Communication and Coordination in Games with Third-Party Externalities

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Abstract

Decision-makers in coordination problems often impose negative externalities on non-decision-making third parties. This thesis investigates whether the introduction of pre-play communication in such coordination problems can work to alleviate such negative externalities, consequently increasing group welfare. Unlike previous studies, we find no significant effect following the introduction of communication in this laboratory experiment. Further, there is no evidence to suggest that communication opportunities heighten social image concerns. Such social image concerns might act as a mechanism to induce socially efficient behavior and alleviate negative externalities. A small subject pool and the nature of the communication technology employed are important factors to consider when interpreting the results.

I. Introduction

From two individuals deciding where to meet for lunch to the actions of firms in tacit collusion, coordination problems are ubiquitous in daily life. In many cases the actions of decision-makers in such coordination problems do not solely impact personal welfare, but also the welfare of non-decision-making third parties. Standard models of agents' preferences, which do not consider the welfare of others in utility functions, predict agents to behave in a rational, self-maximizing way. That is, even in the context of large negative externalities, the decision-maker is expected to behave according only to considerations of his own payoffs,[1] without any weight given to the outcomes for third parties. One can imagine how this leads to socially inefficient outcomes, the alleviation of which has potentially far-reaching implications for policy-making in corporate and social spheres. Recently, Bland and Nikiforakis (2013) investigated whether varying the size and sign of an externality born by a non-decision-making third-party in a series of one-shot coordination games could affect equilibrium selection. The basic coordination game they used in their experiment is shown in Table 1 below.

Table 1: *The basic coordination game from Bland and Nikiforakis (2013)*

		Person Y: H	Person Y: L
Person X	L	0, 0, 0	5, 5, 4
	H	7, 7, z_H	0, 0, 0

N.B. Payoffs are (X,Y,Z), e.g. if Person X chooses strategy H and Person Y chooses strategy {H} then; Person X earns 7, Person Y earns 7, and Person Z earns z_H Experimental Currency Units. Person X and Person Y are active decision-makers, Person Z is an inactive, non-decision-making third-party. The variable z_H is adjusted to induce externalities of different sizes and signs, where Externality= $z_H - 4$.

The game consists of two decision-making players (Person X and Person Y) who select {H} or {L} without having previously communicated. The tacit coordination of these two decision-makers determines their own payoffs as well as that of a non-decision-making third-party (Person Z). The hypothesis of their study is that larger negative externalities [2] are positively related to selection of the socially efficient {L} strategy. The rationale being that other-regarding preferences concerning the

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[1] While the decision-maker may consider the payoffs of other decision-makers, it is not because of any other-regarding preferences, but purely because his beliefs concerning the other decision-makers' strategy impact and dictate what his own strategy selection should be if he is a rational, self-maximizing agent.

[2] Where Externality = $z_H - 4$

[3] Rational behavior prescribes selection of {H} regardless of the sign and size of the externality. The outcome being the Pareto dominant {(H,H)} equilibrium (that is, Pareto dominant if the third-party's payoff is ignored, as rational behavior mandates).

welfare of the third-party would induce self-sacrificing behavior not predicted by standard models.[3] Given the heterogeneity of other-regarding concerns between individual subjects, the expectation was that as the negative externality increased in size, even those with fairly weak other-regarding concerns would switch to strategy {L}. The decision to switch to {L} as the negative externality increased was expected to comprise both of subjects' own concerns for the third-party as well as the concern that the other decision-maker would want to select {L}, making selecting {L} the self-maximizing choice.[4]

The results of the study showed that the hypothesized relationship between the size of the negative externality and the selection of {L} was very weak. That is, participants were willing to act in a way that increased their income only slightly, even if doing so caused substantial negative externalities on third parties and reductions in total group welfare. When playing a coordination game, individuals tended to behave selfishly in spite of having other-regarding preferences in a non-strategic situation (in this case in a payoff allocation task), even when negative externalities for third parties were severe. This raises the question of how social welfare may be improved in such coordination problems.

Many previous studies have shown that communication can improve group welfare (Cooper et al. 1992, Van Huyck et al. 1993, Charness 2000, Charness and Grosskopf 2004, Duffy and Feltovich 2002, 2006, Blume and Ortmann 2007, Riechmann and Weimann 2008, Chaudhuri et al. 2009, Cason and Mui 2014). Two potential explanations put forward for this finding are 1) that subjects with other-regarding preferences may manage to convince selfish subjects to alter behavior, and 2) that the latter may be reluctant to admit their selfish tendencies publicly, owing to social image concerns. However, in these studies, increases in group welfare did not require a sacrifice in the earnings of decision-makers. Hence, it remains unclear whether communication will have the same effect when increasing total surplus implies a reduction in earnings of the decision-makers.

