INFORMATION DELIVERY UNDER ENDOGENOUS COMMUNICATION: EXPERIMENTAL EVIDENCE FROM THE INDIAN DEMONETIZATION

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Abstract. To inform the public, how should policymakers disseminate information: by broadcasting widely (e.g., via mass media), or letting word spread from a small number of initially informed "seed" individuals? While conventional wisdom suggests more information is better, we argue that it may not be when participation in social learning is endogenous. In a field experiment during the chaotic 2016 Indian demonetization, we vary how information is delivered to villages: the number informed (broadcasting versus seeding) and whether it is common knowledge who is informed. Our results are consistent with four predictions of a signaling model in which, endogenously, people are more willing to engage in learning about information considered scarcer. First, without common knowledge, broadcasting does cause more conversations than seeding. Second, under seeding, adding common knowledge increases conversations. Third, holding common knowledge fixed, broadcasting *decreases* conversations relative to seeding. Fourth, when broadcasting, adding common knowledge also *decreases* conversations. Moreover, the treatments that increase (decrease) conversations also lead to better (worse) knowledge and incentivized decisions.

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1. Introduction

How should a policymaker deliver information to a community? In practice, there are two commonly used, very different, strategies: (1) broadcasting information widely to all (e.g., radio, television, newspaper, or a Twitter feed) and (2) delivering information to a select few "seed" individuals and relying on subsequent diffusion (e.g., viral marketing, extension services, or the introduction of microcredit)[1].Holding fixed agents' participation in learning, informing more people should always be better. More signals would be received and aggregated throughout society. However, in fact, participation in learning, especially social learning, may be affected by the delivery strategy used. In order to know whether broadcasting or seeding is the best strategy to follow, we first need to understand this effect.

To consider how delivery strategies may affect participation, it is helpful to examine how these strategies differ on dimensions other than the number of people informed. One key dimension is individuals' beliefs, not just about the facts being communicated, but about others' access to the information. With broadcasts, individuals consider it likely that most others have access to certain information, and that everyone understands this. Thus, in particular, a typical individual knows that others believe that he has access to information that has been broadcast. Meanwhile, with targeted seeding, this may or may not be true. In viral marketing campaigns, for example, there is no presumption that the community knows how many or which individuals were initially informed. Alternately, in settings such as model farms, agricultural extension agents may inform the community who is receiving the farming information. Thus, there are two basic dimensions of delivery strategies that guide our work: (1) the number of people to whom information is delivered and (2) the nature and extent of knowledge about the delivery mechanism.

When there is endogenous participation in social learning, these two dimensions can interact in interesting ways. Meta-knowledge about the information delivery mechanism has one obvious consequence—namely that, when it is known who is informed, an agent who needs clarification knows that there is information out there and even where to look for it. But there are also less obvious effects. Imagine a situation in which capable individuals can learn everything they need to know from the initial delivery of information, as long as they receive it, but less capable ones

[1]See, e.g., Leskovec et al. (2007); Ryan and Gross (1943); Conley and Udry (2010); Banerjee et al. (2013); Beaman et al. (2016); Cai et al. (2015).

need help to process the information or understand its relevance. In prior work, Chandrasekhar, Golub, and Yang (2017) consider such a situation theoretically and in an experiment, and show that signaling concerns arise endogenously and deter communication: those who especially need to participate in social learning choose not to, in order to avoid revealing an attribute correlated with that need. In a different context, the theory and experiments of Bursztyn, Egorov, and Jensen (2016) show that related signaling concerns affect willingness to seek help in an educational context.[2]

Such forces have immediate consequences for dissemination strategies. If an agent knows that others believe he has received information, then in the situation of the previous paragraph, he may be less willing to raise questions with others. But if the information is thought to be scarce, there is no negative signal in not having internalized it already. The role of ability in the above story may also be replaced or augmented by other considerations, such as a notion that it is more polite, or more interesting, to discuss issues of common interest about which information is scarce, than to go over statements that have been made (nearly) common knowledge. All these forces will make engagement responsive—indeed, negatively affected—by a perception of a broad announcement.

This line of thinking about individual behavior leads us to four predictions about social learning at the community level: (1) If few signals are provided to a community, then adding common knowledge of who has the information should increase engagement in social learning, because it helps people find the information without exposing them to any negative signaling concerns; (2) If there is no common knowledge of the delivery mechanism, going from seeding the information narrowly to broadcasting should increase engagement in social learning; (3) if there is common knowledge of the delivery mechanism, then going from seeding the information narrowly to broadcasting should actually reduce engagement in social learning; (4) if information is broadcast to all, not having common knowledge of this fact can lead to more participation in social learning than when there is common knowledge.

Motivated by such considerations, we conducted a field experiment in India approximately six weeks after Prime Minister Narendra Modi announced the demonetization

[2]Concerns of this sort come out not only in theory and experiments, but also in survey data: Chandrasekhar et al. (2017) report that 88% of households in their sample felt there was a limit on how much they could ask members of their community for information about farming, health, or finances. In 64% of these cases, the respondents said they refrained from engaging in learning because they did not want to appear weak or uninformed.

of all Rs. 500 and Rs. 1000 notes. The policy was unexpected and far-reaching, affecting 86% of India's currency. While there was near-universal awareness of the policy in India, its chaotic implementation, with over 50 rule changes in a seven week period led to widespread confusion and misinformation (see Appendix A). For example, in our sample, 15% thought that the Rs. 10 coin was being demonetized and 25% did not understand that over-the-counter exchange was no longer available as an option. Thus, the period following the policy announcement constitutes a fitting laboratory with real stakes for studying information dissemination strategies available to policy-makers.

In over 200 villages, in the ten days (starting on December 21, 2016) prior to the bank deposit deadline, we randomly varied how we provided information to villages. The experiment varied at the village level (1) whether information was provided to all households or just five seed households; (2) whether there was common knowledge of the delivery mechanism; (3) whether 24 facts or 2 facts were provided. The information we provided always consisted of a list of facts in a short pamphlet and the same pamphlet was provided to all households who received information in that village. The facts came directly from the Reserve Bank of India's circulars, and thus represent the information that the policy-makers themselves chose to communicate to the public. We then returned to the villages to collect our outcome data, approximately three days after the intervention.

Our outcome data measured engagement in social learning, policy knowledge, and choice in an incentivized decision. For engagement in social learning, we asked how many conversations villagers had about demonetization over the prior three days. For knowledge, we asked about a number of facts. For incentivized choice, we asked the subjects to select one of the three following options: (a) a Rs. 500 note (worth 2.5 days' wage) redeemable at the end of the day, (b) an IOU for Rs. 200 in Rs. 200 notes unaffected by demonetization redeemable 3-5 days later, and (c) an IOU for dal (pigeon peas) worth Rs. 200, again redeemable 3-5 days later. At the time of the choice, subjects still had time to deposit the Rs. 500 note at the bank, no questions asked, for the cost of going to the bank.

A naive, frictionless perspective would say that providing information to all households in a village (a 10-fold increase), providing more meta-information (common knowledge), and providing more information per household (a 12-fold increase) should lead to more conversations, more knowledge being aggregated, and better decision-making on the part of our subjects. In sharp relief, a perspective that takes the endogenous participation into account along the lines outlined above, has rather different predictions. Namely, that adding common knowledge to a strategy where only few are seeded should lead to more participation in social learning and presumably better aggregation. Meanwhile, if there is to be common knowledge, adding more signals going from 5 households being informed to 100% being informed should actually reduce the number of conversations. Whether this amounts to reduced learning as well is an empirical question. Finally, if information is to be broadcast, having no common knowledge can lead to more engagement in social learning than having common knowledge, since in the latter case it is known that one is supposed to have received signals as well.

Our core results are as follows. First we look at endogenous participation in social learning. Adding common knowledge to a seeding strategy adds considerable value: going from (Seed, No CK) to (Seed, CK) increases the number of conversations by 103% ($p = 0.04$). Furthermore, if we look at strategies that use common knowledge, going from seeding 5 households to broadcasting to 100% of households, a 10-fold increase in the number of households informed, leads to a 61% decline in the volume of conversations ($p = 0.029$). However, in contrast, going from seeding to broadcast without common knowledge leads to an increase in the number of conversations by 113% ($p = 0.048$). Moreover, turning to broadcast strategies, if we begin with broadcast without common knowledge (which is not a feasible policy solution) and compare that to broadcast with common knowledge, there is a 63% decline in the volume of conversations ($p = 0.02$). That adding common knowledge has opposite effects across seeding and broadcast strategies, and that providing information to more people under common knowledge leads to less engagement in social learning, is consistent with the sort of endogenous participation in learning model sketched above.

Second, we turn to whether the changes in endogenous participation in learning correspond to changes in knowledge. This is primarily an empirical question. To see this, observe that even though there is less conversation happening in (Broadcast, CK) as compared to (Seed, CK), 10-times the number of households received information in the broadcast treatments, so it is entirely possible that they still learned more. On the other hand, if this is the kind of setting in which aggregation needs to happen to fight rumors and clean up noisy perceptions, then the social learning component may be very valuable. We find that the results are consistent with social learning being an important component of belief formation. Going from (Seed, No CK) to (Seed, CK) decreases the error rate on our knowledge survey by 7.3%

($p = 0.0142$). Furthermore, conditional on strategies that use common knowledge, going from seeding to broadcast leads to a 5.6% increase in the error rate on our knowledge survey ($p = 0.062$). This shows that even though all households receive signals instead of merely five, the amount of knowledge for a random household is less, not more, suggesting that aggregation matters. The exact opposite happens when going from seeding to broadcasting, when there is no common knowledge. Turning to broadcast strategies, adding common knowledge leads to a 4.6% increase in the error rate, though the effect is not statistically significant ($p = 0.17$).

Third, when we look at whether subjects choose the Rs. 500 note, which at that time was still accepted for deposit by banks, or an IOU worth Rs. 200 in cash or in kind to be paid in 3-5 days, we again see a similar pattern. Going from (Seed, No CK) to (Seed, CK) leads to a 81% increase in the probability of choosing the Rs. 500 note ($p = 0.037$). Going from seeding to broadcast, conditional on common knowledge, leads to a 38.5% decline in the probability of choosing the Rs. 500 note ($p = 0.104$). Again, in contrast, there is a 114% increase in the probability of choosing the note when going from seeding to broadcast, without common knowledge ($p = 0.014$). Looking at broadcast strategies adding common knowledge leads to a 48% decline in the probability of choosing the Rs. 500 note ($p = 0.041$).

These results demonstrate the importance of considering endogenous participation in social learning when designing information dissemination strategies. They are consistent with the idea that by varying whether others know who has or does not have information, the incentive to participate in learning itself can be affected.

The remainder of the paper is organized as follows. Section 2 describes the setting and experimental design. In Section 3, we investigate the implications of the simplest frictionless benchmark. Section 4 presents our theoretical framework where agents endogenously choose to participate in social learning, study the Bayes-Nash equilibria of our model, and show how social learning varies as we change whether information is broadcast or seeded and common knowledge is or is not provided. We present our empirical results in Section 5. Section 6 provides a discussion.

