Spatial coordination in Payment for Environmental Service schemes: can we nudge the agglomeration bonus to enhance its effectiveness?

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Abstract

The environmental benefits from Payment for Environmental Service (PES) schemes can often be enhanced if farmers can be induced to enrol land in a spatially-coordinated manner. This is because the achievement of many targets for biodiversity conservation policy or water quality improvements are increasing in the spatial connectedness of enrolled land. One incentive mechanism which has been proposed by economists to achieve such connectedness is the Agglomeration Bonus (the AB). There has also been an interest within the literature on PES design in using "nudges" to enhance participation and performance. In this paper, we test whether a specific nudge in the form of information provided to participants on the environmental performance of their group can improve participation and spatial coordination, and/or enhance the impacts of the AB. We design a lab experiment whereby the environmental benefits generated by a PES scheme are generated by real contributions to an environmental charity. We argue that this mirrors the situation in actual PES schemes where participants derive utility from contributing to the environmental outputs of the scheme, in addition to the monetary payoffs they receive. Our results confirm the environmental benefits of the AB, but the impact of our nudge is much less environmentally effective. Interestingly, we find that the nudge does not significantly supercharge the AB, and can even worsen its performance.

Keywords: agglomeration bonus, nudge, lab experiments, coordination games, agriculture policy, environmental performance.

JEL codes: C91, C92, Q15, Q18, Q57

1. Introduction

The spatial coordination of participants can be a determinant of the effectiveness of Payment for Environmental Services (PES) schemes when the provision of environmental services or biodiversity conservation depends on the spatial configuration of ecosystems (Cong *et al.* 2014, Banerjee *et al*. 2014). Examples of environmental objectives which favour spatial coordination of participants include reduction of pesticide leaching into rivers, flood alleviation through wetlands enhancement, the creation of wildlife corridors, and species re-introductions where the species in question requires a minimum area of contiguous conservation land in which to survive. Parkhurst *et al.* (2002) propose the use of an Agglomeration Bonus (AB) to tackle this spatial coordination problem. The principle of this mechanism is that landholders get a payment for participating in the PES, which is then topped-up with an additional payment if the enrolled plot is contiguous to a plot enrolled by another landowner. The implementation of such an incentive structure creates a coordination game, which typically has multiple Nash equilibria which can be Pareto-ranked.

The AB scheme, typically tested in decontextualized conditions in the laboratory, has been shown to have significant effects on spatial coordination. Banerjee *et al.* (2014) show that providing players with information on their neighbours' choice can improve the efficiency of the AB for spatial coordination. Other studies have shown that the performance of the AB depends on the size of the network over which the coordination game is played out, the transactions costs of participating in the scheme, and opportunities for communication between players (Banerjee *et al.*, 2017). Moreover, the performance of the AB has been found in some settings to decline over time, in the sense that participants increasingly switch away from the Pareto-dominant equilibrium of participation to the risk-dominant equilibrium of non-participation. This is a rather gloomy finding for the potential of the AB to generate the kinds of spatial coordination over time desired by the policy planner.

The AB as presented originally by Parkhurst *et al.* (2002) depends on landowners comparing the financial pay-offs from alternative actions to enrol or not enrol land, given their beliefs about the likely actions of others. However, studies of what actually motivates farmers to participate in actual PES schemes have found that such monetary pay-offs are only part of the story: an empirical literature suggests a broader set of motivations for farmers participating in actual PES schemes, with factors such as altruism or conforming to social norms being important (Michel-Guillou and Moser 2006, Sheeder and Lynn 2011). Taking into account such non-pecuniary motivations in the design of PES schemes, and in particular in the implementation of the AB, could be a way of enhancing their performance. Indeed, the use of behavioural incentives to increase participation and performance in environmental policy has also been the focus of a growing literature in recent years.

Behavioural incentives consist of any policy intervention which aims to change the behaviour of economic agents (households, farmers) by changing the framing or information context of economic decisions, without changing the financial payoffs from alternative actions (Croson and Treich 2014). Examples of behavioural interventions include changing the default option, sending positive messages about individual behaviour, and providing information on social norms. In this paper, we are particularly interested in the last of these. Social norms are "shared understandings of how individual members should behave in a community" (Chen *et al.* 2009). They encompass both what an individual understands the actions of others in some relevant peer group to be, and what she believes is expected of her by members of this group (Abbott *et al.* 2013). If individuals derive dis-utility from diverging from a social norm, then providing information of this kind can be expected to change behaviour if the weight the individual places on the opinions of others or her own selfish concern for social ranking is strong enough (Czajkowski *et al.* 2015). Ferraro and Price (2013) evaluate the effects of social comparison information on demand for water by residential customers in the USA. They found that such information had a bigger effect on consumption than simply asking people to reduce water use or telling them how to do so; and that the effects of social comparison information was greatest for those consumers who had relatively high water use. There are now many other examples of the effects of such nudges (Alcott 2011). A summary of this evidence would be that (i) the effects of nudges tend to be rather small (ii) the effects may erode over time (iii) how the nudge is delivered tends to be important.

In the context of PES schemes, analyses of such nudges are scarce. Chen *et al.* (2009) show that individual decisions to re-enrol in a PES scheme subsidising farmers for afforestation in China can be positively influenced by the information that neighbours also intend to re-enrol. Kuhfuss *et al.* (2016a) show that the introduction of a payment conditioned to a minimum level of participation by neighbours significantly increases farmers' participation in an AES. Kuhfuss *et al.* (2016b) found that providing information on what percentage of other farmers said they would carry on with "green" farm practices after the end of a PES contract had a significant effect on the stated intentions of study participants to behave likewise. These results suggest that some farmers value conforming to social norms and are more likely to participate if they know that others also participate. An obvious question is what the effects of such a nudge would be in the agglomeration bonus, since this explicitly addresses a problem of group behaviour.

In this paper, we thus evaluate the performance of the AB in the context of two aspects which are important to understanding the effects of such PES schemes. These are that (i) farmers' motivations to participate in a PES can include non-pecuniary motivations, in particular, a concern to protect the environment; and (ii) some individuals are likely to be sensitive to the provision of social norm information in deciding whether to enrol in an AB-type PES. A consequence for spatial coordination through the AB is that farmers might be more willing to cooperate (i) if they know that spatial coordination has a higher real beneficial impact on the environment and (ii) if they know that other farmers also participate. Therefore, we modify the AB protocol used by Banerjee *et al.* (2012, 2014) to account for individuals' environmental preferences and additionally test the effect of information on group performance on coordination.