To that end, using an experimental set-up similar to Bland and Nikiforakis (2013), we investigate the impact of communication opportunities on the outcomes of a coordination game featuring one socially efficient and one socially inefficient equilibrium. Firstly, we elicit subjects' own preferences over the two equilibrium outcomes in a non-strategic payoff allocation task. Secondly, we elicit subjects' beliefs about the preferences of others over the two equilibria in a belief elicitation exercise. Finally, by putting subjects into a coordination game featuring the two equilibria of interest across two treatments, one with and one without communication opportunities, we find whether communication improves group welfare. The experiment presented in this thesis tests the hypothesis that the introduction of communication opportunities promotes socially efficient behavior in coordination games with third-party externalities.

The remainder of the paper is organized as follows: section 2 provides a discussion of related literature; section 3 presents the experimental design; section 4 presents the results from the experiment; section 5 presents the findings; and section 6 concludes.

II. Related Literature

This research project stands at the intersection of three distinct strands of behavioral economics literature. The first strand is that which explores the nature of social preferences, probing the standard assumptions of rationality and selfishness made in economics, positing the interdependence of agents' preferences, and attempting to model how these preferences might be represented in mathematical form. The second strand is that on coordination games, exploring behavior in strategic games such as stag-hunt and minimum-effort games. The third strand is the growing body of research studying the effect of the introduction of communication opportunities on such games.

The social preferences literature is extensive and covered in detail elsewhere (e.g., Cooper and Kagel 2013). The majority of studies focus primarily on concerns of agents for other decision-makers and record the willingness of agents to reward or punish other participants at a personal cost. Relatively few previous studies have focussed on the concerns of agents for third parties who are not decision-makers (i.e., few studies on social preferences have accounted for third-party concerns), although decision-makers often do impose externalities on third parties in economic contexts.

The few studies that have focused on social preferences regarding third parties generally present evidence suggesting that agents care less about inactive third parties than the welfare of other active decision-makers (Engel and Zhurakhovska 2012, Güth and van Damme 1998, Kagel and Wolfe 2001). However, in some cases the presence of third parties has been shown to have an impact on behavior, particularly when decision-makers are in a worse monetary position than said third parties

[4]Since if they selected {H} the outcome would be coordination failure with zero personal payoff, rather than 5 ECUs from the {(L,L)} outcome.

(Engel and Rockenbach 2011, McDonald et al. 2013). Although agents have generally been shown to care less about third parties, uncertainty about the social concerns of other decision-makers, which is salient in the present study, may have an impact on behavior that concerns the third-party.

Camerer (2003) documents the extensive studies that have used controlled experiments to investigate equilibrium selection in coordination games. Within the literature on social preferences, there are only two studies investigating how social concerns affect equilibrium selection. The first is the study of which this project directly extends the line of inquiry (Bland and Nikiforakis 2013). By varying the sign and size of a third-party externality in a tacit coordination game, the study showed that individuals were willing to act in a way that increased their income only slightly even if the negative externality is extremely high. The present study investigates how the introduction of communication between decision-makers may affect behavior within a similar experimental set-up. The second study by Chmura et al. (2005) investigates how social concerns affect equilibrium selection. It examines how concerns for efficiency and equality in the payoffs of decision-makers affect choices in 2 x 2 coordination games. The main finding is that concerns for equality and efficiency are both important determinants of decisions in their coordination game.

Bigoni et al. (2013) and Cason and Mui (2007) offer two related studies that investigate behavior in three-player games. The latter consist of 2 x 2 coordination games embedded in a second stage of the experiment in which the decisions of two of the players determine the payoffs for all three. However, the third player is not inactive, having made a decision in the first stage which affects available options in the second stage. Hence, these studies do not provide an examination of the impact of third-party externalities per se.

As hitherto mentioned, many previous studies have shown that communication can improve group welfare in an experimental set-up. For instance, Cooper et al. (1992) present experimental evidence on non-binding pre-play communication in bilateral coordination games. They find that, in games with a cooperative strategy, one-way communication increases play of the Pareto-dominant equilibrium relative to the no communication baseline. More recently, Chaudhuri et al. (2009) used overlapping generation experiments to investigate the use of advice as a coordinating device in the "Minimum Effort Game, conjecturing that the intergenerational design might enable subjects to converge on the payoff-dominant outcome. They find that coordination is most likely to result when the advice is made public and distributed in a manner that makes it common knowledge. No previous studies of coordination games with communication opportunities have featured situations in which increases in group welfare require a sacrifice in the earnings of decision-makers as in the present study.

III. The Experiment

I. The Basic Coordination Game

The experiment uses as a basis the coordination game in Table 2 below. This game has two pure-strategy Nash equilibria: {(L, L)} and {(H, H)}.[5]. Note that the self-maximizing equilibrium outcome which maximises the payoffs of the two decision-makers {(H, H)} is not the efficient one that maximizes total surplus {(L, L)}. The {(H,H)} outcome imposes a significant negative externality on a third person (Person Z). To recapitulate and contextualize, the goal of the project is to investigate whether making Person X and Person Y communicate their intended actions (ex ante) promotes socially efficient behavior (selection of {L}).

Table 2: *The coordination game in Part 3 of the experiment*

		Person Y	
		H	L
Person X	L	0, 0, 0	5, 5, 4
	H	7, 7, -6	0, 0, 0

N.B. Payoffs are (X,Y,Z), e.g. if Person X chooses strategy {H} and Person Y chooses strategy {H} then; Person X earns 7, Person Y earns 7, and Person Z loses 6 Experimental Currency Units. Person X and Person Y are active decision-makers, Person Z is an inactive, non-decision-making third-party.

