Competition or Cooperation? Using team and tournament incentives for learning among female farmers in rural Uganda

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Abstract

This study explores the behavioral aspect behind learning by quantifying the amount of information learned by smallholder female farmers in Uganda under different incentive schemes. The paper shows how competitive versus team incentives compare in motivating Ugandan farmers to learn and share information relevant to adopting a new agricultural technology. We find that tournament-based incentives provide greater outcomes in terms of total information learned than threshold-based team incentives. Furthermore the order of the incentive - whether the tournament precedes or follows the team incentive scheme - does not affect the volume of information learned. New information introduced between rounds was learned by more individuals under team incentives than under tournament incentives. The study provides direct practical policy recommendations for improving learning in the context of agriculture in Uganda.

Keywords: Team, Tournaments, Competition, Learning, Agricultural Training, Uganda

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1 Introduction

There is little consensus about the reasons for low levels of technology adoption in Sub-Saharan Africa, especially in agriculture. In contrast, there is wide acknowledgment of the importance of agriculture in Sub-Saharan Africa especially as a vehicle to alleviate poverty and improve general well-being. Estimates indicate that about 91% of the rural extreme poor participate in agriculture, with about 75% of extreme poor living in rural areas (Kilic et al., 2013). The potential culprits for low technology adoption range from low information access, inadequate input delivery systems, behavioral biases of farmers as well as risk aversion (Duflo et al., 2006; Shiferaw et al., 2008). Much attention has been directed to technology diffusion and extension workers. Questions raised include how information spreads across villages, if at all, and whether extension agents are able to trigger learning. Central to this discussion is can learning be encouraged? More importantly, if one views farmers in a village as a group embedded in a social network, can certain incentives take advantage of this feature to improve the spread of information?

To understand the role of group dynamics in learning, we conducted field experiments using female farmers who are deciding on whether to adopt a new cash crop, cotton, in Northern and Eastern Uganda.[1] We specifically examined two incentive schemes, which would take advantage of group dynamics and reasonably mimic reality within the context of Uganda while being feasible.[2] The first scheme we implemented was a team-based threshold incentive scheme where individuals were encouraged to share information in a session, and the full session of participants were rewarded if all participants demonstrated learning a minimum threshold of information. This was contrasted to the second scheme, a tournament-based

[1]This was part of the larger Randomized Controlled Trial (RCT) that implemented a cotton training program under "Gender Dimension of Cotton Productivity in Uganda" led by Laoura Maratou (University of Maryland) and John Baffes (World Bank). For a basic overview of the interventions see Vasilaky (2013) and Baffes and Maratou-Kolias (2013). For an evaluation of the larger RCT see Vasilaky and Leonard (2016).

[2]For example, a piece rate incentive scheme would be costly to implement in reality in terms of monitoring output as well as administering payouts to farmers. This is true, even more so for farming, where we only observe the aggregate output as in Holstrom (Holmstrom, 1982a).

scheme, in which all participants were still encouraged to share information, but only the best performing participant was rewarded. Details of the schemes are presented later in the paper.

The incentive schemes are motivated by two strands of literature. The first strand involves the importance of peer learning in technology adoption, and thus both incentive schemes require that farmers exchange information with one another. The second literature, firmly rooted in experimental and behavioral economics, involves the exertion of effort and outcomes under tournament versus team-based incentive schemes. The question of whether team incentives would be more effective than tournament incentives at increasing worker effort is part of a long literature in the context of public good contributions (Dechenaux et al., 2014; Groves, 2014; Hamilton et al., 2003; Orrison et al., 2004). Experiments have compared the effectiveness of different variations of team and tournament incentive schemes in the lab (Barham et al., 2014; Nalbantian and Schotter, 1997). This literature is also relevant to the context of information sharing, as information can be seen as a public good that is non-excludable and non-rival (Romer, 1990). Team incentives generally take the form of a communally generated prize that is distributed among the team. Team members are awarded a fixed fraction of the team's collective product, or a portion contingent on their level of effort or contribution. In a team goal scenario, free riding is a natural concern, where reducing effort is beneficial to one's own utility, and compromises the team outcome. Tournament-based incentives take the form of a competition between individuals. The individual who exerts the most effort and obtains the highest outcome is rewarded, or rewarded the most. As a result, tournament-based incentives typically encourage greater competition and less cooperation. Therefore, even in a public good scenario where collective action is needed, tournament incentives have been shown to be a more effective mechanism than team-based incentives in inducing effort to contribute to the public good (Irlenbusch and Ruchala, 2008; Sutter, 2006).

While experiments may provide a wide range of general implications for encouraging learning in a group context, specific practical policy implications are needed for agricultural extension work. In the developing world, new information is not readily available and thus the burden of information dissemination falls on extension agents or trainers. Such trainers and extension agents typically provide information and knowledge about new technologies in person. Given the high cost and time involved in training remotely situated smallholder farmers, extension agents will often train only a handful of farmers at one time, often the most productive or most visible, with the expectation that newly trained farmers will then share their expertise. There are two issues with this. First, traditional extension training is costly. The vehicle and fuel costs to reach remote areas alone can be prohibitive, averaging 30 USD per day to visit say 3 villages at most. This is important as most extension officers have a limited supply of resources, and thus choose the perceived most productive farmer, and provide advice or improved seeds to them. Second, trained farmers will not necessarily adopt the technology nor spread the information (Evenson and Mwabu, 2001). Thus, agricultural extension workers in developing country settings often see low adoption rates of new agricultural technologies despite their efforts, especially with female farmers.