In order to capture the effects of non-pecuniary motivates on PES participation, some researchers recreate pro-environmental behaviour through donations to environmental charities. For example Clot *et al.* (2014) use an adapted dictator game to mimic pro-environmental behaviours, where players are asked how much of their endowment they are willing to give to an environmental charity. We make use of this idea by implementing an experimental design whereby players' choices of opting into the PES scheme generate a real money donation paid by the experimenters to an environmental charity of the player's individual choice. Introducing some level of context around the charity donation in AB coordination game is likely to reflect individuals' preferences in the environmental domain. Indeed, Dubois *et al.* (2015) show in a recent experiment that introducing context in a repeated coordination game (stag hunt game), stating that "X (or Y) has a positive (or negative) impact on the environment", is enough to change individual choices during the game. We interpret the size of donations as the change in the supply of an environmental public good from which individuals may derive direct utility in addition to the monetary pay-offs from their choices.

Use of this donation mechanism also provides a means of generating a social norm toward the environment within the lab. As subjects play within groups of "networked farmers", the donation of each group relative to the donations of other groups in the previous round gives information about a social norm. Ranking which introduces competition between groups has already been employed in public good games (Gunnthorsdottir and Rapoport 2006, Tan and Bolle 2007) to reduce free riding issues; and in coordination games as a way to address the issue of coordination failure (Bornstein *et al.* 2002, Riechmann and Weimann 2008). Bornstein *et al.* (2002) introduce inter-group competition in a coordination game and show that ranking increases coordination only if it has payoff consequences (in their case, only the winning group was paid or the winning group received a bonus). However, introducing information on groups ranking without monetary incentives in the context of a public goods game was enough to reduce free riding in (Tan and Bolle 2007).

In summary, our paper tests three research questions. First, what is the performance of the AB when environmental benefits generated by a PES scheme, and thus non-pecuniary benefits to participants, are generated in the lab by real contributions to environmental charities? Second, can the use of a nudge based on group comparison "supercharge" the effects of an AB both in terms of participation and spatial coordination? Third, can a nudge actually replicate the effects of the AB absent such a monetary incentive for spatial coordination of participation?

2. Modelling Framework

We consider a finite number of farmers $i = 1, \dots, N$ who can manage their land in two different and mutually-exclusive ways, labelled X, Y. Land management option X refers to a pro-environmental or conservation land management, whilst Y indicates that the land is managed for agricultural production and generates lower or zero environmental benefits. Following previous studies (e.g., Banerjee *et al.* 2012, 2014), we assume that agricultural revenue under conventional land use is higher than under land used for conservation purposes, i.e., $r(X) < r(Y)$.[1] Farmers' participation in a PES usually generates environmental benefits, e, which is considered a public good or a positive externality (e.g., improved biodiversity or better flood protection), from which the landowner might benefit, but which mainly generates benefits for the wider society at a larger spatial scale. This last point is crucial as, contrarily to previous papers on the AB, we do not assume here that "landowners receive the full social benefits generated by their pro-environmental land-use activities" (Banerjee *et al.* 2014, p. 1013). The production of this environmental benefit is conditioned to spatial coordination on the adoption of pro-environmental land management, X. To emphasize the issue of spatial coordination, we assume that the environmental benefit is only produced if at least one of a farmer's direct neighbours also adopts this similar type of land-management practice. Let n_i be the number of direct neighbours of farmer i who choose X. We assume that the aggregate environmental benefit generated by farmer i choosing X is simply en_i.

To facilitate an effective delivery of environmental benefits, and as long as the environmental benefit generated outweighs the loss of agricultural revenue ($e > r(Y) - r(X)$), it is the policymaker's objective to foster contiguous adoption of land use X in order to maximize social welfare. To this end, the policymaker can individually incentivize neighbouring farmers with an agglomeration bonus, b, only if both farmers manage to coordinate on X. Thus, given that farmer i chooses X, she receives the agglomeration bonus bn_i. Therefore, the agglomeration bonus paid and received is proportional to the environmental benefits generated through land management choices.

[1] To keep the payoff structure simple and transparent, we abstain from including a fixed subsidy for enrolling in the PES, although the revenue under land used for conservation purposes, $r(X)$, could include such a component.

In view of the above setup, assuming to begin with that farmers do not take into account their impact on the environment and only consider the monetary payment (agricultural revenue and agglomeration payment), the payoffs of farmer $i = 1, \dots, N$ can now be summarized as follows. In case farmer i adopts land use strategy $\sigma_i = X, Y$, her monetary payoff $p_i(\sigma_i)$ reads:

$$(1) \quad p_i(\sigma_i) = r(\sigma_i) + b(\sigma_i)n_i$$

with $b(X) = b > 0$ the agglomeration bonus, $b(Y) = 0$, and n_i the number of direct neighbours of farmer i choosing X.

As noted in the preceding section, farmers may not only consider monetary revenues when choosing how to manage their land. Indeed, they may not only consider their financial gains, represented by the above payoff functions, but may also feel concerned about the impact of their practices on the environment and thus deviate from the standard economic model. That is, farmers may display altruistic preferences towards environmental conservation and therefore may value the environmental benefit generated by choosing a pro-environmental land management (X) in coordination with their neighbours, even though they do not derive financial gains from it. To take this into account we propose to enrich our model. Of course, farmers are heterogeneous about their preferences for the environment and/or their altruism (parameter a_i), but we assume that this non-monetary utility term is proportional to the environmental benefit they generate with their choice of X and therefore depends on their neighbours' choices. One step further is to consider that farmers may also derive utility from choosing X independently of the choice of their neighbours, a "warm glow" effect (Andreoni 1989, 1990) reflected by parameter w_i, even though no significant environmental benefit is produced. Indeed, what might be important to farmers is to do their best in choosing X for their self-esteem and/or to signal they are "responsible citizens," and maybe to induce others to choose X as well. Taking into account these additional two elements, the utility function of choosing X or Y can be re-stated as follows:

$$(2) \quad U_i(\sigma_i) = r(\sigma_i) + b(\sigma_i)n_i + a_i e(\sigma_i)n_i + w_i(\sigma_i)$$

with $e(X) = e > 0$, $e(Y) = 0$ and $w_i(X) \geq 0$, $w_i(Y) = 0$.[2]

If we consider the payoff function (1), that is assuming that farmers have no consideration for the environment, and in the absence of an AB scheme, the only Nash equilibrium is that all farmers choose Y since $r(X) < r(Y)$. However, if we consider farmers' utility function (2), thereby bringing in environmental and altruistic preferences, some farmers might prefer choosing X over Y, even without the offer of agglomeration bonus. In this case there exist many Nash equilibria, depending of the value of the behavioural parameters. If the agglomeration bonus is introduced and is sufficiently large $\left(b \geq \frac{r(Y)-r(X)}{N}\right)$, there are two Nash equilibria: one in which all the farmers choose X and one with all farmers choose Y. The latter constitutes a coordination problem with X being the Pareto dominant equilibrium and Y the risk dominant equilibrium.

