MONITORING TEAMWORK: HOW DO PUNISHMENT MOTIVATIONS CHANGE WITH GROUP SIZE

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Teamwork monitoring and control is a crucial matter in firm management. While teamwork can attain higher efficiency than individual work given the potential synergies arising, free riding in effort-intensive tasks leads to underperformance of the team. Such groups are usually monitored by a group manager or by a Chief Executive Officer (CEO), who can implement control and penalty mechanisms over the team. Using a game theoretical approach, team

tasks can be seen as public goods to which workers contribute with their costly effort. Moreover, centralized monitoring mechanisms can be endowed with punishment power with which to exert control.

The purpose of this work is to analyse two important factors in teamwork monitoring. On the one hand, the effect of the monitor's payoff scheme and, on the other hand, the impact of the size of the group that is being monitored. In particular, we explain the impact on contributions and punishment actions of the monitor's payoff scheme for two different group sizes. In other words, how does the CEO's payoff scheme affect group effort in small and in large teams? We do this using an experimental economics approach.

Results show that CEOs punish according to the combination of their payoff scheme and of the group size that they are monitoring. Workers, however, do not respond positively to aggressive punishment strategies and, in fact, do not exert higher levels of effort in the common task when the CEO applies a more stringent control.

In management literature, the impact of different payoff schemes has been a central issue. In this area, researchers study the influence that fixed and variable payoff schemes have on the final outcome. There is a great controversy in this literature about whether there is an optimal scheme applicable to most firms (Gerhart *et al*. 1996; Huselid, 1995) or, instead, whether their effect depends on their interaction with specific strategies (Montemayor, 1994; Youndt *et al*. 1996, Gerhart and Fang, 2005; Gerhart and Rynes, 2009). Payoff structures can be understood as granting importance to the extrinsic and intrinsic motivations that workers and CEOs have in their day-to-day tasks. Our perspective is to add a centralized punishment mechanism in order to disentangle the different types of motivations. For this reason, we use a Public Goods Game (PGG) frame.

In this line, there is limited literature referring to how do payoff schemes affect others' behaviour as well. Alventosa *et al*. (2018) analyse what is the effect in a de-framed environment and show that monitors' motivations do not only affect themselves, but they

also affect contributors, who perceive punishment from variable-payoff monitors as an illegitimate action. This, however, occurs in a context with a neutral frame and for only one group size. Our works enriches this line of economic literature by analysing the influence of different payoff schemes for different group sizes in a frame that replicates a firm's hierarchy. The impact that a particular frame can have on decision-making has been broadly studied in behavioural economics since Tversky and Kahneman (1981) and more specifically in coordination problems in Rege and Telle (2004), Cookson (2000), Sonnemans *et al*. (1998) and Andreoni (1995) among others.

In the strand of literature on group size effect, contributions to public goods have been repeatedly proven to have an inverse relationship with group size. That is, as groups increase in size, free riding attitudes proliferate. Findings indicate that the group size effect occurs due to the diminishment in the marginal per capita return (MPCR). However, if the MPCR is kept constant, such an effect is weak or inexistent (Isaac and Walker 1988). Isaac *et al*. (1994) replicate this experiment at a larger scale. They argue that moving from 4 to 10-subject groups may not be a substantial difference and run the experiment with 40 and 100 subject groups. Remarkably, these considerably large groups are more efficient in the provision of a public good than the smaller ones of 4 and 10 subjects.

However, a group size effect has scarcely been evaluated with punishment options and the only studies that do so consider peer punishment as a punishment scheme. Carpenter (2007) is the first study to link group size effect and punishment actions to find out that punishment can indeed raise contributions and it does so more strongly in large groups than in small groups. The author argues that this is driven by informational issues: as the group increases in size, there are more subjects to monitor but at the same time, they are monitored by more peers.

Our setup with a centralized external enforcer is completely different and the forces driving individuals' behaviour in Carpenter (2007) are no longer present in the scenario we consider. In our case, the variation from small to large groups is that punishment can now become more costly for the punisher. If everybody free rides, for instance, the cost the monitor would bear would be larger. Hence, we aim to study whether free riding attitudes increase making monitors punish less often in large groups and whether this is also driven by the payoff scheme.

