Incentives for Effort Provision in Groups

PhD Thesis

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Abstract

This thesis consists of three independent essays, unified by the common theme of incentives for effort provision in groups.

In Chapter 2 we develop a multi-stage contest design where heterogeneous agents face the prospect of promotion and the threat of demotion from one stage to the next. We illustrate theoretically that if agents are homogeneous in ability, the principal is better off pooling agents in one division. However, if there are ability differences, the principal is better off assigning agents to separate divisions based on ability level, while allowing for agents to be promoted and demoted after each stage of play. The experimental results support the use of promotion and demotion in multi-stage contests when abilities are heterogeneous. In contrast with the theoretical predictions, we did not find significant differences in total effort between the pooled contest and the contest with promotion and demotion when abilities were homogeneous.

Chapter 3 provides a comparison between a two-strike exclusion policy and a zero-tolerance exclusion policy as a means for fostering cooperation in groups. The results from our experiment suggest that group members tend to cooperate more after receiving a strike. However, requiring group members to issue strikes to one another prior to exclusion seemed to be less effective than allowing for exclusion without prior receipt of strikes.

In Chapter 4 we determine whether the efficacy of mutual monitoring in fostering cooperation is dependent on the degree of approval motivation within teams. Approval motivation is defined as the desire to produce positive perceptions in others and the incentive to acquire the approval of others as well as the desire to avoid disapproval, Martin (1984). The hypotheses developed in the theoretical section provide support for the notion that individuals will be more responsive to mutual monitoring if they possess a higher degree of approval motivation. However, the results generated from the experiment suggest that the efficacy of mutual monitoring in fostering cooperation is negatively correlated with the degree of approval motivation within teams.

Certificate of original authorship

I, Jonathan Levy, declare that this thesis is submitted in fulfillment of the requirements for the award of Doctor of Philosophy, in the Business School at the University of Technology Sydney. This thesis is wholly my own work unless otherwise indicated in the references or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This document has not been submitted for qualifications at any other academic institution. This research was supported by the Australian Government Research Training Program.

Signature:

Date: February 14, 2020

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Chapter 1

Introduction

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In Chapter 2 we develop a multi-stage contest design where heterogeneous agents face the prospect of promotion and the threat of demotion from one stage to the next. We illustrate theoretically that if agents are homogeneous in ability, the principal is better off pooling agents in one division. However, if there are ability differences, the principal is better off assigning agents to separate divisions based on ability level, while allowing for agents to be promoted and demoted after each stage of play. The experimental results support the use of promotion and demotion in multi-stage contests when abilities are heterogeneous. In contrast with the theoretical predictions, we did not find significant differences in total effort between the pooled contest and the contest with promotion and demotion when abilities were homogeneous. This research has direct policy implications for management practices in a variety of settings e.g. organizations, education and sport. In settings where contests are already being used to incentivize effort among employees, we recommend that the manager subdivides employees based on ability and implement some form of promotion and demotion, if they observe a sufficiently high level of heterogeneity in abilities.

In many cases poor performers must receive a warning in the form of a strike prior to being excluded from their group. Chapter 3 provides a comparison between a two-strike exclusion policy and a zero-tolerance exclusion policy as a means for fostering cooperation in groups. The results from our experiment suggest that group members tend to cooperate more after receiving a strike. However, requiring group members to issue strikes to one another prior to exclusion seemed to be less effective than allowing for exclusion without prior receipt of strikes. Individuals were less cooperative under the two-strike regime as they only faced the threat of exclusion after they received a strike. Consequently, the zero-tolerance approach commonly utilized by US companies to dismiss employees for poor performance may indeed be the most effective and efficient form of exclusion for fostering cooperation in groups.

In Chapter 4 we determine whether the efficacy of mutual monitoring in fostering cooperation is dependent on the degree of approval motivation within teams. Approval motivation is defined as the desire to produce positive perceptions in others and the incentive to acquire the approval of others as well as the desire to avoid disapproval, Martin (1984). The hypotheses developed in the theoretical section provide support for the notion that individuals will be more responsive to mutual monitoring if they possess a higher degree of approval motivation. However, the results generated from the experiment suggest that the efficacy of mutual monitoring in fostering cooperation is negatively correlated with the degree of approval motivation within teams. Considering the production setting, a principal could potentially use the findings of this study to screen for agents who have a greater propensity to cooperate in teams, e.g. recruiters seeking to hire workers in open-plan office spaces.

This dissertation concludes with Chapter 5, in which the key findings are summarized and ideas for future areas of research are outlined.

Chapter 2

Promotion and demotion in multi-stage contests

Forms of promotion and demotion are regularly implemented in a variety of settings, for example the gig economy. Uber introduced their Pro reward scheme in select cities around the world in 2018. The Pro reward scheme involves drivers being allocated to different "tiers" based on their feedback score and the number of rides they complete. High performing drivers are assigned to higher tiers where they receive more lucrative perks such as free college tuition and 24/7 roadside assistance. At the same time, drivers face the prospect of being demoted to lower tiers if their performance drops. Under such circumstances they would no longer receive the same perks as they did previously.

Another example where promotion and demotion is frequently observed is in sales. Real estate agents are assigned to sell either high or low value properties based on their sales history. Agents who prove to be relatively successful in selling property may be assigned to more lucrative properties in the future where they receive a higher commission on the sale of the property. Whereas, agents who fail to sell properties for an extended period of time face the threat of being replaced by one of their colleagues, thus, not receiving any commission and potentially being assigned to sell less desirable properties in the future.

The objective of this study is to determine whether promotion and demotion is effective in motivating individuals to compete with one another. Specifically, we investigate promotion and demotion within a lottery contest framework (Tullock 1980). By conducting laboratory experiments we can control for the influence of unobservable variables that might affect performance and promotion/demotion decisions in the field, such as employee soft skills or supervisor favoritism (Prendergast and Topel 1996).

The most heavily investigated contest design is the single-prize pooled contest. In some cases, single-prize pooled contests may be optimal in terms of incentivizing effort. However, in many cases these contests are suboptimal. For example, consider a situation where several agents are of high ability and the rest are of low ability. Under such circumstances one would expect the low ability agents to exert a low amount of effort as their likelihood of winning the prize would be quite low.[1] A simple way for the principal to encourage the low ability agents to exert higher levels of effort is to group agents based on ability level and create multiple sub-contests. By reducing the heterogeneity within subgroups, the principal should expect higher levels of engagement from the low ability agents. Assuming a fixed prize size, the principal would need to reduce the prize awarded to high ability agents in order to increase the incentive for low ability agents to exert effort. Hence, dividing the prize across subgroups simply results in a more even distribution of effort across all agents, and it does not necessarily increase total effort.[2] In addition to grouping agents, we believe the principal should allow for promotion and demotion across sub-groups to incentivize higher levels of effort than what they would generate under the pooled contest design. Note, the focus of this study is on how different contest designs incentivize effort. We are not interested in how contests can be used to sort agents.

In this study we theoretically and experimentally compare the performance of two contest designs. In the first contest design (our benchmark), all agents compete

[1] This phenomenon is commonly referred to as the "discouragement effect", see Dechenaux et al. (2015) for more details.

[2] A contest designer could implement an intermediate design where agents are assigned to separate divisions based on ability without the opportunity for promotion or demotion across divisions. We illustrate in section 2.7 that this intermediate design is never better at incentivizing total effort than the pooled design.

with one another in one "division" for a single prize in each stage of the game (henceforth "Pooled contest"). In the second contest design, high ability agents begin by competing for a high-value prize in Division 1 and low ability agents begin by competing for a low-value prize in Division 2. Agents who win in stage t of the game in Division 2 are promoted to Division 1 in stage $t+1$, and agents who lose in stage t of the game in Division 1 are demoted to Division 2 in stage $t+1$ (henceforth "Promotion and demotion contest"). The objective of this study is to determine whether the Promotion and demotion contest induces more effort than the Pooled contest.

We develop a three-stage contest design where heterogeneous agents face the prospect of promotion and the threat of demotion from one stage to the next. The game must consist of at least three stages in order to allow for agents to be promoted and demoted within the same game. We establish theoretically that if abilities are homogeneous, the principal is better off implementing a Pooled contest. However, if abilities are heterogeneous, the principal should instead employ the Promotion and demotion contest. These theoretical findings can be explained intuitively. Suppose all agents are homogeneous in ability. Under such circumstances it is best to pool agents and award a single prize. By maximizing the stakes and the number of competitors in play the principal can generate higher effort. However, if abilities are heterogeneous, agents with low ability will be discouraged from exerting effort. Hence, it would be better to split agents across separate divisions based on their ability level, while allowing for promotion and demotion to stimulate high levels of engagement from all agents. The experimental results support the use of promotion and demotion in multi-stage contests when abilities are heterogeneous. In contrast with the theoretical predictions, we did not find significant differences in total effort between the Pooled and Promotion and demotion contest when abilities were homogeneous. A possible explanation for this discrepancy between the theory and the experimental findings is participants' desire to achieve a higher status.

This study contributes to the vast literature on performance-based incentives. Bull et al. (1987), Lazear (2000), Ariely et al. (2009) and Ederer and Manso (2013) investigate the impact of piece rate payments on performance. In contrast, we compare the efficacy of different contest designs in incentivizing effort. Others such as Tullock (1980), Lazear and Rosen (1981), Schotter and Weigelt (1992), Moldovanu and Sela (2001), Moldovanu et al. (2007) and Sheremeta (2011) also study the effects of contests on effort exertion. We focus on settings where contestants make decisions dynamically, whereas, those mentioned previously studied contests of a static nature.

The literature which is most relevant to this study is on multi-stage contests. Parco et al. (2005), Amaldoss and Rapoport (2009), Sheremeta (2010a, 2010b) and Höchtl et al. (2011) study two-stage elimination contests. In elimination contests agents exert effort in order to progress to the final stage and win a prize. At the end of each stage, a specific number of agents are eliminated from participation in the subsequent stages of the contest. Once an agent has been eliminated, they are no longer in contention for the prize. By contrast, in our study agents have the opportunity to return to a higher division after being demoted in a prior stage. Jasina and Rotthoff (2012) construct a multi-stage contest model where homogeneous agents get promoted and demoted, whereas we examine promotion and demotion in an environment where agents are heterogeneous in ability. This feature enables us to contribute to the literature by illustrating how the efficacy of Promotion and demotion contests in incentivizing effort depends on ability differences. Unlike Jasina and Rotthoff (2012), we show theoretically that the Promotion and demotion contest is suboptimal when abilities are homogeneous.[3]

We also contribute to the literature on endogenous group formation. Ahn et al. (2008), Brekke et al. (2011) and Aimone et al. (2013) study endogenous group formation in public-goods provision games. Carrell et al. (2013) investigate the effects of endogenous group formation on academic performance for entering freshmen at the United States Air Force Academy. We allow for groups to endogenously form within a contest framework. In our study agents are either promoted or demoted based on their behaviour in the previous stage of the game. Büyükboyacı (2016) investigates a Parallel contest where agents were able to choose which division to

[3] Jasina and Rotthoff (2012) do not compare the Promotion and demotion contest with the Pooled contest. This explains why they did not establish the suboptimality result we derive.

compete in. However, in her study there was no possibility of promotion or demotion. Büyükboyacı (2016) found that the Parallel contest design was more effective in fostering effort than a pooled design, when ability differences were large. By contrast, we illustrate theoretically how the Pooled contest is suboptimal even for small ability differences. Moreover, we are the first to illustrate theoretically and experimentally how the efficacy of promotion and demotion policies depends on ability differences.

2.1 Model

2.1.1 Promotion and demotion contest

The game consists of three stages, where agents participate in a lottery contest in each stage. Agents are split into two divisions, Division 1 and Division 2. The model has four risk neutral agents and each division has two agents. Agents placed in Division 1 in stage 1 have ability level $a_h > 0$ and agents placed in Division 2 in stage 1 have ability level $a_l > 0$, where $a_h \geq a_l$. The ability level for an agent does not change from one stage to the next. Each agent's type is common knowledge. Agents compete within their respective divisions in each stage. One agent is promoted from Division 2 and demoted from Division 1 after the contest held in stages 1 and 2. In each stage the prize for winning the contest in Division 1 is $v_1 > 0$ and the prize for winning the contest in Division 2 is $v_2 \geq 0$, where $v_1 > v_2$. The prize for not winning a contest is 0. The effort that type $i \in \{h, l\}$ exerts when facing type $j \in \{h, l\}$, in Division $d \in \{1, 2\}$, at stage $t \in \{1, 2, 3\}$ is denoted $e^j_{idt} \geq 0$ and the cost of exerting a unit of effort is 1 for all agents.

The probability of type i winning the contest against type j, in Division d, at stage t is given by the following (Tullock based) success function:

$$S^j_{idt} = \frac{a_i e^j_{idt}}{a_i e^j_{idt} + a_j e^i_{jdt}}.$$

The stage game payoff for type i against type j, in Division d, at stage t is given by the following:

$$\pi^j_{idt} = \frac{a_i e^j_{idt}}{a_i e^j_{idt} + a_j e^i_{jdt}} v_d - e^j_{idt}.$$

Payoffs are additive across stages. For simplicity, we assume that there is no discounting. Since the game consists of multiple stages, our equilibrium concept is that of Subgame Perfect Equilibrium. Agents observe the effort choice of their opponent and the outcome of the contest in each stage. In theory, the effort level chosen by an agent could be history dependent. However, in the Subgame Perfect Equilibrium this will not be the case. Since efforts are unique, the Subgame Perfect Equilibrium is unique.

Equilibrium in stage 3

We begin by deriving the equilibrium in stage 3. In stage 3 there are three possible pairings across the two divisions. We could have both high types in Division 1, both low types in Division 1 or a high and a low type in both divisions.

The problem for type i against type j, in Division d, at stage 3 is as follows:

$$\max_{e^j_{id3} \geq 0} \quad \frac{a_i e^j_{id3}}{a_i e^j_{id3} + a_j e^i_{jd3}} v_d - e^j_{id3}.$$

The Nash equilibrium effort level for type i against type j, in Division d, at stage 3, $\hat{e}^j_{id3} \in \{\hat{e}^h_{h13}, \hat{e}^l_{h13}, \hat{e}^h_{l13}, \hat{e}^l_{l13}, \hat{e}^h_{h23}, \hat{e}^l_{h23}, \hat{e}^h_{l23}, \hat{e}^l_{l23}\}$ is as follows:

$$\hat{e}^j_{id3} = \frac{a_i a_j v_d}{(a_i + a_j)^2}.$$

The equilibrium payoff for type i against type j, in Division d, at stage 3, W^j_{id3} is as follows:

$$W^j_{id3} = \frac{a_i^2 v_d}{(a_i + a_j)^2}.$$

Equilibrium in stage 2

When we allow for promotion and demotion across divisions one of the high type agents in Division 1 is demoted to Division 2 in stage 2, and one of the low type agents in Division 2 is promoted to Division 1 in stage 2. Thus, in stage 2 high types compete with low types in both divisions. The problem for type i against type $-i$, in Division d, at stage 2 is as follows:

$$\max_{e_{id2}^{-i}\geq 0} \quad \frac{a_i e_{id2}^{-i}}{a_i e_{id2}^{-i} + a_{-i} e_{-id2}^{i}}(v_d + P_{i13}^{-i}) + \left(1 - \frac{a_i e_{id2}^{-i}}{a_i e_{id2}^{-i} + a_{-i} e_{-id2}^{i}}\right) P_{i23}^{-i} - e_{id2}^{-i},$$

where,

$$P_{i13}^{-i} = \frac{a_i e_{i-d2}^{-i}}{a_i e_{i-d2}^{-i} + a_{-i} e_{-i-d2}^{i}} \frac{v_1}{4} + \left(1 - \frac{a_i e_{i-d2}^{-i}}{a_i e_{i-d2}^{-i} + a_{-i} e_{-i-d2}^{i}}\right) \frac{a_i^2 v_1}{(a_i + a_{-i})^2},$$

and,

$$P_{i23}^{-i} = \frac{a_i e_{i-d2}^{-i}}{a_i e_{i-d2}^{-i} + a_{-i} e_{-i-d2}^{i}} \frac{a_i^2 v_2}{(a_i + a_{-i})^2} + \left(1 - \frac{a_i e_{i-d2}^{-i}}{a_i e_{i-d2}^{-i} + a_{-i} e_{-i-d2}^{i}}\right) \frac{v_2}{4}.$$

Note, the first part of P_{i13}^{-i} represents the expected payoff that type i receives in stage 3 if the type i agent in the other division, $-d$, wins the contest in stage 2. The second part of P_{i13}^{-i} represents the expected payoff that type i receives in stage 3 if the type i agent in the other division, $-d$, does not win the contest in stage 2. These descriptions can also be applied to the expressions which constitute P_{i23}^{-i}.