As stated in the Introduction, one of the objectives of this paper is to test the impact of information about a social norm on farmers' behaviour. We speculate whether a nudge, based on social comparison information, may induce more farmers to coordinate on the Pareto dominant Nash equilibrium, X. Contrary to the agglomeration bonus, a nudge does not change farmers' monetary pay-offs nor the environmental benefits generated, but instead can impact farmers' utility if they are sensitive to social comparisons. We propose a nudge which consists of ranking farmers' networks

[2] Note that this utility function does not include the aggregate level of the environment. Indeed, we are only interested in the difference $U_i(Y) - U_i(X)$.

according to the level of environmental benefits they generate as a group through their choice of farming practices. This nudge should inform farmers on how their group performs compared to other groups of farmers, thus providing information about a descriptive norm (*i.e.*, what most people do)[3] and additionally inducing some inter-group competition that could encourage the choice of X. This ranking also provides information about the injunctive norm, *i.e.*, the "perception of what most people approve or disapprove of" (Cialdini *et al.* 1991). Announcing a ranking according to the generation of environmental benefits emphasizes the importance of the environment in the choice of farming practices. We hypothesise that this nudge may impact positively on the choice of X over Y. Indeed, the ranking might affect farmers' utility in the following way:

$$(3) \quad U_i(\sigma_i) = r(\sigma_i) + b(\sigma_i)n_i + a_i e(\sigma_i)n_i + w_i(\sigma_i) + f_i(rank(\sigma_i))$$

With $f_i(rank = 1^{st}) \geq f_i\left(rank = 2^{nd}\right) \geq f_i(rank = 3^{rd})$… as subjects are assumed to value social reward.

The choice of X increases the chances of generating higher donations within a group and thereby increases the probability of achieving a higher rank in the inter-group competition. In the absence of environmental preferences, a warm glow effect and sensitivity to a social norm, then the theoretical predictions are the same as those previously described when considering payoff function 1: the only Nash equilibrium is reached when all farmers choose Y. However, when subjects display these behaviours, then some farmers might prefer choosing X over Y, even without the agglomeration bonus, either to satisfy their environmental preferences, as a warm glow effect or to enter the inter-group competition. There exist therefore many Nash equilibria, depending on the value of the behavioural parameters.

3. Experimental Design and Hypotheses

3.1. General settings

Modelling the spatial connectivity between farmers requires the imposition of a spatial structure on subjects. In this respect, we follow the network structure used by Banerjee *et al.* (2012, 2014, 2017), where subjects' are arranged on a circular network. The main advantage of utilising a circular network configuration is its symmetry, with each subject having a similar number of *direct* neighbours (i.e., one on the LH-side and one on the RH-side); thus the number of farmers choosing X, n_i, can either be 0, 1 or 2. Note that a subject is *indirectly* linked to all other subjects on the network through their direct neighbours. The direct and indirect linkages between subjects across space are essential in order to capture the environmental benefits through agglomeration. Furthermore, a fixed and symmetric network structure ensures that the decision problems faced by all subjects are identical given they all face the same degree of strategic uncertainty. That is, a farmer may know what land management actions his *direct* neighbouring farmer is pursuing, but may not fully know the decisions of other *indirect* neighbouring farmers on the network. As a consequence, a symmetric network structure of a given size allows us to identity the impact of a nudge on spatial coordination and hence environmental benefits without having to worry about confounding factors, such as subjects being able to extract rents because of their specific position on the network[4]. Therefore, in this experiment, under each

[3] Note that another descriptive norm is conveyed by information on what others within a group do, in particular neighbouring farmers. We will discuss this in section 4.3.

[4] For example, a linear network is an example of a spatial structure that exhibits more asymmetry where farmers located centrally may have a more favourable position for rent extraction.

treatment, subjects are placed around a circular network in groups of 6 ($N = 6$). In addition, each session includes 3 groups of 6 subjects. Each subject was asked to choose between action X or Y.

To recreate the environmental benefits of farming practices in the lab with non-farmer participants, we told subjects that the choices they make during the experimental session can generate a donation to an environmental charity[5]. The environmental charity implements actions from which subjects can benefit, but which mainly generate benefits for the wider society as it is the case for more environmentally friendly practices of farmers. In this setup, subjects who want to behave pro-environmentally will choose X at the cost of a lower individual monetary payoff, just as some farmers decide to participate in PES for non-pecuniary motivations. As assumed in the theoretical model in previous section, the level of the donation depends on the number of direct neighbours also choosing X given the subject chooses X. Subjects do not benefit from the donation directly. The donation generated by a subject is placed in an envelope at the end of each session in the presence of the subject (Figure 1). The experimenters subsequently sent the total amount of donations of each envelop to the corresponding charities, and transferred to the subjects a confirmation of their donations by email.

Figure 1: Envelopes used to put cash donations to the charities

Apart from using specifically-designated environmental charities, the rest of the experiment was decontextualized in order to purely consider how financial incentives affect the choices and outcomes in the experiment (Cason and Raymond 2011). We decided to explicitly mention that the charities were environmental charities as we wish to capture subjects' preferences for the environment.

16 sessions with 18 subjects each were run between April and September 2016 at the LEEM (Economic Experimental Laboratory of Montpellier) in France, and a total of 288 participants recruited. We aimed at obtaining 6 independent observations for each treatment. In treatments T0 and T1 with no nudge, an independent observation is that obtained at the group level (6 subjects). In treatments T2 and T3

[5] Subjects had to choose, after reading the instructions and before the start of the experiment, one charity to which their donation would be sent. The choice included 1 international charity (WWF), 2 French national charities (France Nature Environnement and Fondation Nicolas-Hulot pour la nature et l'homme) and 1 local charity (Ouvre-Tête).

with the nudge, since information on the performance of the other 2 groups present during the session is provided, the choices subjects make are not independent from the performance of other groups in the session. Hence, an independent observation for these treatments is a session. Therefore, as shown in Table 1, we had 6 groups participating in treatments T0 and T1 and 6 sessions of 3 groups for each treatment with a nudge (T2 and T3).

Table 1: Number of participants per treatment

Treatment	Number of participants
T0	2 sessions, 3 groups of 6 players each = 36 participants
T1	2 sessions, 3 groups of 6 players each = 36 participants
T2	6 sessions, 3 groups of 6 players each = 108 participants
T3	6 sessions, 3 groups of 6 players each = 108 participants
	Total 16 sessions, 288 participants

Each session was composed of 15 periods, where players were repeating the same choice under the same treatment, within the same group and keeping the same neighbours (partner design). After each period, each player was informed of their own monetary payoff, the donation generated given their choice of "land use strategy", and the choices of their two direct neighbours. No communication was allowed within groups. At the end of a session, 3 periods were randomly selected and subjects were paid their average payoff for these 3 periods. The actual donation made to the charity was the average donatation generated in these 3 periods.

In view of our treatments, we consider a two-by-two design as shown in Table 2 below. We next outline each treatment in more detail by providing the underlying payoff tables and by deriving hypotheses. This is based on a numerical implementation using parameter values reported in Table 3.

Table 2: Treatments

		Nudge	
		NO	YES
Agglomeration bonus	NO	T0	T2
	YES	T1	T3

Table 3: Parameter values

Parameters	X	Y
Agricultural revenue (r)	€7	€13
Agglomeration payment (b)	€3	€0
Donation (d)	€8	€0

Since the environmental benefit (e) defined in the model is split between the two neighbours, the donation actually corresponds to $d = e/2 = €8$. Note that the pay-off for choosing land management strategy Y is €13, and is the same in all 4 treatments.