The experiment consists of three parts,[6] only one of which is randomly selected for payment at the end of the experiment to avoid income effects and hedging incentives. Subjects received instructions for each part of

[5]N.B. We interchangeably refer to strategy {L} as "low" or "socially efficient" and strategy H as "high," "socially inefficient," "self-maximizing," or "selfish." A"socially efficient" strategy is defined as that which intends to maximise group welfare. Hence, the strategy L which intends to play to the (5,5,4) equilibrium is "socially efficient" because it intends to result in a total group welfare of 5+5+4 = 14 which is greater than group welfare in the (7,7,-6) "socially inefficient" equilibrium outcome where total group welfare is 7+7-6 = 8.

[6]The parts of the experiment were always ordered as follows; Part 1) Payoff Allocation Tasks, Part 2) Belief Elicitation Task, Part 3) The Coordination Game. This order was necessary since part 2 must come after part 1 (as payoffs in part 2 depend on what happened in part 1) and part 3 must come after part 1 and part 2 since the communication from the coordination game in part 3 would contaminate behavior in part 1 and part 2.

the experiment only upon completing the immediately preceding part.

II. Part 1 – The Payoff Allocation Tasks

The payoff allocation tasks undertaken by Persons X and Persons Y are shown below. Persons Z had no decisions to make in this part.

Table 3: *Payoff Allocation Task 1: {h} vs. {l}*

	Allocation {h}		
	Person X	Person Y	Person Z
Task 1	7	7	-6
	Allocation {l}		
	Person X	Person Y	Person Z
	5	5	4

The choice between {h} or {l} corresponds to the strategy selection between {H} or {L} in the coordination game in Table 1 where {h} gives the payoffs from outcome {(H,H)} (namely 7,7,-6) and {l} gives the payoffs from outcome {(L,L)} (that is, 5,5,4).

Table 4: *Payoff Allocation Task 2: {h} vs. {f}*

	Allocation {h}		
	Person X	Person Y	Person Z
Task 2	7	7	-6
	Allocation {l}		
	Person X	Person Y	Person Z
	0	0	0

The allocation resulting from selecting {f} corresponds to coordination failure in the coordination game in Table 2 where (H,L) or (L,H) is the outcome and payoffs are (0,0,0).

Table 5: *Payoff Allocation Task 3: {l} vs. {f}*

	Allocation {h}		
	Person X	Person Y	Person Z
Task 3	5	5	4
	Allocation {l}		
	Person X	Person Y	Person Z
	0	0	0

The aim of the payoff allocation tasks is to elicit distributional preferences which allow the ranking of the different outcomes of the coordination game for each individual. The main comparison of interest is the preference of {h} versus {l} (as illustrated in Table 3), since the payoffs from these allocations correspond directly to the two pure-strategy Nash equilibria in the coordination game in Part 3 (coordination game shown in Table 2). The two other comparisons (Table 4, {h} versus {f} and Table 5, {l} versus {f}) are included for completeness in the comparison of preferences over possible outcomes of the coordination game.

III. Part 2 – The Belief Elicitation Task

The belief elicitation task is for all subjects to guess how many fellow subjects chose payoff allocation {l} versus payoff allocation {h} in Payoff Allocation Task 1. Out of 10 subjects, there are 5 Persons X and 5 Persons Y in each experimental session. Payoffs are tied to the accuracy of the guess and are summarized in Table 6 below.

Table 6: *Payoffs versus accuracy of guess in the belief elicitation task*

Accuracy of guess	Payoff in ECUs
0	5
|1|	2
|2|	0
|3|	-2
|4|	-5
>|4|	-6

Accuracy of guess = (Actual number of subjects who chose {l} in Part 1) – (Subject's guess of number of subjects who chose {l} in Part 1). I.e., if the actual number of subjects who chose {l} in Part 1 was 5 out of 10 and a subject makes a guess of 4 out of 10, the accuracy of their guess is \|1\| and their payoff is 2 ECUs.

The primary aim of the belief elicitation task in Part 2 of the experiment is to elicit subjects' beliefs about the preferences of others over the two pure-strategy Nash equilibria in an incentive-compatible way. Persons X, Y, and Z all partake in this part of the experiment. The fact Person Z partakes in the belief elicitation task but does not decide between {h} and {l} in the payoff allocation tasks reveals any potential effect on beliefs of others resulting from having made a decision between the two allocations in Payoff Allocation Task 1. The hypothesis here is that subjects are likely to think others might behave in the same way as them if they have done the task in Part 1. This is known as the "false-consensus effect."[7]

IV. Part 3 – The Coordination Game and Experimental Treatments

Part 3 is the coordination game. Here the experiment consists of two different treatments: 1) No Communication, and 2) One-Way Communication. Note that while Parts 1-3 imply a within-subject design, the game in

[7]For a comprehensive look at the false-consensus effect, see the well-cited Ross et al. (1977).