Let the Nash equilibrium effort level for type i against type $-i$, in Division d, at stage 2 be $\hat{e}_{id2}^{-i} \in \{\hat{e}_{h12}^{l}, \hat{e}_{l12}^{h}, \hat{e}_{h22}^{l}, \hat{e}_{l22}^{h}\}$. Furthermore, let the equilibrium payoff for type i against type $-i$, in Division d, at stage 2 be W_{id2}^{-i}.[4]

Equilibrium in stage 1

Recall, in stage 1 high types compete with one another in Division 1 and low types compete with one another in Division 2. The problem for agent $m \in \{1, 2\}$ against

[4] We chose not to include the closed form solutions for the Nash equilibrium effort levels in stage 2 in this study as these expressions are very large. However, we do provide the closed form expression for equilibrium total effort across stages in section 2.5.

agent $n \neq m \in \{1,2\}$,[5] in Division d, at stage 1 is as follows:

$$\max_{e^n_{md1} \geq 0} \quad \frac{e^n_{md1}}{e^n_{md1}+e^m_{nd1}}(v_d + W^{-i}_{i12}) + \left(1 - \frac{e^n_{md1}}{e^n_{md1}+e^m_{nd1}}\right) W^{-i}_{i22} - e^n_{md1}.$$

The Nash equilibrium effort level for type i against type i, in Division d at stage 1, $\hat{e}^i_{id1} \in \{\hat{e}^h_{h11}, \hat{e}^l_{l21}\}$ is the following:

$$\hat{e}^i_{id1} = \frac{v_d + W^{-i}_{i12} - W^{-i}_{i22}}{4}.$$

After calculating W^{-i}_{i12} and W^{-i}_{i22} we can derive $\hat{e}^i_{id1}$ explicitly.

Total effort in the Promotion and demotion contest

Now that we have derived the equilibrium effort functions in each stage it is possible to calculate the total effort across all three stages in the Promotion and demotion contest, TE_{PD}, as follows:

$$TE_{PD} = \underbrace{2(\hat{e}^h_{h11} + \hat{e}^l_{l21})}_{\text{Stage 1 effort}} + \underbrace{\hat{e}^l_{h12} + \hat{e}^h_{l12} + \hat{e}^l_{h22} + \hat{e}^h_{l22}}_{\text{Stage 2 effort}} + \underbrace{\Pr(hh)[2(\hat{e}^h_{h13} + \hat{e}^l_{l23})]}_{\text{Stage 3 effort part I}}$$
$$+ \underbrace{\Pr(ll)[2(\hat{e}^h_{h23} + \hat{e}^l_{l13})] + (1 - \Pr(hh) - \Pr(ll))(\hat{e}^l_{h13} + \hat{e}^h_{l13} + \hat{e}^l_{h23} + \hat{e}^h_{l23})}_{\text{Stage 3 effort part II}},$$

where,

$$\Pr(hh) = \frac{a_h \hat{e}^l_{h12}}{a_h \hat{e}^l_{h12} + a_l \hat{e}^h_{l12}} \frac{a_h \hat{e}^l_{h22}}{a_h \hat{e}^l_{h22} + a_l \hat{e}^h_{l22}},$$

and,

$$\Pr(ll) = \frac{a_l \hat{e}^h_{l12}}{a_h \hat{e}^l_{h12} + a_l \hat{e}^h_{l12}} \frac{a_l \hat{e}^h_{l22}}{a_h \hat{e}^l_{h22} + a_l \hat{e}^h_{l22}}.$$

Recall, in stage 2 high types compete against low types in both divisions. $\Pr(hh)$ represents the probability that both high types win in stage 2 and $\Pr(ll)$ represents the probability that both low types win in stage 2.

[5]We index with m and n instead of i and j as i and j relate to the agent's type rather than their identity. In stage 1, agents compete against the same type as themselves in both divisions.

2.1.2 Pooled contest

Suppose the principal decides to allow all four agents to compete with one another in one division over 3 stages, where the winner of the lottery contest in each stage of the game receives a prize $V = v_1 + v_2$. The total prize size V represents the maximum amount of money the principal can spend on prizes which is fixed in each stage for all contest designs. The problem for type i at each stage is as follows:

$$\max_{e_i \geq 0} \quad \frac{a_i e_i}{a_h \sum_{m=1}^{2} e_m + a_l \sum_{n=3}^{4} e_n} V - e_i.$$

The Nash equilibrium effort level in each stage in the Pooled contest for high ability agents, e_h^{PO}, and low ability agents, e_l^{PO}, is the following:

$$e_h^{PO} = \frac{3a_l(2a_h - a_l)}{4(a_h + a_l)^2} V,$$

$$e_l^{PO} = \frac{3a_h(2a_l - a_h)}{4(a_h + a_l)^2} V.$$

Note, the above equilibrium only holds if $a_h \leq 2a_l$. Otherwise, if $a_h > 2a_l$, then $e_l^{PO} = 0$ and $e_h^{PO} = \frac{V}{4}$ is the unique Nash equilibrium.

Now that we have derived the equilibrium effort functions for each stage it is possible to calculate the total effort across all three stages in the Pooled contest, TE_{PO}, as follows:

$$TE_{PO} = 3[2(e_h^{PO} + e_l^{PO})] = 6(e_h^{PO} + e_l^{PO}).$$

2.1.3 Comparisons

Suppose the objective of the principal is to maximize total effort across divisions and across stages. After solving each of the three-stage games outlined earlier it is possible to derive the following.

Proposition 1: If abilities are homogeneous (i.e. $a_h = a_l$), the optimal prize structure in the Promotion and demotion contest is $\hat{v}_1 = V$ and $\hat{v}_2 = 0$.

The above result is in line with the proposition made in Moldovanu and Sela (2001), i.e. it is optimal to implement a single-prize contest when agents are homogeneous. Given proposition 1 we assume $v_1 = V$ and $v_2 = 0$ in the rest of the analysis.

Proposition 2: If abilities are homogeneous (i.e. $a_h = a_l$), the Pooled contest yields higher total effort than the Promotion and demotion contest. If abilities are heterogeneous (i.e. $a_h > a_l$), the Promotion and demotion contest yields higher total effort than the Pooled contest.

For proofs of propositions 1 and 2 see section 2.5.

Proposition 2 can be explained intuitively. If the agents are homogeneous in ability, it is better to pool agents as you get higher effort when you have more agents engaged in competition. If abilities are heterogeneous, agents with low ability will be discouraged from exerting effort. Hence, it is suboptimal to pool agents as you essentially only have two out of the four agents fully engaged in competition for the prize. Under such circumstances it would be better to split agents across two divisions while allowing for promotion and demotion as you can generate higher levels of engagement from all four agents.

Remark: It is worth mentioning that proposition 2 is a knife edge result, which suggests that there is some discontinuity in the derived equilibrium. The discontinuity stems from the equilibrium effort calculation in the second stage of the Promotion and demotion contest. If abilities are heterogeneous, agents cannot determine in advance the ability of their opponent in stage 3. However, if abilities are homogeneous, agents know ahead of every stage the ability of their opponent. This difference in the level of strategic uncertainty creates the discontinuity which is present in proposition 2.

Figure 2.1 illustrates the dissipation rate across the two types of contests.

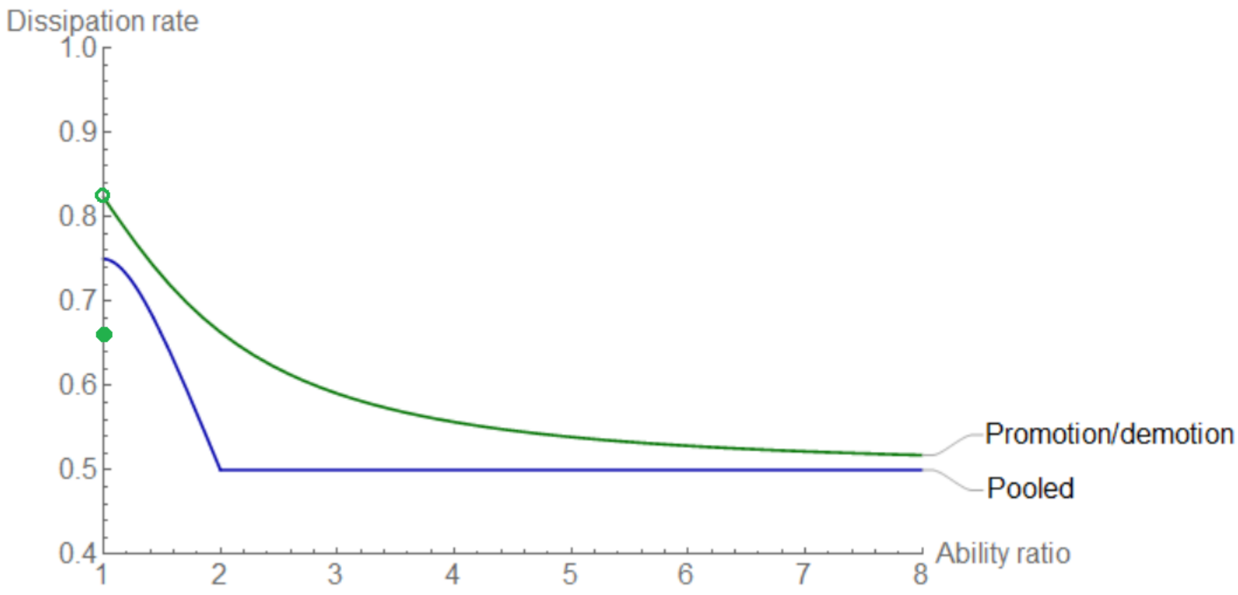


Figure 2.1: Dissipation rate comparison

The dissipation rate is simply the total effort divided by the total prize value across all three stages, i.e. total effort divided by $3V$. Recall, the total prize value is equal across the two types of contests. Hence, the dissipation rate is essentially a proxy for total effort. The horizontal axis represents the ability ratio, which is simply a_h/a_l. As the ability ratio changes we keep a_l constant. In line with proposition 2, we can see that total effort is lower (higher) in the Pooled contest than in the Promotion and demotion contest when the ability ratio is greater than (equal to) 1.

2.2 Experimental design and procedures

The experiment implemented the lottery contests described in the previous section. For the treatments corresponding to the Promotion and demotion contest, four participants competed across two divisions in a three-stage lottery contest. Two high ability participants were assigned to Division 1 and two low ability participants were assigned to Division 2 at the beginning of the game. Participants in Division 1 competed for a prize of 120 Francs, and participants in Division 2 competed for a prize of 0 Francs, where 10 Francs was equal to 1 AUD.[6] Effort provision was

[6]Note, the incentive to exert effort for those placed in Division 2 was the prospect of being placed in Division 1 in stages 2 and 3 where they would be able to compete for a prize of significant

implemented in terms of investments in a lottery. Participants were told that they could buy a discrete number of lottery tickets in each stage. The lottery tickets purchased by the subjects as well as those purchased by their respective opponents in each stage were then said to be placed in the same "urn", of which one ticket was randomly drawn. The participant who purchased the ticket that was randomly drawn received a prize equal to 120 Francs if they were in Division 1, or 0 Francs if they were in Division 2. Prizes were awarded in each of the three stages. Participants were informed of the ability level of the other participants who they competed with in each stage prior to making their decision. To capture ability differences in the experiment we used the following approach. Suppose the ability levels for low types and high types was $(a_l, a_h) = (1, 2)$. The low types would have been told that each Franc they invest bought them 10 lottery tickets and the high types would have been told that each Franc they invest bought them 20 lottery tickets. This was also made common knowledge among participants.

For the treatments where we implemented the Promotion and demotion contest, the process in stages 2 and 3 was very similar to that in stage 1, except the participants who changed division after stage t would compete for a different prize in stage $t+1$. Moreover, in stages 2 and 3 there was a chance that participants would compete against other participants with different ability levels. In all treatments participants received an endowment of 60 Francs in each stage which they could use to purchase lottery tickets. Note, the endowment could only be used in a given decision stage, i.e. it was not possible for participants to transfer Francs across stages.

For the treatments corresponding to the Pooled contest, all four participants (comprising of two high and two low types) were placed in the same division where they competed with each other in three identical lottery contests, each with a prize of 120 Francs.

To summarize, the experiment followed a 2×2 between subject design. The two dimensions that varied were the following:

value.

1. The contest design: Pooled, Promotion/demotion

2. The ability difference: $(a_l, a_h) \in \{(1,1),(1,2)\}$

The table below provides a summary of the treatments.

Table 2.1: Summary of treatments and sessions

Contest	(a_l, a_h)	**Number of Sessions**	**Total Participants**	**Number of Periods**
Pooled	$(1,1)$	2	32	15
Promotion/demotion	$(1,1)$	2	32	15
Pooled	$(1,2)$	2	32	15
Promotion/demotion	$(1,2)$	2	32	15

Each participant played the same three-stage game 15 times. This enabled us to determine whether participants converged towards the Nash predictions over time. Participants were randomly matched for every three-stage game. After each stage, participants were informed about their own decision, the decision of their opponent(s) and about their own payoff. To avoid wealth effects, the participants were told that one period (out of 15) would be chosen randomly and paid out at the end of the experiment. To avoid framing effects the instructions were written in neutral language. For example, instead of saying that we will **demote** a **high type** participant from **Division 1** to **Division 2** we would say that we will **move** a **type A** participant from the **Blue division** to the **Red division**.

The procedures in every experimental session were as follows. First, the participants received some general information about the experimental session. Then, the instructions for the three-stage contest with four players as described above, was distributed and read out loud by the experimenter. After each participant confirmed that they understood the instructions, they answered a set of control questions to ensure that they had fully understood the instructions (which are available in section 2.9). Furthermore, participants had one practice period of play. Only after participants had completed all the preliminary steps did the first real decision period start. At the end of each session participants were informed about their overall payoff in the experiment. They were also asked to complete a short demographic survey. 16 subjects participated in each of the 8 computerized sessions using the z-Tree software (Fischbacher 2007). All 128 participants were students from the University of Technology Sydney (UTS). The experiment was conducted in the UTS Behavioural Lab. Participants were recruited via ORSEE (Greiner 2015). Each session lasted between 1 to 1.5 hours, and participants earned on average 29 AUD (including the 10 AUD show-up fee).

2.2.1 Predictions

Given $(v_1, v_2) = (120, 0)$ and $(a_l, a_h) \in \{(1,1), (1,2)\}$ we have the following equilibrium predictions across treatments.

Table 2.2: Equilibrium point predictions across treatments

	$(a_l, a_h) = (1,1)$			$(a_l, a_h) = (1,2)$		
	Promotion and demotion		Pooled	Promotion and demotion		Pooled
	Division 1	Division 2	–	Division 1	Division 2	–
e_1/e_l^{PO}	37.50	7.50	22.50	42.64	12.65	0.00
e_h^{PO}	–	–	–	–	–	30.00
e_{l2}	37.50	7.50	22.50	29.04	2.94	0.00
e_{h2}	–	–	–	32.87	5.92	30.00
e_{l3} vs low type	30.00	0.00	22.50	30.00	0.00	0.00
e_{h3} vs low type	–	–	–	26.67	0.00	30.00
e_{l3} vs high type	–	–	–	26.67	0.00	–
e_{h3} vs high type	–	–	–	30.00	0.00	–
Total effort stage 1	90.00		90.00	110.57		60.00
Total effort stage 2	90.00		90.00	70.76		60.00
Total effort stage 3	60.00		90.00	57.44		60.00
Total effort across all stages	240.00		270.00	238.78		180.00

Note, the cells that are blank in the above table are not applicable.

When $(a_l, a_h) = (1,2)$ the total effort exerted across all stages in the Nash equilibrium is 180 in the Pooled contest. This is approximately 33% less effort than the principal could yield at no extra cost by employing the Promotion and demotion contest.

From Table 2.2 our main hypotheses are as follows:

Hypothesis 1: If $(a_l, a_h) = (1, 1)$, the Pooled contest yields higher total effort than the Promotion and demotion contest.

Hypothesis 2: If $(a_l, a_h) = (1, 2)$, the Promotion and demotion contest yields higher total effort than the Pooled contest.

2.3 Results

2.3.1 Aggregate results

In this subsection we investigate the differences in total effort across all experimental treatments. The following figures illustrate the total effort level for each contest design when abilities were homogeneous and heterogeneous. The left side of each figure shows how total effort varied from period to period. The right side of each figure indicates the predicted and actual average total effort level across all 15 periods for each treatment. The error bars represent 95% confidence intervals.