The findings of this study can aid extension workers, who remain primary agents in spreading information. Activating social ties to share knowledge around a new technology may be one way to introduce technologies into the lives of remote and poor households in a cost effective manner. Despite limited budgets and mixed findings regarding extension workers, extension agents continue to be used as a source of learning (Anderson and Feder, 2007; Davis et al., 2012). The literature has explored avenues of increasing the effectiveness of extension workers. Kondylis et al. (2014) specifically explore technology diffusion and find that Training & Visits (T&V) models, where extension agents offer ad hoc training to a contact farmer in a village, with the hopes that they then transfer knowledge across the village, are inferior to centrally training contact farmers. Their recommendation is that running small-scale, low-cost training of designated communicators may be one way to improve overall learning.

Yishay and Mobarak (2014) also study the use of more central contact farmers, and find that they are effective at spreading information, but only when provided with individual incentives. Conversely, very few studies have explored increasing effectiveness of extension work using group incentives. Social ties and networks have been extensively studied regarding the spread of information (Bandiera and Rasul, 2006; Conley and Udry, 2010; Duflo et al., 2006; Yishay and Mobarak, 2014). And in the overarching evaluation in which this game was implemented, local social networks were found to be a complementary and cost effective means of improving outcomes for female farmers in rural Uganda (Vasilaky, 2013; Vasilaky and Leonard, 2016). However, less work has been done in studying the degree to which group versus individual incentives can help drive the actual exchange and learning of new information.

Another important aspect of our study is the focus on female farmers. Two key features of sub-Saharan Africa agriculture are the higher labor participation rates of females as compared to males and the lower productivity and wages for females. Women supply 70-80% of agricultural labor in rural Uganda and are responsible for up to 80% of food crop production (Tanzarn, 2005), and yet their productivity and wages lag behind males', where female productivity is a fraction of males' (Baffes, 2009), and wage gaps can range from 4 to 40% (Palacios-Lopez and Lopez, 2014). Disparities in input use and adoption between female and male farmers have been identified as potential explanations for the gender disparities (see Peterman et al. (2010) for a review), which may be the result of the absence of direct extension training for females. As a result, the primary impetus for this study was to explore whether females' production deficiencies could be improved through training, namely traditional versus social network based training (Vasilaky and Leonard, 2016).

With regards to extension services, studies have indicated that extension officers have positive and significant effects on input adoption for male-headed households, but no significant effect for female-headed households. Part of the explanation may be reduced access to extension services by females as compared to males. For example, a study of extension services in Uganda for banana crops showed that 4.11% of female heads of households had contact with extension services while the corresponding figure for males was 7.78% (Katungi et al., 2008). Thus, improving the spread of information from extension officers to female networks may result in greater dividends in terms of technology adoption.

There is also the matter of the spread of information within female-dominated networks. We might assume that neighbors who live in close proximity to one another in rural developing country contexts also know and talk to one another about agricultural production issues. However, even if networks are dense, it is not necessarily the case that individuals discuss all subject matters with their connections. This is particularly true for our setting where a new technology (cotton) is being introduced to female farmers. As Katungi et al. (2008) indicate, women may be less likely to discuss production issues with other women, and may not speak with men regarding production issues due to cultural norms. Additionally, female growers may be less likely to be connected to key information leaders in their village, who are generally male. Thus, encouraging communication and learning among peers may be able to increase the effectiveness of information exchange and consequently technology adoption among female farmers.

Our findings from the experiment are as follows. We find that tournament-based incentives provide greater outcomes in terms of information learned overall than threshold-based team incentives, which is in accordance with the literature. Given that in some villages tournament-based incentives were employed before team-based incentives, and in other villages, the incentives schemes were switched, we can make statements on whether the order of incentives matter. For overall information learned, we find that the order of incentive schemes does not matter. Finally, we introduced new information every round to account for learning that can naturally occur between rounds. An unexpected finding was that this new information was learned by far more individuals under team-based incentives than tournament-based incentives. We do acknowledge that given that our sample includes only female farmers we cannot make any statements as to whether such schemes would have a similar effect for male farmers, though recent studies have not found any inherent differences in learning abilities across genders, despite perceived differences in ability (Reuben, 2015; Yishay et al., 2015).

The contribution of our research is, therefore, twofold; first, we add to the literature by conducting a field experiment that compares two incentive schemes that have been explored rigorously using lab experiments but not necessarily for learning outcomes in the field; second, we utilize the two incentive schemes in a unique developing country context with tangible policy implications. By effectively suggesting ways to improve learning from agricultural extension agents, any resulting technology adoption could have considerable benefits for agricultural productivity, especially for women. The findings can also be applied to more than agricultural adoption, including the adoption of health interventions or information communication technologies.

The paper is organized as follows. Section 2 lays out the conceptual considerations under the two different incentive schemes. Section 3 describes the data collection, and Section 4 presents the econometric specification and results. Finally, Section 5 concludes.