We implement a between-subjects design where subjects are randomly assorted into groups of either 4 or 6 subjects and play a PGG. In each group, one of the subjects was randomly assigned the role of a group monitor and the rest were assigned the role of group contributors. Subjects either participated in an environment where the monitor received a fixed or a variable endowment (a bonus) to carry out the punishment decisions.

Notice that punishment is a costly action with no direct benefit for the monitor and, hence, the Nash Equilibrium would be to not carry out any punishment at all. Thus, implementing any punishment action must be due to an intrinsic motivation. This would be the only driving force explaining punishment when the monitor is endowed with a fixed salary. Moreover, if the monitor is provided with a bonus, he/she could punish as an attempt of raising future contributions, which would generate greater future bonuses. Therefore, there could also be an extrinsic motivation behind variable-payoff monitors' punishment.

This work shows that monitors have both an intrinsic and an extrinsic motivation in punishing. For this reason, they implement punishment both when they receive a fixed salary and when they are paid with a bonus. In small groups, fixed-payoff monitors punish more than monitors who are paid with a bonus. Nevertheless, as groups increase in size, these fixed-payoff monitors start free riding on punishment and those who have a bonus perform a more aggressive punishment strategy. This occurs because the intrinsic motivation of punishment gets restrained and the extrinsic one gets accentuated. The reason behind this reverse in the predominant motivations occurs due to the greater expected returns that variable-payoff monitors expect in larger groups.

Workers, on the other hand, are influenced by the behaviour of their colleagues and by the monitor's scheme. Namely, they exert higher effort when the monitor receives a bonus for their work. Therefore, knowing that the monitor is benefiting from their teamwork and that, therefore, he/she has an extrinsic motivation in punishing, does not cause a negative reaction on effort exertion. Group size and punishment actions, nevertheless, do not affect workers. This makes the monitors' objective of raising contributions to the common task through aggressive punishment strategies to fail.

This study helps us understand that interacting particular payoff schemes with different group sizes may provide inefficient results. One strand of management literature suggests that bonus payoffs increase efficiency. Moreover, economic literature claims that punishment mechanisms can also increase efficiency by overcoming free riding issues. Nonetheless, providing monitors with a bonus payoff can have a counterproductive effect if the monitored group is large.

The rest of this paper is organized as follows. First we describe the experimental design and implementation. Then we present the model's theoretical predictions and hypotheses. The central section explains the main results and finally, the last section states some concluding remarks.

EXPERIMENTAL DESIGN

The experiment was carried out at the Laboratory for Research in Behavioural Experimental Economics (LINEEX) from the University of Valencia from October 2017 to September 2018. A total of 300 participants

TABLE 1
CITIZENS' PAYOFF FUNCTION

	$n = 4$	$n = 6$
Punished	$10 - g_i + \frac{1.2}{3}\sum_{i=1}^{3} g_i - 3$	$10 - g_i + \frac{2}{5}\sum_{i=1}^{5} g_i - 3$
Not punished	$10 - g_i + \frac{1.2}{3}\sum_{i=1}^{3} g_i$	$10 - g_i + \frac{2}{5}\sum_{i=1}^{5} g_i$

Source: Authors.

TABLE 2
SHERIFFS' PAYOFF FUNCTION

	$n = 4$	$n = 6$
Fixed	$13 - p$	$15 - p$
Bonus	$3 + 0.4\sum_{i=1}^{3} g_i - p$	$5 + 0.4\sum_{i=1}^{5} g_i - p$

Source: Authors.

took part in 5 sessions of 60 subjects each. Subjects only participated in one of the four treatments. The experimental currency was expressed in points, where 20 points=1€. Each session lasted approximately 90 minutes and the average earnings a subject made were of 15€. See instructions in the Appendix.

Teamwork can be seen as a public good, where effort exertion is the contribution to a common project from which workers benefit, such as the firm's goal or the firm's success. An external monitor can be the Chief Executive Officer (CEO), who can punish workers' under effort through their salary. For this reason, we use a Public Goods Game (PGG) experimental setup to approach this problem.