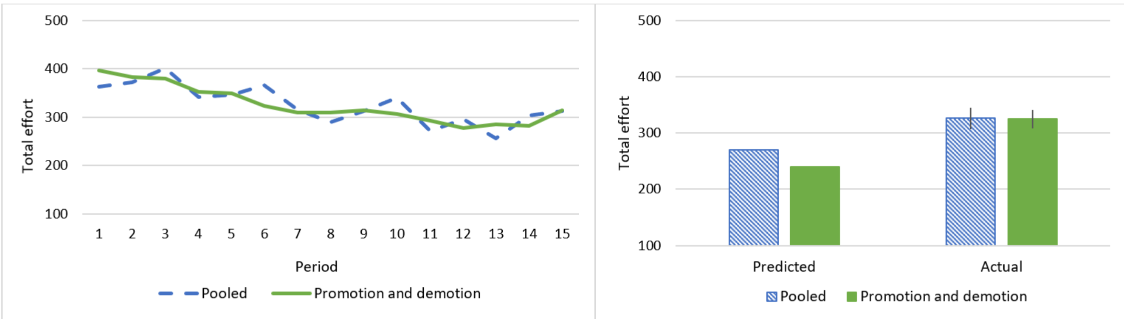


Figure 2.2: Total effort – Homogeneous

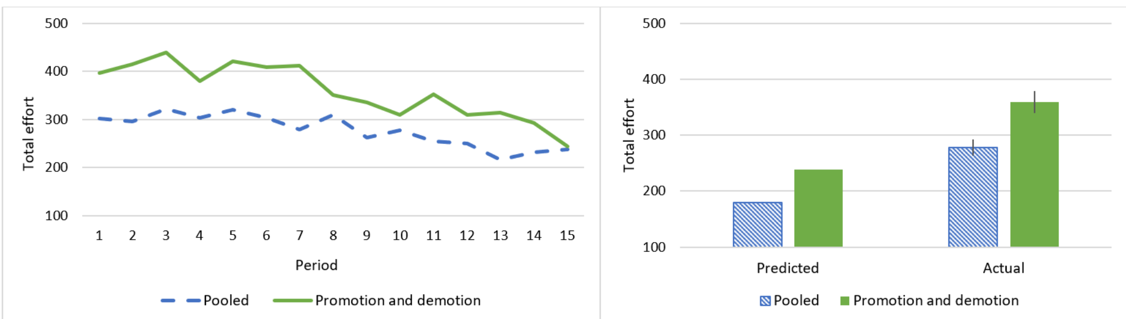


Figure 2.3: Total effort – Heterogeneous

We obtained 120 observations relating to total effort per treatment. We study whether the contest design explains total effort by running a linear random-effect model, clustering errors at the session level. We include a dummy for the Promotion and demotion treatment. See Table 2.3 for the results of the estimation process.

Table 2.3: Treatment comparison – Total effort

Variable	Total effort Homogeneous	Total effort Heterogeneous
Promotion and demotion	-1.079	80.967***
	(37.603)	(30.533)
Constant	325.858***	277.746***
	(20.933)	(20.554)
No. of observations	240	240
Prob > χ^2	0.977	0.008

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note, the baseline treatment in the above estimation is the Pooled contest.

Result 1: *There was no significant difference in total effort between the Pooled contest and the Promotion and demotion contest when abilities were homogeneous.*

Support: In the first column of Table 2.3 the coefficient estimate is not statistically significant for the Promotion and demotion treatment dummy. This indicates that there was no significant difference in total effort between the Promotion and demotion contest and the Pooled contest when abilities were homogeneous.

Unlike the theory predicted, we did not observe a significant difference in total effort between the Pooled and Promotion and demotion contest when abilities were homogeneous. One potential explanation for overbidding in contests is risk aversion, e.g. Stracke et al. (2014) and Hafalir et al. (2018). In our theoretical model agents are risk neutral, however, in our experiment participants may have been risk averse. The theoretical results with respect to risk aversion in contests are very dependent on the underlying assumptions of the model. Moreover, risk aversion might explain overbidding in both types of contests. Whether it can explain higher rates of overbidding in the Promotion and demotion contest than in the Pooled contest is unclear.[7]

Others such as Goeree et al. (2002) and Sheremeta (2010b) use the "joy of winning" theory to explain overbidding in contests. This theory proposes that individuals derive some intrinsic pleasure from winning. Our analysis indicates that the minimum utility one would need to receive from winning in Division 2 in the Promotion and demotion contest to support result 1 is equal to 2/3 of the endowment. In comparison, Sheremeta (2010b) estimated the utility derived from winning to be approximately equal to 1/2 the endowment. We can estimate the "joy of winning" parameter by looking at the average level of effort chosen in Division 2 at stage 3 in the Promotion and demotion contest in the homogeneous treatment. Our findings suggest that the utility derived from winning in our experiment was approximately equal to 1/3 of the endowment, which is significantly less than what it would need to be to support result 1. Thus, we are not convinced that result 1 was due solely to our participants' desire to win. For a more in-depth analysis of the "joy of winning" theory refer to section 2.8.

We propose an alternative explanation for result 1. We believe that participants derived some intrinsic benefit relating to higher status when they played in Division 1. This explanation is outlined formally in subsection 2.3.3.

Result 2: *Total effort was significantly higher in the Promotion and demotion contest than in the Pooled contest when abilities were heterogeneous.*

Support: In the second column of Table 2.3 the coefficient estimate is positive and statistically significant at the 1% level for the Promotion and demotion treatment dummy. This indicates that total effort was significantly higher in the Promotion and demotion contest than in the Pooled contest when abilities were heterogeneous.[8]

Result 2 is in line with the theoretical prediction.

[7] We elicited risk preferences at the end of each experimental session by asking participants whether they were "generally a person who is fully prepared to take risks or do you try to avoid taking risks?" We found that participants who indicated that they try to avoid taking risks made lower effort choices in our experiment. If anything, we observed a negative correlation between risk aversion and overbidding behaviour.

[8] Results 1 and 2 are consistent across periods 1 - 8 and periods 9 - 15.

The following table summarizes the predicted and actual probability of Division 1 pairings in stage 3 in the Promotion and demotion contest when abilities were heterogeneous.

Table 2.4: Division 1 pairings in stage 3

	Predicted %	**Actual %**
High vs High	55.57	35.00
High vs Low	38.34	30.83
Low vs Low	6.09	34.17

Table 2.4 indicates that the low vs low type outcome prevailed in stage 3 much more frequently than we anticipated. A closer look at the data suggests that it was not a lack of rationality that led to this discrepancy between the predicted and actual probabilities but merely chance.[9] Moreover, the probability that a high type was paired with a low type in stage 3 was slightly less than the predicted probability (38.34% vs 30.83%). We know from prior research (e.g. Dechenaux et al. (2015)) that there is a negative correlation between effort and the degree of asymmetry in contests. The fact that asymmetric contests occurred less frequently than we expected when abilities were heterogeneous could have contributed to higher effort choices in the Promotion and demotion contest. Although, given our theoretical predictions on effort exertion in stage 3 it is unlikely that the distribution of stage 3 pairings had much of an effect on total effort.

2.3.2 Individual behaviour

Determinants of individual effort choice

In this subsection we focus on effort at the individual level within the Promotion and demotion contest treatments. For more details about how participants behaved relative to the equilibrium predictions in all treatments refer to the tables in section 2.6. We investigate the determinants of individual level effort when abilities are heterogeneous in the Promotion and demotion contest by running a Tobit regression

[9] Based on lottery tickets purchased in stage 2 the probability that the low type would win in either division was approximately 34%. However, low types actually won 51% of the time in Division 1 and 48% of the time in Division 2. The discrepancy between the expected probability of low types winning and actual probability of low types winning was statistically significant.

with random effects, clustering errors at the session level.[10] We study whether the division participants were in, whether a participant was a high type and whether their opponent was a high type explains effort choices. We have also included covariates relating to major and gender in the estimation that follows. See Table 2.5 for the results from the estimation process.

Table 2.5: Factors influencing individual effort choice across stages

Variable	Stage 1	Stage 2	Stage 3
Division 1	21.596***	28.860***	43.763***
	(2.179)	(2.216)	(2.903)
High ability		4.077*	2.056
		(2.226)	(4.220)
Other high ability			-2.901
			(4.295)
High ability × Other high ability			5.197
			(5.987)
Econ or Fin major	13.878***	6.712**	0.313
	(3.205)	(3.249)	(4.113)
Male	3.571	3.361	1.438
	(2.243)	(2.305)	(2.909)
Constant	20.329***	12.516***	-1.822
	(2.872)	(3.337)	(4.323)
No. of observations	480	480	480
Prob > χ^2	0.000	0.000	0.000

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note, the lower limits and upper limits on the dependent variables in Table 2.5 are 0 and 60 respectively.

Result 3: *Participants chose significantly higher effort levels in Division 1 than in Division 2.*

Support: Table 2.5 provides strong evidence to suggest that being in Division 1 had a positive impact on effort in all stages. This result is in line with the theoretical predictions.

According to the theory, a participant's effort choice in stage 2 should be positively correlated with their own ability and their effort choice in stage 3 should not be affected by their own ability. The coefficient estimates relating to the participant's

[10] We also ran a multilevel mixed effects model which yielded very similar results.

ability provide support for the theoretical model. The coefficient estimate for effort in stage 2 is positive and statistically significant at the 10% level. The coefficient estimate for effort in stage 3 is not statistically significant.

The theoretical model suggests that in stage 3 participants with low ability will exert less effort against opponents with high ability and high ability participants will exert more effort against opponents with high ability. The coefficient estimates in Table 2.5 provide weak evidence of this. The fact that our coefficient estimates are not statistically significant might be due to a lack of data.

Table 2.5 suggests that Economics and Finance majors exerted more effort in stages 1 and 2 than students majoring in other areas. We found no evidence to suggest that the participant's gender had any impact on effort choice.

Result 4: *Participants chose a positive level of effort in Division 2 at stage 3.*

Support: The average level of effort chosen in Division 2 at stage 3 was 8.43. We estimated a simple panel regression for each treatment, where the dependent variable was effort in Division 2 at stage 3 and the independent variables were a constant and session dummy-variables. The model included a random effects error structure, clustering standard errors at the session level. Based on a standard Wald test, conducted on the estimates of the model, we found that for both treatments with promotion and demotion the constant estimates were significantly higher than 0 (p-value < 0.05).

Result 4 suggests that participants in Division 2 at stage 3 chose positive effort even though they had no chance of being promoted and they were competing for a prize with no monetary value. This result supports the notion that individuals derive utility from winning, as highlighted in Sheremeta (2010b).

2.3.3 Effect of status on effort choice

In this subsection we provide a possible explanation for the discrepancy between hypothesis 1 and result 1. Given both hypothesis 1 and result 1 pertain to the case where abilities are homogeneous, we focus on this case. Unlike before, assume agents receive additional utility, M, when they compete in Division 1 and no additional utility when they compete in Division 2. The additional utility generated from being in Division 1 can be interpreted as the satisfaction one receives when they attain a higher status.

Equilibrium in stage 3

We begin by deriving the equilibrium in stage 3. The problem for agent m against agent n, in Division d, at stage 3 is as follows:

$$\max_{e_{md3} \geq 0} \quad M\mathbb{1}(d=1) + \frac{e_{md3}}{e_{md3}+e_{nd3}} v_d - e_{md3}.$$

The Nash equilibrium effort level for agents in Division d, at stage 3, $\hat{e}_{d3}$ is as follows:

$$\hat{e}_{d3} = \frac{v_d}{4}.$$

The equilibrium payoffs for agents in Division 1, at stage 3, W_{13}, and in Division 2, at stage 3, W_{23} are as follows:

$$W_{13} = M + \frac{v_1}{4} \quad \text{and} \quad W_{23} = \frac{v_2}{4}.$$

Equilibrium in stages 1 and 2

The problem for agent m against agent n, in Division d, at stage 2 is as follows:

$$\max_{e_{md2} \geq 0} \quad M\mathbb{1}(d=1) + \frac{e_{md2}}{e_{md2}+e_{nd2}}(v_d + W_{13}) + \left(1 - \frac{e_{md2}}{e_{md2}+e_{nd2}}\right) W_{23} - e_{md2}.$$

The Nash equilibrium effort levels for agents in Division 1, at stage 2, $\hat{e}_{12}$, and in Division 2 at stage 2, $\hat{e}_{22}$ are as follows:

$$\hat{e}_{12} = \frac{4M + 5v_1 - v_2}{16} \quad \text{and} \quad \hat{e}_{22} = \frac{4M + v_1 + 3v_2}{16}.$$

The equilibrium payoffs for agents in Division 1, at stage 2, W_{12}, and in Division 2, at stage 2, W_{22} are as follows:

$$W_{12} = \frac{20M + 5v_1 + 3v_2}{16} \quad \text{and} \quad W_{22} = \frac{4M + v_1 + 7v_2}{16}.$$

To derive the equilibrium in stage 1, simply repeat the solution process described in stage 2 but replace W_{d3} with W_{d2} in the objective function. The Nash equilibrium effort levels for agents in Division 1, at stage 1, $\hat{e}_{11}$, and in Division 2 at stage 1, $\hat{e}_{21}$ are as follows:

$$\hat{e}_{11} = \frac{4M + 5v_1 - v_2}{16} \quad \text{and} \quad \hat{e}_{21} = \frac{4M + v_1 + 3v_2}{16}.$$

Comparisons

Accounting for the fact that participants may derive some utility from status, the new equilibrium total effort function for the Promotion and demotion contest, TE^S_{PD}, and original equilibrium total effort function for the Pooled contest, TE_{PO}, are as follows:

$$TE^S_{PD} = 2(M + v_1) + v_2,$$

$$TE_{PO} = \frac{9(v_1 + v_2)}{4}.$$

In our experiment $v_1 = 120$ and $v_2 = 0$. If we assume these parameter values and subtract TE^S_{PD} from TE_{PO}, we get the following:

$$TE_{PO} - TE^S_{PD} = 30 - 2M.$$

Clearly the difference in total effort generated in the Pooled contest and the Promotion and demotion contest depends on M, which reflects the intrinsic benefit from competing in Division 1. If $M = 15$ Francs $= 1.50$ AUD, then total effort in the Promotion and demotion contest will be equal to the total effort in the Pooled contest when abilities are homogeneous. By specifying M in this way we can rationalize the lack of a difference in total effort between the Pooled contest and the Promotion and demotion contest when participants were homogeneous.

2.4 Conclusion

Prior to conducting this research, the efficacy of promotion and demotion in incentivizing effort was unclear. This study investigated promotion and demotion within a multi-stage lottery contest framework. The theory indicates that if abilities are homogeneous, the principal is better off pooling agents. However, if abilities are heterogeneous, the principal is better off assigning agents to separate divisions based on ability level, while allowing for agents to be promoted and demoted after each stage of play. The experimental results support the use of promotion and demotion in multi-stage contests when abilities are heterogeneous. In contrast with the theoretical predictions, we did not find significant differences in total effort between the Pooled contest and the Promotion and demotion contest when abilities were homogeneous. One possible explanation for this discrepancy between the theory and the experimental findings might be our participants' desire to achieve a higher status.

Our findings have direct policy implications for management practices in settings where contests are already used to incentivize effort, for example organizations that implement the employee of the month award. In order to elicit higher effort among agents, we recommend that the principal subdivides agents based on ability and implement some form of promotion and demotion, if they observe a sufficiently high level of heterogeneity in abilities.[11]

[11] Although it might be difficult to directly measure ability, in many cases one can proxy for ability, e.g. a salesperson's prior sales record or the score a student receives on a standardized test.

2.5 Proofs

Proof of proposition 1. Assume abilities are homogeneous, i.e. $a_l = a_h$.

Recall, the principal's primary concern is to maximize total effort across divisions and stages. After adding the equilibrium effort functions for each stage of play we derive the following equilibrium total effort function for the Promotion and demotion contest:

$$TE_{PD} = 2v_1 + v_2.$$

Suppose V is the total amount of prize money available to the principal in each stage of the game. The principal's objective is to maximize total effort; hence, they face the following problem:

$$\begin{aligned} \max_{v_1,v_2} \quad & 2v_1 + v_2 \\ \text{s.t.} \quad & v_1 + v_2 = V \\ & v_1, v_2 \geq 0. \end{aligned}$$

Clearly the principal maximizes the above objective by setting $(v_1, v_2) = (V, 0)$.

□

Proof of proposition 2. Without loss of generality normalize $a_l = 1$.

<u>*Case 1*</u>: Let $a_h = 1$.

The equilibrium total effort functions for the Pooled contest, TE_{PO}, and Promotion and demotion contest, TE_{PD}, are as follows:

$$TE_{PO} = \frac{9(v_1 + v_2)}{4},$$

$$TE_{PD} = 2v_1 + v_2.$$

Subtracting TE_{PD} from TE_{PO} we get the following:

$$TE_{PO} - TE_{PD} = \frac{v_1 + 5v_2}{4} > 0.$$

Therefore, total effort is higher in the Pooled contest when $a_h = a_l$.

Case 2: Let $a_h \in (1, 2]$.