2 Conceptual Considerations

Experimentation with payment schemes using group incentives have been commonly used to induce greater effort in the work place. The same mechanisms translate well with regards to learning. Team incentives typically fall under group incentives where a group is rewarded by the overall team performance, not the individual performance. An individual under team incentives could face two opposing forces. One is the increasing cost of exerting effort. Since rewards are not tied to the individual effort but to the group outcomes, there could be an incentive to free ride if other members of the group may compensate with additional effort. On the other hand, excessive shirking may result in negative reputation effects, or an individual may wish to exert more effort due to positive social interactions within the group. This setting is similar to a public goods game (Harbring, 2006; Ledyard, 1997). To limit free riding, group incentives can be complemented with target-based mechanisms where targets are set exogenously for individuals and if the target is achieved by all individuals then the group is rewarded with the pay-off, but if the targets are not reached, a lower or no pay-off is awarded (Holmstrom, 1982b; Nalbantian and Schotter, 1997).

A popular alternative to team incentives is tournament incentives. Under this setting, individuals within groups are rewarded for outcomes based on their relative performance (Nalbantian and Schotter, 1997). In this scenario the individual with the highest outcome is awarded the largest reward while individuals with lower outcomes receive a lower or no reward. Thus, individuals have incentives to exert more effort in order to claim the largest reward. More importantly, individuals in a group have incentives to outperform their peers, and their effort level may create a negative externality on fellow group members' exertion of effort. Hence the competitive element in a tournament setting provides ample incentives for higher levels of individual effort. This has been found in the literature where team incentives have resulted in lower effort but greater cooperation than that of tournament incentives (Dijk et al., 2001).

The implications for learning within our experiment are straightforward. In one setting we implement team incentives with a target mechanism - individual farmers in a group share a fixed proportion of the prize if all individuals learn a minimum amount of information. In this setting cooperation between farmers can be expected to be considerable as the group tries to ensure that information is shared such that the minimum threshold is met (details of the experiment are provided in the ensuing section). However, it still may be optimal for a farmer to only meet the minimum target and not exert any further effort in acquiring additional information.[3] In our tournament setting, only the farmer who learns the most information is awarded a prize with no other prizes provided to other farmers, regardless of the information learned. This induces competitive forces as farmers attempt to obtain as much information from their peers, but may also introduce strategic interactions where participants reduce others' chances by providing incorrect or incomplete information.[4]

Two other elements to consider are the order of the incentive schemes and the introduction of new information. In terms of order, whether a group faces team incentives followed by tournament incentives or vice versa may matter for our findings. Initial interactions may build positive or negative relationships, which could affect subsequent interactions within the group. For instance, Nalbantian and Schotter (1997) find that when past experience of a group is positive (in terms of output) then current output remains high. However, all rounds following (revenue sharing) team incentive schemes exhibit increasingly lower levels of output. The rationale builds on work by Van Huyck et al. (1990, 1991). Because team incentives involve free-riding or shirking, the latter may introduce group distrust leading to lower output in subsequent rounds. Conversely, team incentives may provide information about the identities of the group members, which may then encourage collaboration with respected performers.

Given the various mechanisms that could encourage or discourage information dissemination

[3] Note that participants do know the maximum number information points that can be learned within each round from talking to others

[4] While cooperation within the group may still exist in order to learn information, we would expect it be less than under the team incentive setting.

via team or tournament incentives, an interesting question is how a new information point is absorbed in subsequent rounds of the game (excluding the first round as all information is new in the first round). If the new information is treated the same as any other information, there is no reason to expect players' calculus under team versus tournament incentives to change. However, previous studies have shown that the uncertainty surrounding new information may play a role. Irlenbusch and Ruchala (2008) find that team incentive schemes increase an outcome when the expected uncertainty around information transmission is low, while competitive incentives increase output when the expected uncertainty around information transmission is high. Thus, if the new information carries with it low uncertainty concerning information transmission then we can expect that the number of individuals who learn this information would be higher under team incentives than under tournament incentives. Similarly, if the new information has higher uncertainty, the opposite would occur. In our experiment, it may be that the new information stands out, and thus has a higher certainty of being transmitted. On the other hand, given that older information has been passed around quite frequently, the newly introduced information has greater uncertainty regarding transmission than the existing older information. As we cannot know the degree of uncertainty surrounding the new information, we leave this as an empirical question to be explored.

3 Experimental Design

The following game was conducted in 19 villages in Eastern and Northern Uganda, with groups of 14 women in each village.[5] The game was designed to mimic realistic information sharing among women, and served as a learning tool for the participants. Fourteen female-headed and non-female-headed household participants, approximately evenly split, were randomly selected to participate in the games, prior to any surveys. All 14 female

[5] In two villages, we had 12 participants and adjusted the number of information points accordingly.

farmers in a village were trained in one information point confidentially from a list of 14 information points concerning cotton growing that had been identified as knowledge that most female farmers (in the East and North of Uganda) lacked. The farmers were then encouraged to learn from and teach other farmers. Tournament or team incentives were provided in separate rounds, in a randomized order, and the total information points learned by all farmers per round were tallied. The comparison of performance between the schemes is based on the total number of information points learned. Information points were taken from local cotton extension agents' standard training materials.[6] Incentive schemes that would be prohibitive to implement in a real world context, outside the game, such as as piece rate schemes, were intentionally avoided. Piece rate schemes demand that each individual is paid according to a particular output or effort. Thus, rather than administering one payout under tournament or team incentives, one must administer 14 separate payouts. We also avoided purely monetary payouts, as they would traditionally be taken by participants' husbands (Golan and Lay, 2008), making the payout less salient. Rather, we chose prizes that were valuable and used in daily home life (e.g. salt, sugar, matches, wash basins).