2. Experiment

2.1. **Demonetization.** On November 8, 2016, Indian Prime Minister Narendra Modi announced a large-scale demonetization. At midnight after the announcement, all outstanding Rs. 500 and Rs. 1000 notes (the "specified bank notes" or SBNs) ceased to be legal tender. Demonetization affected 86% of circulating currency, and individuals holding SBNs had until December 30, 2016 to deposit them in a bank or post office account. Modi intended for the surprise policy to curb "black money" and more broadly to accelerate the digitization of the Indian economy. The policy affected almost every household in the country, either because they held the SBNs, or through the cash shortages that resulted from problems in printing and distributing enough new bills fast enough.

The implementation of the policy was chaotic. The initial rollout revealed a number of ambiguities, loopholes, and unintended outcomes. As a result, the government changed the rules concerning demonetization over 50 times in the seven weeks following the announcement. The rule changes concerned issues such as the time frame for over-the-counter exchange of SBNs, the cash withdrawal limit, the SBN deposit limit, and various exemptions—e.g., for weddings, which tend to be paid for in cash. See Appendix A for a timeline of these rule changes.

2.2. **Setting.** Our study takes place in 225 villages across 9 sub-districts in the state of Odisha, India. The baseline was conducted starting December 21, 2016, the intervention on December 24, 2016, and the first endline ran from December 27 to 30, 2016. It is important to note that the last day to legally deposit SBNs at bank branches was December 30, 2016.

All of our villages have two or more hamlets segregated by major caste group. Typically one hamlet consists of scheduled caste and/or scheduled tribe individuals (SCST), commonly referred to as lower caste, and the other hamlet consists of general or otherwise-backwards caste (GMOBC) individuals, commonly referred to as upper caste. The two hamlets are typically 1/2 to 1 km apart. While the primary occupation differs by caste, the majority of the people across the villages in our sample are involved in agriculture and agriculture-related activities. Given the hamlet structure of the study area, all of our treatments were focused in only one of the hamlets in each village. Basic sample statistics are provided in Tables 1 and 2. 89% of our sample had some kind of formal bank account, 80% were literate, and major occupations included being a casual laborer (21%), domestic worker (16%), landed farmer (16%) and share-cropper (9%).

2.3. **Baseline Knowledge of Demonetization Rules.** Using responses from our baseline survey, we first explore the beliefs of villagers about the rules prior to our intervention. While villagers almost universally understood that the Rs. 500 and Rs.

1000 notes were being taken out of circulation, we document in Table 3 that many households had inaccurate beliefs regarding numerous other aspects of the policy. For example, more than 14% of the population thought (inaccurately) that the Rs. 10 coin was also being taken out of circulation with the policy.[3] 25% of villagers believed (falsely) that, at the time of our baseline survey, they could still exchange notes at the bank without first depositing them into an account. Moreover, only a handful of respondents could accurately tell us the deadline for making exchanges and only 50% of respondents could tell us that post offices/RBI offices/panchayat offices could be used for depositing the demonetized notes.

Our subjects were particularly uninformed about some of the economically important details, such as banks' weekly withdrawal limits. 33% of respondents reported that they did not know the limits, and of those who claimed to know, only about 40% of those were within Rs. 5,000 of the correct answer (Rs. 24,000). The accuracy of subjects' knowledge for rules pertaining to ATM withdrawals look comparably low, while respondents had even less knowledge about the rules governing low-documentation accounts used by the poor. It is also important to note that the low levels of knowledge are not due to limits to financial inclusion in the study setting. As noted before, in our sample, 89% of respondents had bank accounts (Table 2).

One might ask if it is important for poor rural farmers with limited formal savings to understand minute details of the policy. However, one important implementation problem associated with demonetization was that there simply were not enough notes to meet demand, which ended up affecting the lives of most people. For example, employers were not able to pay cash wages on time, microfinance borrowers were not able to service their loans, and demand for cash purchases at small shops fell. Even for individuals without bank accounts, understanding the rules would have been useful for deciding whether to accept an IOU from an employer or customer, for example. Measuring these types of effects is beyond the scope of our study.

2.4. **Experimental Design.**

Sample. We enumerated an initial list of 276 villages which were assigned to treatments. We conduct our experiment in one hamlet in each village in our sample, so half of the villages were randomly assigned to have their GMOBC hamlet in our experiment and the other half to have their SCST hamlet in our experiment. We

[3]This specific rumor spread across much of the country and was reported in the Indian press.

randomized villages to treatments before we verified that each village met our criteria. Any hamlet that had fewer than 20 households was dropped from the sample, yielding a set of 221 villages. Sixteen villages were then added in a new subdistrict to increase the sample to 237.[4] A baseline survey was administered only in the chosen hamlets, described above, from these villages. Given the rush of implementing 200+ interventions in a matter of days, some field errors were made which led to not collecting endline data (in 6 villages) or not conducting interventions nor having endline data (in 5 of the villages). Village elders refused entry in two villages as well. Ultimately, we have a sample of 225 villages that were treated and received endline surveys.[5]

Before we describe the treatments, it is important to note that the baseline survey also contained a module based on Banerjee et al. (2016) ("the gossip survey") to identify the individuals in each treatment hamlet that were assessed by others to be good at spreading information.[6,7]

Treatments. All of our experimental treatment arms involved distributing pamphlets with information about demonetization to the study villages. Our goal was to spread the official policy rules, and thus all information comes from the December 2016 RBI circulars. We took this official information, published by the central bank, and subdivided it into 30 distinct policy rules. Through informal conversations in pilot villages, we identified the 10 most useful rules for a typical villager in the study area.[8] Our experimental protocol involved giving a randomly-selected set of facts to each village. All individuals receiving lists of facts in a village received the same list.

[4]Online Appendix K repeats our main analysis dropping these new villages and shows that our conclusions remain the same.

[5]Unfortunately, given the rush of implementing 200+ interventions in a handful of days, in 16 of the villages our field team administered the intervention and endline to the wrong hamlet. While this should be idiosyncratic and orthogonal to treatment, we therefore collected outcome data in the right hamlet and redo our estimation using treatment assignment as instruments for treatment in Online Appendix J. All our results look nearly identical.

[6]We asked each individual "If we want to spread information about the money change policy put in place by the government recently, whom do you suggest we talk to? This person should be quick to understand and follow, spread the information widely, and explain it well to other people in the village. Whom do you think is the best for this from your hamlet?" and we allowed them to nominate anywhere from 0 to 4 individuals.

[7]13 villages were dropped before information was even delivered because they were inaccessible to the survey staff. We show in Online Appendix M that this was not differential by treatment.

[8]For example, one rule explained how foreigners could exchange their SBNs. This was not one of the "useful" facts on our list.

Our core design is a 2x2 that varies how many people got information as well as whether there was common knowledge. We also crossed this with whether individuals received long or short lists of facts.[9] Thus, the treatments are:

(1) Information dissemination:
- *Broadcast:* information was provided to all households in the hamlet.
- *Seed:* information was provided to 5 seed households in the hamlet, chosen via the gossip survey.

(2) Common knowledge:
- *No common knowledge:* we did not tell any subject that we were providing information to anyone else in the community.
- *Common knowledge:* we provided common knowledge of the information dissemination protocol. In "Broadcast" treatments in arm (1), every pamphlet contained a note that all other households received the same pamphlet. (Thus, if subjects understood and believed us, they had common knowledge of the pamphlet's distribution.) In the "Seed" treatments, every household received a notification that five individuals in their community (who were identified) were provided information about demonetization by us, and that the seeds were informed that we would inform everyone. Again, common knowledge of this information was induced among all the non-seeds. Figure 1 summarizes the design.

(3) Information volume:[10]
- *Long:* 24 facts were provided.
- *Short:* 2 facts were provided.

Appendix B provides the total list of facts that we selected from for each pamphlet, in the manner described above and Appendix C provides examples of the pamphlets we handed out.[11]

2.5. **Outcomes.** We have three main outcomes of interest at endline: engagement in social learning; general knowledge about facts surrounding the demonetization; and

[9]We also attempted to get 30 villages of data where we did not intervene whatsoever and instead only collect endline data. We call these "status quo" villages. Unfortunately, these villages are not entirely comparable to our core set due to implementation failures that led to violations of randomization. We detail this in Online Appendix L.

[10]The Short lists of facts contained one "useful" fact, drawn uniformly at random, and a second fact drawn uniformly at random from the remaining 29, while the Long list of facts were drawn uniformly.

[11]Appendix G contains a version of our main analysis, looking separately at the endline knowledge of useful facts and facts that were told to a village versus omitted from the village pamphlets.

whether the respondent selected the demonetized Rs. 500 note as opposed to an IOU payable in 3-5 days for either Rs. 200 in non-demonetized notes or Rs. 200 in *dal*, a staple commodity.

First, we collected data on the volume of conversations about demonetization. This allows us to see whether engagement in social learning increased or decreased based on the signal distribution and knowledge structure provided in the treatment arm.

Second, we assess knowledge of facts surrounding demonetization. We survey the respondent on 34 facts and create a simple metric of knowledge.

Third, we offered subjects a choice between: (a) a Rs. 500 note; (b) an IOU to be filled in 3-5 days for Rs. 200 in two Rs. 100 notes; (c) an IOU to be filled in 3-5 days for Rs. 200 worth of dal. With a 1/6 probability, subjects actually received the item they chose. To implement the payment, we returned to each household in the sample before exiting the village, rolled the die, and provided either the Rs. 500 or the IOU notice.[12] At the time of treatment, the cost of taking a note worth Rs. 500 and depositing it into an account was not large. As noted above, 89% of respondents had bank accounts. Further, we document that waiting times at banks averaged 15 minutes in the area, and the average village in our sample was within 30 minutes of a bank by foot.[13] At the time of our experiment, depositing the bill required no documentation of the source of the cash. Thus, selecting Rs. 200 or the equivalent was giving up more than one day's wages, even accounting for the travel to and time at the bank. We argue that this is evidence of confusion and measures a willingness to pay to avoid holding on to the demonetized note in a period where it was both legal and easy to convert (see Table 2). Further, we asked respondents who did not choose the Rs. 500 to provide an open-ended justification at the end of the survey module. Figure 3 shows that most individuals who did not choose the Rs. 500 note believed, mistakenly, that the deposit deadline had already passed. The choice between 200 rupees and the equivalent in dal was intended to capture general trust in paper currency and confusion about whether the 100 rupee bills had also become demonetized. Taking the money offered more flexibility, and the dal was easily available in village stores.[14]

[12]In practice, we surprised the respondents by paying the cost of going to the bank for them and giving them the value in non-demonetized notes. Note that this was done as the last thing before we exited the village, after each and every subject had already locked in their responses.

[13]At this time, there were still news reports of very long queues at banks and ATMs in other, more urban parts of the country. However, during this period in our study area, the waits had become much more manageable compared to the weeks following the policy announcement.

[14]We explore this further in the Online Appendix G.