Part 3 varies across sessions (i.e., it involves a between-subject comparison).

IV.1 Treatment 1 (Baseline) – No Communication

Person X and Person Y select actions independently (tacit coordination) without communication.

IV.2 Treatment 2 – One-Way Communication

Person X and Person Y both write a short message[8] (select either {MH} or {ML}) limited to 140 characters in length. They are told that, "The message should pertain to your intended action in the scenario along with a brief justification."[9] One of the messages is randomly selected to be sent to the other decision-maker (i.e., messages are collected using the strategy method).

The aim in Part 3 is to ascertain whether the introduction of communication opportunities induces socially efficient behavior as previously defined.

V. Procedures

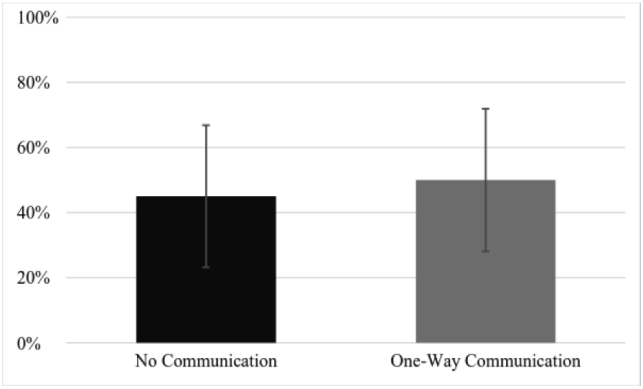
The experiment[10] was run at NYU Abu Dhabi's Social Sciences Experimental Laboratory (SSEL) between February 1 and February 12, 2015. In total, 90 subjects are included in the analysis. All were enrolled NYU Abu Dhabi undergraduate students at the time and all were recruited into the experiment by invites sent via random selection through the IRB-approved subject recruiting system, "hroot,"[11] for which they had all previously registered. The only incentive to participate was monetary and consisted of advertised average earnings of 100.00 AED (actual average earnings were 100.11 AED) for the hour-long experiment which included a 30.00 AED show-up fee. Additionally, a 60.00 AED lump sum fee was given to each subject at the start of the experiment to account for any losses sustained during the course of the experiment.[12] The exchange rate was fixed at 10.00 AED = 1 Experimental Currency Unit (ECU). All participants gave informed consent before the decision-making portion of the experiment began.

The equal division of subjects between the three player "types" means that there are 30 "Person X," 30 "Person Y," and 30 "Person Z" in the sample. 30 subjects underwent the No Communication treatment and 60 subjects underwent the One-Way Communication treatment, generating 20 independent observations in the coordination game in Part 3 of each respective treatment. Since there is communication between subjects, every coordination game in Part 3 of the experiment represents only one independent observation in the One-Way Communication treatment, whereas it represents two independent observations in the No Communication treatment where coordination is tacit.

IV. Results

Figure 1[13] below shows the percentage of participants who chose Allocation {l} over Allocation {h} in Part 1 of each treatment. As expected, establishing an equivalence between the two sub-samples (split across the two treatments), there is no significant difference in the averages of 45 percent in the No Communication treatment (9 out of 20 observations) and 50 percent in the One-Way Communication treatment (20 out of 40 observations). This shows that within the entire sample, 48.3 percent of subjects (29 out of 60 observations) preferred the socially efficient (5,5,4) payoff allocation to the socially inefficient (7,7,-6) payoff allocation. The corresponding Fisher's exact test across the two treatments gives a p-value of 0.788, indicating that there is indeed no significant difference in this ratio across treatments.

Figure 1: *Percent of subjects who chose Allocation {l} over Allocation {h}*



The results from the allocation task shown in Fig-

[8] We will use {MH} to denote instances in which the message of a given subject proposed they play {H} and {ML} for instances in which the message proposed they play {L}.

[9] Additionally Person X and Person Y are given the following two rules to ensure anonymity: "You may not; 1) Reveal any aspect of your identity (name, gender, class, major, nationality, etc.) 2) Make any threats or promises except ones regarding the permissible actions within the scenario (for example, "I promise to play x_1..." is acceptable. "Hello it's Joe, make sure to find me after the experiment..." is not acceptable.)"

[10] Which was created using z-Tree ("Zurich Toolbox for Readymade Economic Experiments"), citation included in "References" at end of document.

[11] Citation included in "References" at end of document.

[12] Loss per subject cannot exceed 60 AED by design.