Summary statistics of age, years of education, yield for participants in the experiment are provided in Table 1.[7] Age is largely bimodal, with females in their 30-40's and then 50's. Our sample was concerned with women who were making decisions around cotton; therefore, widowers or divorcees would be more likely to be in this position and are older. Education was quite low, with mean and median years of education near 3. Average cotton seed yields are 194 kilograms per acre for this sample, and acreage towards cotton was around 0.5 to 1 acre.

Team incentives involved a prize that was won collectively if all individuals in the team

[6] See the Appendix.

[7] Note that the summary statistics for age, years of education, yield for participants in the experiment are from a smaller sample size, because only half of the participants in the game were surveyed as part of the larger study.

acquired a minimum of 5 information points about cotton growing. This threshold of 5 information points was chosen for the team incentive after observing that the mean number of information points learned in three pilot rounds of the game was 5. Note that under this incentive scheme, all 14 farmers operate together as one team. In contrast, under tournament incentives the farmer who learned the most information correctly in a round won a prize of unknown value and contents. Any tied outcomes resulted in a prize for each of the farmers who tied.

The rounds were structured as follows. Round 1 offered no prize. This round served as a practice round from which we derived baseline effort in which there were no learning incentives. Rounds 2 and 3 offered the tournament or team incentive. The order of these incentives was randomized across villages to control for order effects. Each round of information exchange among participants was timed to last 15 minutes. At the end of each round, participants remained seated quietly as they individually, privately, and verbally recounted what they had learned to the experiment coordinators, who recorded information learned.

In addition, we considered the following challenges that may affect the experiment: the strength and size of existing social networks, learning between rounds, and the characteristics of the prize.

The structure of existing networks can bias the experiment. Farmers who may already know each other may communicate more easily. Finally, personality traits that make some farmers more adept at networking while others less so may bias the results. Although these effects cannot be completely ruled out, we limit them in the following ways. First, each of the 14 farmers selected in a village received a number between 1 and 14. Second, participants' numbers were randomly assigned some initial network size between 1 and 4 individuals at the beginning of the experiment. For example, if person 1 was randomly assigned to a network size of 3, then 3 unique numbers from a uniform distribution between 1 and 14 were selected, where each number represented an individual with whom the participant would speak. The histogram of assigned network size is in Figure 3. Even though the initial network was a random size and randomly assigned, once a woman spoke with her assigned network partners, she was encouraged to branch out to other participants in the group. The primary purpose of the network assignment within the game was to create an even playing field for participants, such that more poorly-networked individuals would still actively participate.

Another important concern is that by the time round 3 was reached much of the information may have been learned under round 2's incentive scheme. To account for this, we distributed one new information point at the start of round 2 and at the start of round 3, randomly, to a game participant.[8] This enables us, to some extent, to control for learning and reinforcement that naturally occurs between rounds. It also allows us to explore whether the type of incentive had any influence in learning the new information.

Finally, the game was not designed to study the effects of prize size on behavior. The group prize (split evenly) and the individual prize were the same, that is 10,000 Shillings per person, however, both the structure and size of a prize, which can affect participant behavior (Ehrenberg and Bognanno, 1990), remained unknown across all treatments until the end of the game, as did the identity of winners. Therefore, to confirm that the expected size of the prizes did not differ between team versus competitive incentives, we conducted a post-game survey, asking survey participants what they believed the prizes to be worth. Guesses were variable, but we found that the median expected values were not statistically different, with the median expected group prize (divided by 14) being 10,714 shillings, and the median expected individual prize to be 10,000 shillings.

[8]This was done in between rounds, once an individual recounted what they had learned.

4 Estimation and Results

Summary statistics of experimental data are provided in Table 1. On average, participants learned one point in the practice round (beyond the point that was taught to them). Team incentives resulted in an average point of 1.76 out of a maximum possible 14 points with a standard deviation of 1.14. Under tournament incentive the average point was 2.25 with a standard deviation of 1.18. By the end of the game participants had learned 7 points on average. It is relevant to note then that only half of the total information was learned on average, therefore, leaving considerable room to increase learning, which was not accomplished in this 3 hour interval.

Result 1) The distribution of total information points learned under tournament incentives first order stochastically dominates (FOSDs) the distribution of total information points learned under team incentives.

Females in our games learned more under tournament incentives than under team incentives. Figure 2 plots the total number of points learned in a game, pooling the information points learned per round (not cumulatively) by treatment. FOSD indicates that the learning distribution under tournament incentives is uniformly below the learning distribution under team incentives, i.e. higher values are realized with greater probability under tournament incentives. Thus, while FOSD implies that the mean number of points must be higher under tournament conditions, it also means that there is a higher probability of learning more points across the entire distribution of total points learned.

A non-parametric Wilcoxon matched-pairs signed-rank test comparing the median number of points learned between treatments, pooling over the order in which treatments were received, confirms that the median frequency in learning significantly differs between the two treatments (p=0.0001). A Kolmogorov Smirnov test shows that the distribution of the total information points under tournament incentives is statistically significantly different from the distribution of the total information points under team incentives at the 1% level.

Result 2) Order of incentives, that is playing the game under tournament incentives before team incentives or vice versa, has no effect on overall learning.