3. A Frictionless Benchmark

It is useful to start with a simple benchmark in which incentives to seek or pass information are not an issue, information flows frictionlessly, and individuals process it in a Bayesian way. Consider a society where every individual receives m units of information with probability q, i.i.d. Every individual can interpret all information and pass it on to others, and seeks to be better-informed about the payoff-relevant state. There may be a "network" constraint in terms of whom agents can pass information to and when. But, critically, the operation of this channel is independent of the nature of information (e.g., how many people got it). Individuals are Bayesian, with correctly specified beliefs, in using information. For canonical formalizations of this, see Parikh and Krasucki (1990), Rosenberg, Solan, and Vieille (2009), and Mueller-Frank (2013). In such a world, either an increase in m (more information per person) or an increase in q (more people being informed) should improve decisions. This is because an increase in either parameter leads to a Blackwell improvement in information for the community, yielding better decision-making.

We begin by documenting in Table 4 that these two simple hypotheses from any standard model of frictionless social learning in the data do not appear to hold in our setting. First, do people converse more and learn more when each informed individual receives more information (Short vs. Long)? Second, do people converse more and learn more when more people are informed (Seed vs. Broadcast)? Panel A shows that more information per person does not lead to better outcomes. Providing a 12-fold increase in the number of facts leads to a 26% decline in the number of conversations, no change in knowledge, and no change in the probability of picking Rs. 500. Panel B shows that broadcasting information to 100% of households instead of 10% leads to no detectable change in either the number of conversations, knowledge, or in the probability of picking Rs. 500.

To sum up, social learning can get worse when we provide a greater amount of information to each person.[15] Furthermore, when we provide information to ten times the number of people, we do not see the expected large increase in conversations and knowledge and no clear improvement in quality of decisions made. Note that this is despite the fact that there are low levels of knowledge on average, even among seeds,

[15] This is consistent with Carvalho and Silverman (2017), who argue that complexity can lead to worse decision-making and can lead to individuals taking dominated options. They study this issue in the context of portfolio choice.

which suggests that there is considerable scope for improvement in learning in these communities. This suggests a world where mechanical benchmarks do not hold, and there are endogenous communication choices and information frictions; we explore these next.

4. Endogenous Participation in Social Learning

As discussed in the introduction, our focus is mainly on the the demand for information: the endogenous decisions to engage in conversations by agents who would like to be informed. It is natural also to consider the supply side: whether the initially informed invest effort in communicating. We discuss such considerations, which can analyzed in public goods/free-rider problems, in Appendix E, and consider the associated predictions.

The model of reductions in seeking effort is related to recent work by Bursztyn et al. (2016) and especially Chandrasekhar et al. (2017) on how reputational incentives affect information-seeking—indeed, the formal framework we use is borrowed from the latter paper.

4.1. **The environment: information.** The model focuses on a single decision-maker, D, and a single conversation partner A (for Adviser). The model focuses on one decision made by D: whether to seek information from A. D's decision is denoted by

$$d \in \{\text{NS (No Seeking)}, \text{S (Seeking)}\}.$$

D should be interpreted as a typical individual in the village, not one of those seeded in the seeding treatments. A should be interpreted as anyone who is likely to have information conditional on its presence—someone in a central location ("the town square") who knows the interesting news in the village on a given day.[16] This may be one of the individuals initially given information in the seeding treatments, but need not be. It will be clear in our formal assumptions where these interpretations play a role.

Let $x_i \in \{0,1\}$ denote whether $i \in \{\text{D}, \text{A}\}$ has information (in our application, information about demonetization). There is a random variable $\mathfrak{p} \in \{\text{CK:BC}, \text{CK:Seed}, \text{No-CK}\}$ that is publicly observed and is informative about the individuals' information endowments. The following table records what, if anything, is common knowledge conditional about each of the x_i under the various values of $\mathfrak{p}$.

[16]It is important to emphasize that this needn't be one of the seeded nodes.

$\mathfrak{p}$	x_{D}	x_{A}
CK:BC	1	1
CK:Seed	0	1
No-CK	—	—

In terms of interpretation, $\mathfrak{p}$ captures what is publicly announced about the information dissemination procedure. In CK:BC, it is common knowledge that everyone (D and A in particular) have received information. In CK:Seed, it is common knowledge that A has information but not D. In No-CK, the public information is that it is "business as usual": the absence of a public announcement.

The assumptions about the first two rows are stark. In practice, it is will not be exactly common knowledge that A is informed while a typical villager is uninformed. In fact, only an approximation of common knowledge will hold: it will be considered likely that certain A's have heard the information, and it will be considered unlikely that various D's have, and these views about likelihood will be shared.

4.2. **The environment: payoffs.** D's direct payoff to not seeking is denoted by $V^{\mathrm{NS}}(x_{\mathrm{D}}, x_{\mathrm{A}}) = V^{\mathrm{NS}}(x_{\mathrm{D}})$, which does not depend on A's signal status, and the direct payoff to seeking is denoted by $V^{\mathrm{S}}(x_{\mathrm{D}}, x_{\mathrm{A}})$. These payoffs correspond to expected payoffs from using information to make some later decisions.

D has an ability type, $a \in \{\mathrm{H}, \mathrm{L}\}$ (high or low). The prior belief of A that D's ability is high, $a = \mathrm{H}$, is π. In addition to the direct payoff, agents receive a *perception payoff*. This enters D's utility function additively: $\lambda\mathbb{P}(a = \mathrm{H} \mid \mathrm{d})$, where λ is a positive number. The idea is that D is better off when A assesses D's ability to be high—for example, because A is then more likely to collaborate with S.[17] D's total payoff given seeking decision d, is therefore,

$$V^d(x_{\mathrm{D}}, x_{\mathrm{A}}) + \lambda\mathbb{P}(a = \mathrm{H} \mid \mathrm{d}).$$

The distribution of the *gain from seeking* to D depends on D's ability, a.

$$\Delta(x_D, x_A) := V^{\mathrm{S}}(x_{\mathrm{D}}, x_{\mathrm{A}}) - V^{\mathrm{NS}}(x_{\mathrm{D}}, x_{\mathrm{A}}) \sim F_a(x_{\mathrm{D}}, x_{\mathrm{A}}).$$

The following are our assumptions on payoffs:

Assumption **1.**

[17]Foundations are discussed in Chandrasekhar et al. (2017).

P1. $F_{\mathrm{L}}(1,1)$ strictly[18] first-order stochastically dominates $F_{\mathrm{H}}(1,1)$, and both have full support on the real line.[19]

P2. The following ranking of payoffs holds:

$$\Delta(\cdot,0) < 0 < \Delta(0,1).$$

P3. The random variable $\Delta(0,0)/\Delta(0,1)$ has positive density at 0.

The first assumption ensures that, when agents use a cutoff in equilibrium, seeking when $V^{\mathrm{S}}(1,1) - V^{\mathrm{NS}}(1,1)$ exceeds that cutoff, seeking will be a signal of low ability when it is known or considered likely that, in D's view $(x_{\mathrm{D}}, x_{\mathrm{L}}) = (1,1)$. The second simply captures that the gain from seeking is negative when the adviser is ignorant, and positive when he knows something while the seeker does not. The final assumption is a regularity condition on the costs of seeking in the bad case (when A is ignorant) relative to their benefits in the good case (when A is informed).

4.3. **Environment: beliefs in the absence of common knowledge.** To understand individuals' incentives to seek, we need to consider both the benefits—which depend on whether information is out there to be found—and the costs. Given what we have said at the end of the last section, seeking costs depend on perceptions of the individual's reason for seeking: seeking is a negative signal when the agent is believed to have received information. Thus, for D's seeking decision, it will ultimately be important what D believes about others' perceptions of D's likelihood of having information.

Consider a situation corresponding to $\mathfrak{p}$ = No-CK, i.e., the absence of a public announcement of how information is delivered. When there is information delivery without a public announcement, individuals' beliefs about who is informed (and about others' beliefs about about who is informed) are shaped by their ordinary experience of such situations. To motivate the key assumption we make in this section about those beliefs, consider a particular description of an information delivery without a public announcement.

For concreteness, one can think of a world where leaflets are distributed on some days to some people in a community. First, nature decides whether information delivery occurs on this particular day: with probability μ it does; otherwise nobody receives information. Conditional on information delivery, people are informed i.i.d. with probability β.

[18] I.e., for every cutoff, $F_{\mathrm{L}}(1,1)$ assigns a lower probability of being below that cutoff.

[19] Full support is assumed for simplicity: wide enough support would suffice.

Now, consider any i and j. Let β denote $\mathbb{P}^i(x_j = 1 \mid x_i = 1)$: i's subjective probability, given that i himself is informed, that j is informed. (All probabilities here are also conditioned on the public information of $\mathfrak{p}$ = No-CK.) Then what we have said about the way information is delivered implies that:

$$\begin{aligned}\mathbb{E}^i[\mathbb{P}^j(x_i = 1 \mid x_j) \mid x_i = 1] &= \mathbb{P}^i(x_j = 1 \mid x_i = 1)\Big[\mathbb{P}^j(x_i = 1 \mid x_j = 1) + O(\mu)\Big] \\ &= \beta^2 + O(\beta\mu)\end{aligned}$$

The left-hand side, in words, is i's expectation of j's subjective probability, conditional on receiving information himself, that i is informed. In other words, it is a measure of i's second-order beliefs about information in the community. The calculation allows us to bound this quantity. In particular, if $\mu \leq C\beta$, so that social information campaigns are not very frequent, then the left-hand side can be bounded as $O(\beta^2)$. The second-order expectations about the receipt of information in the community, even from the perspective of someone who has received information, are of a smaller order than the first-order expectations (from the same perspective).

Assumption B1 below captures the aspect of higher-order uncertainty, illustrated by the example, that will be important for us.

Assumption 2. Let $\beta = \mathbb{P}^i(x_j = 1 \mid x_i = 1)$.

- B1. Conditional on $\mathfrak{p}$ = NO-CK and $x_{\mathrm{D}} = 1$, D's expectation of $\mathbb{P}^{\mathrm{A}}(x_{\mathrm{D}} = 1 \mid x_{\mathrm{A}})$ is $o(\beta)$.
- B2. Conditional on $\mathfrak{p}$ = NO-CK, $\mathbb{P}(x_A = 1 \mid x_D = 0)$ is $o(\beta)$.

Assumption B2 simply says that the probability one assesses of someone else being informed, conditional on not having seen information, is much smaller than the same probability conditional on being informed. This is also seen to be verified in the example if μ is small (so that $\mu\beta$ is $o(\beta)$).

Though it did not play a role in our story, the assumption can accommodate a small probability of everyone receiving leaflets without there being common knowledge of that. As long as the probability of such an event is perceived to be small, the addition of this event will not upset our analysis.