We implement 4 treatments in a 2x2 arrangement, where we vary (i) group size and (ii) the monitor's payoff scheme. Regarding group size, we assort groups of 4 and 6 subjects. Moreover, we provide monitors with either a fixed salary or a variable salary (bonus) from which to decide on the punishment actions.

At the beginning of each session, subjects are randomly assembled into groups of n members, where. $n \in \{4,6\}$. In each group, $n-1$ were randomly assigned the role of citizens (workers) and 1 was randomly assigned the role of sheriff (CEO). They would play a minimum of 10 and a maximum of 20 rounds of the following 2-stage game.

Stage 1- PGG

Citizens were given an endowment of 10 points, from which they individually decided how much to devote to the public good, g_i. The rest was kept as savings. Once the contributions were made, the aggregate contributions were multiplied by a factor λ_n (where $\lambda_4 = 1.2$ and $\lambda_6 = 2$) and divided among the $n-1$ citizens. (1)

Stage 2- Punishment

The group sheriff was provided with an endowment for punishment. For the «*fixed*» treatments, this endowment was fixed and equal to $\bar{s}_n$ points ($\bar{s}_4 = 13$ and $\bar{s}_6 = 15$). (where In the «*bonus*» treatments, this endowment was variable and equal to s_n points (where $s_4 = 3 + 0.4\sum_{i=1}^{n-1} g_i$ and $s_6 = 5 + 0.4\sum_{i=1}^{n-1} g_i$).(2)
Everybody observed the individual anonymous contributions and the sheriff decided whom to punish at a cost of 1 point for every citizen punished, amount which was deduced from his or her endowment. Let's denote with p the number of citizens a sheriff decides to punish in a particular round. Once these decisions were made, each punished citizen paid a fine of 3 points.

Payoff functions are summarized in tables 1 and 2.

Before the game started, all subjects played 5 unpaid trial rounds without punishment, i.e. only Stage 1. This was of common knowledge. After those rounds, the real game would start with a minimum of 10 and a maximum of 20 periods. The probability that the game continued after the tenth round was of 80%. (3)

THEORETICAL PREDICTIONS AND HYPOTHESES

If we assume participants are selfish agents, no citizen would contribute to the public good and no sheriff would implement punishment. This would be the game's Nash Equilibrium. However, experimental literature has repeatedly shown the existence of other preferences and biases that deviate behaviour from the theoretical prediction. In this context, our objective is to analyse the impact on punishment and on contributions of different payoff schemes and of different group sizes. With this end, we propose the following set of hypotheses, aligned with selfish preferences, such that their rejection implies deviation from the Nash Equilibrium.

Monitors

H1: *The proportion of punished contributions when the monitor has a bonus is the same than the proportion of punished contributions when the monitor has a fixed salary.*

As punishment is a costly action that has no direct benefit for the monitor, a selfish monitor would not implement punishment at all, regardless of his/her payoff scheme. Thus, if punishment is implemented, it must be due to an intrinsic motivation to achieve a more socially efficient outcome. Furthermore, if punishment is implemented more frequently when the monitor has a bonus, it must be due to an extrinsic motivation to punish. Specifically, a monitor could be interested in punishing in order to raise contributions, which, in turn, would increase his/her bonus in future rounds.

H2: *The proportion of punished contributions when the monitored group has 3 members is the same as the proportion of punished contributions when it has 5 members.*

Punishment costs depend on the number of punished citizens. In particular, the monitor pays 1 point for every punished citizen. For this reason, the number of citizens in the group should not vary the punishment strategy of selfish monitors, who would not implement punishment at all, regardless of group size. However, if there is punishment, due to the intrinsic motivation formerly explained, and it is less frequent in large groups, it will be because monitors free ride on punishment as groups increase in size.

Citizens

H3: *Average contributions when the monitor has a bonus are the same than average contributions when the monitor has a fixed salary.*

Citizens' payoff function does not depend on the monitors' incentives. Therefore, citizens' contributions should not vary across different payoff schemes. If, alternatively, contributions were positive, it would be because of the existence of social preferences among participants. Furthermore, if contributions varied across treatments and were always lower when the monitor had a bonus, it would be because citizens react negatively to the fact that the monitor is indirectly benefitting from their contributions.