For simplicity, assume $v_1 = V$ and $v_2 = 0$. The equilibrium total effort functions for the Pooled contest, TE_{PO} and Promotion and demotion contest, TE_{PD}, are as follows:

$$TE_{PO} = -\frac{9(1 + a_h(a_h - 4))}{2(a_h + 1)^2}V,$$

$$TE_{PD} = -\frac{Y}{400(a_h - 1)(a_h + 1)^4(3 + a_h(2 + 3a_h))^3}V.$$

where,

$$Y = 33425 + 142205a_h + 404027a_h^2 + 579611a_h^3 + 447658a_h^4 + 398642a_h^5 - 660458a_h^6 - 630970a_h^7 - 615659a_h^8 - 390911a_h^9 - 144545a_h^{10} - 23825a_h^{11} + X(605 - 1401a_h - 2655a_h^2 + 9087a_h^3 - 9297a_h^4 + 3333a_h^5 + 4563a_h^6 + 1525a_h^7),$$

and,

$$X = \sqrt{25 + 260a_h + 804a_h^2 + 1084a_h^3 + 2054a_h^4 + 1084a_h^5 + 804a_h^6 + 260a_h^7 + 25a_h^8}\ .$$

Subtracting TE_{PO} from TE_{PD} we get the following:

$$TE_{PD} - TE_{PO} = \lambda_1(a_h)V.$$

Using mathematical software we can show that $\lambda_1(a_h) > 0$ for all $a_h \in (1, 2]$. Therefore, total effort is higher in the Promotion and demotion contest when $a_h \in (a_l, 2a_l]$.

Case 3: Let $a_h > 2$.

Again, assume $v_1 = V$ and $v_2 = 0$. The equilibrium total effort functions for the

Pooled contest, TE_{PO}, and Promotion and demotion contest, TE_{PD}, are as follows:

$$TE_{PO} = \frac{3V}{2},$$

$$TE_{PD} = -\frac{Y}{400(a_h - 1)(a_h + 1)^4(3 + a_h(2 + 3a_h))^3}V.$$

where,

$$Y = 33425 + 142205a_h + 404027a_h^2 + 579611a_h^3 + 447658a_h^4 + 398642a_h^5 - 660458a_h^6 - 630970a_h^7 - 615659a_h^8 - 390911a_h^9 - 144545a_h^{10} - 23825a_h^{11} + X(605 - 1401a_h - 2655a_h^2 + 9087a_h^3 - 9297a_h^4 + 3333a_h^5 + 4563a_h^6 + 1525a_h^7),$$

and,

$$X = \sqrt{25 + 260a_h + 804a_h^2 + 1084a_h^3 + 2054a_h^4 + 1084a_h^5 + 804a_h^6 + 260a_h^7 + 25a_h^8}\ .$$

Subtracting TE_{PO} from TE_{PD} we get the following:

$$TE_{PD} - TE_{PO} = \lambda_2(a_h)V.$$

Using mathematical software we can show that $\lambda_2(a_h) > 0$ for all $a_h > 2$. Therefore, total effort is higher in the Promotion and demotion contest when $a_h > 2a_l$.

Hence, we have shown that total effort is higher in the Pooled contest when $a_h = a_l$. Otherwise, when $a_h > a_l$, total effort is higher in the Promotion and demotion contest.

□

2.6 Predicted vs Actual effort choice

For $(a_l, a_h) = (1, 1)$ and $v_1 = V = 120$ we have the following.

Table 2.6: Predicted vs Actual effort choice – Homogeneous

	Theoretical prediction			**Actual effort choice**		
	Promotion and demotion		Pooled	Promotion and demotion		Pooled
	Division 1	Division 2	–	Division 1	Division 2	–
e_1	37.50	7.50	22.50	42.49	16.44	25.36
e_2	37.50	7.50	22.50	41.94	14.90	28.24
e_3	30.00	0.00	22.50	40.99	5.63	27.87
Total effort stage 1	90.00		90.00	117.87		101.43
Total effort stage 2	90.00		90.00	113.67		112.96
Total effort stage 3	60.00		90.00	93.24		111.48
Total effort across all stages	240.00		270.00	324.78		325.86

For $(a_l, a_h) = (1, 2)$ and $v_1 = V = 120$ we have the following.

Table 2.7: Predicted vs Actual effort choice – Heterogeneous

	Theoretical prediction			**Actual effort choice**		
	Promotion and demotion		Pooled	Promotion and demotion		Pooled
	Division 1	Division 2	–	Division 1	Division 2	–
e_1/e_l^{PO}	42.64	12.65	0.00	41.30	25.07	25.52
e_h^{PO}	–	–	30.00	–	–	24.70
e_{l2}	29.04	2.94	0.00	43.05	16.36	20.98
e_{h2}	32.87	5.92	30.00	42.08	22.55	21.79
e_{l3} vs low type	30.00	0.00	0.00	41.37	8.29	21.65
e_{h3} vs low type	26.67	0.00	30.00	35.58	14.77	24.24
e_{l3} vs high type	26.67	0.00	–	39.35	6.57	–
e_{h3} vs high type	30.00	0.00	–	40.13	14.77	–
Total effort stage 1	110.57		60.00	132.74		100.43
Total effort stage 2	70.76		60.00	124.03		85.55
Total effort stage 3	57.44		60.00	101.94		91.77
Total effort across all stages	238.78		180.00	358.71		277.75

2.7 Parallel contest without promotion and demotion

Unlike in the Promotion and demotion contest, now suppose high ability agents compete in Division 1 and low ability agents compete in Division 2 in every stage (henceforth "Parallel contest").

The problem for agent m against agent n in Division d, at each stage is as follows:

$$\max_{e_{md}\geq 0} \quad \frac{e_{md}}{e_{md}+e_{nd}}v_d - e_{md}.$$

The Nash equilibrium effort level in each stage in the Parallel contest for agents in Division d, $\hat{e}_d^{PA}$ is the following:

$$\hat{e}_d^{PA} = \frac{v_d}{4}.$$

We chose to exclude the Parallel contest design from the main part of this chapter as it is less effective than the Pooled contest design in incentivizing total effort. Now we will illustrate how total effort is never higher in the Parallel contest than in the Pooled contest. Without loss of generality normalize $a_l = 1$.

<u>*Case 1*</u>: Let $a_h \in [1, 2)$.

The equilibrium total effort functions for the Pooled contest, TE_{PO} and Parallel contest, TE_{PA} are as follows:

$$TE_{PO} = -\frac{9(1 + a_h(a_h - 4))V}{2(a_h + 1)^2},$$

$$TE_{PA} = \frac{3(v_1 + v_2)}{2} = \frac{3V}{2}.$$

Subtracting TE_{PA} from TE_{PO} we get the following:

$$TE_{PO} - TE_{PA} = \frac{3(2 - a_h)(2a_h - 1)V}{(a_h + 1)^2} > 0 \quad \text{for all} \quad a_h \in [1, 2).$$

Therefore, total effort is higher in the Pooled contest than in the Parallel contest when $a_h \in [a_l, 2a_l)$.

Case 2: Let $a_h \geq 2$.

The equilibrium total effort functions for the Pooled contest, TE_{PO} and Parallel contest are as follows:

$$TE_{PO} = \frac{3V}{2},$$

$$TE_{PA} = \frac{3(v_1 + v_2)}{2} = \frac{3V}{2}.$$

Subtracting TE_{PA} from TE_{PO} we get the following:

$$TE_{PO} - TE_{PA} = 0.$$

Hence, we have shown that total effort is never higher in the Parallel contest than in the Pooled contest.

2.8 Joy of winning

In this subsection we determine whether the "joy of winning" theory can explain the discrepancy between hypothesis 1 and result 1. Given both hypothesis 1 and result 1 pertain to the case where abilities are homogeneous, we focus on this case. Now suppose in the Promotion and demotion contest agents receive additional utility, w_d, in Division d when they win.

Equilibrium in stage 3

We begin by deriving the equilibrium in stage 3. The problem for agent m against agent n, in Division d, at stage 3 is as follows:

$$\max_{e_{md3} \geq 0} \quad \frac{e_{md3}}{e_{md3} + e_{nd3}}(v_d + w_d) - e_{md3}.$$

The Nash equilibrium effort level for agents in Division d, at stage 3, $\hat{e}_{d3}$ is as follows:

$$\hat{e}_{d3} = \frac{v_d + w_d}{4}.$$

The equilibrium payoffs for agents in Division 1, at stage 3, W_{13}, and in Division 2, at stage 3, W_{23} are as follows:

$$W_{13} = \frac{v_1 + w_1}{4} \quad \text{and} \quad W_{23} = \frac{v_2 + w_2}{4}.$$

Equilibrium in stages 1 and 2

The problem for agent m against agent n, in Division d, at stage 2 is as follows:

$$\max_{e_{md2} \geq 0} \quad \frac{e_{md2}}{e_{md2} + e_{nd2}}(v_d + w_d + W_{13}) + \left(1 - \frac{e_{md2}}{e_{md2} + e_{nd2}}\right) W_{23} - e_{md2}.$$

The Nash equilibrium effort levels for agents in Division 1, at stage 2, $\hat{e}_{12}$, and in

Division 2 at stage 2, $\hat{e}_{22}$ are as follows:

$$\hat{e}_{12} = \frac{5v_1 - v_2 + 5w_1 - w_2}{16} \quad \text{and} \quad \hat{e}_{22} = \frac{v_1 + 3v_2 + w_1 + 3w_2}{16}.$$

The equilibrium payoffs for agents in Division 1, at stage 2, W_{12}, and in Division 2, at stage 2, W_{22} are as follows:

$$W_{12} = \frac{5v_1 + 3v_2 + 5w_1 + 3w_2}{16} \quad \text{and} \quad W_{22} = \frac{v_1 + 7v_2 + w_1 + 7w_2}{16}.$$

To derive the equilibrium in stage 1, simply repeat the solution process described in stage 2 but replace W_{d3} with W_{d2} in the objective function. The Nash equilibrium effort levels for agents in Division 1, at stage 1, $\hat{e}_{11}$, and in Division 2 at stage 1, $\hat{e}_{21}$ are as follows:

$$\hat{e}_{11} = \frac{5v_1 - v_2 + 5w_1 - w_2}{16} \quad \text{and} \quad \hat{e}_{21} = \frac{v_1 + 3v_2 + w_1 + 3w_2}{16}.$$

Comparisons

Recall, $(v_1, v_2, V) = (120, 0, 120)$ in our experiment. Accounting for the fact that participants may derive some utility from winning, the new equilibrium total effort functions for the Promotion and demotion contest, TE^W_{PD}, and Pooled contest, TE^W_{PO}, are as follows:

$$TE^W_{PD} = 240 + 2w_1 + w_2,$$

$$TE^W_{PO} = 270 + \frac{9u}{4},$$

where u represents the utility derived from winning in the Pooled contest. Result 1 from our experiment states that the difference in total effort between the Pooled contest and the Promotion and demotion contest was insignificant when abilities were homogeneous. To derive this result by incorporating the “joy of winning” theory, the following condition must hold:

$$TE_{PD}^{W} = TE_{PO}^{W} \;\Rightarrow\; u = \frac{4(2w_1 + w_2 - 30)}{9} \quad (1).$$

The utility derived from winning in the Pooled contest should be at least as large, if not larger than the utility derived from winning in either division in the Promotion and demotion contest, due to the fact that you would have won in a larger cohort (i.e. defeating 3 other people should not be less satisfying than defeating 1 other person).[12] Hence, assume $u \geq w_1$. Combining this condition with condition (1) we can establish the following:

$$w_1 \leq 4w_2 - 120 \quad (2).$$

Furthermore, the utility derived from winning in Division 1 should be at least as large, if not larger than in Division 2 in the Promotion and demotion contest, for the reason that winning in a higher division might be considered to be a greater achievement. Hence, assume $w_1 \geq w_2$. Combining this with condition (2) we can establish that the critical value for the "joy of winning" parameter in Division 2 which satisfies all of the above conditions simultaneously is $w_2^* \geq 40$. Hence, the minimum utility one would need to receive from winning in Division 2 to support result 1 is equal to 2/3 of the endowment. In comparison, Sheremeta (2010b) estimated the utility derived from winning to be approximately equal to 1/2 the endowment.

We can estimate the "joy of winning" parameter, $\tilde{w}_2$, by looking at the average level of effort chosen in Division 2 at stage 3 in the Promotion and demotion contest in the homogeneous treatment. We find that $\tilde{w}_2 = 22.52 < 40 \leq w_2^*$.[13] Thus, we are not convinced that result 1 from our experiment was solely due to our participants' desire to win.

[12] This notion is consistent with Sheremeta (2010b).

[13] Equilibrium effort in Division 2 at stage 3 is equal to $w_2/4$. From Table 2.6 we can see that the average effort chosen by participants in Division 2 at stage 3 in the Promotion and demotion contest was 5.63. Therefore, the implied value of w_2 is $4 \times 5.63 = 22.52$.

2.9 Instructions

The following instructions were used for the heterogeneous ability treatments. The instructions for the homogeneous ability treatments are very similar.

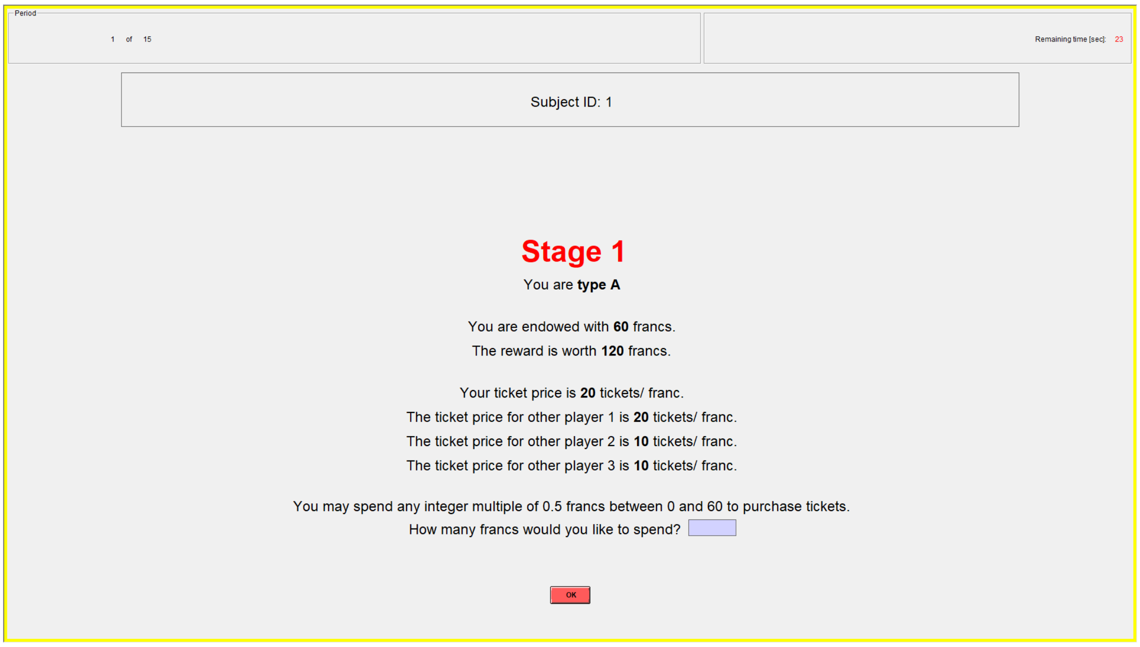
Pooled contest

General Instructions

This is an experiment in the economics of strategic decision making. If you follow the instructions closely and make appropriate decisions, you can earn a considerable amount of money. You will be required to make a series of economic choices which determine your total earnings. The currency used in the experiment is Francs. Francs will be converted to AUD at a rate of **10** Francs to **1** AUD. At the end of today's experiment, you will be paid in private and in cash. **16** participants are in today's experiment. It is very important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave, and you will not be paid. We expect and appreciate your cooperation.

Your decision

The next part of the experiment consists of **15** decision-making periods and each period consists of **three stages**. First, the computer will randomly determine whether you are going to be type A or type B. Once your type has been determined you will remain that type for the duration of the experiment. At the beginning of each period, you will be randomly and anonymously placed into a group of **four participants**. Each group will consist of **two type A** and **two type B** participants. Participants who have been grouped together will play against one another in each stage of the game. In each stage participants will be given an initial endowment of **60** Francs. This endowment is not transferable across stages. You will use this endowment to purchase lottery tickets for a chance of receiving a reward in each stage. The reward is equal to **120** Francs. In all stages of the game **type A** participants receive **20 lottery tickets** for every Franc they spend and **type B** participants receive **10 lottery tickets** for every Franc they spend. Participants may spend any number of Francs between **0** and **the number of Francs remaining from the initial endowment** (including 0.5 decimal points). An example of the decision screen in **stage 1** is as follows.



After you have played the game in stage 1 you will play the same game with the same participants in stage 2 and in stage 3.

Your Earnings

Your earnings depending on whether you received the reward are as follows.