4.4. **Result.** By the basic results about the model in Chandrasekhar et al. (2017), an equilibrium in cutoff strategies exists for for each realization of $\mathfrak{p}$ and x_D. Indeed, there is a number $v(x_D; \mathfrak{p})$ so that an agent's decision (independent of ability type) is

$$d = \mathrm{S} \quad \text{if} \quad V^{\mathrm{S}}(x_{\mathrm{D}}, x_{\mathrm{A}}) - V^{\mathrm{NS}}(x_{\mathrm{D}}, x_{\mathrm{A}}) > v(x_D; \mathfrak{p})$$

$$d = \mathrm{NS} \quad \text{if} \quad V^{\mathrm{S}}(x_{\mathrm{D}}, x_{\mathrm{A}}) - V^{\mathrm{NS}}(x_{\mathrm{D}}, x_{\mathrm{A}}) < v(x_D; \mathfrak{p})$$

Let $\sigma(x_{\mathrm{D}}; \mathfrak{p})$ be the probability that a seeker (pooling across ability types) goes to seek advice. We focus on this statistic because it is what is observed in our experiments.

Proposition **1.** *Assume that P1-P3 and B1-B2 hold. For each large enough λ (importance of signaling concerns), if β is small enough, the following inequalities among values $\sigma(x_D; \mathfrak{p})$ hold:*

$$\sigma(1; \textit{CK:BC}) \leq \sigma(0; \textit{No-CK}) < \sigma(1; \textit{No-CK}) \leq \sigma(0; \textit{CK:Seed}).$$

That is, there is least seeking in broadcast with common knowledge, followed by seed without common knowledge, followed by broadcast without common knowledge, and most seeking in seed with common knowledge. The proof appears in Section D.

4.5. **Application to Experiment.** The theoretical model sketched above is extremely simplified, but gives guidance on how demand for information, when affected by signaling concerns, would respond to our treatments.

- We expect to see more seeking under Seeding and Common Knowledge as compared with Seeding *without* Common Knowledge: turning on Common Knowledge makes information easy to find and signaling concerns are not substantial: only those who got information have a chance to signal ability, and since few people did, there is not much signal in the decision to seek.
- We expect to see more seeking in (Broadcast, No CK) than in (Seed, No CK): note that the public signal $\mathfrak{p}$ =NO-CK same in both. When D receives no information, $x_{\mathrm{D}} = 0$, then information is very unlikely to be out there (because β is low), so most agents will not find it worthwhile to seek even at a low cost. However, when $x_{\mathrm{D}} = 1$, information is more likely to be out there, and since small costs have positive probability, some agents will choose to seek. Since many more agents receive the information in Broadcast, there will overall be more seeking.
- (Seed, CK) features more seeking than (Broadcast, CK): the Broadcast treatment turns on signaling concerns, deters conversations. In either case, D knows where to find information.
- (Broadcast, No CK) features more seeking than (Broadcast, CK). The argument we made in the second bullet point implies considerable seeking when

$x_{\mathrm{D}} = 1$ and $\mathfrak{p}$ =No-CK. As in the third bullet point, signaling concerns deter seeking in the CK case.

5. Results

5.1. **Endogenous Participation in Social Learning.** We begin by looking at which delivery mechanisms led to more or less endogenous participation in social learning, measured by the number of conversations the subject had over the prior three days about demonetization.

Table 5 presents regressions of the number of conversations on treatment.[20] In each regression, (Seed, No CK) is the omitted treatment arm. The coefficients are additive, so to compare (Broadcast, Common Knowledge) to the omitted category, it is necessary to add the coefficients: CK, Broadcast, and Broadcast $\times$ CK. In each regression specification, we present the p-values for two key comparisons. The test (CK + BC x CK = 0) allows us to compare (Broadcast, CK) to (Broadcast, No CK). The test (BC + BC $\times$ CK = 0) allows us to compare (Broadcast, CK) with (Seed, CK).

The outcome variable in column 1 is all conversations that the respondent was a part of. Going from (Seed, No CK) to (Seed, CK) increases the number of conversations by 103% (0.65 more conversations, $p = 0.04$). This of course is consistent with the model described above: a typical villager now knows that there is no expectation that they had to know the information because it is common knowledge that they did not receive signals and because seeds are known.[21]

Next we look at what happens when we compare strategies that employ common knowledge. Going from (Seed, CK) to (Broadcast, CK), which corresponds to a 10-fold increase in the number of households informed from 5 households to 100% of households, leads to a 61% decline in the volume of conversations (0.78 fewer conversations, $p = 0.029$). Again this is consistent with the model. Though there are gains from seeking, because it is known that the agent himself has also directly received signals, we see less engagement in social learning though many more people are informed.

[20]For all of our main results, we focus on our core 2x2 treatment design, pooling across the Long and Short lists of facts. Appendix F provides the analysis separately for Long and Short information and also discusses how one might interpret the length of the fact list through the lens of the model.

[21]Of course, seeds may also have more of a motivation to spread information, though we do not find evidence consistent with this. See Appendix H.

In sharp contrast, when we look at (Broadcast, No CK) versus (Seed, No CK), we are comparing a situation where we provide signals to all versus just a few, but in either case no agent knows whether or not any other agent has necessarily received a signal. We find that adding a 10-fold increase in the number of households informed leads to an increase in the volume of conversations by 113% (0.708 more conversations, $p = 0.048$). This is consistent with the idea that it is more likely that others have some signals, so the return to seeking is higher for a random household with (Broadcast, No CK), whereas in the (Seed, No CK) case in the model a typical household doesn't even know that there is something to converse about. The previous two results show that informing more people is beneficial in the case without common knowledge, but detrimental to conversation rate when there is common knowledge.

When we look at broadcasting strategies, going from (Broadcast, No CK) to (Broadcast, CK) corresponds to a 63% decline in the volume of conversations (0.84 fewer conversations, $p = 0.02$). This is consistent with the model when stigma is strong: in that world, the fact that it is not common knowledge that one received a signal allows the agent to ask questions about demonetization more freely. This corresponds to a decline in participation in social learning.

That adding common knowledge has opposite effects across seeding and broadcast strategies, and that providing information to more people under common knowledge leads to less engagement in social learning, is consistent with the sort of endogenous participation in the learning model sketched above.

Having looked at conversations as a whole, we can next inquire about the types of conversations. Loosely speaking, there are two types of conversations. First, there are conversations that are initiated with the sole purpose of talking about demonetization. These are of the form where either a respondent seeks information from others or where others seek information from the respondent. Second, there are conversations which were initiated organically in a different setting – an unanticipated or incidental conversation – but where the topic of demonetization may have come up. One can think about this as nature pairing randomly two agents from the village, and then they can choose in this happenstance whether or not they ask each other about demonetization. Note that incidental conversations comprise the vast majority, 78%, of reported conversations as one might imagine.

Columns 2 and 3 of Table 5 break up the number of conversations that the subject participated in by whether they were incidental (column 2) or purposeful (column 3). When we look at incidental conversations we see that going from (Seed, No CK) to

(Seed, CK) corresponds to a 91% or a 0.447 increase, on a base of 0.49, in the volume of conversations (column 2, $p = 0.09$). Then when we look at going from (Seed, CK) to (Broadcast, CK), we see a 63% decline in the volume of incidental conversations (column 2, $p = 0.04$). Again, this decline in conversation volume is overturned when there is no common knowledge: going from (Seed, No CK) to (Broadcast, No CK) leads to a 106% or 0.52 increase in conversation volume. Finally, when we go from (Broadcast, No CK) to (Broadcast, CK), there is a 66% decline in the number of incidental conversations.

When we look at purposeful conversations, we see broadly a similar pattern, though the effects are slightly more noisy. Comparing (Seed, No CK) to (Seed, CK) we see a 150% or 0.204 increase, on a base of 0.137, in the volume of purposeful conversations. We cannot statistically distinguish (Seed, CK) and (Broadcast, CK) with $p = 0.247$, though going from (Broadcast, No CK) and (Broadcast, CK) corresponds to a 54% decline in conversations ($p = 0.119$). That our effects are starker in incidental conversations makes sense because purposeful conversations are far sparser (comprising only 21.9% of conversations) and are likely to be inframarginal. One may be most inclined to go to specific people in a doubt, but many if not most of the conversations about a topic may organically arise in everyday life.

To sum up, our results show that common knowledge matters considerably when seeding with only a few, leading to far more conversation. We have also shown two striking non-monotonicities consistent with our perspective. Adding common knowledge to a broadcast delivery mechanism can discourage conversations. Further, if there is common knowledge, going from only 10% to 100% of the population being informed actually discourages conversations. As one may have expected, if there is no common knowledge, increasing the number informed increases conversations, in contrast. Next we ask whether this has implications for information aggregation and subsequent choice behavior.

5.2. **Information Aggregation and Choice.** We present regressions in Table 6 which show how knowledge and choice behavior depend on treatment cell.

In column 1, we turn to whether the changes in endogenous participation in learning correspond to changes in knowledge. This is primarily an empirical question. To see this, observe that even though there is less conversation happening in (Broadcast, CK) as compared to (Seed, CK), 10-times the number of household received information under broadcast treatments, so it is entirely possible that they still learned more. On the other hand, if this is the kind of setting in which aggregation needs to happen to fight rumors and clean up noisy perceptions, then the social learning component may be very valuable.

We find that the results are consistent with social learning being an important component of belief formation. The outcome variable is the error rate on our knowledge metric. In our metric, the (Seed, no CK) mean is 0.434. Going from (Seed, No CK) to (Seed, CK) decreases the error rate on our knowledge survey by 7.3% ($p = 0.0142$). Furthermore, conditional on strategies that use common knowledge, going from seeding to broadcast leads to a 5.6% increase in the error rate on our knowledge survey ($p = 0.062$). This is striking and shows that though 100% of households receive information instead of 10%, the amount of aggregated information that a random household has at the end of the day is actually less, not more. Again, however, in the case where there is no common knowledge, going from (Seed, No CK) to (Broadcast, No CK) actually increases information and declines the error rate by 6.4% ($p = 0.05$). Finally, turning to broadcast strategies, adding common knowledge leads to a 4.6% increase in the error rate, though the effect is not statistically significant ($p = 0.174$). All of this strongly suggests that aggregation plays a crucial role and that the decline in conversations is followed by a decline in knowledge. Exactly when we saw declines in conversations do we see declines in knowledge.

In column 2, we turn to the impacts of our experimental treatments on incentivized choice. We look at whether subjects choose the Rs. 500 note on the spot which was still able to be deposited in their accounts (worth 2.5 days' wage) or an IOU worth Rs. 200 to be paid in 3-5 days. The probability of selecting the Rs. 500 note in the omitted category (Seed, No CK) is only 5.92%. Going from (Seed, No CK) to (Seed, CK) leads to a 4.8pp or an 81% increase in the probability of choosing the Rs. 500 note ($p = 0.037$). Meanwhile, going from seeding to broadcast, conditional on common knowledge, leads to a 38.5% or 4.13pp decline in the probability of choosing the Rs. 500 note ($p = 0.104$). But when there is no common knowledge, this corresponds to a 6.77pp or 114% increase in the probability of choosing the Rs. 500 note ($p = 0.014$). Looking at broadcast strategies adding common knowledge leads to a 48% decline in the probability of choosing the Rs. 500 note ($p = 0.041$).

Taken together, we have shown that broadcasting information is better than seeding in a world without common knowledge. However, increasing the number of informed households has opposite effects, depending on the presence of Common Knowledge. In a world without Common Knowledge, the conventional wisdom holds: increasing the number informed encourages more conversations and better decision making.