H4: *Average contributions when the monitored group has 3 members are the same as average contributions when the monitored group has 5 members.*

Similarly, following selfishness assumptions, contributing strategies should not be affected by group size. If, nevertheless, this were the case and contributions were lower in larger groups it must be due to a proliferation of free riding.

RESULTS

In this section, we aim to understand how did the monitor's motivations and the size of the group he/she was monitoring affect contributions to the public good and sanctions. With this end, we present in Table 3 the average contribution in points for the four treatments and in Table 4, the proportion of contributions that were punished.

TABLE 3
AVERAGE CONTRIBUTIONS IN POINTS

	Fixed	Bonus
$n = 4$	4.1	5.51
$n = 6$	4.42	4.83

Source: Authors.

TABLE 4
PROPORTION OF PUNISHED CONTRIBUTIONS

	Fixed	Bonus
$n = 4$	29.3%	24%
$n = 6$	19.07%	24.27%

Source: Authors.

The first result to be emphasised is that citizens place positive contributions to the public good, which in our context would mean that workers exert positive levels of effort in the common task. This reveals that individuals have social preferences. Additionally, contributions were not equal across treatments.

As it is noticeable, contributions when the monitor received a bonus were always greater than contributions when the monitor had a fixed salary, regardless of group size. Furthermore, the distance between contributions shortens as groups become larger. All differences are statistically significant ($p^{***} = 0.000$ for all comparisons). (4) If we compare contributions in small and large groups, we can claim that citizens contribute less in large groups when the monitor has a bonus and contribute more in large groups when the monitor has a fixed salary. Therefore, when increasing group size, there is only a free riding proliferation in contributions under the presence of variable-payoff monitors.

Regarding sanctions, the first result to be highlighted is that monitors make use of their sanctioning power by implementing punishment. As this action is a costly action, any punishment decision must be driven by an intrinsic motivation caused by the disagreement with the level of cooperation achieved by the group members. Furthermore, this power is not equally implemented across treatments.

Comparing across payoff schemes, we observe that the proportion of punished contributions is only larger with a bonus when groups are sufficiently large. In

TABLE 5
MONITORS' BEHAVIOUR – PROBABILITY THAT A CONTRIBUTION IS PUNISHED

	Groups of $n = 4$			Groups of $n = 6$		
	Estimate	**Std. Error**	**Pr(>|t)**	**Estimate**	**Std. Error**	**Pr(>|t)**
Diff. with avg. contribution t	-0.40960	0.04081	0.0000***	-0.54409	0.03585	0.0000***
Group fines $t-1$	0.26878	0.09614	0.00518**	0.54166	0.06483	0.0000***
Round	-	-	-	-0.37819	0.11818	0.00137**
Round^2	-	-	-	0.02748	0.01052	0.00896**
Bonus	-0.36458	0.16725	0.02927*	0.26017	0.14991	0.08266 .
			N=900			**N=1500**

Source: Authors.

. $p<0.1$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$

small groups, however, fixed-salary monitors punish more. If we compare across group sizes, punishment is more frequent in small groups than in large groups only when there is a fixed salary. With a bonus, however, the proportion of punished contributions is only slightly larger in large groups. Hence, when moving from small to large groups, the payoff scheme under which punishment is more aggressive is reversed.

Therefore, broadly speaking, as groups increase in size, monitors' extrinsic motivation gets accentuated with respect to the mere intrinsic motivation present in any kind of punishment. Their strategy is to implement punishment in a more aggressive manner when groups are larger and they are paid with a bonus. Nevertheless, aggressive punishment is not effective in the sense that it does not achieve greater levels of group cooperation. This is summarized in the following results.