3.2. Treatments and hypothesis

<u>Control treatment (T0)</u>

In the control treatment, subjects can choose X and receive a lower agricultural revenue, $r(X) = 7$, or they can choose Y and receive a higher agricultural revenue equal to $r(Y) = 13$. When choosing X, they can generate a donation $d(X) = 8$ if one of their neighbours also chooses X, or $2d(X) = 16$ if both neighbours choose X.

The payoff table for the control treatment is shown in (Table 4):

Table 4: Payoff table for the control treatment (T0) and nudge the only treatment (T1)

		Your Direct Neighbours' Choices		
		Both choose X	One chooses X, the other one chooses Y	Both choose Y
Your Choice	X	Your payoff: €7 Donation generated: €16	Your payoff: €7 Donation generated: €8	Your payoff: €7
	Y	Your payoff: €13	Your payoff: €13	Your payoff: €13

As discussed in the previous section, if subjects only maximize their own monetary pay-off (payoff function 1), the unique Nash equilibrium is reached by all players choosing Y. In contrast, taking into account the environmental benefits that are produced, from the policy maker perspective the Pareto optimal situation is reached by all players choosing X. This situation might be an equilibrium if subjects derive utility from the environmental benefits generated by this management action and/or receive a warm glow effect from choosing X, as proposed in the utility function 2. Indeed, depending on the individual values of a_i and w_i, multiple Nash equilibria can exist, Y remaining the risk dominant equilibrium. Therefore, according to our behavioural model (utility function 2), we anticipate some participation due to the presence of the donation that will trigger altruistic behaviours (encapsulated in parameter a_i of our model) and to warm glow feelings (parameter w_i). We hypothesize that a majority of subjects will choose Y and that few subjects i displaying high a_i and w_i may choose X.

Hypothesis 0.0: $\forall i \in \{1, \dots, N\}, a_i e(X) n_i + \omega_i(X) < r(Y) - r(X)$, therefore $\forall i \in \{1, \dots, N\}, \sigma_i = Y$ and all subjects choosing Y is the unique Nash equilibrium.

Hypothesis 0.1: $\exists i \in \{1, \dots, N\} | a_i e(X) n_i + \omega_i(X) \geq r(Y) - r(X)$, therefore $\exists i \in \{1, \dots, N\} | \sigma_i = X$ and multiple Nash equilibria exist, all subjects choosing Y being the risk dominant equilibrium.

Agglomeration bonus treatment (T1)

In this treatment, we implicitly introduce the agglomeration bonus to the protocol, which changes the monetary payoff of choosing X described in T0. When choosing X, each player receives a different payoff depending on their neighbours' choices. If one neighbour chooses X, the player receives $r(X) + b = 7 + 3 = 10$, when 2 neighbours choose X, they receive twice the agglomeration payment , that is $r(X) + 2b = 7 + 6 = 13$. If none of their neighbours choose X, then they do not receive agglomeration bonus and their monetary payoff is only $r(X) = 7$, as in the control treatment. The payoff table for this treatment is:

Table 5: Payoff table for the AB treatment (T1) and the AB and nudge treatment (T3)

		Your neighbours' choices		
		Both choose X	One chooses X, the other one chooses Y	Both choose Y
Your choice	X	Your payoff: 13€	Your payoff: 10€	Your payoff: 7€

		Donation generated: 16 €	Donation generated: 8€	
	Y	Your payoff: 13€	Your payoff: 13€	Your payoff: 13€

When looking at payoff functions only, all players choosing X and all players choosing Y are both Nash equilibria with equivalent payoffs, all players choosing Y being the risk dominant equilibrium. However, when considering the overall utility functions (2), then all players choosing X is the Pareto dominant equilibrium (if at least 1 subject values the choice of X, i.e. $\exists i | a_i > 0$ or $w_i > 0$).

Therefore, compared to the control treatment, we expect to have more subjects choosing X, as the risk of a lower monetary pay-off is lower (respectively null) in T1 compared to T0 if a neighbour (respectively both neighbours) also choose X.

Hypothesis 1.0: $\forall i \in \{1, \dots, N\}, a_i e(X) n_i + \omega_i(X) = 0$, therefore two Nash equilibria of equal payoff exist, one where all subjects choose *X* and one where all subjects choose *Y*, the latest being the risk dominant equilibrium.

Hypothesis 1.1: $\exists i \in \{1, \dots, N\} | a_i e(X) n_i + \omega_i(X) > 0$, therefore $U(X | n_i = 2) > U(Y)$ and multiple Nash equilibria exist, all subjects choosing *X* becoming the Pareto dominant equilibrium while all subjects choosing *Y* remains the risk dominant equilibrium.

Hypothesis 1.2: $N_{X,T_1} > N_{X,T_0}$ since in T1, subjects with lower a_i and ω_i than in T0 will choose *X* rather than *Y*.

<u>Nudge treatment (T2)</u>

This treatment is similar to the control treatment (same payoff table, see Table 4) but subjects are provided with a nudge, which is this case is a "group comparison" nudge. Before the first period starts, subjects are told in the instructions of the game that after each period, each participant will be informed of the ranking of their group in terms of total donations to the environmental charities compared to the two other groups in the room (Figure 2). Three groups of 6 subjects were participating to the experiment simultaneously during a session. The group who generated the highest donation during a period received the following message at the end of that period: "Well done, your group is ranked first in terms of donations". This includes an injunctive norm (judgment of "well done") as well as the comparison to the other groups. The second (*third*) group received the message: "Your group is ranked second (*third*) in terms of donations".

Figure 2: Succession of periods with the nudge

When two groups generated the same level of donations during a period, then they were ranked according to the number of players choosing X. The group with the highest number of players choosing Xobtained the higher ranking.[6]

Again, looking at payoffs, the only Nash equilibrium is reached by all players choosing Y. However if we consider utility function (3), then multiple equilibria arise.

Hypothesis 2.0: $\forall i \in \{1, \dots, N\}, a_i e(X) n_i + \omega_i(X) + f_i(rank(X)) - f_i(rank(Y)) < r(Y) - r(X)$, therefore $\forall i \in \{1, \dots, N\}, \sigma_i = Y$and all subjects choosing *Y* is the unique Nash equilibrium.

Hypothesis 2.1: $\exists i \in \{1, \dots, N\} | a_i e(X) n_i + \omega_i(X) + f_i(rank(X)) - f_i(rank(Y)) \geq r(Y) - r(X)$, therefore $\exists i \in \{1, \dots, N\} | \sigma_i = X$ and multiple Nash equilibria exist, all subjects choosing *Y* being the risk dominant equilibrium.

Hypothesis 2.2: $f_i(rank(X)) - f_i(rank(Y)) \geq 0$, therefore $N_{X,T_2} > N_{X,T_0}$ since, in T2, subjects with lower $a_i$and ω_i than in T0 will choose *X* rather than *Y*.