However, under Common Knowledge, broadcasting information actually backfires, leading to worse outcomes across the board. These results are consistent with our framework of strategic communication. One bottom line result is that seeding just five households combined with Common Knowledge makes the outcomes indistinguishable from (Broadcast, No CK), where ten times as many people were seeded. And finally, and perhaps more striking, across the board either holding fixed Common Knowledge, and moving from Seed to Broadcast, or holding fixed Broadcast and moving from No Common Knowledge to Common Knowledge, actually reduces conversation volume, knowledge, and quality of choice.

6. Conclusion

Social learning happens in part through endogenous communication. We show that, consistent with our framework and prior work by Chandrasekhar et al. (2017), the number of signals and the structure of common knowledge matters considerably for the extent of participation in social learning. When looking at targeted seeding, going from no common knowledge to common knowledge increases conversations. The exact opposite is true for broadcast strategies. And strikingly, conversations actually decline when, holding common knowledge fixed, more people are provided information. Furthermore in our setting, this increase or decline in conversation volume is met with a corresponding increase or decline in knowledge about the rules as well as quality of choice. Thus, the success of an information intervention depends crucially on the details of the design and how it affects endogenous communication.

Of the full set of experimental interventions, two consistently perform well on the conversations, knowledge, and choice dimensions and have comparable benefits to one another: seed with common knowledge and broadcast without common knowledge. Note, however, that broadcast, no common knowledge does not lend itself well to widespread policy scale-up. Most, if not all, broadcast technologies such as radio, television, newspaper, or political rallies contain intrinsically a common knowledge component.

The results have implications for how researchers and policymakers should think about the use of news media versus extension to educate individuals, and how extension should be structured. The results indicate that the benefits of extension strategies can be magnified with common knowledge.

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Figures

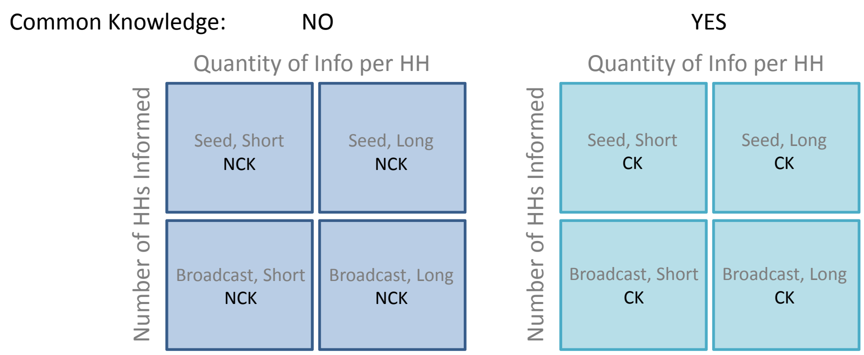


Figure 1. Experimental Design

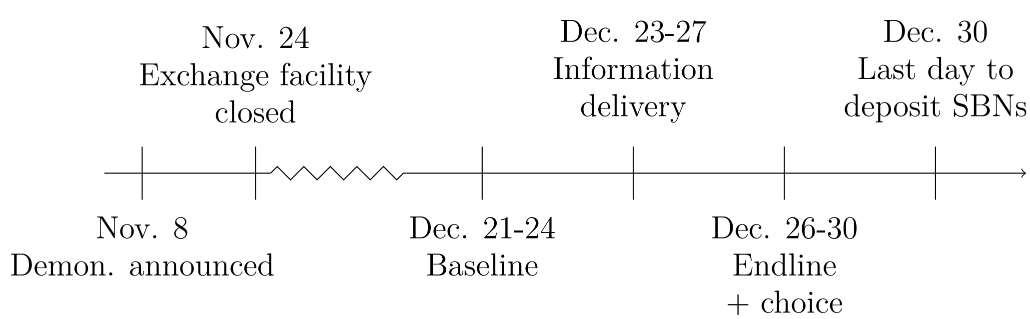


Figure 2. Intervention Timeline

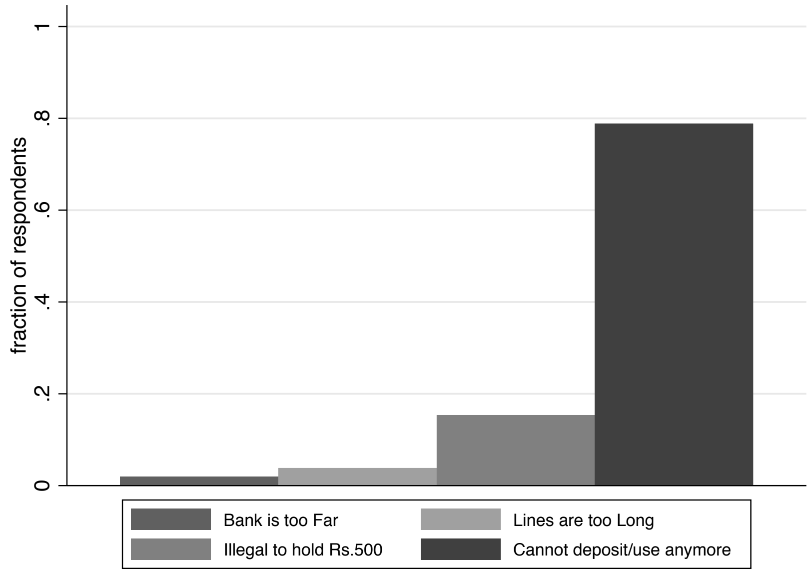
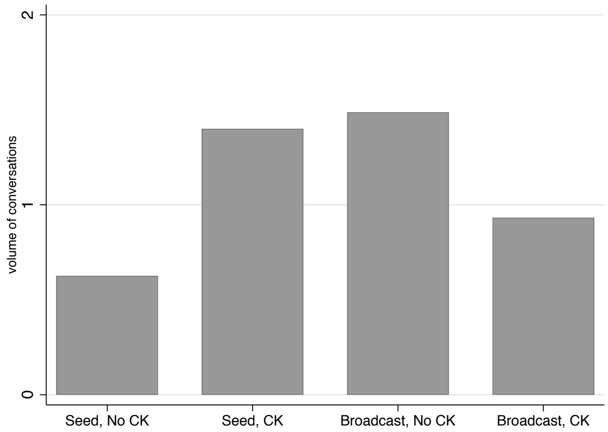
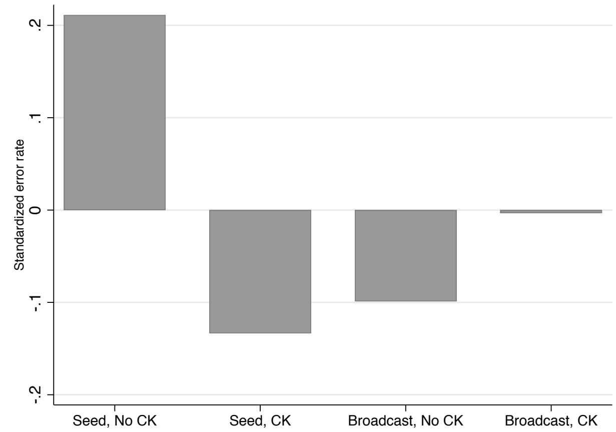


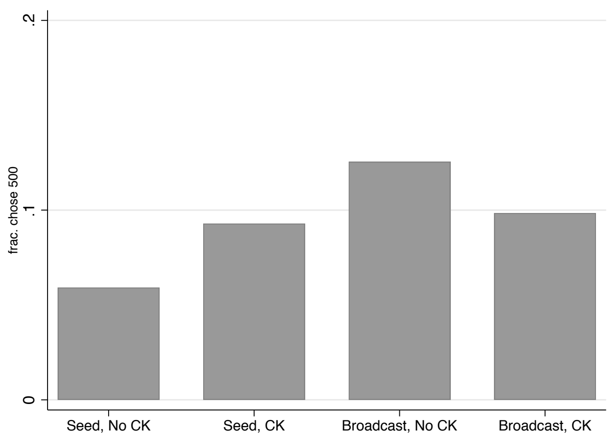
FIGURE 3. Why did you not choose 500?



(A) Volume of conversations



(B) Knowledge error



(C) Chose old 500

FIGURE 4. Core Experiment Outcomes

Tables

Table 1. Summary Statistics

	mean	sd	obs
Female	0.32	(0.47)	1082
SC/ST	0.50	(0.50)	1082
Age	39.18	(11.88)	1079
Casual laborer	0.21	(0.41)	1082
Farmer: landed	0.16	(0.37)	1082
Domestic work	0.16	(0.37)	1082
Farmer: sharecropper	0.09	(0.29)	1082
Unemployed	0.02	(0.14)	1082
Bank account holder	0.89	(0.31)	1078
Literate	0.80	(0.40)	1047

Notes: This table gives summary statistics on the endline sample used for analysis.

Table 2. Bank Summary Statistics

	median	mean	sd	obs
Actual wait time at banks (mins)	10.00	11.86	(7.87)	51
Perceived wait time at banks (mins)	15.00	17.06	(22.13)	32
Nearest Bank (mins)	20.00	19.84	(9.88)	63

Notes: This table gives actual wait time at banks near our sample villages. We surveyed bank employees at 51 banks. It also gives perceived wait time and perceived time taken to reach the nearest bank by a sub-sample of the endline respondents.

Table 3. Baseline Error Statistics

	mean	sd	obs
10 rupees coin	0.15	(0.36)	965
General currency	0.17	(0.38)	965
Withdrawal limits on Jan Dhan accounts	0.87	(0.33)	965
Over-the-counter exchange	0.25	(0.44)	965
Weekly withdrawal limits from bank accounts	0.78	(0.41)	965
Daily withdrawal limits on ATMs	0.90	(0.30)	965
Exchange locations other than banks	0.50	(0.50)	966

Notes: This tables gives error rates on knowledge about demonetization in the baseline sample.

Table 4. Frictionless benchmark

Panel A: Short vs. Long

	(1)	(2)	(3)
	OLS	OLS	OLS
VARIABLES	Volume	Knowledge error	Chose 500
Long	-0.296	0.00692	-0.0183
	(0.250)	(0.00946)	(0.0180)
	[0.238]	[0.465]	[0.309]
Observations	1,078	1,082	1,067
Short Mean	1.136	0.417	0.0954

Panel B: Seed vs. Broadcast

	(1)	(2)	(3)
	OLS	OLS	OLS
VARIABLES	Volume	Knowledge error	Chose 500
Broadcast	-0.0399	-0.00236	0.0129
	(0.253)	(0.00936)	(0.0186)
	[0.875]	[0.802]	[0.490]
Observations	1,078	1,082	1,067
Seed Mean	0.998	0.418	0.0755

Notes: All columns control for randomization strata (subdistrict) fixed effects. They also control for date and time of entry into the village, caste category of the treatment hamlet and distance from the village to an urban center. Respondent-level controls include age, gender, literacy and potential seed status. Standard errors (clustered at the village-level) are reported in parentheses and p-values are reported in brackets.