[13] All bar charts shown throughout include 95 percent Confidence Interval error bars in dark grey.

ure 1 above are somewhat surprising when compared to the results from the payoff allocation task in Bland and Nikiforakis (2013). Namely, the subjects used here were much more likely to choose Allocation {l} (the socially efficient payoff allocation) than were the subjects in Bland and Nikiforakis (2013). Specifically given 48.3 percent of subjects in the present study chose {l} when the negative externality was -10, only 20 percent of subjects in the latter study chose {l} when the negative externality was even higher (-12).[14] This suggests that there is a difference in the preferences of the subjects in the two samples, with the sample in the present study having more intense other-regarding preferences than the sample from the Bland and Nikiforakis (2013) study.[15]

The belief elicitation task in Part 2 calls for subjects to guess the proportion of individuals who chose Allocation {l} over Allocation {h} in Part 1, with payoffs tied to the accuracy of that guess. In aggregate, subjects' guesses were extremely accurate. The average guess of 45.9 percent (of Persons X and Y having chosen {l} in Part 1) is only 2.4 percentage points away from the true proportion of 48.3 percent. Despite this accuracy in the aggregate, subjects fared poorly individually in terms of the accuracy of their beliefs about the preferences of others over the two payoff allocations. Guesses ranged from 0 percent to 100 percent in some cases. To illustrate further, if we define "accuracy of guess" as "subject's guess" minus "actual number who chose Allocation {l}," while the mean accuracy is -0.22 (on average, guesses were only -0.22 below the actual number in absolute terms), the standard deviation is large at 2.95. A histogram of the accuracy of guesses is shown in Figure 2 below to illustrate how varied subjects' beliefs of others' preferences were when deciding between the two payoff allocations. Despite the spike at an accuracy of -1 (i.e., of those whose guesses were only one below the true value), there is otherwise a fairly uniform split across the rest of the range of accuracies. That is, the aggregated mean is only close to perfect accuracy because many very inaccurate guesses at either end of the spectrum canceled each other out.

The output of a Wilcoxon rank-sum equality test of unmatched data in comparing the accuracy of guesses of the active decision-making "Person X" and "Person Y" types versus the inactive non-decision-making "Person Z" type shows no significant difference generating a p-value of 0.318.[16] Hence, there is no evidence for a systematic bias in the accuracy of beliefs about others' preferences over the two allocations in the sample caused by subjects having not personally chosen an allocation in the previous part. There is no evidence here for a false-consensus effect among decision-makers.

Figure 2: *The accuracy of subjects' beliefs about the preferences of others over Allocation {l} versus Allocation {h}*

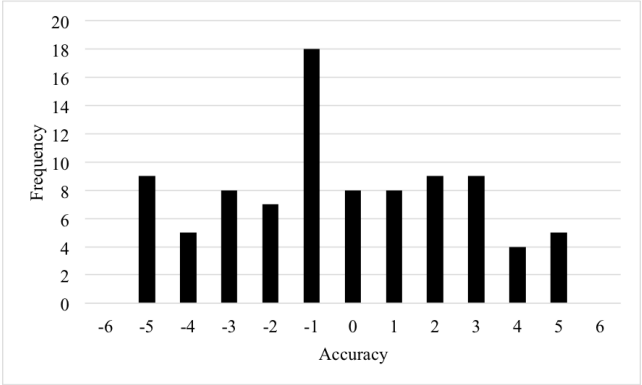
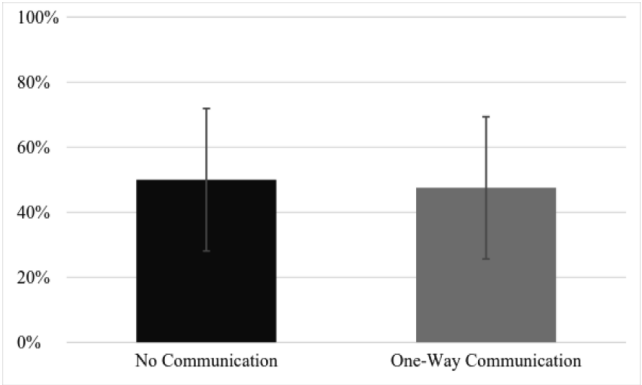


Figure 3 below shows the proportion of individuals who played "low" {L} (selected the socially efficient strategy) versus "high" H (selected the socially inefficient strategy) in the coordination game across the two treatments. As is immediately apparent, there is no significant difference between the two proportions[17] (50 percent in the No Communication treatment and 48 percent in the One-Way Communication treatment). That is, there is insufficient evidence to reject the null hypothesis of no treatment effect in this experiment. There is no evidence that making subjects indicate their strategy via ex ante one-way messaging induces a greater degree of socially efficient behavior.

Figure 3: *Percent of subjects who played {L} in coordination game*



[14] See Figure 1 in Appendix A of Bland and Nikiforakis (2013).

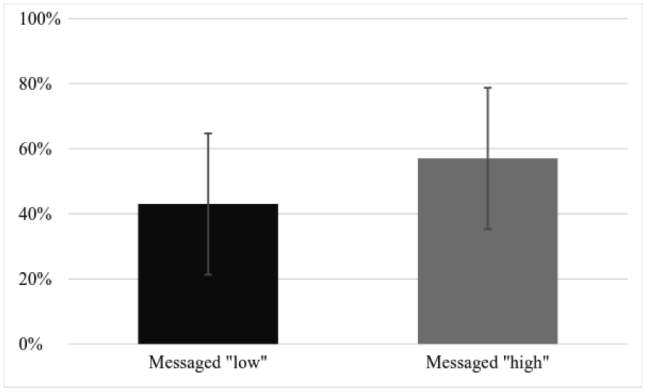
[15] The potentially problematic differences between the two samples and the possible reasons these differences exist will be revisited later on in the paper (see p. 24 in section 5, "Findings").