Nudge plus agglomeration bonus treatment (T3)

In T3, the payoffs remain the same as in T1 (see Table 5), but additionally, subjects were nudged in the same way as described for T2. The theoretical prediction is the same as in T1 if we consider financial payoffs only. Though when considering utility function (3), X can become a utility-maximizing strategy.

Hypothesis 3.0: $\forall i \in \{1, \dots, N\}, a_i e(X) n_i + \omega_i(X) + f_i(rank(X)) - f_i(rank(Y)) = 0$, therefore two Nash equilibria exist, one where all subjects choose *X* and one where all subjects choose *Y*, the latest being the risk dominant equilibrium.

Hypothesis 3.1: $\exists i \in \{1, \dots, N\} | a_i e(X) n_i + \omega_i(X) + f_i(rank(X)) - f_i(rank(Y)) > 0$, therefore multiple Nash equilibria exist, all subjects choosing *X* being the Pareto dominant equilibrium while all subjects choosing *Y* being the risk dominant equilibrium.

Hypothesis 3.2: $f_i(rank(X)) - f_i(rank(Y)) \geq 0$, therefore $N_{X,T_3} > N_{X,T_1}$ since, in T_3, subjects with lower $a_i$and ω_i than in T_1 will choose *X* rather than *Y*

Additionally, we aim to compare the performance of the AB with that of the nudge alone, by comparing T_1 to T_2. We hypothesize that the nudge, being based on non-monetary incentives will be less efficient than the AB in inducing cooperation. Alternatively, if some subjects are more responsive to the ranking than to the AB, then the nudge might perform better.

Hypothesis 4.0: $\forall i \in \{1, \dots, N\}, f_i(rank(X)) - f_i(rank(Y)) < b(X) n_i$ therefore $N_{X,T_1} > N_{X,T_2}$

Hypothesis 4.1: $\exists i \in \{1, \dots, N\}, f_i(rank(X)) - f_i(rank(Y)) \geq b(X) n_i$ therefore $N_{X,T_1} \leq N_{X,T_2}$

[6] When groups could not be discriminated based on their donations or the number of players choosing X, then they were considered equal and given the same ranking. In this case, if two groups could not be discriminated, they were ranked first if the third group was worse off, or third if the third group was better. When the three groups in a session were equal, they were all ranked first if they had all chosen X (to "reward" pro-environmental behaviour), but third if at least one player in each group had chosen Y.

4. Results

4.1. Effect of treatments on participation and coordination at group level

We first look at the effect of treatments on participation, reflected by the number of players choosing X, and on spatial coordination on X, reflected by the level of environmental benefits produced at the group level (amount of donations). Figure 3 shows that, as predicted, treatment T0 displays the lowest levels of participation, ranging from 15 to 40%. Since choosing X leads to lower individual payoffs, this result clearly indicates that a share of subjects do value the potential donation to an environmental charity (high a_i) and/or the warm glow feelings associated with choosing to play X (high w_i), rejecting hypothesis 0.0 as well as hypothesis 2.0 whilst not rejecting hypothesis 0.1 and hypothesis 1.1. However, the proportion of people choosing X decreases over time, with groups converging to the risk dominant equilibrium. This is also reflected when looking at coordination (Figure 4), as the level of coordination quickly declines toward zero in the T0 control groups. This indicates that the choice of X is mainly lead by environmental preferences (reflected in a_i), which relies on coordination, rather than by warm glow effects (w_i).

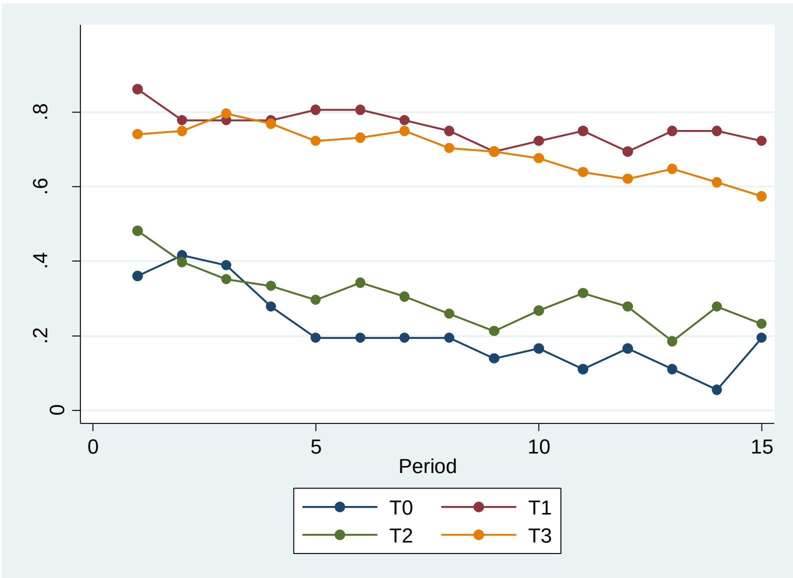

Figure 3: Average proportion of players choosing X by period and treatment

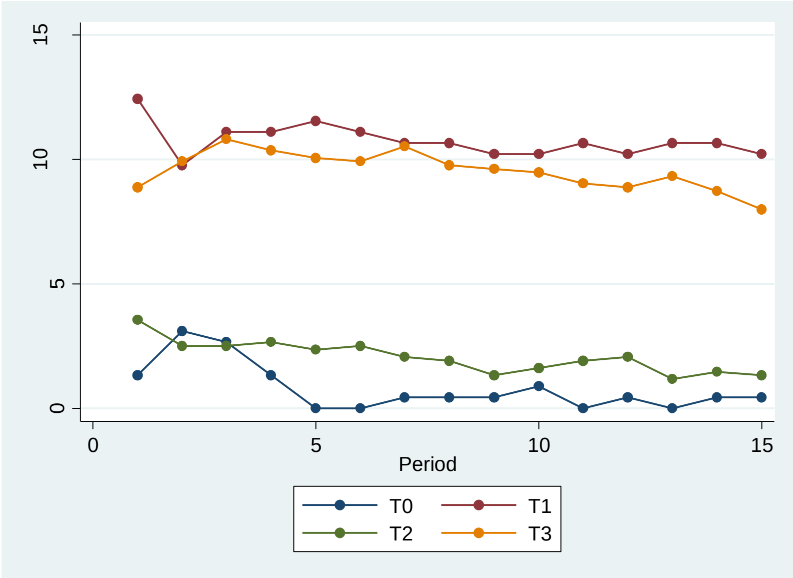

Figure 4: Average individual donation by period and treatment

Comparing T0 and T1 reveals that the agglomeration bonus increases participation (Figure 3) and coordination (Figure 4), and this effect is statistically significant (Table 6), therefore confirming hypothesis 1.2. This result accords with findings in previous experimental papers, either with different settings (Parkhurst *et al.*, 2002) or with similar protocols (Banerjee *et al.*, 2014). However, our results show a more robust effect since in our setting we have adjusted the rate of the agglomeration bonus so that the individual monetary pay-off of strategy X, when the two neighbours also choose X, matches the pay-off of strategy Y. Therefore in this setting, the choice of X is motivated by environmental preferences a_i, as no increase in individual financial payoffs can be expected from choosing *X,* but the agglomeration bonus incentivizes subjects with relatively lower values of a_i to choose *X*. The agglomeration bonus and donations induce players to coordinate on the Pareto optimal Nash-equilibrium instead of picking the risk-dominant Nash-equilibrium.