If you **did** receive the reward:

$$\begin{aligned} \text{Earnings} &= \text{Endowment} + \text{Reward} - \text{Francs you spent in that stage} \\ &= 60 + 120 - \text{Francs you spent in that stage} \end{aligned}$$

If you **did not** receive the reward:

$$\begin{aligned} \text{Earnings} &= \text{Endowment} - \text{Francs you spent in that stage} \\ &= 60 - \text{Francs you spent in that stage} \end{aligned}$$

The more you spend on lottery tickets, the more likely you are to receive the reward. The more the other participants spend on lottery tickets, the less likely you are to receive the reward. At the end of a stage the computer **randomly draws** one ticket among all the tickets purchased by **you and the other participants in your group**. The owner of the ticket drawn receives a reward in that stage.

Thus, your chance of receiving the reward is given by the number of lottery tickets you purchased divided by the total number of lottery tickets you and the other participants in your group purchased.

$$\text{Prob. of reward } \% = \frac{\text{Number of tickets you purchased}}{\text{Total number of tickets purchased in your group}} \times 100$$

In case all participants within a group purchase zero lottery tickets in a stage, the computer randomly chooses one participant to receive the reward in that stage.

Example of random draw

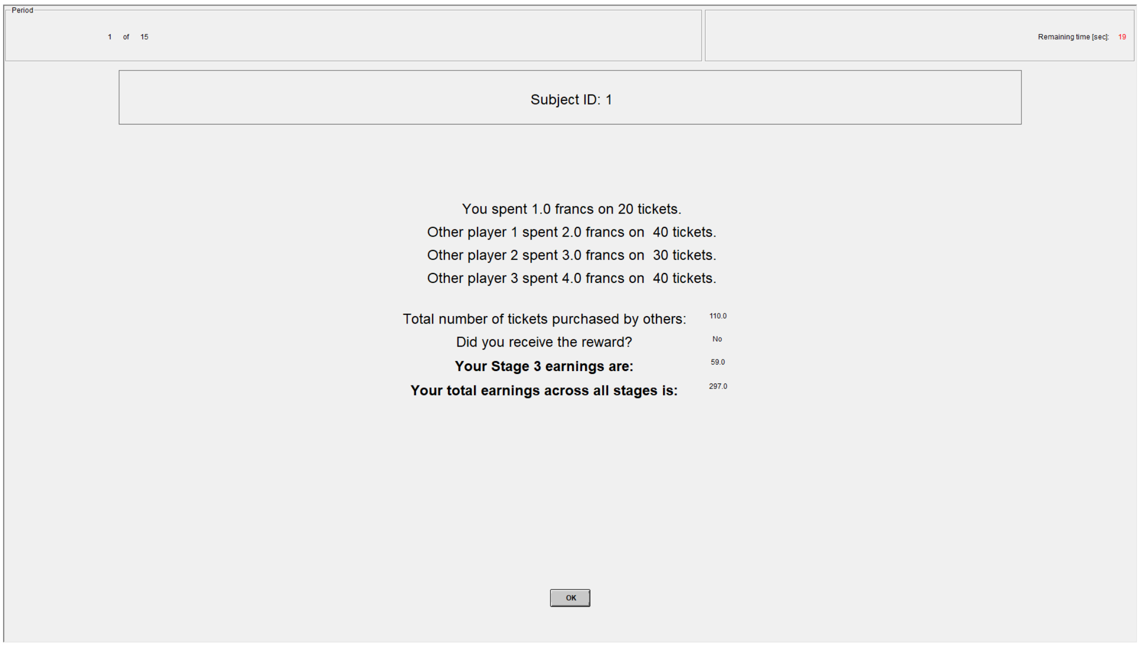
This is a hypothetical example of how the computer makes a random draw. Let's say, in stage 1, we have the following:

Participant	**Number of Francs spent**	**Number of tickets purchased**	**Total number of tickets purchased in division**	**Prob. of reward %**
1	15	300	480	62.50%
2	5	100	480	20.83%
3	4	40	480	8.33%
4	4	40	480	8.33%

The computer randomly draws **one lottery ticket out of 480** (300 lottery tickets for participant 1, 100 lottery tickets for participant 2, 40 lottery tickets for participant 3 and 40 lottery tickets for participant 4). As you can see, participant 1 has a **higher chance** of receiving the reward: **62.50% = (300/480) × 100**. Participant 2 has a **20.83% = (100/480) × 100** chance of receiving the reward. Participant 3 and participant 4's chance of receiving the reward is **8.33% = (40/480) × 100**.

After you have completed all three stages of the game the computer will calculate your total earnings for the period. Your total earnings for a period are equal to the sum of your earnings across stages 1, 2 and 3. These earnings will be converted to cash and paid at the end of the experiment if the current period is the period that is randomly chosen for payment.

At the end of each stage, your expenditure on lottery tickets, the other participants' expenditure on lottery tickets, whether you received the reward or not, and the earnings for the stage are reported on the outcome screen as shown below.



After you have made your decision in stage 3 you will be shown your total earnings for the period.

Important Notes

You will not be told which of the participants in this room are assigned to which group. At the beginning of each period you will be randomly re-grouped with 3 other participants to form a four-person group. You can never guarantee yourself the reward. However, by increasing your expenditure on lottery tickets, you can increase your chance of receiving the reward in each stage. At the end of the experiment we will randomly choose **1 of the 15 periods** for actual payment using a bingo cage. Your earnings will be converted and paid out in AUD.

Are there any questions?

Promotion and demotion contest

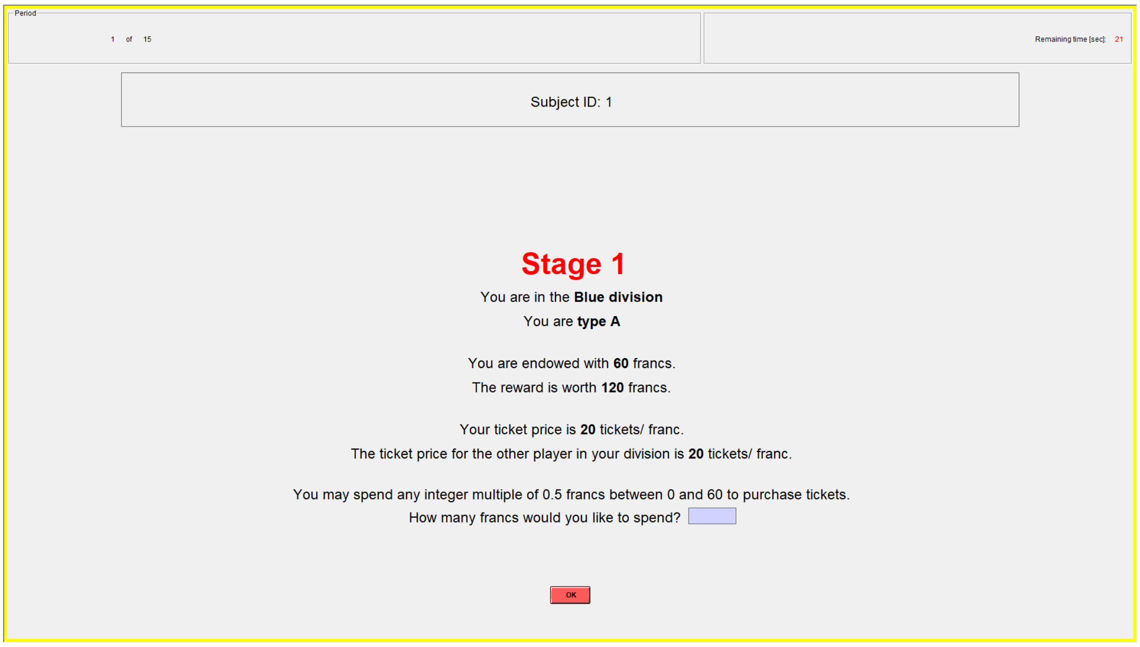
General Instructions

This is an experiment in the economics of strategic decision making. If you follow the instructions closely and make appropriate decisions, you can earn a considerable amount of money. You will be required to make a series of economic choices which determine your total earnings. The currency used in the experiment is Francs. Francs will be converted to AUD at a rate of **10** Francs to **1** AUD. At the end of today's experiment, you will be paid in private and in cash. **16** participants are in today's experiment. It is very important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave, and you will not be paid. We expect and appreciate your cooperation.

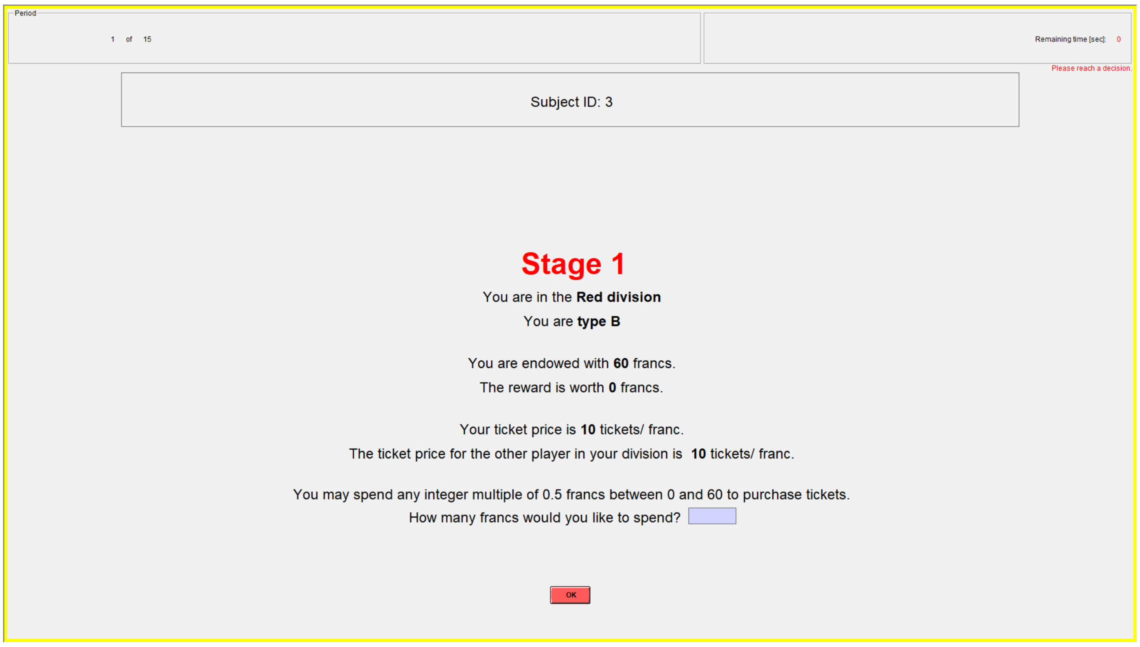
Your decision

The next part of the experiment consists of **15** decision-making periods and each period consists of **three stages**. First, the computer will randomly determine whether you are going to be type A or type B. Once your type has been determined you will remain that type for the duration of the experiment. At the beginning of each period, you will be randomly and anonymously placed into a group of **four participants**. Each group will consist of **two type A** and **two type B** participants. In **stage 1** type A participants will be placed in the Blue division and type B participants will be placed in the Red division. Participants will play with one another within each division in each stage of the game. In each stage participants will be given an initial endowment of **60** Francs. This endowment is not transferable across stages. You will use this endowment to purchase lottery tickets for a chance of receiving a reward. The reward in the **Blue division** is equal to **120** Francs and the reward in the **Red division** is equal to **0** Francs. In all stages of the game **type A** participants receive **20 lottery tickets** for every Franc they spend and **type B** participants receive **10 lottery tickets** for every Franc they spend. Participants may spend any number of Francs between **0** and **the number of Francs remaining from the initial endowment** (including 0.5 decimal points).

The decision screen for participants placed in the **Blue division in stage 1** is as follows.



The decision screen for participants placed in the **Red division in stage 1** is as follows.



Your Earnings

Your earnings depending on whether you received the reward are as follows.

If you are in the **Blue division** and you **did** receive the reward:

$$\begin{aligned}\text{Earnings} &= \text{Endowment} + \text{Reward} - \text{Francs you spent in that stage} \\ &= 60 + 120 - \text{Francs you spent in that stage}\end{aligned}$$

If you are in the **Red division** and you **did** receive the reward:

$$\begin{aligned}\text{Earnings} &= \text{Endowment} + \text{Reward} - \text{Francs you spent in that stage} \\ &= 60 + 0 - \text{Francs you spent in that stage}\end{aligned}$$

If you **did not** receive the reward:

$$\begin{aligned}\text{Earnings} &= \text{Endowment} - \text{Francs you spent in that stage} \\ &= 60 - \text{Francs you spent in that stage}\end{aligned}$$

The more you spend on lottery tickets, the more likely you are to receive the reward. The more the other participant in your division spends on lottery tickets, the less likely you are to receive the reward. At the end of a stage the computer **randomly draws** one ticket among the tickets purchased by **you and the other participant in your division**. The owners of the tickets drawn in each division receives a reward in that stage. Thus, your chance of receiving the reward is given by the number of lottery tickets you purchased divided by the total number of lottery tickets you and the other participant in your division purchased.

$$\text{Prob. of reward } \% = \frac{\text{Number of tickets you purchased}}{\text{Total number of tickets purchased in your group}} \times 100$$

In case all participants within a division purchase zero lottery tickets in a stage, the computer randomly chooses one participant to receive the reward in that stage.

Moving across divisions

The participants who receive the reward in either the Blue or Red division will be placed in the Blue division in the following stage. The participants who do not receive the reward in either the Blue or Red division will be placed in the Red division in the following stage.

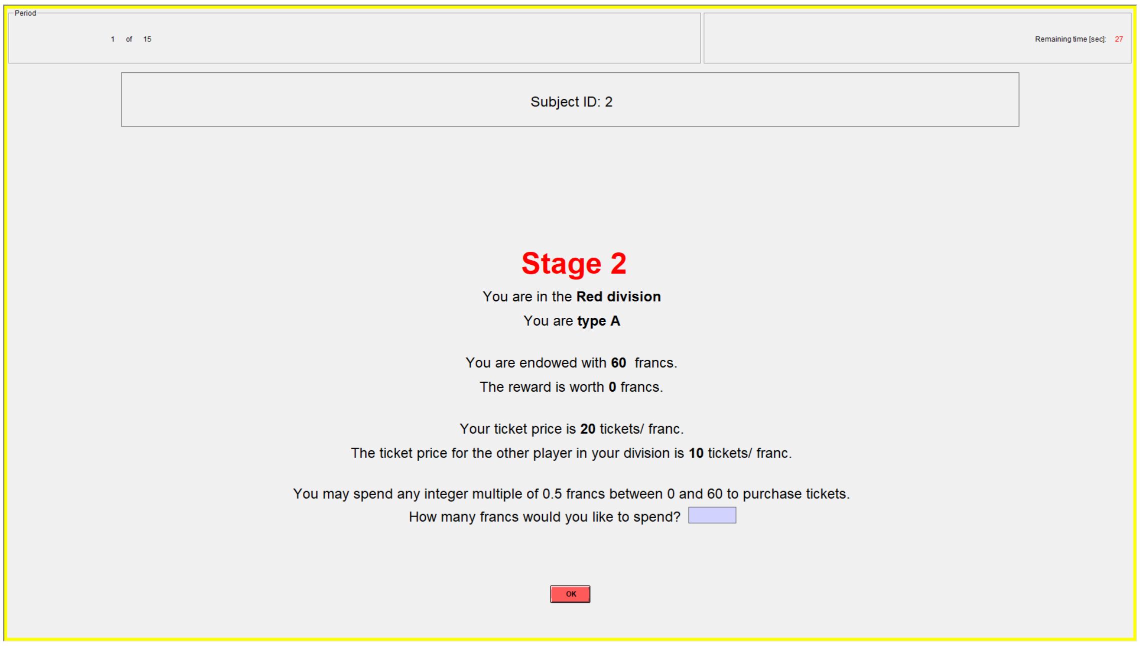
This is a hypothetical example of how the computer determines who moves divisions after stage 1. Let's say, in stage 1, we have the following:

Participant	Division	Number of Francs spent	Number of tickets purchased	Total number of tickets purchased in division	Prob. of reward %
1	Blue	15	300	400	75%
2	Blue	5	100	400	25%
3	Red	4	40	80	50%
4	Red	4	40	80	50%

For the Blue division the computer randomly draws **one lottery ticket out of 400** (300 lottery tickets for participant 1 and 100 lottery tickets for participant 2). As you can see, participant 1 has a **higher chance** of receiving the reward: $\mathbf{75\% = (300/400) \times 100}$. Whereas participant 2 has a $\mathbf{25\% = (100/400) \times 100}$ chance of receiving the reward. Suppose participant 1's ticket was drawn and, as a result, they received the reward, hence, they will remain in the Blue division in stage 2 and participant 2 will be moved to the Red division in stage 2.