RESULT 1: *As groups increase in size, monitors implement more aggressive punishment when they receive a bonus than when they receive a fixed salary.*

RESULT 2: *Aggressive punishment strategies do not raise contributions.*

These results indicate that contributions and sanctions are not mutually responsive. In other words, we cannot ascertain that contributions are responding to a specific punishment strategy and/or that punishment is reacting to particular contribution levels. For this reason, there must be other forces driving contributors and monitors to behave as they did. In what follows, we analyse monitors and contributors' behaviour separately to explore the potential forces affecting their behaviour in small and in large groups.

MONITORS' BEHAVIOUR

The first question we raise in the setup of monitoring teamwork focuses on understanding how do CEOs behave when monitoring a team, as the size of the group that is being monitored changes. With this end, we run a generalized linear model with a logit function, where the dependent variable is the individual probability that a contribution of individual i is punished in round t. See Table 5.

In any of the scenarios, monitors punish less as the distance of the contribution with respect to the group average contribution increases. This variable has a greater explanatory power than the contribution itself. This implies that monitors do not consider the absolute value of contributions, but relativize an individual's contribution with respect to that of their colleagues. Furthermore, monitors are someway anchored to the number of group sanctions they implemented in the previous period as this variable presents a positive impact in their present behaviour. Additionally, the probability that a contribution is punished has a decreasing probability over time, only significant in larger groups.

However, what deserves particular attention in this analysis is the impact of the bonus payoff scheme on monitors' behaviour. When the group is of a small size, receiving a bonus diminishes the probability that a contribution is punished by 0.36. This is what makes punishment more aggressive with fixed payoff schemes in small groups. However, in large groups, receiving a bonus payoff scheme increases by 0.26 the probability that a contribution is punished. Thus, punishment in large groups is more aggressive with variable payoff schemes.

Therefore, the change in the direction of the impact of the payoff scheme on monitors' behaviour accounts for the reversal of aggressive punishment. As it was appreciated in Table 4, monitors punished more aggressively with a fixed payoff in small groups and with a bonus in large groups.

Intuitively, with a bonus, as the monitors' payoff depends on the level of group cooperation to the public good, they could punish to a larger extent in order to raise contributions, which, in turn, would raise their future payoffs. Punishment with a bonus, therefore, can be driven by an extrinsic motivation as well as by an intrinsic motivation. However, this only occurred when groups were sufficiently large.

TABLE 6
CONTRIBUTING BEHAVIOUR

	Groups of $n = 4$			Groups of $n = 6$		
	Estimate	**Std. Error**	**Pr(>|t|)**	**Estimate**	**Std. Error**	**Pr(>|t|)**
Contribution $t-1$	0.32569	0.03209	0.0000***	0.380881	0.025313	0.0000***
Avg. contribution $t-1$	0.38655	0.03774	0.0000***	0.275396	0.035637	0.0000***
Round	-0.91046	0.12632	0.0000***	-1.008039	0.110063	0.0000***
Round^2	0.06156	0.01092	0.0000***	0.068861	0.009579	0.0000***
Bonus	0.53046	0.15294	0.0005***	0.201867	0.125274	0.107
			N=900			**N=1500**

Source: Authors.

*.p<0.1; * p<0.05; ** p<0.01; *** p<0.001*

Contributors' behaviour

The second objective that we propose in this context is to analyse how do employees that are working in a team react to the monitor's payoff scheme and to their group size. With this purpose, we run an ordinary least squares regression, where the dependent variable is the probability that contribution of individual i is punished in round t. See Table 6.

An individual's contribution to the public good is, in any of the two group sizes proposed, strongly influenced by how much he/she has contributed in the previous period and how much the group has contributed in the previous period. Both of these variables have a positive effect, showing that high individual and group contributions yesterday lead to higher individual and group contributions today. As with sanctions, and in line with literature on public goods games, contributions presented a decreasing pattern over time.

Concerning the effect of previous punishment, this was not a factor conditioning the contributing strategy, as its impact is not significant on contributions. However, the relation between average contributions and proportion of punished contributions presented in Tables 3 and 4 suggest that there is an intermediate threshold of punishment which contributors tolerate. If, punishment is too low, it has no positive impact on contributions. If, instead, it is too high, it causes a rebound effect. The characterization of such threshold we leave for future research.

