment has little effect on willingness to pay.

5 Conclusion

Adoption of new technologies is crucial to improve the livelihood of poor communities. One important factor that promotes this process is information sharing through social networks. Adoption of a new technology is a social process because its adoption by an individual creates a positive information externality to peers which increases their expected welfare (Bardhan and Udry, 1999). Does rewarding individuals who make a conscious effort to communicate information about new technologies increase WTP by members of a social network? Whose social network in the household matters for the flow of information about new technologies? In this paper, we attempted to answer these questions by crafting a randomized controlled trial which involves distribution of multi-purpose solar lanterns under different treatments.

Our results show that learning about the technology via peers can significantly increase WTP. Our unincentivized treatment, for example, implies that having people using solar lanterns in one's social network makes it more likely to be willing to purchase one as well. Typically, technology diffusion starts with a few early adopters trying out the new product. These first adopters generate knowledge externalities, "learning-by-using", which the next generation of adopters can use to update their belief regarding the costs and benefits of the technology. The unincentivized treatment effect is, therefore, maybe best understood as capturing the magnitude of the knowledge spillovers from one wave of adopter to the next. Even though the absolute magnitude is small (about INR 120), it represents almost a doubling of the initial WTP (about a 90% increase).

The incentivized treatment, on the other hand, investigates a way of increasing the intensity of information exchanges about solar lanterns. The key idea here is to leverage some actors to take a more active role in the diffusion of information within their social network. We found that attending a demonstration session led by a peer increased WTP by INR 195, a 145% increase compared to the control group. We also seeked to investigate whether the social identity may be instrumental in how susceptible to information respondents may be. Here, surprisingly, we found that the communicator's gender did not seem to matter. Our study experiments with one type of actors and one type of interactions, but our results motivate new questions and more research. In particular, who are the most efficient communicators? And what types of interactions should they engage potential adopters with? We consider our experiment as a first proof of concept that should motivate further inquiry.

Our study can also help draw useful implications for policies that aim at promoting diffusion of new technologies in developing countries. Since the process of technology diffusion is rigged with positive externalities such as knowledge spillovers, subsidies are often advocated to foster adoption. The revealed WTP data generated in this experiment allows to predict what the adoption rate would be under each treatment over varying subsidy rates. Such analysis is useful to governments and other stakeholders aiming at promoting adoption of solar lanterns in non-electrified low-income communities. Figure 6 illustrates that, starting from a blank slate where no household know about solar lanterns (i.e. our control group), covering 20% of the population would require a subsidy of about INR 950 per lantern. But once information have started diffusing (for example, thanks to early adopters), a lower subsidy is required: covering 20% of the population would then require a INR 700 subsidy (unincentivized treatment). Finally, assuming a scheme that incentivize communication about the lanterns, the subsidy would decrease to INR 600. As a point of comparison, this is about the same amount that the Indian government is currently spending per household using kerosene, albeit per year Garg, Sharma, Clarke, and Bridle (2017).

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