Table 5. Engagement in social learning

VARIABLES	(1) OLS Volume of conversations	(2) OLS # incidental conversations	(3) OLS # purposeful conversations
CK	0.651	0.447	0.204
	(0.318)	(0.262)	(0.105)
	[0.0420]	[0.0901]	[0.0527]
Broadcast	0.708	0.520	0.188
	(0.356)	(0.320)	(0.127)
	[0.0477]	[0.106]	[0.142]
Broadcast × CK	-1.491	-1.113	-0.378
	(0.529)	(0.442)	(0.190)
	[0.00535]	[0.0125]	[0.0482]
Observations	1,078	1,078	1,078
Seed, No CK Mean	0.627	0.490	0.137
CK + BC × CK = 0 p-val	0.0211	0.0314	0.247
BC + BC × CK = 0 p-val	0.0292	0.0399	0.119

Notes: All columns control for randomization strata (subdistrict) fixed effects. They also control for date and time of entry into the village, caste category of the treatment hamlet and distance from the village to an urban center. Respondent-level controls include age, gender, literacy and potential seed status. Standard errors (clustered at the village-level) are reported in parentheses and *p*-values are reported in brackets.

Table 6. Knowledge and decision-making

VARIABLES	(1) OLS Knowledge Error	(2) OLS Chose 500
CK	-0.0318	0.0480
	(0.0129)	(0.0228)
	[0.0142]	[0.0368]
Broadcast	-0.0279	0.0677
	(0.0143)	(0.0272)
	[0.0525]	[0.0135]
Broadcast $\times$ CK	0.0506	-0.109
	(0.0193)	(0.0392)
	[0.00958]	[0.00583]
Observations	1,082	1,067
Seed, No CK Mean	0.434	0.0592
CK + BC $\times$ CK = 0 p-val	0.174	0.0409
BC + BC $\times$ CK = 0 p-val	0.0621	0.104

Notes: All columns control for randomization strata (sub-district) fixed effects. They also control for date and time of entry into the village, caste category of the treatment hamlet and distance from the village to an urban center. Respondent-level controls include age, gender, literacy and potential seed status. Standard errors (clustered at the village-level) are reported in parentheses and *p*-values are reported in brackets.

Appendix A. Timeline of Rule Changes

Nov-08	Rs. 500 and Rs. 1000 notes shall have their legal tender withdrawn wef midnight Nov 8
	Closure of ATMs from Nov 9th to Nov 11th
	All ATM free of cost of dispensation
	ATM machine withdrawal limit: Rs. 2000 per day per card (till Nov. 18th); Rs. 4000 thereafter
Nov-09	Re-Calibration of ATMs to dispense Rs. 50 and Rs. 100 notes
	Withdrawal of Rs. 2000 limit per day per card
	Cash withdrawals could be made from Banking Correspondents and Aadhar Enabled Payment Systems
Nov-10	Rs. 4000 or below could be exchanged for any denomination at banks
	Max deposit for an account without KYC: Rs. 40000
	Cash withdrawal per day: Rs. 10,000; with a limit of Rs. 20,000 in one week
Nov-13	Limit for over the counter withdrawal: Rs. 4500
	Daily withdrawal on debit cards: Rs. 2500
	Weekly withdrawal limit: Rs. 24,000
	Daily limit of Rs. 10,000: withdrawn
	Separate queues for senior citizens and disabled
Nov-14	Waivers of ATM customer charge
	Current account holders: Withdrawal limits Rs. 50,000 with notes of mostly Rs. 2000
Nov-17	Over the counter exchange of notes limited to Rs. 2000
	PAN card is mandatory for deposits over Rs. 50,000, or opening a bank account
Nov-20	Withdrawal of ATM: limit unchanged at Rs. 2500
Nov-21	Cash withdrawal for wedding: Rs. 2,50,000 for each party for wedding before Dec. 30th, for customers with full KYC
	60 day extra for small borrowers to repay loan dues
	Limit of Rs. 50,000 withdrawal also extended to overdraft, cash credit account (in addition of current account - Nov-14)
	Farmers can purchase seeds with the old Rs. 500 notes
Nov-22	Prepaid payment instruments: limit extended from Rs. 10,000 to Rs. 20,000 in order to push electronic payment systems
	For wedding payments: a list must be provided with details of payments for anyone to whom a payment of more that 10,000 is to be made for wedding purposes
Nov-23	SBNs not allowed to deposit money in Small Saving Schemes
Nov-24	No over the counter exchange of SBNs wef midnight Nov-24
	Only the old Rs. 500 notes will be accepted till Dec. 15th in the following places: government school or college fees, pre-paid mobiles, consumer co-op stores, tolls for highways
Nov-25	Weekly withdrawal limit: Rs. 24,000 (unchanged)
	Foreign citizens allowed to exchange Rs. 5000 per week till Dec 15th

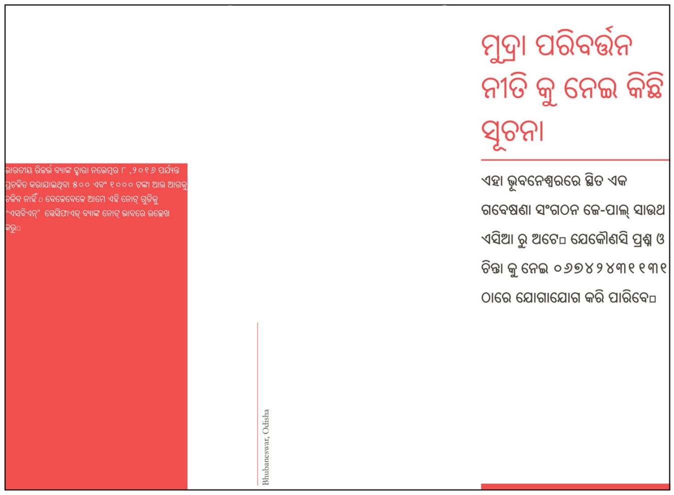
Nov-28	Relaxation in norms of withdrawal from deposit accounts of deposits made in legal tender note wef Nov-29
Nov-29	For account holders of Pradhan Mantri Jan Dhan Yojana: limit of Rs. 10,000 withdrawal per month for full KYC customers; Rs. 5000 with customers with partial KYC
Dec-02	Aadhaar-based Authentication for Card Present Transactions
Dec-06	Relaxation in Additional Factor of Authentication for payments upto Rs. 2000 for card network provided authentication solutions
Dec-07	Old Rs. 500 notes can only be used for purchase of railway tickets till Dec. 10th
Dec-08	OTP based e-KYC allowed
Dec-16	Pradhan Mantri Garib Kalyan Deposit Scheme Issued wef Dec 17
	Foreign citizens allowed to exchange Rs. 5000 per week till Dec 31st
	Merchant discount rate for debit card transactions revised
	No customer charges to be levied for IIMPS, UPI, USSD
Dec-19	SBNs of more than Rs. 5000 to be accepted only once till Dec 30th to full KYC customers
Dec-21	The limit of Rs. 5000 deposit not applicable to full KYC customers
Dec-26	60 day extra for short term crop loans
Dec-29	Additional working capital for MSEs
Dec-30	Closure of the scheme of exchange of Specified Bank Notes
	PPI guideline (issued Nov 22) extended
	ATM machine withdrawal limit: Rs. 4500 per day per card
Dec-31	Grace period for non-present Indians for SBN exchange at RBI
Jan-03	Allocation changes to cash in rural areas
	Foreign citizens allowed to exchange Rs. 5000 per week till Jan 31
Jan-16	ATM limit extended to Rs. 10,000 per day per card
	Current account withdrawal limits extended to 1,00,000

Appendix B. List of Facts

Chapter 1: DEPOSITING OR TENDERING SPECIFIED BANK NOTES	1. The old Rs. 500 and Rs.1000 notes will be accepted at bank branches until 30/12/2016. If you deposit more than Rs. 5,000 then you will have to provide a rationale for why you didnt deposit the notes earlier. 2. You will get value for the entire volume of notes tendered at the bank branches / RBI offices. 3. If you are not able to personally visit the branch, you may send a representative with a written authority letter and his/her identity proof with tendering the notes. 4. Banks will not be accepting the old Rs.500 and Rs. 1000 notes for deposits in Small Saving Schemes. The deposits canbe made in Post Office Savings accounts. 5. Quoting of PAN is mandatory in the following transactions: Deposit with a bank in cash exceeding Rs. 50,000 in a single day; Purchase of bank drafts or pay orders or bankers cheques from a bank in cash for an amount exceeding Rs. 50,000 in a single day; A time deposit with a Bank or a Post Office; Total cash deposit of more than Rs. 2,50,000 during November 09 to December 30th, 2016
Chapter 2: EXCHANGING SPECIFIED BANK NOTES	1. The over the counter exchange facility has been discontinued from the midnight of 24th November, 2016 at all banks. This means that the bank wont exchange the notes for you anymore. You must first deposit them into an account. 2. All of the old Rs.500 and Rs. 1,000 notes can be exchanged at RBI Offices only, up to Rs.2000 per person. 3. Until December 15th, 2016, foreign citizens will be allowed to exchange up to Rs. 5000 per week. It is mandatory for them to have this transaction entered in their passports. 4. Separate queues will be arrangedfor Senior Citizens and Divyang persons, customers with accounts in the Bankand for customers for exchange of notes (when applicable).
Chapter 3: CASH WITHDRAWAL AT BANK BRANCHES	1. The weekly limit of Rs. 20,000 for withdrawal from Bank accounts has been increased to Rs. 24,000. The limit of Rs. 10,000 per day has been removed. 2. RBI has issued a notification to allow withdrawals of deposits made in the valid notes (including the new notes) on or after November 29, 2016 beyond the current limits. The notification states that available higher denominations bank notes of Rs. 2000 and Rs. 500 are to be issued for such withdrawals as far as possible. 3. Business entities having Current Accounts which are operational for last three months or more will be allowed to draw Rs. 50,000 per week. This can be done in a single transaction or multiple transactions. 4. To protect innocent farmers and rural account holders of PMJDY from money launders, temporarily banks will: (1) allow account holders with full KYC to withdraw Rs. 10,000 in a month;(2) allow account holders with limited KYC to withdraw Rs.5,000 per month, withthe maximum of Rs.10,000 from the amount deposited through SBN after Nov 09,2016 5. District Central Cooperative Banks (DCCBs) will also facilitate withdrawals with the same limits as normal banks.
Chapter 4: ATM WITHDRAWALS	1. Withdrawal limit increased to Rs. 2,500 per day for ATMs that have been recalibrated to fit the new bills. This will enable dispensing of lower denomination currency notes for about Rs.500 per withdrawal. The new Rs. 500 notes can be withdrawn 2. Micro ATMs will be deployed to dispense cash against Debit/Credit cards up to the cash limits applicable for ATMs. 3. ATMs which are yet to berecalibrated, will continue to dispense Rs. 2000 till they are recalibrated.
Chapter 5: SPECIAL PROVISIONS FOR FARMERS	1. Farmers would be permitted to withdraw up to Rs. 25,000 per week in cash from their KYC compliant accounts for loans. These cash withdrawals would be subject to the normal loan limits and conditions. This facility will also apply to the Kisan Credit Cards (KCC). 2. Farmers receiving payments into their bank accounts through cheque or other electronic means for selling their produce, will be permitted to withdraw up to Rs.25,000 per week in cash. But these accounts will have to be KYC compliant. 3. Farmers can purchase seeds with the old bank notes of 500 from the State or Central Govenment Outlets, Public Sector Undertakings, National or State Seeds Corporations, Central or State Agricultural Universities and the Indian Council of Agricultural Research (ICAR), with ID proof.