To be able to explore whether the order of incentives matters - that is whether team preceded tournament or vise versa - we adopt a regression analysis framework. We estimate the below equation using OLS:

$$\textbf{Total}_{i,j} = \alpha + \beta_1 * \textbf{Tournament}_j + \beta_2 * \textbf{Order}_j + \beta_3 * \textbf{Round One Effort}_{i,j} + \beta_4 * \textbf{Network Size}_{i,j} + \epsilon_{i,j} \tag{1}$$

where "Total" is the number of points learned by person i in session j by the end of the game, that is, the cumulative number of points learned by the end of round 3; "Tournament" equals 1 for tournament incentive and 0 for team incentive; "Order" equals 1 if a session received the team (in Round 2) followed by the tournament (in Round 3) incentive, and 0 otherwise. "Effort" is individual i's effort and ability to acquire information, and is the total number of points learned in round 1 when individuals were not exposed to any incentives. The effort variable is an approximate measure for an individual's effort to learn within the confines of the game rules, where players were only instructed to learn from their assigned network in round 1. The amount of information learned in round 1 is summarized in Figure 1. Furthermore we control for "Network Size", which is the number of individuals to which a player is initially randomly assigned, as the size of network varied between 1 and 4 initial links.

Findings are presented in Table 2. All estimations are clustered at the village level. Column 1 confirms result (1), where tournament incentives result in more information learned than team incentives. The coefficient for the order variable is statistically insignificant at all conventional levels, indicating that there is no statistical differences between the total cumulative number of information points learned between the two different orderings by Round 3. This indicates that order had no effect on overall learning. Note that team incentives were introduced with a minimum number of points to be learned in order for the group to receive a prize. Thus there may be no individual incentives to excel beyond that minimum.

Result 3) An unexpected finding was that the new information point was more likely to be learned under team than tournament incentives.

We modify equation (1) and explore the probability of new information learned by incentive scheme using the following equation estimated by a Probit model:

$$\textbf{New Info}_{i,j} = \alpha + \beta_1 * \textbf{Tournament}_j + \beta_2 * \textbf{Order}_j + \beta_3 * \textbf{Effort}_{i,j} + \beta_4 * \textbf{ Network Size}_{i,j} + \epsilon_{i,j} \tag{2}$$

Where "New Info" is a binary variable that takes on a value of 1 if new information introduced in the experiment is learned, and 0 if it is not learned. The findings are presented in column 2 of Table 2 with errors clustered at the village level. The marginal effects are presented in the table. The results show that the probability of learning new information was greater under team incentives than tournament incentives - a reversal of the findings of total information learned. Furthermore order seems to matter. Under team-then-tournament incentives order, individuals are less likely to learn the new information point than under tournament-then-team incentives order. However, we do urge caution in the interpretation of these findings. The new information was introduced to limit the effect of similar information circulating across both incentive schemes in a session in the village. The experiment was not constructed to explore the effect of learning in the context of introducing new pieces of information in subsequent rounds. However our findings may be of interest for future research.

5 Discussion

In this paper we report on an experiment designed to test for incentive effects on information sharing in a developing country context. Our findings extend the existing literature on the impact of team versus tournament effects by qualifying how incentives affect information transmission. We also add to the literature on gender and competition by showing when competitive incentives increase effort more than team incentives in an all female work context, which is a common context in rural Uganda and much of rural Sub-Saharan Africa. Our findings also have the advantage over lab experiments by being conducted in field, as the former would abstract from features of the learning environment that farmers face in rural Uganda.

This research has several implications for understanding information transmission in the context of technology adoption in agricultural settings. We show that competitive schemes are effective for encouraging overall information transmission between females. Our results inform us that tournament incentives still induce the greatest information dispersion among women in female networks. This result holds despite behavioral evidence that females are more pro-social and public good oriented than men, as well as the complication that a competitive incentive structure might lead to strategic disincentives for sharing, even after controlling for initial effort and ability. Given that the experiment participants were all women, this may be consistent with literature that finds women to be competitive in single sex environments (Gneezy et al., 2003). Second, the order in which incentives are introduced does not matter for the volume of information learned but does affect whether new information is learned.

Thus, even in a very specific context, the forces of competition remain just as effective in encouraging the exertion of effort. Our research also has implications on how extension agents in agriculture, or training agents in other contexts, including health and information communication technologies, choose incentives, as well as the order in which they introduce incentives. Given the challenges that development agents, trainers, and trainers-of-trainers face in introducing new technologies and increasing their adoption, there is a need to deepen our understanding of how information is learned and transmitted in the rural developing country context. In addition, there may be considerable room to improve the impact of programs on outcomes, if learning is not at its maximum. In this study, we saw that the average farmer learned only half of the total information in the game. While we do not claim that the game implemented here is representative of extension training services, we do to point out that the absence of measuring actual learning outcomes could be foregoing substantial gains to farmers, without added inputs.

In the context of Uganda, our findings are important. The National Agricultural Advisory Services (NAADS) has become more decentralized and is utilizing numerous providers and experimenting with methodologies for extension services (Kahubire, 2005; Lungahi and Opira, 2013). Furthermore, NAADs is departing from the use of direct visitation and encouraging group based visits given the ineffectiveness of the former (Benin et al., 2011). Our results show that low-cost group-based training is possible without a top-down training structure, and it can be effective at increasing learning.