Additionally, the payoff scheme of the monitor had a significant impact on the contributors' decisions. In particular, when the monitor received a bonus, contributions were 0.53 points higher in small groups and 0.2 points higher in large groups than when the monitor received a fixed payoff. This result indicates us that in a teamwork environment, how the CEO is paid is going to have an impact on how the team works. The extrinsic motivation to punish is not perceived as something negative by workers and, in fact, is going to have a positive impact on their effort contributions to the common task.

Nevertheless, group size did not have a significant effect on contributing behaviour. In other words, belonging to larger teams does not thrive free-riding among workers. This result is also supported by previous works on group size, which claim that if the MPCR is kept constant from small to large groups, contributions should also remain constant (Isaac and Walker, 1988).

Pilot sessions

As part of this experiment, we also run two pilot sessions with a larger$n = 8.$group size, That is, with 7 contributors and 1 monitor. Even though data is not sufficient as to include in our analysis, it allows us to assert that the consideration of a larger group size reinforces our results.

In groups of 7 contributors and 1 monitor, punishment became even more aggressive when monitors received a bonus. Specifically, 27.8% of contributions were punished in this case. This only led to lower contributions (3.76 points on average) supporting the result that aggressive punishment does not raise contributions. Moreover, the intrinsic motivation to punish also faded with the fixed-salary monitor, being only 13.8% of the contributions in this context punished.

CONCLUDING REMARKS

Monitoring of teamwork can be seen as a public goods game with punishment opportunities, where workers contribute with their effort to a costly common task. The team manager or the firm's CEO can be represented by a centralized external monitor with punishment power. In this context, we analyse the effect of the different motivations that monitors have provided by different payoff schemes for different group sizes. This way, we aim to understand the interdependence that payoff schemes and group size have in the structure of a teamwork culture.

Our experimental results provide us novel insights about teamwork culture. In particular, as the monitored group

increases in size, fixed-payoff monitors start free riding on punishment. Their intrinsic motivation dilutes as the number of controlled workers grows in size. With bonuses, however, the extrinsic motivation effect does not fade away and punishment becomes more aggressive in large groups. This happens because monitors expect higher returns from groups of 5 contributors than from groups of 3. Thus, the salient punishment motivation changes when monitored groups change of size.

Contributors (workers), on the other side, do not respond in a significant manner to group size. Instead, their contributions are driven by group contributions and the monitor's payoff scheme. In particular, they find the monitor's contingent payoff legitimate and contribute more in these cases. However, punishment does not have the effect that monitors would expect: aggressive punishment strategies do not achieve an increase in teamwork effort.

These results allow us to take notice about a factor that can strongly affect firm culture: group size. Literature has already pinpointed that group size can lead to a more efficient outcome but that, at the same time, it can also increase the coordination problem among group members. In order to mitigate the coordination issue, economic literature has proposed the introduction of monitoring possibilities, which can either be endowed with punishment power or not. However, the monitor's payoff scheme is going to have an impact on the outcome, and the magnitude and direction of this effect is going to depend on the size of the group that is being monitored.

These findings open up new questions. Can the negative effect of some payoff schemes in some group sizes be reverted? Should contributors be provided more information about the monitors' behaviour? Should monitors be monitored as well? Ultimately, who guards the guardians?

NOTES

[1] Notice that the different values λ_n takes makes the MPCR ($\frac{\lambda_n}{n}$) not change across treatments. $\frac{1.2}{3} = \frac{2}{5} = 0.4$. Specifically, This way, no group size effect is expected occur, following experimental results by Isaac and Walker (1988).

[2] Providing the sheriffs with a fixed endowment of 3 or 5 units in the bonus treatments allows for punishment in a possible scenario where everybody fully free rides on the public good.

[3] This made the number of rounds in each session to differ. We observe an end-of-the-world effect in the 10^{th} round, being there a diminishment in the size of contributions and a restart pattern after that. As this phenomenon was common across treatments, for the analysis we only take the 10 first rounds.