	4. Traders registered with APMC markets/mandis will be permitted to withdraw up to Rs. 50,000 per week in cashfrom their KYC compliant accounts as in the case of business entities. 5. The last date for payment of crop insurance premium has been extended by 15 days to 31st December,2016.
Chapter 6: SPECIAL PROVISIONS FOR WEDDINGS	1. In the case of a wedding, one individual from the family (parent or the person themselves) will be able to withdraw Rs. 2,50,000 from a KYC compliant bank account. PAN details and self-declaration will have to be submitted stating only one person is withdrawing the amount. The girls and the boys family can withdraw this amount separately. 2. The application for withdrawal for a wedding has to be accompanied by the following documents: An application form; Evidence of the wedding, including the invitation card, copies of receipts for advance payments already made, such as Marriage hall booking, advance payments to caterers, etc.; A declaration from the person who has to be paid more than Rs. 10,000 stating that they do not have a bank account, anda complete list of people who have to be paid in cash and the purpose for the payment.
Chapter 7: OTHER DETAILS	1. In Odisha, Panchayat offices can be used for banking services in areas where banks are too far or banking facilities are not available. 2. You can use NEFT/RTGS/IMPS/InternetBanking/Mobile Banking or any other electronic/ non-cash mode of payment. 3. Valid Identity proof is any of the following: Aadhaar Card, Driving License, Voter ID Card, Pass Port, NREGA Card, PAN Card, Identity Card Issued by Government Department, Public Sector Unit to its Staff. 4. You may approach the control roomof RBI on Telephone Nos 022-22602201 22602944 5. The date for submission of annual life certificate has been extended to January 15, 2017 from November for all government pensioners 6. As of December 15, 2016, specified bank notes of only Rs. 500 can no longer be used for the following: Government hospitals and pharmacies, railway and government bus tickets, consumer cooperative stores, government and court fees, government School fees, mobile top-ups, milk booths, crematoria and burial grounds, LPG gas cylinders, Archaelogical Survey of India monuments, utilities, toll payments

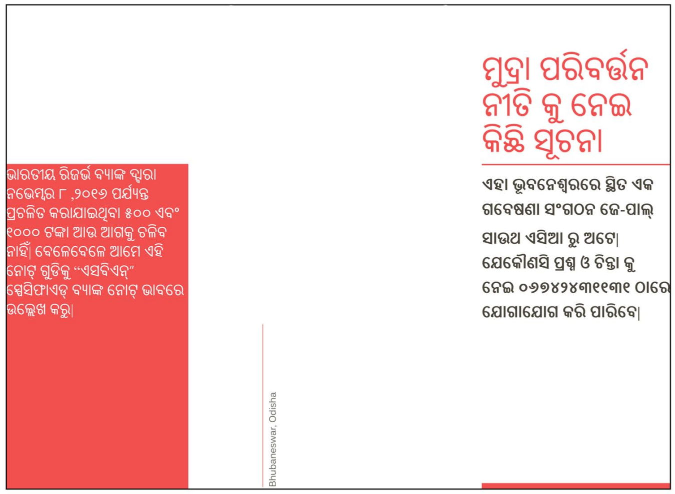
Appendix C. Example Pamphlet Excerpts



(A) Front

(B) Back

Figure C.1. Short pamphlet (2 facts)



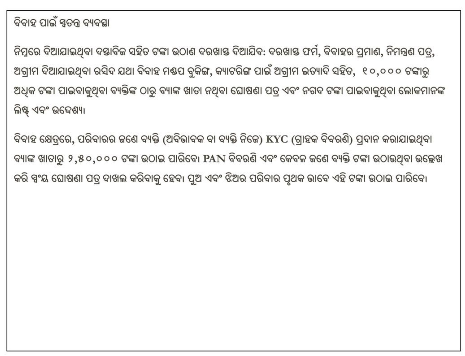
ମୁଦ୍ରା ପରିବର୍ତ୍ତନ ନୀତି କୁ ନେଇ କିଛି ସୂଚନା

ଏହା ଭୁବନେଶ୍ୱରରେ ସ୍ଥିତ ଏକ ଗବେଷଣା ସଂଗଠନ ଜେ-ପାଲ୍ ସାଉଥ ଏସିଆ ରୁ ଅଟେ। ଯେକୌଣସି ପ୍ରଶ୍ନ ଓ ଚିନ୍ତା କୁ ନେଇ ୦୬୭୪୨୪୩୧୧୩୧ ଠାରେ ଯୋଗାଯୋଗ କରି ପାରିବେ।

ଭାରତୀୟ ରିଜର୍ଭ ବ୍ୟାଙ୍କ ଦ୍ବାରା ନଭେମ୍ବର ୮ ,୨୦୧୬ ପର୍ଯ୍ୟନ୍ତ ପ୍ରଚଳିତ କରାଯାଇଥିବା ୫୦୦ ଏବଂ ୧୦୦୦ ଟଙ୍କା ଆଉ ଆଗକୁ ଚଳିବ ନାହିଁ। ବେଳେବେଳେ ଆମେ ଏହି ନୋଟ୍ ଗୁଡିକୁ "ଏସବିଏନ୍" ସ୍ପେସିଫାଏଡ୍ ବ୍ୟାଙ୍କ ନୋଟ୍ ଭାବରେ ଉଲ୍ଲେଖ କରୁ।

Bhubaneswar, Odisha

(A) Front

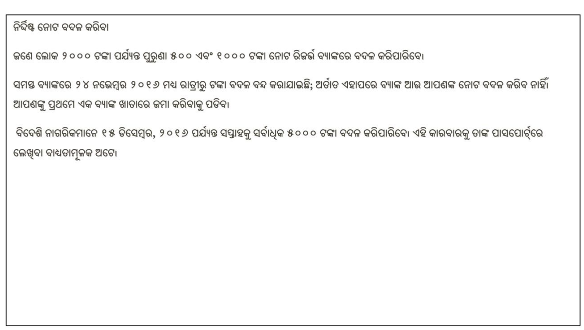


ବିବାହ ପାଇଁ ସ୍ୱତନ୍ତ୍ର ବ୍ୟବସ୍ଥା

ନିମ୍ନରେ ଦିଆଯାଇଥିବା ଦସ୍ତାବିଜ ସହିତ ଟଙ୍କା ଉଠାଣ ଦରଖାସ୍ତ ଦିଆଯିବ: ଦରଖାସ୍ତ ଫର୍ମ, ବିବାହର ପ୍ରମାଣ, ନିମନ୍ତ୍ରଣ ପତ୍ର, ଅଗ୍ରୀମ ଦିଆଯାଇଥିବା ରସିଦ ଯଥା ବିବାହ ମଣ୍ଡପ ବୁକିଙ୍ଗ, କ୍ୟାଟରିଙ୍ଗ ପାଇଁ ଅଗ୍ରୀମ ଇତ୍ୟାଦି ସହିତ, ୧୦,୦୦୦ ଟଙ୍କାରୁ ଅଧିକ ଟଙ୍କା ପାଇବାକୁଥିବା ବ୍ୟକ୍ତିଙ୍କ ଠାରୁ ବ୍ୟାଙ୍କ ଖାତା ନଥିବା ଘୋଷଣା ପତ୍ର ଏବଂ ନଗଦ ଟଙ୍କା ପାଇବାକୁଥିବା ଲୋକମାନଙ୍କ ଲିଷ୍ଟ୍ ଏବଂ ଉଦ୍ଦେଶ୍ୟ।

ବିବାହ କ୍ଷେତ୍ରରେ, ପରିବାରର ଜଣେ ବ୍ୟକ୍ତି (ଅବିଭାବକ ବା ବ୍ୟକ୍ତି ନିଜେ) KYC (ଗ୍ରାହକ ବିବରଣି) ପ୍ରଦାନ କରାଯାଇଥିବା ବ୍ୟାଙ୍କ ଖାତାରୁ ୨,୫୦,୦୦୦ ଟଙ୍କା ଉଠାଇ ପାରିବେ। PAN ବିବରଣି ଏବଂ କେବଳ ଜଣେ ବ୍ୟକ୍ତି ଟଙ୍କା ଉଠାଉଥିବା ଉଲ୍ଲେଖ କରି ସ୍ବଂୟ ଘୋଷଣା ପତ୍ର ଦାଖଲ କରିବାକୁ ହେବ। ପୁଅ ଏବଂ ଝିଅର ପରିବାର ପୃଥକ ଭାବେ ଏହି ଟଙ୍କା ଉଠାଇ ପାରିବେ।

(B) Page 1/8



ନିର୍ଦ୍ଦିଷ୍ଟ ନୋଟ ବଦଳ କରିବା

ଜଣେ ଲୋକ ୨୦୦୦ ଟଙ୍କା ପର୍ଯ୍ୟନ୍ତ ପୁରୁଣା ୫୦୦ ଏବଂ ୧୦୦୦ ଟଙ୍କା ନୋଟ ରିଜର୍ଭ ବ୍ୟାଙ୍କରେ ବଦଳ କରିପାରିବେ।

ସମସ୍ତ ବ୍ୟାଙ୍କରେ ୨୪ ନଭେମ୍ବର ୨୦୧୬ ମଧ୍ୟ ରାତ୍ରୀରୁ ଟଙ୍କା ବଦଳ ବନ୍ଦ କରାଯାଇଛି; ଅର୍ଥାତ ଏହାପରେ ବ୍ୟାଙ୍କ ଆଉ ଆପଣଙ୍କ ନୋଟ ବଦଳ କରିବ ନାହିଁ। ଆପଣଙ୍କୁ ପ୍ରଥମେ ଏକ ବ୍ୟାଙ୍କ ଖାତାରେ ଜମା କରିବାକୁ ପଡିବ।

ବିଦେଶି ନାଗରିକମାନେ ୧୫ ଡିସେମ୍ବର, ୨୦୧୬ ପର୍ଯ୍ୟନ୍ତ ସପ୍ତାହକୁ ସର୍ବାଧିକ ୫୦୦୦ ଟଙ୍କା ବଦଳ କରିପାରିବେ। ଏହି କାରବାରକୁ ତାଙ୍କ ପାସପୋର୍ଟ୍‌ରେ ଲେଖିବା ବାଧ୍ୟତାମୂଳକ ଅଟେ।

(C) Page 2/8

FIGURE C.2. Long pamphlet (24 facts)

Appendix D. Proof of Proposition

First let us analyze CK:BC. Suppose that for infinitely many values of λ, there were a difference bigger than $\delta > 0$ between

$$\mathbb{P}^A(a = \mathrm{H} \mid d = \mathrm{S}) \text{ and } \mathbb{P}^A(a = \mathrm{L} \mid d = \mathrm{S}).$$

Then as $\lambda \uparrow \infty$, the probabilty of a realization $V^{\mathrm{S}} - V^{\mathrm{NS}}$ exceeding the reputational cost would tend to 0, a contradiction. This, along with P1, shows that as $\lambda \uparrow \infty$, the probability $\sigma(1; \text{CK:BC})$ tends to 0.