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Figure 1: Total Agricultural Information Learned in Round 1

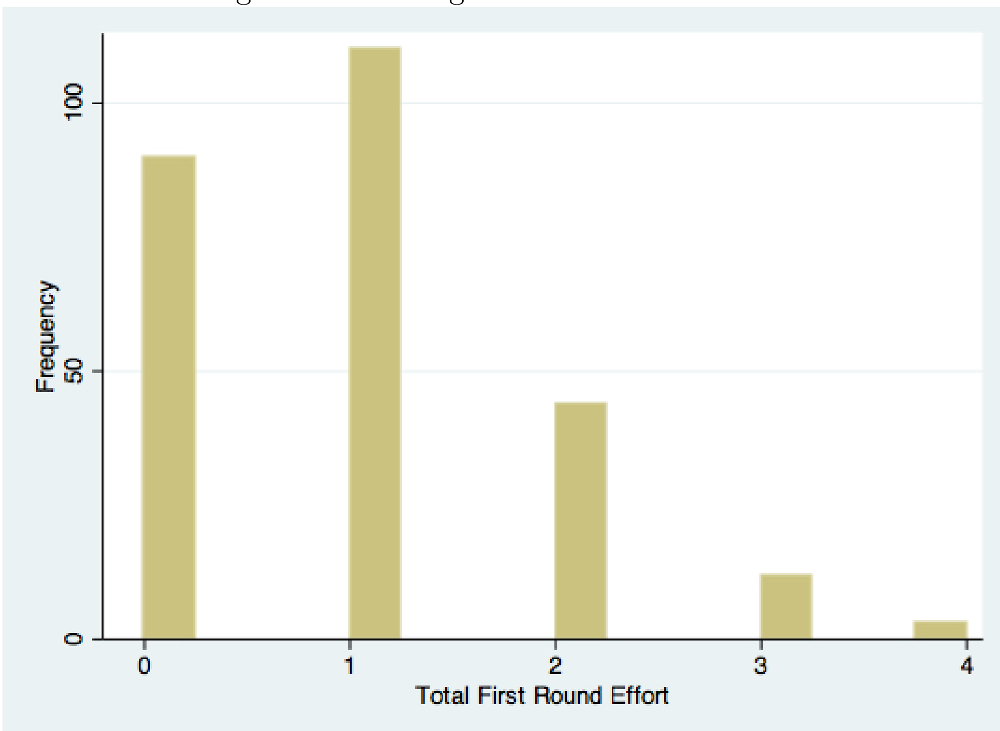

Figure 2: Total Agricultural Information Learned

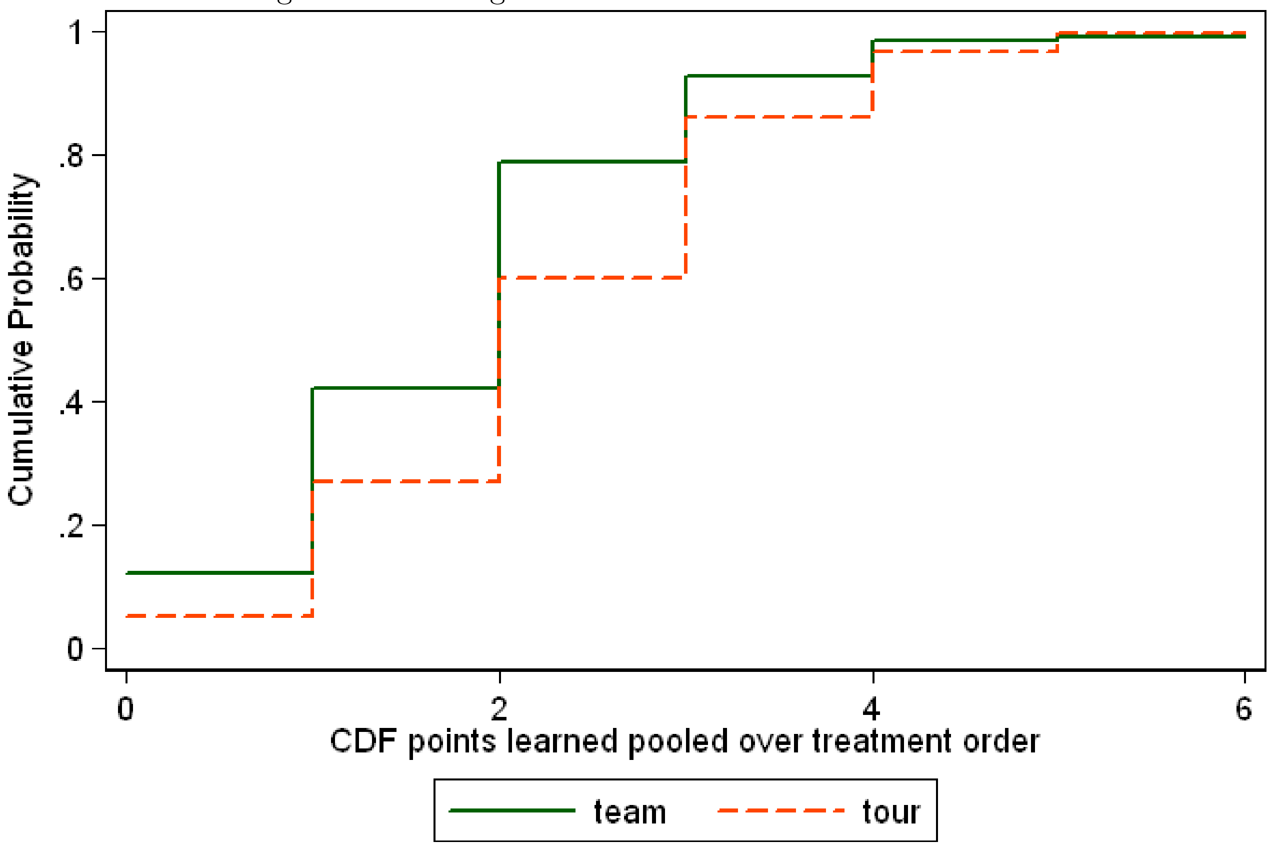

Figure 3: Assigned Network Size by Participant

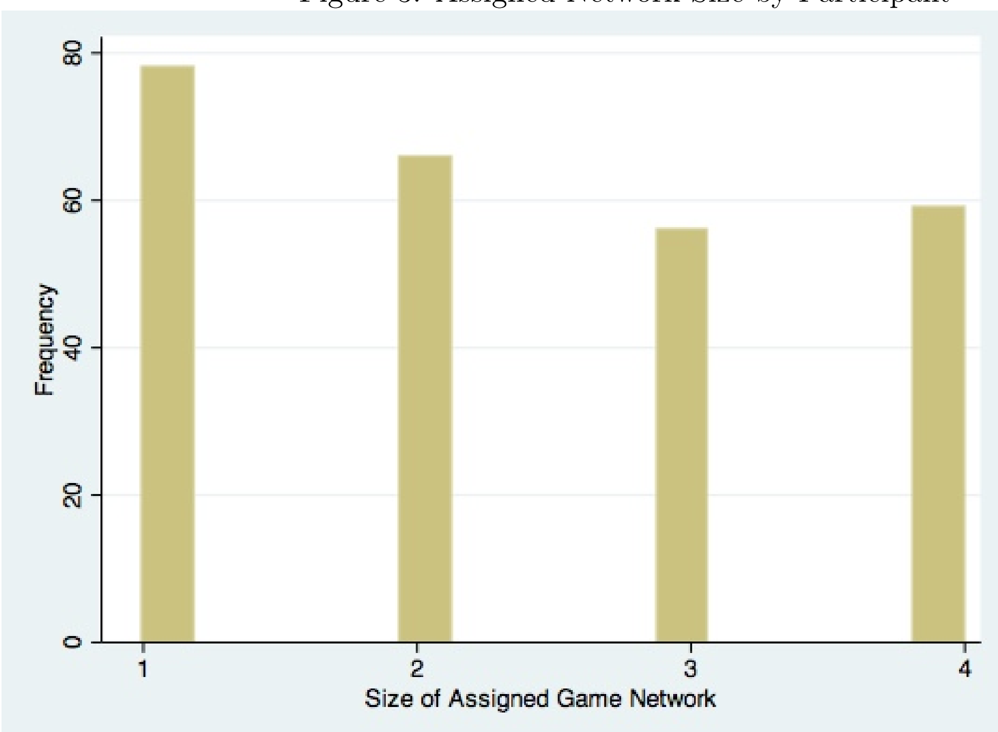

Table 1: Summary Statistics

	Mean	Median	Sd	Min	Max	N
Effort (Round 1 Points)	0.94	1	0.89	0	4	263
Points Under Team	1.76	2	1.138	0	6	263
Points Under Tournament	2.25	2	1.178	0	6	263
Total Points	6.58	7	1.60	1	10	263
Size of Network (in Game)	2.36	2	1.13	1	4	263
Age	49.57	47	13.07	22	80	159
Years Education	4.62	5	2.85	0	14	127
Yield (kg/acre)	165.66	104.66	202.67	0	1420	156
Used Acreage	0.79	0.8	0.53	0	2.8	159

Table 2: Game Effects

	(1)	(2)
Variables	Total	New Information
Model	OLS	Probit (Marginal effects)
Tournament	0.490*	-0.173***
	(0.100)	(0.00808)
Order	0.108	-0.163**
	(0.203)	(0.0373)
Effort	-0.0413	0.0340
	(0.311)	(0.242)
Size of Network	0.0166	0.00397
	(0.636)	(0.836)
Constant	1.730***	
	(6.84e-09)	
Observations	526	526
R-squared	0.045	

Cluster SEs. P-values in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Tournament = 1 if tournament, and team if 0.

Order = 1 if team is followed by tournament.

Appendix
Fourteen Game Points

1. Ladybirds are good insects (show picture)
2. Spacing between rows is 75 cm (3 sheets long)
3. Spacing between plants is 30 cm long (1 sheet)
4. Only plant 3-5 seeds per hole
5. More than 2 seedlings in one place will reduce cotton yield
6. First weeding occurs between the 2nd and 3rd week after planting
7. Second weeding occurs between the 6th and 10th week after planting
8. Bollworm (show picture) larvae appears between the 8th and 9th week after planting
9. Check germination after 5 days-replants seeds at gaps to get even crop cover
10. Prepare land several weeks in advance for cotton planting
11. Use pesticide 5th to7th week after planting for Lygus bug (show picture)
12. Use pesticide 8th to 9th week after planting for Bollworm (show picture)
13. Cotton is good for mixed and rotational crop
14. Always cover hands and mouth when spraying pesticides

New Points

1. At most, breastfeed children no more than 2 years
2. Do not store food or seeds in fertilizer or pesticide bags. It's bad for your health.