Additionally, by triggering subjects' extrinsic and intrinsic motivations to choose X, through the AB and through the use of a real donation to charities, we obtain higher levels of participation and coordination and a comparatively smaller decline in these rates compared with previous experiments (Banerjee *et al.* 2014).

The introduction of inter-group competition via the nudge (T2 vs T0) seems to slightly improve the situation for both participation and coordination. However, Mann-Whitney tests (Table 6) comparing the average proportion of subjects choosing X and the average donation generated by subjects in both treatments show that these differences between T2 and T0 are not significantly different from zero. This seems to indicate that the $f_i(rank)$ component of the hypothesized player's utility function has little average effect on choices, providing little support to hypothesis 3.2. Despite this non-significant average effect, we see that the nudge has a significant small impact on participation and coordination for some of the periods, including the first. This is encouraging, as it means that some improvement in coordination could be obtained at low cost by simply signalling relative group performance.

When comparing T1 and T2, we find a superior and statistically significant effect of the agglomeration bonus over the nudge, confirming hypothesis 4.0 rather than hypothesis 4.1. What is more surprising is the comparison of T1 versus T3. We speculated that a nudge would "supercharge" the positive effect of the agglomeration bonus on participation and coordination, by providing a positive feedback to groups with the highest donations (and thus the highest level of environmental outputs). In fact, the analysis of pooled data suggests that the nudge combined with the agglomeration bonus has a slightly negative effect, although not in a statistically significant extent (Table 6), signalling that hypothesis 3.2 should be refuted. Further analysis, developed in section 4.3, aims to understand this counterintuitive outcome.

Table 6: Results - treatment effects

	Mean value (*Standard Deviation*)				Tests (Mann-Whitney) results: Prob > |z|			
Variable	T0: control	T1: AB	T2: Nudge	T3: AB+nudge	T0vsT1	T0vsT2	T1vsT2	T1vsT3
Number of independent observations	6	6	6	6				
Choice of X (proportion)	0.21 *(0.10)*	0.76 *(0.29)*	0.30 *(0.14)*	0.70 *(0.19)*	0.006	0.262	0.016	0.423
Donation €/player	0.80 *(0.89)*	10.76 *(5.83)*	2.07 *(1.57)*	9.56 *(4.07)*	0.007	0.150	0.016	0.631
Efficiency	0.19	0.71	0.25	0.65	0.007	0.078	0.016	0.631

4.2. Efficiency analysis

We now define a variable representing group net benefits $groupB$, reflecting the total benefits produced at group level (individual payoffs and donations), net of the budgetary costs linked to AB payments. From a policy-maker perspective, it embodies the total benefits produced (agricultural production and environmental benefits) from which we deduct the public spending (AB). This can be used as a proxy for net social welfare (at the group level): $groupB = \sum_i (r_i + dn_i - bn_i)$ with i members of the group, and then summed across groups.

We analyse the efficiency of a treatment as its capacity to induce coordination and to generate the greatest net benefit at group level. Under all treatments, the maximum net benefit can be obtained when all players coordinate on X. Numerically this amounts to: $groupB_{max}$ = 6*(13 + 16 – 6) = 138. Conversely, the minimum net benefit that can be produced is reached when no neighbours coordinate to choose the same action, i.e. the pattern of choices at the group level is: X - Y - X - Y - X - Y. In this case the group net benefit is: $groupB_{min}$ = 3*7 + 3*13 = 60. We define the average efficiency of a treatment as:

$$efficiency = \frac{1}{n_{groups}} \sum_{groups} \frac{groupB - groupBmin}{groupBmax - groupBmin} \in [0,1]$$

A treatment is perfectly efficient if *efficiency* = 1, meaning that the groups under this treatment generated the maximum net benefit. It is perfectly un-efficient if *efficiency* = 0, meaning that all the groups in this treatment generated the minimum net benefits possible, *i.e.* reached the minimum level of coordination.

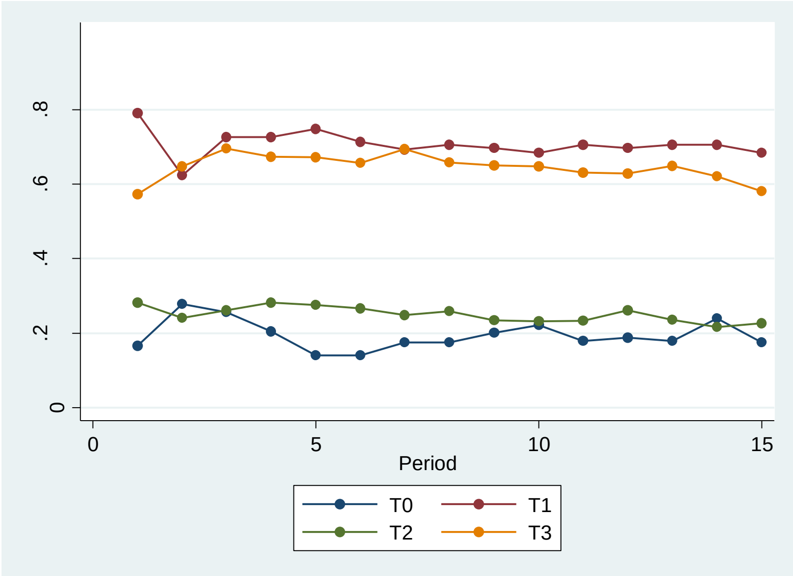

Figure 5: Average efficiency by period and treatment

The comparison of the different treatments' efficiency brings an additional perspective to the results (Figure 5). The AB increases the efficiency score from 0.19 in the absence of incentives (T0) to 0.71 (T1). We also observe that group efficiency is significantly improved (Table 6) by the introduction of a nudge only (T2) compared to T0. This is due to the fact that the nudge bears no budgetary costs. The efficiency comparison between T1 and T3 does not display a significant difference.

4.3. Analysis of individual strategies

In order to analyse how treatments impact individual decisions, we use random effects probit regressions (Banerjee *et al.* 2012, 2014). We estimate the treatment effect Δ in:

$$y_{it} = \alpha + \Delta T + \theta n_{i(t-1)} + \gamma t + u_i + \varepsilon_{it}$$

Player *i*'s action in period t, y_{it} ($y_{it} = 1$ if X is chosen, $y_{it} = 0$ if Y is chosen), depends on treatment T, period t, and neighbours' choices in the previous period (n_{it-1}: number of *i*'s neighbours choosing X in previous period). α is a constant term, γ is a parameter to be estimated, u_i, are individual random effects and ε_{it} the error term.