[16] For completeness, the average accuracy of the guesses of decision-makers is -0.05, while the average accuracy of the guesses of non-decision-makers is -0.57.

[17] Fisher's exact = 1.000.

The proportion of subjects who messaged "low" {ML} versus "high" {MH} is shown in Figure 4 below. There is no significant difference between the two proportions of 43 percent messaging "low" and 57 percent messaging "high". Although this 43 percent is lower than the 50 percent who chose the allocation with identical payoffs to the outcome of both playing "low" in the payoff allocation task in Part 1, there is no significant difference[18] to be found given the small sample size and the minor disparity.

Figure 4: *Percent of subjects who messaged "low" versus "high", {ML} versus {MH}*



One factor that could lead to the apparent lack of a treatment effect where one potentially exists (i.e., a Type II error) is in the random selection of messages in Part 3. That is, although more individuals wished to message to propose that a particular equilibrium outcome prevail, disproportionately more messages advising playing to the other equilibrium outcome were sent. This happened (albeit weakly) in the present study where, although only 43 percent of the messages were proposing the socially efficient equilibrium outcome {ML}, 50 percent of randomly selected messages were of this type. Since the probability of an individual playing "low" {L} given that they received a message of "low"[19] Pr({L}|MRL) was so great in the present study (Pr({L}|MRL) = 90 percent),[20] the fact that messages selected were disproportionately of the "low" type could lead to the mitigation of any treatment effect.

Therefore, Figure 5 is included below to represent the predicted percentage who would have played "low" in the coordination game in One-Way Communication had random message selection been exactly proportional to messages intended to be sent.[21] Although the probability of playing "low" falls to 41.1 percent, the difference between the treatments remains insignificant. Still, this evidence reinforces support for the finding that communication does not increase the frequency of socially efficient strategy selection.

Figure 5: *Percent of subjects playing "low" {L} in coordination game (corrected for random message selection bias)*

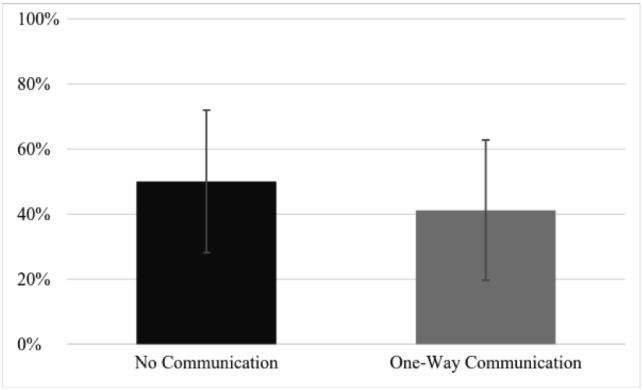


Figure 6: *Pr({MH}|{l}) versus Pr({ML}|{h})*

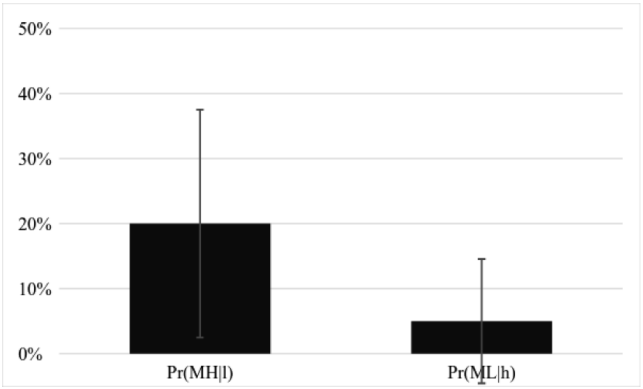


Figure 6 shows the proportion of subjects in the communication treatment who sent messages indicating an intent to play a strategy contrary to the preference they revealed to have in the non-strategic payoff allocation task in Part 1. That is, the figure shows

[18]Two-sided binomial probability test of equality of proportions yields p-value = 0.430.

[19]The notation 'MRL' indicates that the subject received a message from the other decision-maker (i.e. their own message was not sent), and that message proposed the socially efficient, "low", equilibrium outcome. Similarly 'MRH' indicates that the subject receives a message that proposed the socially inefficient, "high", outcome.

[20]In this respect a theme of adopting a "follow-the-sender" strategy was common in the experiment and offers insights into why the results prevailed as they did. The discussion of this strategy and its ramifications is expanded on p. 22 in Section 5, "Findings", below.

[21]The predicted percentage of those playing "low" under exact proportionality of message types is calculated as; Percent playing "low" Pr(L') = Pr(L|MSL)*Pr(ML) + Pr(L|MSH)*Pr(MH) = 41.1 percent. N.B. The notation MSL / MSH denotes that a message of "low" / "high" was selected and was then selected to be sent.