For the Red division the computer randomly draws **one lottery ticket out of 80** (40 lottery tickets for both participants 3 and 4). Hence, both participant 3 and participant 4 have a $\mathbf{50\% = (40/80) \times 100}$ chance of receiving the reward. Suppose participant 4's ticket was drawn and, as a result, they received the reward in the Red division in stage 1. Hence, participant 4 will be moved to the Blue division in stage 2 and participant 3 will remain in the Red division in stage 2. The decision you face in stage 2 is very similar to that of stage 1, however, this time the other participant in your division will be a different type to you, and the reward you play for may also be different.

For example, the decision screen in stage 2 may look like this:

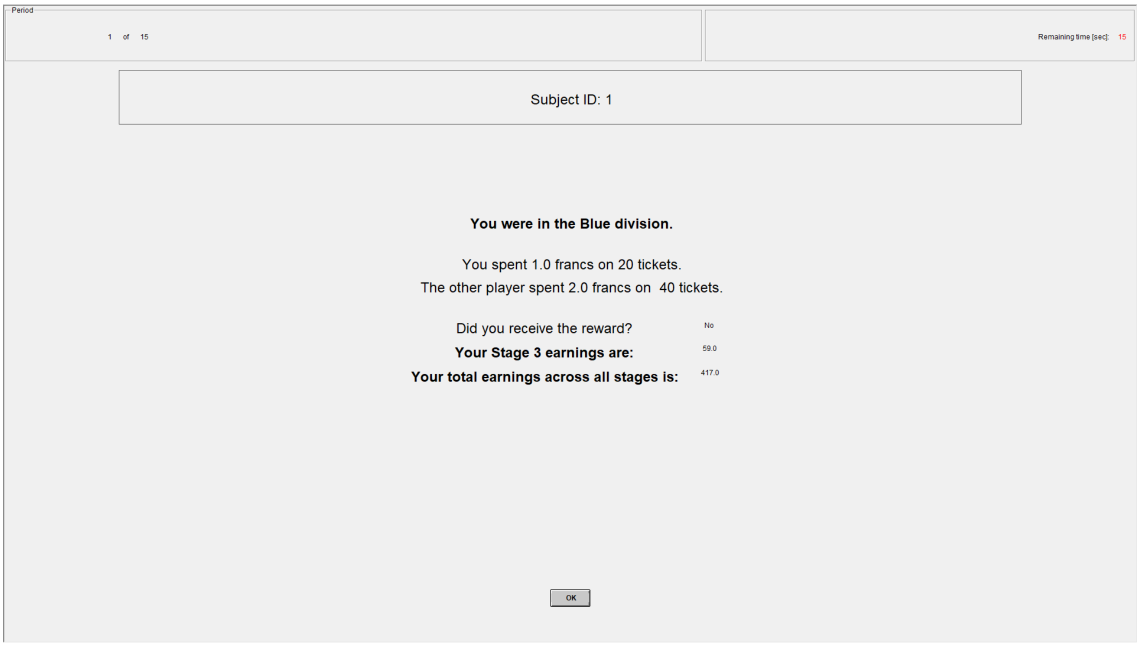


This type A participant from the Blue division was moved to the Red division in stage 2. Now this participant is playing for a reward of 0 Francs instead of 120 Francs. Notice that this participant can purchase 20 tickets/Franc they spend while the other participant can only purchase 10 tickets/Franc spent. Similarly, in the Blue division in stage 2, the type A participant will be able to purchase 20 tickets/Franc they spend while the other type B participant who was moved from the Red division to the Blue division will only be able to purchase 10 tickets/Franc spent.

In stage 2, the participants who receive the reward in either the Blue or Red division will be placed in the Blue division in stage 3. The participants who do not receive the reward in either the Blue or Red division will be placed in the Red division in stage 3.

The decision you face in stage 3 is very similar to that of stages 1 and 2, however, this time the other participant in your division might be a different type to the one you played in the previous stage, and the reward you play for may also be different than the one you played for in the previous stage if you moved divisions. After you have completed all stages of the game the computer will calculate your total earnings for the period. Your total earnings for a period are equal to the sum of your earnings across stages 1, 2 and 3. These earnings will be converted to cash and paid at the end of the experiment if the current period is the period that is randomly chosen for payment.

At the end of each stage, your expenditure on lottery tickets, the other participant's expenditure on lottery tickets, whether you received the reward or not, and the earnings for the stage are reported on the outcome screen as shown below.



After you have made your decision in stage 3 you will be shown your total earnings for the period. Once the outcome screen is displayed for each stage you should record your results for the period on your **Personal Record Sheet** under the appropriate heading.

Important Notes

You will not be told which of the participants in this room are assigned to which group. At the beginning of each period you will be randomly re-grouped with 3 other participants to form a four-person group. You can never guarantee yourself the reward. However, by increasing your expenditure on lottery tickets, you can increase your chance of receiving the reward in each stage. After each stage has been completed the reward recipients in each division will be placed in the Blue division in the following stage, while the participants who do not receive the reward in either division will be placed in the Red division in the following stage. At the end of the experiment we will randomly choose **1 of the 15 periods** for actual payment using a bingo cage. Your earnings will be converted and paid out in AUD.

Are there any questions?

Chapter 3

Two strikes and you are out! An experiment on exclusion

The literature on exclusion in cooperative work settings has only examined forms of exclusion without the need for issuing prior notice. Such forms of exclusion are comparable to the zero-tolerance approach commonly utilized by US companies to dismiss employees for poor performance. However, there are cases where poor performers are notified about their performance prior to being excluded from their group. For example, in many workplaces if an employee is accused of performing poorly or in a negligible manner, they may be subjected to a Performance Improvement Plan.[1] While the employee's performance is being evaluated, they must adhere to the necessary improvements, otherwise they will receive a strike. The manager only has grounds for dismissal if the employee continues to not adhere to the necessary improvements outlined in the Performance Improvement Plan. In this example, employers have grounds to dismiss an employee if they have received the necessary number of strikes while on the plan. In one of the treatments in the current study we required participants to issue strikes to other group members prior to excluding them. After a group member had received a strike the group was made aware at every point in the game that this individual had previously received a strike. This

[1] Performance Improvement Plans are mostly used in offices around the UK, Europe and Australia.

design feature is novel and allows us to provide a comparison between the two-strike exclusion policy and zero-tolerance exclusion policy as a means for fostering cooperation in groups.[2]

Although prior research has shown how effective zero-tolerance exclusion policies can be in fostering cooperation in groups, such policies have limitations. On the one hand, such harsh forms of exclusion have a positive effect on the welfare of the group as it encourages the remaining group members to cooperate vigorously. On the other hand, the exclusion of potentially valuable group members will inevitably have a negative impact on the welfare of the group as the productive capacity of the group will no longer be as large. To illustrate the inefficiencies that may arise under a zero-tolerance regime consider the following example. Suppose we have a group of six individuals and five of them consistently contribute 90% of their endowment while the sixth group member consistently contributes 50% of their endowment towards the provision of the public good. In a setting where group members are not able to issue strikes to one another prior to exclusion it is likely that the sixth group member's relatively small contribution will be tolerated, as the group would prefer to keep this relatively small contributor in the group than to exclude them from the group. A two-strike exclusion policy may address this inefficiency. By requiring group members to issue strikes to one another prior to excluding them, group members are now able to disclose their disapproval to one another. Masclet et al. (2003), Andreoni and Petrie (2004) and Rege and Telle (2004) have shown that people tend to behave more cooperatively when faced with the threat of disapproval. Moreover, Sheremeta et al. (2011) and Charness and Yang (2014) provide evidence to suggest that individuals will cooperate more after being given a second chance to participate in a group. Hence, the two-strike exclusion policy may provide sufficient incentives for cooperation without necessitating the exclusion of any members of the group. As a result, requiring group members to issue strikes to one another prior to

[2]Note, the environment created in our experiment is slightly different to this example. Rather than having a manager choose whom to exclude, we allow for group members to exclude one another via a majority rule. This exclusion approach is still relevant to the example described above as a manager might only believe that an employee is performing poorly if a sufficient number of group members disclose their disapproval of that employee's performance.

exclusion may in fact be more efficient than not having this requirement.

Alternatively, one can rationalize how requiring group members to issue strikes to one another prior to exclusion may prove to be less efficient. Consider a setting where we allow for exclusion without prior receipt of strikes. In such settings group members might behave extremely cooperatively throughout the course of the game as they will constantly be wary of the threat of exclusion. In contrast, in a setting where we require group members to issue strikes to one another prior to exclusion the initial level of cooperation might be relatively low as there is no immediate threat of exclusion prior to receiving a strike. After group members receive strikes from one another the level of cooperation may rise to a significantly higher level. Whether cooperation levels rise enough to justify the use of a two-strike exclusion policy instead of a zero-tolerance exclusion policy is difficult to establish. The experiment described in the current study allows us to determine which of the two exclusion policies is most effective in fostering cooperation in groups.

A broad literature in experimental economics, starting with Fehr and Gächter (2000), demonstrates that peer-to-peer punishment fosters increased cooperation in finite-horizon social dilemma situations such as the prisoner's dilemma and public good games. As opposed to altruistic punishment, others such as Masclet (2003), Cinyabuguma et al. (2005), Maier-Rigaud et al. (2010), Sheremeta et al. (2011) and Charness and Yang (2014) investigated the effects of exclusion in fostering cooperation in groups. These researchers found strong evidence to suggest that the net effect of the threat of exclusion on the level of cooperation within groups was positive.

This research adds to the emerging literature on exclusion in groups. That emerging literature on exclusion in groups can be separated into two categories: studies focused on varying the length of exclusion or studies implementing alternative exclusion rules. Neuhofer and Kittel (2015) and Solda and Villeval (2019) found strong evidence to suggest that lengthening the duration of exclusion has a positive effect on the level of cooperation within groups. Both papers implement exclusion either for one period or for the rest of the game and find that cooperation levels are significantly higher when players are excluded for the rest of the game. Cinyabuguma et al. (2005) and Maier-Rigaud et al. (2010) used a majority voting rule to determine exclusion in groups. Whereas, Croson et al. (2015) simply excluded the lowest contributor in each group after each period. More recently Kopányi-Peuker et al. (2018) varied the periods for which one could be excluded. In all instances the threat of exclusion appeared to have a prevailing positive impact on cooperation within groups regardless of the length of exclusion, or how the individual facing exclusion was determined. To our knowledge, this is the first experimental study evaluating a two-strike exclusion policy.

Several studies such as Masclet et al. (2003), Andreoni and Petrie (2004) and Rege and Telle (2004) have shown that the threat of receiving disapproval from others is effective in deterring free riding behaviour. In one of the treatments in this study we require group members to issue strikes to one another prior to exclusion. A strike can be thought of as a form of disapproval directed to a member of the group. Therefore, the results from this study provide further insight into the impact that disapproval may have on individual behaviour in cooperative settings.

3.1 Experimental design and procedures

102 students were recruited from different departments at the University of Technology Sydney (UTS), to participate in a study which contained six experimental sessions of a computerized experiment, programmed in z-Tree, see Fischbacher, (2007) for more details. The experiment was conducted in the UTS Behavioural Lab. Participants were recruited through the online recruitment system for economic experiments (ORSEE); see Greiner (2015) for more details. In each session, participants were paid a 10 AUD show-up fee, plus their earnings from the experiment. The average payment per participant was 19.67 AUD (including the show-up fee) and the sessions averaged approximately one hour. The experiment consisted of three treatments: (i) a no exclusion treatment (baseline), (ii) an exclusion without strikes treatment and (iii) an exclusion with strikes treatment. This experiment was a between subject design.

The following table outlines how many groups participated in each treatment.

Table 3.1: Treatment summary

Treatment	**Number of groups**
No exclusion	6
Exclusion without strikes	6
Exclusion with strikes	5

At the beginning of each session the instructions were read out loud to all participants, see section 3.6 for a copy of the instructions. After going through the instructions participants were required to complete a short quiz. The quiz was designed to ensure that the participants understood the instructions before they played the game. In each treatment subjects participated in a repeated linear public good game. Participants were randomly assigned to groups of 6 and stayed in the same groups throughout each 10-period game. After participants played the game once for 10 periods, they were randomly assigned to a new group of 6 and the game was restarted for a further 10 periods.[3] In each period, participants first had to simultaneously choose how much to contribute to the Group account out of an endowment of 10 Francs. 1 Franc was equal to 0.025 AUD. The payoff for participant i was calculated according to the following function:

$$\pi_i = 10 - g_i + 0.4 \sum_{j=1}^{n} g_j$$

where g is the contribution to the Group account. With this payoff function, individuals have incentives to free ride, as the marginal private return from contributing to the Group account is smaller than the marginal cost, i.e. $0.4 < 1$. The choice of these parameter values ensures that the social optimum is for everyone to fully invest in the Group account, while the individuals' strictly dominant strategy is to invest nothing.

In all three treatments, there was a second stage in each period. In the second stage, each group member was informed about the contribution levels of the other members

[3]This was a surprise restart, i.e. subjects were unaware of the fact that they would participate in two 10-period games at the beginning of the session. This design feature enables us to replicate the results generated by Maier-Rigaud et al. (2010).

of their group (see section 3.6 for a screenshot of the information provided). However, unlike in Maier-Rigaud et al. (2010), contributions made by the other group members were shown in a fixed order on the screen in all three treatments. Thus, it was possible for members of a group to track the contributions made by other group members over time.[4] This measure was taken to control for the reputation effect across all treatments. In the exclusion without strikes treatment, after examining the contributions made by others, each group member could then assign disapproval points to exclude other group members or to refrain from assigning disapproval points. Each group member was able to allocate any whole number of disapproval points between 0 and 10 to as many members of the group as they wished to.[5]

In both exclusion treatments group members were only informed about the total number of disapproval points they received once they were excluded. This measure was taken to ensure that the difference in contribution levels between the no exclusion and exclusion without strikes treatment could not be attributed to individual tendencies to avoid disapproval from others. In order to be excluded individuals needed to receive more than 50% of the maximum number of disapproval points that could possibly be assigned to an individual in that period, i.e. at least 26 if the group consisted of six members, at least 21 if the group consisted of five members, at least 16 if the group consisted of four members, at least 11 if the group consisted of 3 members and at least 6 when there were only two remaining members. Excluded members continued to receive 10 Francs for all remaining periods and did not participate in future play of the game. The direct effect of excluding a group member was the decrease in group size. Since the marginal benefit from the Group account was set to 0.4, and was independent of the size of the group, the decision to exclude a group member always reduced the potential maximum contribution to the Group account.

The third treatment involving exclusion with strikes was very similar to the treat-

[4]Further to this, participants were provided record sheets to fill out to enhance their ability to track contributions made by other group members over time.

[5]This voting format has been implemented in other studies such as Masclet et al. (2003) and Sheremeta et al. (2011). It allows for richer empirical analyses as the dependent variable is subject to a larger degree of variation.

ment described above involving exclusion without strikes, however, there was one crucial difference between the two treatments. The key difference between the treatments was that in the exclusion with strikes treatment participants had to receive a strike prior to being excluded. If a group member received more than half the maximum number of disapproval points possible but **had not** previously received a strike, then that individual would receive a strike. If a group member received more than half the maximum number of disapproval points possible and **had** previously received a strike, then that individual would be excluded in the same way as in the treatment without strikes. It is worth noting that after a group member had received a strike the group was made aware at every feedback stage that this individual had previously received a strike. This allowed each group member to understand the consequences of their disapproval assignment. For more details about this treatment see the instructions provided in section 3.6.

3.2 Predictions

As highlighted in Maier-Rigaud et al. (2010), employing standard game theoretic techniques will not allow for derivation of any meaningful predictions. To illustrate this point, consider a setting where it is not necessary to issue strikes prior to exclusion. It is evident that in the last period all players remaining in the game will contribute zero towards the Group account, so that the payoff is 10 for all players (including the excluded ones). By backwards induction, cooperation unravels from the end until the beginning of the game and the only requirement for subgame perfection is for each member of the group to contribute zero in every period. Any configuration of disapproval assignment and group sizes can be part of an equilibrium, that is, there exist a multiplicity of equilibria with different disapproval assignment levels and corresponding different group sizes throughout the game. A similar rationale can be used to stipulate the same behaviour should be expected when an individual can only be excluded after they have received a strike. Hence, subgame perfection predicts no difference in the level of cooperation across the three treatments.