GAME SCRIPT

{Everyone Together at Beginning}

WELCOME

In the study today, we will ask you to learn and teach some agricultural information in three rounds. You will each be taught one aspect about growing cotton. Then in three different rounds you will teach your information to others as well as learn the information that others were taught. At the end of a round you will privately recount the information you learned correctly. You can win a prize in this information game, individually, and/or as a group.

We will now give you some information about the study today. In each round, you will talk to other participants in the game and learn their information as best as you can. There are a total of 14 information points related to growing cotton, taken from your local extension agents training materials, one of which you will learn from us, and the remainder you should learn from your peers during the game. When you are done with all three rounds, winners will be announced, and prizes will be distributed.

Script

Welcome to this study.

Today we will ask you to learn information about growing cotton and then teach this information to others. If you listen carefully, you may win a prize today. So pay close attention to the instructions, and ask questions if you do not understand.

Please do not talk with one another while each participant comes up to our desk to learn their information point. Speaking can occur from the start to the end of each round. We will announce when you can begin speaking. You will have 15 minutes in each round to exchange the knowledge that you've learned individually as well as learn as much new information as possible, correctly, from others.

I am happy to answer any questions you have at any time. But please direct your questions only to me.

Assignment of Participant Numbers

We will now assign each of you a number between 1 and 14 [*If there are fewer than 14 participants, then we simply assign numbers according to the total number of participants.*] This is your individual number in the game, so that we can keep track of your progress without using your given family name. Hold on to this number until the end of the game, at which point we will collect your number during an exit survey.

We will also assign you a number between 1 and 4 people with whom you will talk to, in order to learn new information during the game. These individuals are the first people that we suggest you speak to during the game, but once you have spoken to them, please continue to speak to as many other participants as possible, and learn their information as well. Your objective is to learn as much information as possible from others, correctly, in 15 minutes. [*An example is shown now by the interpreter who's number is "10" and she is assigned to speak with persons "3" and "7." She will now point to persons "3" and "7," and go speak to them. This is an example of what each participant should do in the game.]*

[*Assign numbers to each participant. First assign participant numbers and then speaking partners.]*

We will now call each of you up to teach you 1 of 14 possible information points about growing cotton [*If there are fewer than 14 participants, e.g. 12, then we simply assign 12 information points to 12 individuals at random.*]. The information can be anything from clearing your land, weeding, thinning, spacing, or harvesting. Please remain silent during this process. (Each participant now comes up to our desk to learn his or her information and correctly recount the information back to us.)

Round One: No Prize Incentives

We will now begin round one.

When we say go, first start by speaking with the participants' assigned to you. After you have learned their information, and taught them your information point, continue speaking with as many people as possible to learn up to 14 information points about growing cotton. When we say stop, please stop speaking with one another.

Does anyone have any questions? Please begin. [*Timer is set for 15 minutes*.]

[When the time is up, say:] Okay, everyone please stop speaking with each other ***now***.

Now we will call each of you up individually and ask you to tell us exactly what you learned during round one. We will record how much information you have learned, and will also mark whether the information you learned is correct or not.

[*Note: One randomly selected person will be given one new unique information point before the start of round two, after they have recounted all the information that they have learned.****]***

Round two: Team Prize
We will now begin round two.

[Note: Please take note which village your are in and whether team or tournament round comes first now. This will allow us to control for order effects.]

Now we will move to the second round. For this round, the task is exactly the same. However, now you are ALL eligible to win a group prize if each of you can correctly recount at least 5 information points correctly at the end of this round when you recount what you have learned in private. You can help each other by making sure that each person learns at least 5 information points so that you can ALL win the group prize. Whether you receive the group prize will be announced at the end of the third round. If you win, the prize will be awarded to ALL of you, and you can divide the group prize among yourselves as you see fit.

Does anyone have any questions? Please begin. [*Timer is set for 15 minutes*.]
[When the time is up, say:] Okay, everyone please stop ***now***.

Now we will call each of you up individually and ask you to tell us exactly what you learned during round one. We will record how much information you have learned, and will also mark whether the information you learned is correct or not.

[*Note: One randomly selected person will be given one new unique information point before the start of round three after they have recounted all the information that they have learned.]*

Round three: Tournament Prize
We will now begin round three.

Now we will move to the third round. For this round, the task is exactly the same. However, now you are eligible to win an individual prize if each are the person who can tell us the most information points correctly at the end of this round. The individual prize will be announced at the end of the third round and awarded to one individual.

Please do not talk during the task or after you have finished. This is very important. If you have any questions, please raise your hand, and ask me now. Once we begin, you cannot ask any questions. Does anyone have any questions?

Please begin. [*Timer is set for 15 minutes*.] *[When the time is up, say:]* Okay, everyone please stop speaking with each other ***now***.

Now we will call each of you up individually and ask you to tell us exactly what you learned during round one. We will record how much information you have learned, and will also mark whether the information you learned is correct or not.

Ending Statement Thank you very much for your participation today. We will now announce the group and individual prizes. After you have collected your prize, you can go.