[4] For these comparisons, we carried out a t-test where the null hypothesis considered equal contributions and the alternative hypothesis considered greater contributions. N=450 in treatments with $n = 4$. and N=750 in treatments $n = 6$. with

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APPENDIX. INSTRUCTIONS **n=4**

Bienvenidos al experimento

El propósito de este experimento es estudiar cómo toman los individuos decisiones en determinados contextos. Las instrucciones son simples y si las sigues cuidadosamente recibirás una cantidad de dinero en efectivo al final del experimento de manera confidencial, dado que nadie conocerá los pagos recibidos por el resto de participantes. Podéis preguntarnos en cualquier momento las dudas que tengáis levantando primero la mano. Fuera de esas preguntas, cualquier tipo de comunicación entre vosotros está prohibida y sujeta a la exclusión inmediata del Experimento.

¿En qué consiste este experimento?

A lo largo de este experimento vas a formar parte de un grupo de un total de 4 personas, incluyéndote a ti. Dentro de cada grupo de 4 personas, 1 va a ser asignado el rol de sheriff, mientras que los otros 3 serán asignados el rol de ciudadanos. La formación de grupos y la asignación de roles será realizada **una sola vez** al principio de la sesión y de manera aleatoria. Es decir, formarás parte del mismo grupo y tendrás el mismo rol a lo largo de todo el experimento.

El experimento consta de un mínimo de 10 y un máximo de 20 periodos, cada uno de ellos compuesto por dos fases.

Fase 1

En esta fase, los 3 ciudadanos deben tomar una decisión de inversión. Para ello, cada ciudadano recibirá una dotación de puntos y deberá decidir de manera individual cuántos puntos dedicar a la inversión en un proyecto común y cuántos puntos guardar como ahorro. Los puntos que cada ciudadano decida invertir en el proyecto se multiplicarán por 1.2. A esto lo llamamos el **rendimiento de la inversión.** Dicho rendimiento se repartirá a partes iguales entre los 3 ciudadanos del grupo.

Los beneficios para cada ciudadano en esta fase, por tanto serán:

Beneficios Fase 1: $\frac{(R)}{3} + puntos\ ahorrados$

Rendimiento de la inversión **(R)** $= 1.2 \cdot Suma\ de\ los\ puntos\ invertidos$

En esta fase, los sheriffs no tomarán ninguna decisión.

Fase 2

En esta fase, los sheriffs recibirán una dotación para realizar las sanciones que consideren oportunas. A continuación, todos observaréis cuales han sido las inversiones anónimas que cada ciudadano ha dedicado al proyecto común y el sheriff individualmente decidirá si quiere **sancionar** y a quien. Por cada ciudadano que decida sancionar, se deducirá 1 punto de su dotación. Los ciudadanos sancionados pagarán una sanción equivalente a 3 puntos. Todos los jugadores, tanto ciudadanos como sheriffs verán las inversiones de los ciudadanos y la decisión del sheriff sobre las sanciones.

Los **beneficios totales**, por tanto serán:

Sheriff $= Dotación - número\ de\ ciudadanos\ sancionados$

Ciudadano $= \frac{(R)}{3} + puntos\ ahorrados - 3$ si el sheriff ha decidido sancionarle.

Ciudadano $= \frac{(R)}{3} + puntos\ ahorrados$ si el sheriff ha decidido **no** sancionarle.

En esta fase, los ciudadanos no toman ninguna decisión.

Antes de comenzar, todos jugaréis 5 rondas de la fase 1 a modo de prueba. Es decir, en estas 5 rondas, todos seréis ciudadanos y solamente probaréis la fase de inversión. Una vez pasadas las 5 rondas de prueba, comenzará el juego. Se te asignará aleatoriamente el rol de sheriff o ciudadano y jugaréis las dos fases durante un mínimo de 10 y un máximo de 20 periodos. Tras la décima ronda, la probabilidad de seguir jugando el siguiente periodo será del 80%. La suma de los beneficios que tú acumules en cada periodo determinarán tus ganancias totales del experimento. Los puntos se convertirán en Euros al final del experimento según la siguiente relación:

20 puntos = 1 Euro

Una vez finalice el juego, se os pedirá que contestéis a un breve cuestionario cuyas instrucciones observaréis en pantalla.