The experimental literature on exclusion in groups has provided clear evidence to suggest that the threat of exclusion has a positive effect on cooperation. Thus, in order to derive meaningful predictions with respect to the experiment described in this study we need to think of the problem in an alternative way. Suppose the average contribution made towards the Group account when group members **do not** face a threat of exclusion is g_{NE}, and the average contribution made towards the Group account when group members **do** face a threat of exclusion is g_E. Essentially, the threat of exclusion raises the cost of free riding. As a result, we expect group members to contribute less towards the Group account when they do not face a threat of exclusion than when they are faced with a threat of exclusion. Research conducted by Cinyabuguma et al. (2005), Maier-Rigaud et al. (2010), Croson et al. (2015) provides strong evidence to support this claim. In light of this, we assume that $g_E > g_{NE}$. Consider the treatment where we only allow for a group member to be excluded after they have received a strike. Before a given group member receives a strike, they face no threat of exclusion. However, after a group member receives a strike that group member suddenly faces a genuine threat of exclusion. Essentially, this implies that after receiving a strike the representative group member switches from contributing g_{NE} to g_E. Given the fact that we have assumed $g_E > g_{NE}$, we can make the following prediction.

Hypothesis 1: Individuals will contribute more after receiving a strike than prior to receiving a strike.

Suppose the public good game is repeated finitely for $T + 1$ periods and the representative group member receives a strike in period $t \in [1, 2, 3,..., T + 1]$. Note, in the final period of the game there can be no threat of exclusion as the game will cease to continue after this period. Since there is never a threat of exclusion in the final period of the game, we expect contributions to be the same in this period across all three treatments. As a result, we will focus on analysing average contributions over T periods. For t periods the representative group member will contribute g_{NE} as they face no threat of exclusion. For the remaining $T - t$ periods the representative group member faces a genuine threat of exclusion, hence, they contribute g_E.

Therefore, the average contribution made by the representative group member in the exclusion with strikes treatment, g_{ES}, over T periods can be expressed by the following:

$$g_{ES} = \frac{tg_{NE} + (T-t)g_E}{T}.$$

Now that we have derived an expression for the average contribution level in the exclusion with strikes treatment it is possible to make comparisons between average contribution levels in each of the three treatments. First, we must evaluate the difference in average contributions between the exclusion without strikes and the exclusion with strikes treatments. We have that

$$\begin{aligned} g_E - g_{ES} &= g_E - \frac{tg_{NE} + (T-t)g_E}{T} \\ &= \frac{t(g_E - g_{NE})}{T}. \end{aligned}$$

Recall, $g_E > g_{NE}$ by assumption. We also know by construction that group members will never receive strikes prior to the first period, i.e. $t > 0$. Therefore, it must follow that $g_E > g_{ES}$.

Now we must compare average contribution levels between the exclusion with strikes treatment and the no exclusion treatment. We have that

$$\begin{aligned} g_{ES} - g_{NE} &= \frac{tg_{NE} + (T-t)g_E}{T} - g_{NE} \\ &= \frac{(T-t)(g_E - g_{NE})}{T}. \end{aligned}$$

If a group member receives their first strike in the second last period, T, then they cannot be excluded in the final period of the game. Therefore, it is futile giving another member of your group a strike in any period after the third last period of the game as it will most likely not alter their behaviour. For this reason, we believe group members will typically receive a strike at some point before the penultimate period, i.e. $t < T$. Combining this with the assumption that $g_E > g_{NE}$ leads to the proposition that $g_{ES} > g_{NE}$. As a result, we have the following prediction in relation to average contribution levels across the three different treatments described in the previous section.

Hypothesis 2: Individual contributions will be highest in the treatment where issuing strikes prior to exclusion is not required, lower in the treatment where it is necessary to issue strikes prior to exclusion, and lowest in the treatment without the possibility of exclusion.

3.3 Results

3.3.1 Response to strikes

The results that follow were generated from the experiment described in section 3.1. This study contained a total of 102 participants (30 to 36 participants per treatment). The following figure illustrates how individuals responded to receiving strikes as well as the average individual contribution level in the other treatments.

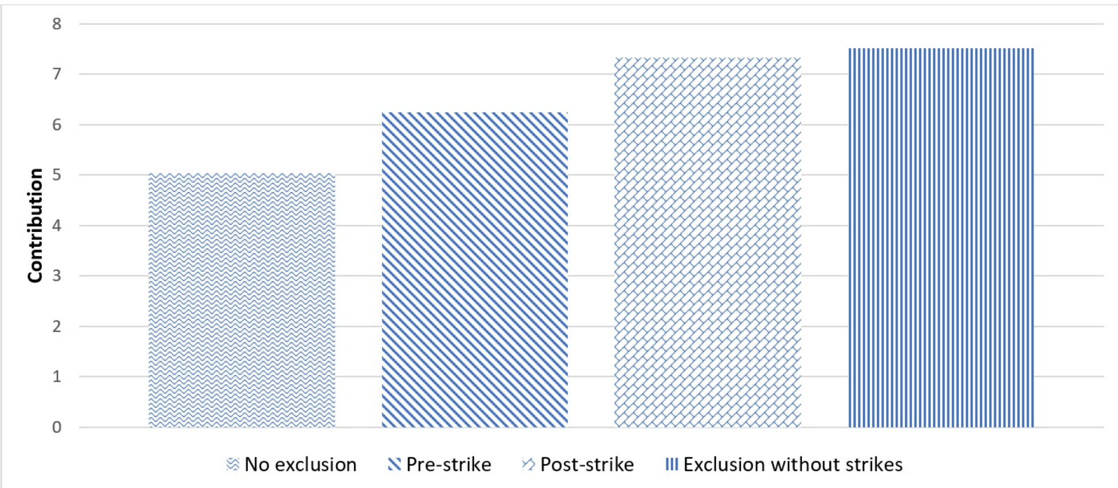


Figure 3.1: Individual contribution levels across treatments

The pre-strike contribution level for an individual represents the average of all contributions made towards the Group account by an individual prior to receiving a strike. The post-strike contribution level for an individual represents the average of all contributions made towards the Group account after receiving a strike.[6] Figure

[6]Note, we did not include observations where individuals received their first strike after the

1 indicates that individuals tended to contribute more after receiving a strike (6.25 vs. 7.33). We estimate a random-effect model of individual contribution on the dummy-variable for whether an individual previously received a strike, while clustering errors at the group level. Our estimates indicate that the response to strikes was significant (p-value < 0.05 for periods 1-10 and periods 11-20). Refer to Table 3.4 in section 3.5 for more details.

Result 1: *Individual contributions increased in response to receiving a strike.*

Result 1 provides strong support for our first hypothesis.

3.3.2 Data comparison across treatments

Table 3.2 outlines the mean and standard errors in individual level contributions, group level contributions, cumulative payoffs for individuals in AUD, prevailing group size and productive capacity in all three treatments. Note, values generated for excluded individuals are included in the calculation of average individual contributions and average cumulative payoffs.

Table 3.2: Data summary

	No exclusion		**Exclusion without strikes**		**Exclusion with strikes**	
	Periods 1-10	Periods 11-20	Periods 1-10	Periods 11-20	Periods 1-10	Periods 11-20
Individual contribution	5.036 (0.357)	5.033 (0.371)	7.442 (0.300)	7.581 (0.299)	6.458 (0.287)	6.617 (0.239)
Group contribution	30.217 (3.651)	26.250 (3.322)	44.650 (2.029)	47.600 (3.615)	38.017 (1.264)	42.550 (3.693)
Cumulative payoff	4.263 (0.105)	4.031 (0.113)	4.926 (0.072)	5.116 (0.108)	4.588 (0.071)	4.663 (0.108)
Prevailing group size	6.000 (0.000)	6.000 (0.000)	4.667 (0.333)	5.500 (0.224)	4.600 (0.510)	4.600 (0.678)
Productive capacity	1.000 (0.000)	1.000 (0.000)	0.950 (0.017)	0.958 (0.020)	0.942 (0.017)	0.913 (0.038)

Productive capacity is the ratio of the actual sum of group sizes throughout the game to the maximum possible sum of group sizes throughout the game. The productive

8th period in the game because strikes received after the 8th period should have no effect on contribution behaviour. We also did not include contributions that were made in the final period in our calculation of the average contribution due to end-game effects.

capacity measure for a group was calculated as follows:

$$PC = \frac{\sum_{t=1}^{10} N_t}{60}$$

Where N_t is the group size in period t and the game goes for 10 periods. Figure 3.2 provides a graphical representation of contributions made at the group level in the experiment.

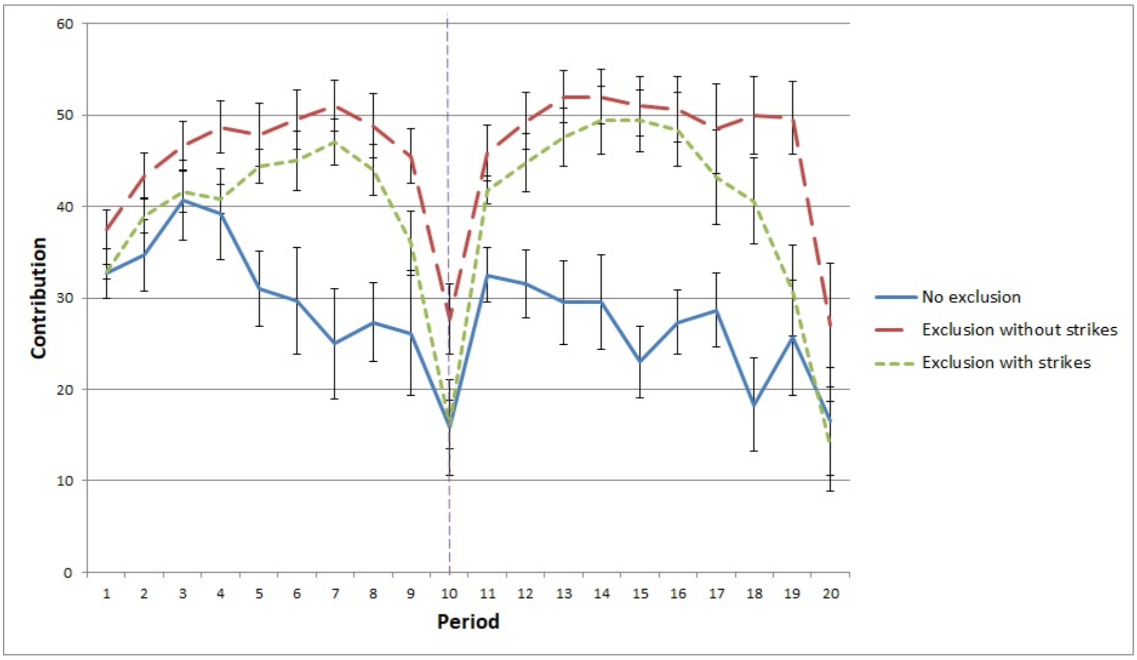


Figure 3.2: Contributions at the group level

We estimate a random-effect model of individual contribution on treatment dummy-variables, while clustering errors at the group level. Our estimates indicate that individual contributions were higher in both exclusion treatments than in the no exclusion treatment (p-value < 0.05 for periods 1-10 and periods 11-20 for both treatment dummies). The coefficient estimates for the treatment dummies also indicate that individual contributions were higher in the exclusion without strikes treatment than in the exclusion with strikes treatment.[7] Refer to Table 3.5 in section 3.5 for more details.

[7]The difference in the estimated coefficients between the two exclusion treatments was statistically significant for periods 1-10 but not for periods 11-20.

Result 2: *On average individuals contributed the most towards the Group account in the exclusion without strikes treatment, less in the exclusion with strikes treatment and the least in the no exclusion treatment.*

Result 2 provides strong support for our second hypothesis. The derivation of the second hypothesis was primarily dependent on two assumptions. The first assumption was that group members would contribute significantly more towards the Group account when they faced a threat of exclusion, i.e. $g_E > g_{NE}$. This claim is strongly supported by result 2. Specifically, we did find that individuals contributed significantly more towards the Group account in the exclusion without strikes treatment than in the no exclusion treatment. The second assumption was that group members would typically receive a strike sometime prior to the second last period of the game. Figure 3.3 outlines the frequency of which an individual received their first strike in a given period of the game.

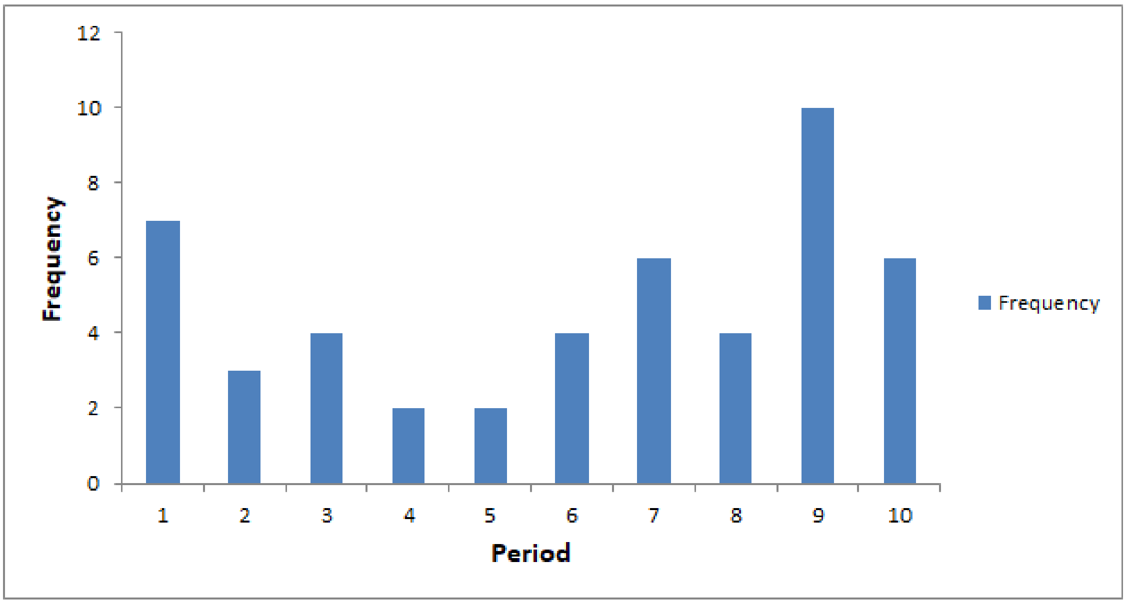


Figure 3.3: Receipt of first strike

It is clear from Figure 3.3 that in many cases individuals received their first strike at some stage prior to the second last period, i.e. sometime prior to period 9. In fact, group members received their first strike prior to the second last period 67% of the time.[8] This result in combination with the fact that individuals tend to contribute

[8]On average group members received their first strike in the 6th period of the game.

more when they face a threat of exclusion explains why we found strong support for hypothesis 2.

We estimate a random-effect model of group level contribution on treatment dummy-variables, while clustering errors at the session level. Our estimates indicate that contributions made towards the Group account at the group level were higher in both exclusion treatments than in the no exclusion treatment (p-value < 0.05 for periods 1-10 and periods 11-20 for both treatment dummies). The coefficient estimates for the treatment dummies also indicate that contributions made towards the Group account at the group level were higher in the exclusion without strikes treatment than the exclusion with strikes treatment.[9] Refer to Table 3.6 in section 3.5 for more details.

Result 3: *On average contributions made at the group level towards the Group account were highest in the exclusion without strikes treatment, lower in the exclusion with strikes treatment and the lowest in the no exclusion treatment.*

Result 3 is significant as it highlights the fact that efficiency was highest in the exclusion without strikes treatment and lowest in the no exclusion treatment. Hence, the positive effect that the threat of exclusion had on cooperation seemed to overshadow the negative impact of reduced group size on overall efficiency.

We can see from Table 3.2 that on average individuals received a higher payoff in the exclusion without strikes treatment than in the no exclusion treatment (Mann-Whitney U test, $n = m = 72$, p-value < 0.00001). There was also evidence to suggest that individual payoffs were higher on average in the exclusion with strikes treatment than in the no exclusion treatment (Mann-Whitney U test, $n = 60$ and $m = 72$, p-value < 0.00001). The data generated from the experiment seems to indicate that on average individuals received a higher payoff in the exclusion without strikes treatment than in the exclusion with strikes treatment (Mann-Whitney U test, $n = 72$ and $m = 60$, p-value < 0.00001).

[9] The difference in the estimated coefficients between the two exclusion treatments was statistically significant for periods 1-10 but not for periods 11-20.

Result 4: *On average individuals received the highest cumulative payoff in the exclusion without strikes treatment, significantly lower cumulative payoffs in the exclusion with strikes treatment and the lowest cumulative payoffs in the no exclusion treatment.*

Given result 2, results 3 and 4 should not be surprising. Higher average contributions at the individual level should lead to higher average contributions at the group level, which in turn should lead to higher average payoffs for each individual within the group.[10] Result 4 indicates that individuals were financially better off in the exclusion without strikes treatment than in the exclusion with strikes treatment. This result is striking as it goes against the widely held belief that overall welfare should be higher under a two-strike regime than a zero-tolerance regime.

3.3.3 Prevalence of exclusion

As highlighted earlier in this chapter, excluding group members has a negative impact on the productive capacity of the group. Consequently, it is worth discussing the prevalence of exclusion across treatments. Figure 3.4 illustrates how the level of exclusion varied across the two exclusion treatments.