Table 7: *Influences on the probability of selecting L in the coordination game*

	(1)	(2)	(3)	(4)
(x_1) Chose {1} (dummy)	0.910** (0.358)			5.178*** (0.873)
(x_2) Belief in Part 2		1.515** (0.736)		-0.887 (1.070)
(x_3) Message received was {L} (dummy)			2.563*** (0.784)	6.747*** (0.563)
Constant	-0.524 (0.327)	-0.764* (0.410)	-1.282** (0.555)	-5.397*** (0.189)
Number of observations	40	40	20	20

Probit regression with group-level random effects; robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

the proportion of individuals who selected {MH} (messaged that they intended to play {H}) in the coordination game, even though they chose {l} in the allocation task (Pr({MH} | {l})) versus the proportion of individuals who selected {ML} (messaged that they intended to play {L}) in the coordination game, despite the fact they chose {h} in the allocation task (Pr({ML} | {h})). The original hypothesis implied that a high proportion of subjects would message to play "low" {ML} (proposing play to the socially efficient equilibrium outcome) even though they had previously chosen the "high" {h} allocation, on account of social image concerns. However, this happened in only 5 percent of cases. In fact, the opposite occurred more frequently, where individuals who preferred the socially efficient allocation (who chose {l}) messaged to play to the socially inefficient equilibrium outcome {MH} (this happened in 20 percent of relevant cases).

The outcome of four probit models presented in Table 6 below give an idea of what was important in determining socially efficient strategy selection in the coordination game for Persons X and Y. In isolation, all three independent variables are significantly positively associated with increasing the likelihood of selecting {L} in the coordination game (the independent "y" variable in the models).[22] That is, given that an individual chose {l} in the allocation task (x_1), the more they tended to believe that others were inclined to select {l} in the allocation task (x_2). The fact that they received a message proposing play to the {(L,L)} equilibrium outcome in the coordination game (x_3) increased the chance that they would select {L} (that they would play the socially efficient strategy selection) in the coordination game (Pr(y=1)). However, when combined in model (4), only two of the variables remain significant and positive, individuals' beliefs about the preferences of others (x_2) becomes statistically insignificant in the presence of the other two independent variables.[23]

V. Findings

The data presented above show that within this sample there is insufficient evidence to reject the null hypothesis that communication has no effect on socially efficient strategy selection. The baseline No Communication treatment generated a percentage of socially efficient strategy selection of 50 percent, while the One-Way Communication treatment generated a corresponding proportion of 48 percent, a decrease of 2 percentage points where an increase was hypothesized. Further, the proportion of socially efficient strategy selection in the communication treatment was bolstered by a disproportionately high selection of messages proposing the socially efficient equilibrium outcome, owing to variance in the method of random selection. Absenting this random disproportionality, it is even less likely that the hypothesized treatment effect would have been found.

What the data from this project do suggest is that individuals overwhelmingly "follow-the-lead" of the message that is selected to be sent, regardless of whether it recommends the selfish and socially inefficient, or the other-regarding and socially efficient action. That

[22] That is, the dependent variable is Pr({L}) = Pr(y = 1).

[23] In terms of the marginal effects of each variable in model (4), dy/dx2 is insignificant, dy/dx1 is significant at the 99 percent level and has a value of 0.99 and dy/dx3 is also significant at the 99 percent level and has a value of 0.99. Only the positive coefficient on x_3 (6.747) is large enough to counter the negative constant (-5.397), indicating that receipt of a message proposing {L} is the most important deterministic factor influencing the likelihood of selecting {L} in the coordination game. This provides further evidence in support of the salience of the "follow-the-lead" strategy, the discussion of which is elaborated in the next section, "Findings."

[24] Pr({L} | MRL) = Pr({H} | MRH) = 0.90. Where "MRL" = "low message received" and "MRH" = "high message received."

is, the probability that the receiver plays in line with the intentions of the message received from the sender is 90 percent,[24] even in the context of a roughly 50-50 preference for the payoffs attached to the equilibrium outcomes as revealed in the payoff allocation task.[25]

In this way, the experiment revealed two distinct "varieties" of individuals in the sample (both approximately equal in number), each with distinct preferences and corresponding behavior. The first "variety" are those individuals who indicated they preferred the payoffs associated with the socially efficient equilibrium in the coordination game by selecting Allocation {l} over Allocation {h} in the payoff allocation task. They were willing to make the sacrifice of 2 ECUs to save the inactive bystander the loss of 10 ECUS (the size of the negative externality). That is, their other-regarding concerns were strong enough to steer them to make this socially efficient, self-sacrificing choice. However, they were not willing to make the much larger sacrifice of playing {L} to non-coordination payoffs of (0,0,0) when the other decision-maker indicated they intended to play {H} in their message. That is, when they were contemplating the outcome of 0 ECUs (from coordination failure) versus the 7 ECUs they would receive if they co-operated with the other decision-makers' proposal (resulting in the loss of 6 ECUs of the inactive bystander), they "gave in" to the will of the sender of the {MH} message and selected {H}. While they revealed at least some degree of other-regarding concerns in the payoff allocation task, these concerns were not strong enough to induce this much larger sacrifice. The second "variety" are those individuals who indicated that they preferred the payoffs associated with the self-maximizing socially inefficient equilibrium payoffs in the coordination game by selecting Allocation {h} over Allocation {l} in the allocation task. If they had any degree of other-regarding concerns, the relative self-sacrifice of 2 ECUs to save the third-party 10 ECUs was too high for these concerns to be captured. These individuals made the rational decision to switch to the {L} strategy if they received a message that the other decision-maker intended to play {L}. In other words, the latter "variety" of individual behaves like the rational homo economicus who performs as the "agent" of standard economic models, while the former is the "irrational," other-regarding human, with both a "brain" (concern for his own welfare) and a "heart" (concern for the welfare of others) who commonly exists in reality.