Table 7: Effect of treatments on individual choices of *X* (random effect probit models)

Variable	Treatment 1 AB	Treatment 2 Nudge	Treatment 3 AB + nudge
T (ref T0)	2.724***	0.287	1.963***
n_{it-1}	0.490***	0.317**	0.966***
t	-0.063**	-0.053***	-0.070***
_cons	-1.169**	-1.036***	-1.434***
Statistics			
N	*1008*	*2016*	*2016*
ll	*-323.92*	*-831.43*	*-584.695*
aic	*657.84*	*1672.87*	*1179.39*

*p<0.1; **p<.05; *** p<.01
Standard errors clustered by independent observation.

The individual analysis (Table 7) confirms the results already suggested by the descriptive statistics of outcomes. The agglomeration bonus (in T1 and T3) increases significantly players' probability to choose strategy X, whereas the nudge alone (T2) has no impact. Players' choices of X are also significantly and positively influenced by their neighbours' choice of X in the previous period in all treatments. With successive rounds, the probability of choosing *X* declines (as shown by negative value of the coefficient on *t*).

Since we have similar models, we can compare the value of estimated parameters to compare the intensity of effects across treatments. We can observe that:

1) The positive and significant effect of T1 and T3 on participation appears to be stronger under AB (T1) than when the nudge and AB are combined (T3),
2) The positive and significant effect of participation by neighbours at the previous period appears to be the strongest when both nudge and AB are activated simultaneously,
3) The decay effect (reduction of participation with time) seems to be of similar intensity in all treatments

We analyse the 4 treatments in a pooled model (using a random effects probit as previously) to confirm that the differences in parameters observed in Table 7 are actually significant (Table 8).

Table 8: Influence of neighbours' choices by treatment

Variable	Coef.
T1 (ref T0)	1.824***
T2 (ref T0)	0.363
T3 (ref T0)	0.663*
n_{it-1}	0.388***
n_{it-1} * T1	0.632*
n_{it-1} * T2	-0.111
n_{it-1}* T3	1.186***
t	-0.054***
_cons	-1.159***
Statistics	
N	*4032*
LL	*-1287.91*
* p<0.1; **p<.05; *** p<.01, standard errors clustered by independent observation	

Table 8 shows that in T1 and T3, the influence of neighbours' choices is much greater and significantly higher than in T0 and T2 (Table 8). A Wald test shows that the difference of neighbours' effect between T1 and T3 is not significant (p-value = 0.11). This accords with our interpretation that the agglomeration bonus triggers strategic behaviours which build on environmental preferences. Indeed, while the neighbours' influence in T0 and T2 only relies on the small number of subject who exhibit high enough environmental preferences (high value of a_i) to compensate the loss of revenue, the AB enables additional individuals with relatively lower values of a_i to choose X, as stated in hypothesis 1.2. Note that the choice of X in this situation remains motivated by the perspective of a donation since individual monetary payoffs when choosing X are not higher than the monetary payoff of the risk dominant strategy Y.

To gain more insight on how the nudge works, and to better understand the results obtained in treatment T_3, we analyse the effect of subjects' group ranking in the previous period ($t-1$) on their choice of X in the following period t. Results of these random effect probit models are presented in Table 9.

Table 9: Ranking effect on choice of X in T2 and T3, all periods included

Variable	T2	T3
Ranked second $(t-1)$ (ref: ranked first)	0.219*	-1.004*
Ranked Third $(t-1)$ (ref: ranked first)	0.281**	-0.823
n_{it-1}	0.359**	1.330***
t	-0.045***	-0.080***
_cons	-1.073***	0.598
Statistics		
N	*1512*	*1512*
LL	*-612.74*	*-341.40*
AIC	*1237.48*	*694.79*

We find that in most cases the group ranking announced at $(t-1)$ has a significant influence on players' choices in t. Interestingly, the effect differs depending on the treatment. When the nudge is used by itself (T2), being ranked third rather than first significantly increases a player's probability of choosing X in t (significant at 10% when ranked second). When the nudge is used in combination with the AB (T3), then not being ranked first in $t-1$ has a negative effect of players' probability to choose X in t (significant at 10% only if ranked second), whilst the effect of being ranked third is not significant.

Thus, when only a nudge is used to improve cooperation, the analysis shows that the expected positive impact of social comparison exists when the group is lagging behind in terms of overall coordination on X. In other words, being ranked first (and being congratulated for this success: remember when ranked first, subjects receive a "well done!" message) is less effective on players' participation than being ranked second or third. We can interpret this as follows. Being ranked second or third might induce subjects to cooperate more simply because they are sensitive to social comparison and want to increase their rank to win the inter group competition. The positive impact of neighbours' choice of X is explained by the same reason, it reinforces the social norm effect (playing like others), but it also increases the chances to generate the environmental good via the donation, something that subjects motivated by environmental outcomes might be sensitive to.

In contrast, when the nudge is used in conjunction with the monetary bonus for cooperation (treatment T3), the information of being ranked second has a negative effect on participation. Indeed the nudge carries also information on the probability of coordination failure: a subject can interpret a second ranking as a signal that his neighbours are not likely to be cooperative, inducing him to play the risk dominant strategy Y. This could indicate that subjects in T3 are more motivated by the AB payment (extrinsic motivations) than by the intrinsic value of generating a donation or the social norm signal. The agglomeration payment seems to crowd out the intrinsic motivation to play X. When combined with a payment, the comparative nudge has a counteractive effect: although it carries the same information to players, it does not trigger the same behavioural reactions. We speculate that the stand-alone nudge "activates" the social norm component of the utility function whereas; when combined with the AB, players use this news as a strategic information to increase their chance of being paid the bonus.

5. Discussion and conclusion

Two interesting ideas in the Payment for Ecosystem Service (PES) literature are (i) private landowners can be encouraged to spatially coordinate their actions using some kind of Agglomeration Bonus; and (ii) behavioural interventions such as nudges can change participation in PES schemes. In this paper, we bring together these two ideas to ask two main questions. First, can a nudge be used to "supercharge" – that is, to improve the performance of – the Agglomeration Bonus (AB)? Second, could a nudge actually be used in place of the AB, such that the effects of the AB on coordination are replicated by the nudge? We use a laboratory experiment to try to answer these questions, with a design that reflects a third feature of the PES literature: namely that farmers' desire to participate in such schemes is partly explained by the value they place on the environmental benefits so generated.