Now let us fix a large λ and analyze the other inequalities. Under CK:Seed our assumption that it is common knowledge that $x_D = 0$ turns off signaling concerns and so by P3 everybody seeks.

Thus it suffices to argue that $\sigma(0; \text{No-CK}) < \sigma(1; \text{No-CK})$. The expected signaling cost is $O(\varepsilon)$, where ε is defined to be D's expectation of A's subjective probability that $x_D = 1$. Under B1, $\varepsilon = o(\beta)$ when $x_D = 1$. However, the probability that there is information to be gained when $x_D = 1$ is $\Omega(\beta)$. It follows, given P3, that for any small β, the mass of types seeking is $\Omega(\beta)$. On the other hand, if $x_D = 0$, then D considers it very unlikely that information is out there ($O(\beta^2)$) and so given P3 it can be ensured that the mass of types seeking is $O(\beta^2)$ as well.

Appendix E. Supply Effects: Information as a Public Good

The core model of Chandrasekhar, Golub, and Yang (2017) and its application to our setting focuses on seeking effort or endogenous participation in learning. A different kind of explanation focuses on the effort of those informed to understand, filter, and communicate the information in a useful way to others. The simplest framework to capture this is a model of public goods provision and free-riding. This class of model has been studied extensively in a development context, and we rely on arguments from Banerjee, Iyer, and Somanathan (2007) to explain why supply-side effects are unlikely to explain our results.

A robust point within such public goods models is that enlarging the set of people who are able to provide a public good should not, in equilibrium, reduce its aggregate provision. Indeed, if anything provision should slightly increase, which is contrary to our empirical results.

For a simple model, consider a situation where those initially given information have the opportunity to provide the public good of processing and disseminating it to others. There are n agents, and each of those informed believes that k in total are able to contribute. Every i who has information invests an effort $z_i \geq 0$ in transmitting. Their payoffs are given by

$$U_i(z_1, \ldots, z_n) = V\left(\sum_i z_i\right) - cz_i.$$

Here V is an increasing, smooth function with $V'(z)$ tending to 0 at large arguments z, and $c > 0$ is a cost parameter. Those who are unable to contribute are constrained to $z_i = 0$ and are passive. The key fact, which is formalized for instance by Banerjee, Iyer, and Somanathan (2007), is that at any equilibrium with some people contribution, for those contributing we have

$$V'\left(\sum_i z_i\right) = c, \tag{E.1}$$

so the aggregate level of contribution cannot depend on n or k. The intuition is simple: the free-riding problem is self-limiting, at least in the sense of aggregate (though not per-person) provision. If more agents try to free-ride, then others have more reason to provide the good. A similar force is present in the network model of Galeotti and Goyal (2010), in which everyone has access to the public good in equilibrium.

If agents have a private benefit term in their utility function, $v_i(z_i)$, where v is increasing and $v'(z_i) > c$ for $z_i \in [0, \delta)$, then as long as there are sufficiently many agents who can provide the public good, the amount provided will be at least $k\delta$—a lower bound which is increasing in k. A similar argument applies if only some agents have such a v term.

Thus, natural public goods theories do not predict a decrease in the amount of overall provision, and thus in overall learning, as k (the number of potential providers) increases. One can, of course, elaborate these models with stochastic k and idiosyncratic c_i, but the basic intuition described above is quite robust.

One further supply-side effect to consider is one of social obligation. If the seeds are publicly "deputized," as they are in the CK treatment, each may face stronger incentives to provide information relative to a situation in which provision opportunities are diffuse. Though this is outside a basic public goods model, our evidence on seed effort does not support this hypothesis.

Application to Experiment. The number of people, k, who can contribute is either $k = 5$ or $k = n$. Under common knowledge, this matches up with the beliefs agents hold, so in this sense the simple model is faithful to the experiment. Thus, the basic public goods theory predicts (contrary to the demand-side theory) that holding CK fixed and moving from Seed to Broadcast should not hurt aggregate provision.

When common knowledge is not present, agents will have beliefs about k. But as long as their beliefs about k are reasonably consistent (e.g., agents have common priors about it), the essence of the above argument goes through: a stochastic version of (E.1) still holds, and changes in beliefs about k alone should not lead to large swings in provision.

This model is inconsistent with our empirical findings for several reasons. First, aggregate provision of effort cannot decline, as established above. If the number of people a typical subject in our random sample conversed with measures conversational effort, this means that the number of conversations for the average person must not decline. Column 1 of Table 5 shows that, conditional on common knowledge, going from $k = 5$ to $k = n$ corresponds to a 61% decline in the number of conversations ($p = 0.029$), which means that aggregate contribution to conversations must be decreasing.

Second, the model suggests that the amount of value being generated cannot decline, since after all otherwise a given individual would have an incentive to put in some more effort to gain more marginal benefit. Here, we can measure this either through knowledge or choice quality. Turning to Table 6, recall that columns 1 (for knowledge) and 2 (for choice) show robust declines in aggregate social learning and quality of choice when we go from $k = 5$ to $k = n$ under common knowledge ($p = 0.0621$ and $p = 0.104$).

Appendix F. Heterogeneity by length of information

We now look at the interaction of our core treatment cells with the amount of information in the pamphlet. Whether this should accelerate or dampen the effect of going to common knowledge in a given information delivery system depends on the details of the model and therefore becomes an empirical question.

To see why, consider the case of (Broadcast, CK) and now imagine comparing a world in which only two facts are given as compared to a world where a lengthy pamphlet of 24 facts is given. What matters is how the type-specific marginal value of information distributions, F_{H} and F_{L}, move when we go from a short set of facts to a long set of facts. Assume for the moment that the cost of figuring out which of the 24 facts are useful, or coordinating on the same topic of conversation out of the now 24 possibilities, is very high no matter if the individual is a high or low ability type. In this case, the scope for signaling reduces, and therefore going from (Broadcast, No CK, Long) to (Broadcast, CK, Long) should generate less of a reduction in endogenous participation in social learning than going from (Broadcast, No CK, Short) to (Broadcast, CK, Short). Now on the other hand, if it was very easy for high ability types to figure out what is useful, but the task was arduous for low ability types, then scope for signaling could actually increase.

Turning to seeding, observe that in seeding with or without common knowledge, the length of the information is not commonly known either way. So, long sets of facts should likely have no effect on endogenous participation.

We now turn to the data in Table E.1 to look at how going from two to 24 facts differentially impacts the effects of interest. For the most part the effect is noisy, and there is no differential effect. The one plausible finding is that going from (Broadcast, No CK) to (Broadcast, CK) is less of a deterrent to purposeful conversations ($p = 0.15$) when the facts are long. If this is to be taken seriously, minding the caveat that for overall conversations this effect is not distinguishable from zero ($p = 0.251$), it is evidence in favor of the idea that sorting through the 24 facts or deciding which topic to coordinate on and converse about is costly enough for both ability types that the signaling motive is dampened by the longer list. Said differently, it is, if anything, consistent with the story that it is much less likely for someone to go ask about information when it is known that they have received two facts, than when it is known that they received a lengthy booklet of facts.

Table E.2 repeats the same exercise now turning to knowledge and choice. Of note is that a similar pattern is true here. There is mostly no detectable effect. But if we

Table E.1. Conversations: Length interactions

VARIABLES	(1) OLS Volume of conversations	(2) OLS # incidental conversations	(3) OLS # purposeful conversations
CK	0.825	0.693	0.132
	(0.496)	(0.412)	(0.163)
	[0.0982]	[0.0937]	[0.421]
Broadcast	0.963	0.665	0.297
	(0.545)	(0.481)	(0.219)
	[0.0787]	[0.168]	[0.175]
Long	-0.0939	-0.00127	-0.0926
	(0.372)	(0.330)	(0.130)
	[0.801]	[0.997]	[0.478]
Broadcast × CK	-2.212	-1.614	-0.599
	(0.735)	(0.626)	(0.264)
	[0.00296]	[0.0107]	[0.0244]
CK × Long	-0.372	-0.485	0.113
	(0.562)	(0.480)	(0.194)
	[0.508]	[0.313]	[0.560]
Broadcast × Long	-0.563	-0.319	-0.244
	(0.680)	(0.616)	(0.233)
	[0.408]	[0.605]	[0.295]
Broadcast × CK × Long	1.448	1.006	0.442
	(0.809)	(0.733)	(0.281)
	[0.0752]	[0.172]	[0.118]
Observations	1,078	1,078	1,078
Seed, No CK, Short Mean	0.523	0.385	0.138
CK + BC × CK = 0 p-val	0.00573	0.0275	0.0365
BC + BC × CK = 0 p-val	0.0170	0.0259	0.0602
Long + CK × Long + BC × Long + BC × CK × Long = 0	0.251	0.520	0.155

Notes: All columns control for randomization strata (subdistrict) fixed effects. They also control for date and time of entry into the village, caste category of the treatment hamlet and distance from the village to an urban center. Respondent-level controls include age, gender, literacy and potential seed status. Standard errors (clustered at the village-level) are reported in parentheses and p-values are reported in brackets.

had to guess, at $p = 0.5$ for both outcomes, it suggests that perhaps introducing CK to the broadcast cell has less of a detrimental effect on both knowledge and choice quality. This is extremely noisy, speculative evidence that suggests if anything, a stigma-like effect operates more when there are only two facts.

Table E.2. Knowledge and choice: Length interactions

VARIABLES	(1) OLS Knowledge Error	(2) OLS Chose 500
CK	-0.0215	0.0542
	(0.0162)	(0.0404)
	[0.185]	[0.181]
Broadcast	-0.0264	0.0804
	(0.0169)	(0.0361)
	[0.121]	[0.0269]
Long	0.0131	-0.00591
	(0.0174)	(0.0300)
	[0.451]	[0.844]
Broadcast × CK	0.0537	-0.144
	(0.0247)	(0.0556)
	[0.0312]	[0.0104]
CK × Long	-0.0167	-0.0144
	(0.0255)	(0.0508)
	[0.513]	[0.777]
Broadcast × Long	0.000655	-0.0284
	(0.0262)	(0.0548)
	[0.980]	[0.605]
Broadcast × CK × Long	-0.00862	0.0696
	(0.0383)	(0.0785)
	[0.822]	[0.376]
Observations	1,082	1,067
Seed, No CK, Short Mean	0.436	0.0374
CK + BC × CK = 0 p-val	0.0919	0.0141
BC + BC × CK = 0 p-val	0.120	0.133
Long + CK × Long + BC × Long + BC × CK × Long = 0	0.532	0.550

Notes: All columns control for randomization strata (subdistrict) fixed effects. They also control for date and time of entry into the village, caste category of the treatment hamlet and distance from the village to an urban center. Respondent-level controls include age, gender, literacy and potential seed status. Standard errors (clustered at the village-level) are reported in parentheses and p-values are reported in brackets.