This analysis also suggests that the technology of communication may be important and that when the technology takes the form of one-way communication, as it does in the present study, receivers tend to go along with the preference of senders to avoid a situation of coordination failure in which all three players receive zero payoff. Therefore, additional treatments with different communication technologies that abate this "follow-the-lead" strategy represent fertile ground for exploration. For instance, the use of simultaneous, one-shot two-way communication would generate interesting scenarios when "Person X" and "Person Y" have differing preferences over the two equilibrium outcomes. When this difference exists would the socially efficient, or socially inefficient outcome more frequently prevail?[26] Further, continuous rich-text communication would reveal the effect of on-going bargaining over whether to play to the socially efficient or socially inefficient outcome. This approach, while being "messy" from a data categorization and analysis standpoint, may represent more accurately real-world situations of coordinating in the presence of third-party externalities. An approach including rich-text communication opportunities would give rise to greater environmental validity which is lacking in the present study.

This study also found significant sampling differences between the population used for analysis and that used in the base paper (Bland and Nikiforakis 2013). The highly salient difference being the probability of observing the choice of the prosocial allocation in the payoff allocation task. With a negative externality in this experimental set-up of -10, 48.3 percent of subjects chose the socially efficient outcome whereas with an even larger externality of -12 in Bland and Nikiforakis' study (where all other parameters were identical), only 20 percent of subjects chose the socially efficient outcome, a difference of 28.3 percentage points.

This finding may have important implications for further behavioral studies conducted using NYU Abu Dhabi undergraduate students as subjects. Conducting experiments in this very small institution where many, if not all, subjects have personal relationships prior to the experiment may give rise to validity concerns. The nature of the students recruited is also strongly influenced by the self-selection effect of being accepted to and enrolling at such a unique institution. These concerns are important in the consideration of results from all behavioral experiments conducted using this student population, as they make extrapolating to general cases more empirically dubious.

[25] Pr({l}) = 0.483 Pr({h}) = 0.517.

[26] According to Cooper et al. (1992) this situation would generate the same outcome as there being no communication at all.

VI. Conclusion

Where many previous studies have found that the introduction of communication opportunities can increase group welfare in an experimental setting, this study finds no such effect. In this regard, the findings are in line with those suggested in several previous studies (namely Engel and Zhurakhovska 2012, Güth and van Damme 1998, and Kagel and Wolfe 2001) which suggest that social preferences are stronger with regard to other decision-makers than inactive bystanders. Ultimately, the results of the study are also in line with those of the base study, Bland and Nikiforakis (2013). Namely, that selfish concerns are not dominated by concerns for the welfare of third parties. That being said, the data from the payoff allocation task in Part 1 of the experiment showed high rates of non-conformance with self-maximizing predictions. That is, social preferences appear to be salient in this population. The fact that the socially efficient allocation choice of {l} over {h} was relatively common in this sample in the non-strategic scenario in Part 1 may contribute to the lack of an effect from the introduction of communication. That is, because other-regarding behavior is already relatively common, it becomes less likely that a significant increase in other-regarding, socially efficient behavior will be found when communication opportunities are introduced. A method of testing this hypothesis would be to decrease the size of the externality in the allocation task and coordination game in order to produce a lower percentage of the socially efficient allocation (of Allocation {l} over Allocation {h}) selection in Part 1 so that there is more scope for a significant difference between behavior across different communication conditions. That being said, there is still plenty of "space" even with the current parameters for the proportion of socially efficient strategy selection to increase (from 50 percent in the No Communication treatment) when communication is introduced.

As previously mentioned, the use of different communication technologies provides a potential route for finding an effect in concurrence with the posited alternative hypothesis. In addition to changing the technology of communication, other changes such as removing the anonymity of subjects and identifying the third parties may contribute to more salient social image concerns and hence greater treatment effects when communication is introduced. The employment of face-to-face communication represents a potentially effective way of inducing greater salience of social image concerns as subjects would have "nowhere to hide" from the social judgement of others. The marked differences in the sample used in this study (especially with regards to the high degree of other-regarding concerns revealed in the allocation task) and that in the base study suggests that testing in a different sample may be warranted and lead to different results.

In sum, while the social preferences in the sample revealed in Part 1 provide evidence disagreeing with the rationality assumptions of standard economic models, the lack of a treatment effect upon the introduction of communication opportunities leaves these models unsullied in this regard. Where it was unclear before, the results from this study suggest that communication may not improve social welfare when this requires a reduction in the earnings of decision-makers.

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