APPENDIX. INSTRUCTIONS **n=6**

Bienvenidos al experimento

El propósito de este experimento es estudiar cómo toman los individuos decisiones en determinados contextos. Las instrucciones son simples y si las sigues cuidadosamente recibirás una cantidad de dinero en efectivo al final del experimento de manera confidencial, dado que nadie conocerá los pagos recibidos por el resto de participantes. Podéis preguntarnos en cualquier momento las dudas que tengáis levantando primero la mano. Fuera de esas preguntas, cualquier tipo de comunicación entre vosotros está prohibida y sujeta a la exclusión inmediata del Experimento.

¿En qué consiste este experimento?

A lo largo de este experimento vas a formar parte de un grupo de un total de 6 personas, incluyéndote a ti. Dentro de cada grupo de 6 personas, 1 va a ser asignado el rol de sheriff, mientras que los otros 3 serán asignados el rol de ciudadanos. La formación de grupos y la asignación de roles será realizada **una sola vez** al principio de la sesión y de manera aleatoria. Es decir, formarás parte del mismo grupo y tendrás el mismo rol a lo largo de todo el experimento.

El experimento consta de un mínimo de 10 y un máximo de 20 periodos, cada uno de ellos compuesto por dos fases.

Fase 1

En esta fase, los 5 ciudadanos deben tomar una decisión de inversión. Para ello, cada ciudadano recibirá una dotación de puntos y deberá decidir de manera individual cuántos puntos dedicar a la inversión en un proyecto común y cuántos puntos guardar como ahorro. Los puntos que cada ciudadano decida invertir en el proyecto se multiplicarán por 2. A esto lo llamamos el **rendimiento de la inversión.** Dicho rendimiento se repartirá a partes iguales entre los 5 ciudadanos del grupo.

Los beneficios para cada ciudadano en esta fase, por tanto serán:

Beneficios Fase 1: $\frac{(R)}{5} + puntos\ ahorrados$

Rendimiento de la inversión **(R)** $= 2 \cdot Suma\ de\ los\ puntos\ invertidos$

En esta fase, los sheriffs no tomarán ninguna decisión.

Fase 2

En esta fase, los sheriffs recibirán una dotación para realizar las sanciones que consideren oportunas. A continuación, todos observaréis cuales han sido las inversiones anónimas que cada ciudadano ha dedicado al proyecto común y el sheriff individualmente decidirá si quiere **sancionar** y a quien. Por cada ciudadano que decida sancionar, se deducirá 1 punto de su dotación. Los ciudadanos sancionados pagarán una sanción equivalente a 3 puntos. Todos los jugadores, tanto ciudadanos como sheriffs verán las inversiones de los ciudadanos y la decisión del sheriff sobre las sanciones.

Los **beneficios totales**, por tanto serán:

Sheriff $= Dotación - número\ de\ ciudadanos\ sancionados$

Ciudadano $= \frac{(R)}{5} + puntos\ ahorrados - 3$ si el sheriff ha decidido sancionarle.

Ciudadano $= \frac{(R)}{5} + puntos\ ahorrados$ si el sheriff ha decidido **no** sancionarle.

En esta fase, los ciudadanos no toman ninguna decisión.

Antes de comenzar, todos jugaréis 5 rondas de la fase 1 a modo de prueba. Es decir, en estas 5 rondas, todos seréis ciudadanos y solamente probaréis la fase de inversión. Una vez pasadas las 5 rondas de prueba, comenzará el juego. Se te asignará aleatoriamente el rol de sheriff o ciudadano y jugaréis las dos fases durante un mínimo de 10 y un máximo de 20 periodos. Tras la décima ronda, la probabilidad de seguir jugando el siguiente periodo será del 80%. La suma de los beneficios que tú acumules en cada periodo determinarán tus ganancias totales del experimento. Los puntos se convertirán en Euros al final del experimento según la siguiente relación:

20 puntos = 1 Euro

Una vez finalice el juego, se os pedirá que contestéis a un breve cuestionario cuyas instrucciones observaréis en pantalla.