Our results show that an agglomeration bonus increases significantly the level of participation and coordination within a PES-type programme. What is important to highlight is that the overall efficiency (in terms of net global welfare) is increased significantly, even when accounting – generously - for the shadow price of public money and when the environmental benefits are not completely included in the subjects' payment, but generated in the lab through donation to charities. Our second conclusion is that replacing an agglomeration bonus by a comparative nudge leads to less socially-valued outcomes in terms of coordination and environmental benefits/donation. Announcing group rankings based on their group environmental performance is not enough to improve coordination. This is in line with the results obtained by Borsntein *et al.* (2002), but goes against the social norm literature such as . The competition induced by providing information to participants on the ranking of their group by environmental performance appears to be stronger than the positive effects of this social norm on the desired outcome. Although we do obtain some efficiency gains with the nudge, due to the fact that the nudge bears no budgetary costs, these remain very low[7].

The third conclusion relates to the combination of a payment and a nudge. Our initial hypothesis was that the nudge would "supercharge" the effects of the agglomeration bonus, both in terms of participation and spatial coordination. In fact, we demonstrate that the nudge has no significant additional effect when implemented alongside the agglomeration bonus, and could even counteract the positive impact of the bonus. There seems to be a negative synergy between these two incentives. One explanation could be that the payment crowds out the intrinsic motivations triggered by the nudge, thus leading to more strategic behaviour instead of encouraging more altruistic strategies. Another explanation is that ranking the groups indirectly provides information on what other members of a subject's group choose, leading the subject to adjust their strategy towards the risk dominant equilibrium when informed that their group is not performing well in terms of coordination.

Acknowledgements: The authors would like to thank the participants of the Manchester Environmental Economics Workshop (May, 2017) for their feedback and valuable suggestions on this work, especially Tim Cason. Laure Kuhfuss acknowledges support from the Scottish Government Research programme, RESAS 1.4.3., in the writing up of the paper.

[7] The assumption of low costs could be challenged in the real world since announcing the relative success of various groups of farmers would of course induce administrative and communication costs.

References

Abbott, A., Nandeibam, S., and O'Shea, L., (2013). Recycling: Social norms and warm-glow revisited. *Ecological Economics*, 90(0):10-18.

Alcott, H. (2011) Social norms and energy conservation. *Journal of Public Economics*, 95, 1082-1095.

Andreoni, J. (1989). Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence. *The Journal of Political Economy*, *97*(6), 1447–1458.

Andreoni, James (1990). "Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving". *Economic Journal*. **100** (401): 464–477.

Banerjee, S., Kwasnica, A. M., & Shortle, J. S. (2012). Agglomeration bonus in small and large local networks: A laboratory examination of spatial coordination. *Ecological Economics,* 84, 142–152. https://doi.org/10.1016/j.ecolecon.2012.09.005

Banerjee S., de Vries F., Hanley N. and van Soest D. (2014) The Impact of Information Provision on Agglomeration Bonus Performance: An Experimental Study on Local Networks. *American Journal of Agricultural Economics*, Vol: 96 (4): 1009-1029.

Banerjee S., Cason T., de Vries F. and Hanley N. (2017) Transaction Costs, Communication and Spatial Coordination in Payment for Ecosystem Services Schemes. *Journal of Environmental Economics and Management* **83**, 68-89

Bornstein, G., Gneezy, U., & Nagel, R. (2002). The effect of intergroup competition on group coordination: An experimental study. *Games and Economic Behavior*, *41*(1), 1–25. https://doi.org/10.1016/S0899-8256(02)00012-X

Cason, T. and Raymond, L. (2011), Framing Effects in an Emissions Trading Experiment with Voluntary Compliance, in R. Mark Isaac, Douglas A. Norton (ed.) *Experiments on Energy, the Environment, and Sustainability (Research in Experimental Economics, Volume 14)* Emerald Group Publishing Limited, pp.77 - 114

Chen, X., Lupi F. and Liu J. (2009) Linking social norms to efficient conservation investment in payments for ecosystem services. *Proceedings of the National Academy of Sciences*, 106 (28), 11812-11817.

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A focus theory of normative conduct. *Advances in Experimental Social Psychology*, 24, 201–234.

Clot, S., Grolleau, G., and Ibanez, L. (2014). Do good deeds make bad people? *European Journal of Law and Economics*. https://doi.org/10.1007/s10657-014-9441-4

Cong, R.-G., Smith, H. G., Olsson, O., & Brady, M. (2014). Managing ecosystem services for agriculture: Will landscape-scale management pay? *Ecological Economics*, *99*, 53–62. https://doi.org/10.1016/j.ecolecon.2014.01.007

Croson R. and Treich N. (2014) Behavioural environmental economics: promises and challenges. *Environmental and Resource Economics*, 58: 335-351.

Czajkowski M., Hanley N. and Nyborg K. (2015) Social norms, morals and self-interest as determinants of pro-environment behaviours: the case of household recycling, *Environmental and Resource Economics,* 66(4) DOI 10.1007/s10640-015-9964-3.

Dubois, D., Farolfi, S., Tidball, M., Désolé, M., & Hofstetter, A. (2015). Does environmental connotation affect coordination issues in an experimental stag hunt game? *Document de Recherche LAMETA*, (October).

Ferraro P. and Price M. (2013) Using non-pecuniary strategies to influence behaviour: evidence from a large scale field experiment. *Review of Economics and Statistics*, 95 (1), 64-73.

Gunnthorsdottir, A., & Rapoport, A. (2006). Embedding social dilemmas in intergroup competition reduces free-riding. *Organizational Behavior and Human Decision Processes*, *101*(2), 184–199. https://doi.org/10.1016/j.obhdp.2005.08.005

Kuhfuss, L, Preget, R, Thoyer, S & Hanley, N (2016a) Nudging farmers to enrol land into agri-environmental schemes: the role of a collective bonus. *European Review of Agricultural Economics*, 43(4), 609-636.

Kuhfuss, L, Preget, R, Thoyer, S, Hanley, N, Le Coent, P & Desole, M (2016b), Nudges, social norms and permanence in agri-environmental schemes. *Land Economics*, 92(4), 641-655.

Michel-Guillou, E., & Moser, G. (2006). Commitment of farmers to environmental protection: From social pressure to environmental conscience. *Journal of Environmental Psychology*, *26*(3), 227–235. https://doi.org/10.1016/j.jenvp.2006.07.004

Parkhurst, G. M., J. F. Shogren, C. Bastian, P. Kivi, J. Donner, and R. B. W. Smith. (2002). Agglomeration bonus: An incentive mechanism to reunite fragmented habitat for biodiversity conservation. *Ecological Economics* 41 (2) (5): 305-28.

Riechmann, T., & Weimann, J. (2008). Competition as a coordination device: Experimental evidence from a minimum effort coordination game. *European Journal of Political Economy*, *24*(2), 437–454. https://doi.org/10.1016/j.ejpoleco.2007.09.004

Sheeder, R. J., & Lynne, G. D. (2011). Empathy-Conditioned Conservation : “Walking in the Shoes of Others ” as a Conservation Farmer. *Land Economics*, *87*(3), 433–452.

Tan, J. H. W., & Bolle, F. (2007). Team competition and the public goods game. *Economics Letters*, *96*(1), 133–139. https://doi.org/10.1016/j.econlet.2006.12.031