[10]This line of implications can only be generated if we assume a fixed group size across treatments. In this case making such an assumption is somewhat tolerable given the fact that the prevalence of exclusion was so low across the three treatments.

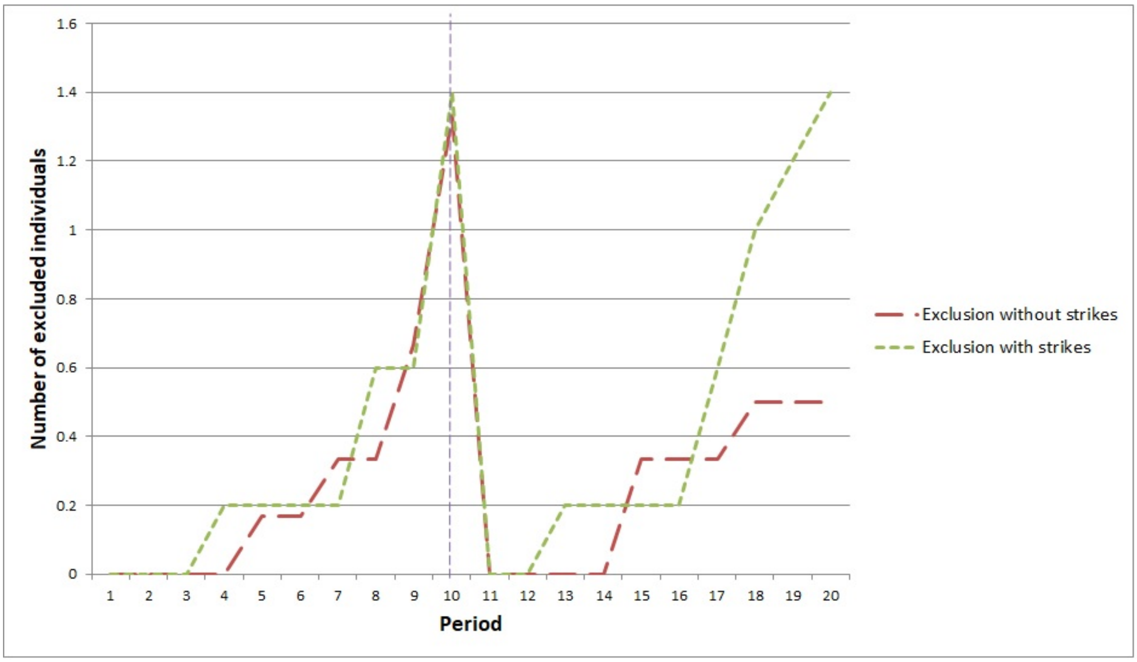


Figure 3.4: Prevalence of exclusion

In the exclusion without strikes treatment the average prevailing group size was 5.08 and the total number of individuals excluded was 11 out of 72, whereas in the exclusion with strikes treatment the average prevailing group size was 4.6 and the total number of individuals excluded was 14 out of 60. The data appears to indicate that exclusion was more prevalent in the treatment with strikes. However, we ran a Mann-Whitney U test to confirm that there was no statistically significant difference in the prevalence of exclusion between the two exclusion treatments. It was clear that in both exclusion treatments group members were aware of the negative impact that excluding other group members would have on the group. As a result, we saw fairly low levels of exclusion in both treatments. This may indeed be the reason why we did not find a statistically significant difference in the prevalence of exclusion across the two treatments.

3.3.4 Disapproval assignment

In this subsection we investigate the determinants of the rate of disapproval assignment by running a Tobit regression. The rate of disapproval assignment is calculated as the ratio of the total number of disapproval points cast by others in the group for a specific member of the group and the maximum possible number of disapproval points a group member could receive in that stage of the game. We study how the others' average contribution, the member's absolute positive deviation from others' average contribution, the member's absolute negative deviation from others' average contribution, whether the member is in the exclusion with strikes treatment and whether they have previously received a strike explain the relative amount of disapproval points cast for a specific group member. See Table 3.3 for the results from the estimation process.

Table 3.3: Factors influencing disapproval assignment

Variable	Disapproval assignment
Others' average contribution	-3.125***
	(0.346)
Positive deviation	-1.560***
	(0.424)
Negative deviation	10.119***
	(0.397)
Exclusion with strikes	8.409***
	(0.898)
Exclusion with strikes × Received strike	5.705***
	(1.432)
Constant	25.096***
	(2.952)
No. of observations	1188
Prob > χ^2	0.000

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note, the dependent variable is expressed as a percentage and the last period in both exclusion treatments was not included in the analysis due to end-game effects. Period dummies have been included in the regression to control for time fixed effects but have been omitted in the presentation above.

Table 3.3 highlights that absolute positive (negative) deviations from others' average contribution decreases (increases) the proportion of disapproval points received. This result is statistically significant at the 1% level. This point can be summarized as follows.

Result 5: *Disapproval assignment was positively (negatively) correlated with negative (positive) deviations from others' average contribution.*

We can see that participation in the exclusion with strikes treatment increased the proportion of disapproval points received. This result is statistically significant at the 1% level.

Result 6: *Disapproval assignment was significantly higher when individuals were in the exclusion with strikes treatment.*

Table 3.3 also indicates that disapproval assignment was significantly higher for group members who had previously received a strike. This result is statistically significant at the 1% level.

Result 7: *Disapproval assignment was significantly higher after individuals previously received strikes.*

Result 7 indicates that group members who had previously received a strike were more likely to receive higher rates of disapproval in the future. In other words, individuals appeared to be less tolerable after they received a strike.

3.4 Conclusion

Prior to conducting this research, the impact that a two-strike exclusion policy would have in fostering cooperation in groups was unclear. We found that individuals tend to cooperate more after receiving a strike. This finding highlights the possibility for undesirable group members to rehabilitate themselves without the need for suspension or expulsion. However, requiring group members to issue strikes to one another prior to exclusion seemed to be less effective than allowing for exclusion without prior receipt of strikes. As a result, the zero-tolerance approach commonly utilized by US companies to dismiss employees for poor performance may indeed be the most effective and efficient form of exclusion for fostering cooperation in groups.

3.5 Estimation tables

In Table 3.4 we estimate a linear random-effects regression of individual contributions on the dummy-variable for whether an individual previously received a strike, while clustering errors at the group level.

Table 3.4: Response to receiving strikes

Variable	Individual contribution Periods 1-10	Individual contribution Periods 11-20
Received strike	1.210***	1.786***
	(0.265)	(0.696)
Constant	6.456***	6.734***
	(0.301)	(0.648)
No. of observations	287	277
Prob > χ^2	0.000	0.010

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In Table 3.5 we estimate a linear random-effects regression of individual contribution on treatment dummy-variables, while clustering errors at the group level. Note, the baseline treatment is the no exclusion treatment.

Table 3.5: Treatment comparison – Individual level contributions

Variable	Individual contribution Periods 1-10	Individual contribution Periods 11-20
Exclusion without strikes	2.552***	3.870***
	(0.657)	(0.751)
Exclusion with strikes	1.591**	2.786***
	(0.265)	(0.747)
Constant	5.036***	4.375***
	(0.573)	(0.521)
No. of observations	991	980
Prob > χ^2	0.000	0.000

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In Table 3.6 we estimate a linear random-effects regression of group level contribution on treatment dummy-variables, while clustering errors at the session level. Note, the baseline treatment is the no exclusion treatment.

Table 3.6: Treatment comparison – Group level contributions

Variable	Group contribution Periods 1-10	Group contribution Periods 11-20
Exclusion without strikes	13.007***	18.064***
	(2.674)	(3.855)
Exclusion with strikes	8.687***	15.266***
	(1.968)	(4.102)
Constant	29.896***	25.283***
	(1.725)	(3.730)
No. of observations	170	170
Prob > χ^2	0.000	0.000

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

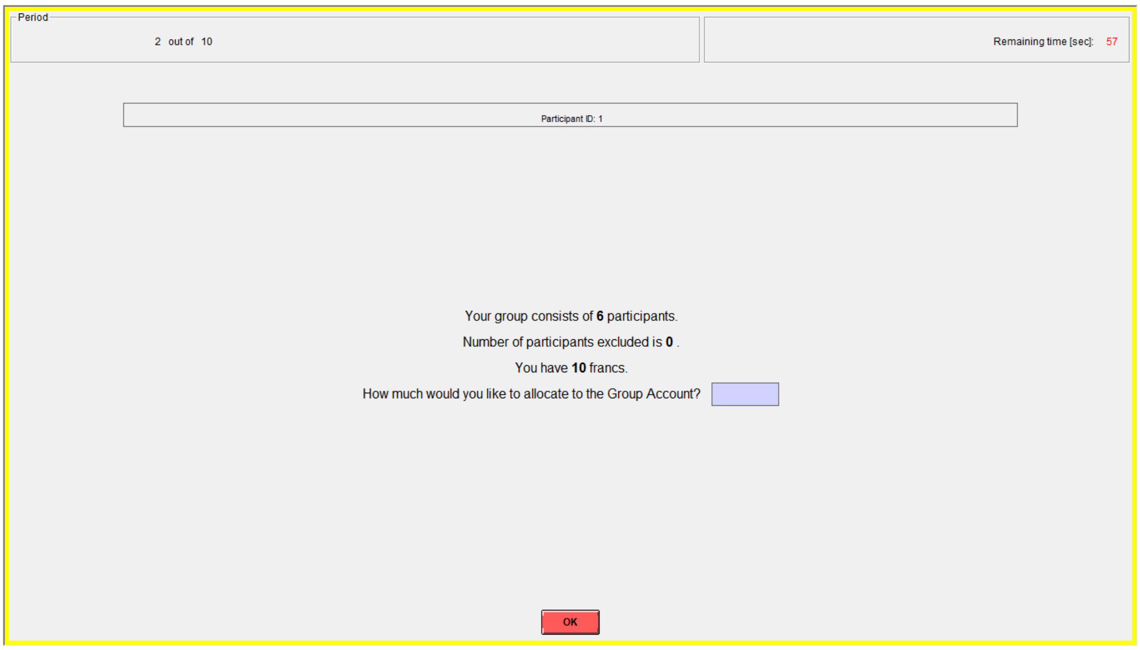
3.6 Instructions

[NOTE: These instructions are for the exclusion with strikes treatment, but those for the exclusion without strikes treatment are very similar.]

You are now participating in an economic experiment. If you read the following instructions carefully, you can, depending on your decisions and the decisions of others, earn a considerable amount of money. It is therefore very important that you read these instructions with care. The currency used in this experiment is Francs, where 40 Francs = 1 AUD. If you talk, laugh, exclaim out loud etc. without receiving permission you will be asked to leave the experiment. Should you have any questions please ask us.

Contribution decision

This part of the experiment is divided into 10 periods. You have been randomly assigned to a group of 6 individuals. You will remain in the same group for the duration of the game. In the beginning of each period you and every other member of your group will be endowed with 10 Francs. Each of you must decide how many Francs you would like to contribute to a Group Account, and, as a result how many Francs you would like to withhold. See contribution screen below.

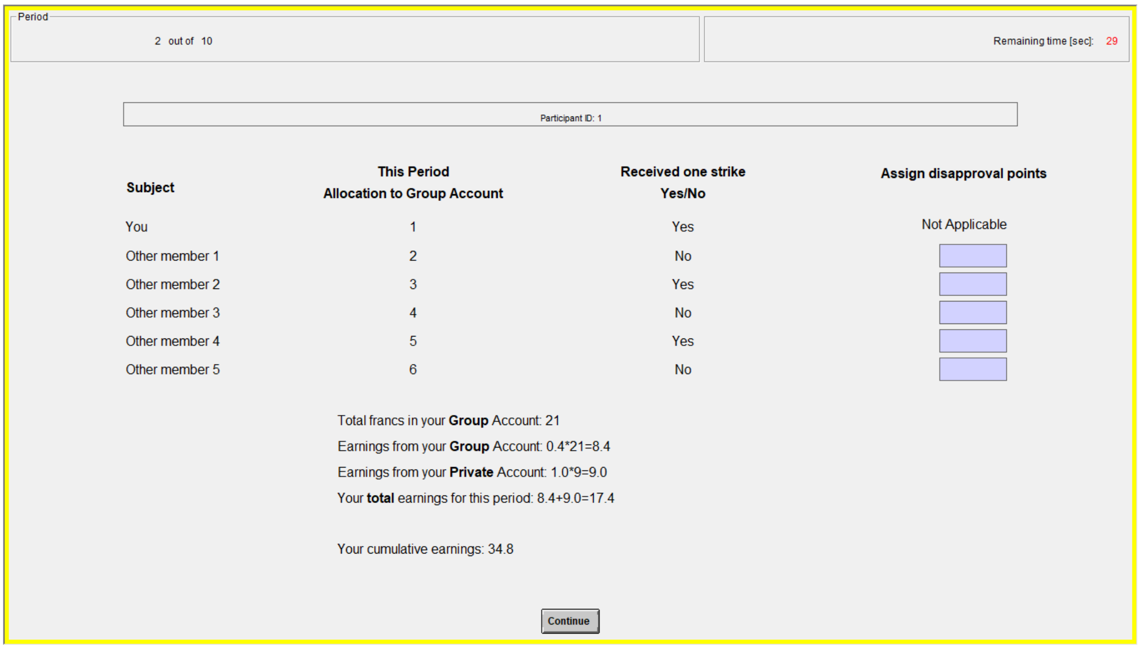


[NOTE: This was the contribution screen participants saw in the two exclusion treatments. In the no exclusion treatment the second line highlighting the number of excluded participants was not included.]

Your allocation decision must be a whole number, e.g. allocating 2.5 Francs to the Group Account is not possible.

Assign Disapproval Points

Once you have decided how much of your endowment to contribute to the Group Account you will receive feedback on your computer screen relating to your contribution as well as the contributions made by the other members of your group towards the Group Account. You will also receive feedback relating to your payoff in Francs for each period. See feedback screen below.



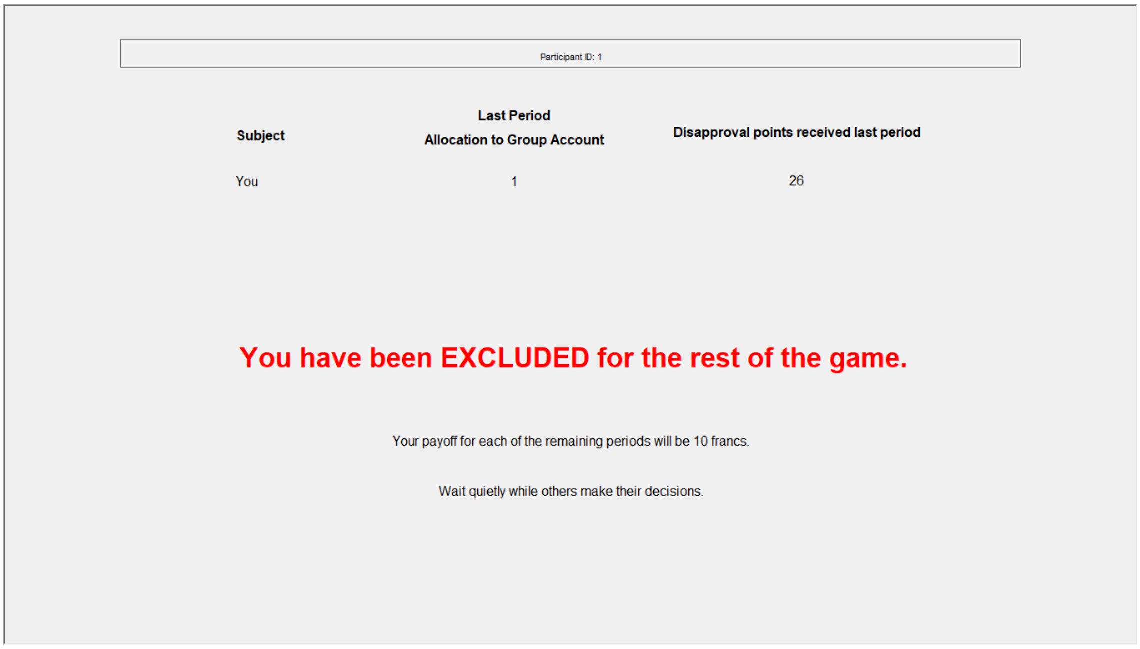
[NOTE: This was the feedback screen participants saw in the exclusion with strikes treatment. In the exclusion without strikes treatment the third column was not included. In the no exclusion treatment the third and fourth column was not included.]

Please note that the order in which the other group members appear on your feedback screen will always be the same for each period. In other words, other member 1 will be the same person in each period, other member 2 will be the same person in each period, so on and so forth.

At this point you are required to distribute disapproval points (whole numbers ranging from 0 to 10) to every member of your group. You are able to give any member in your group 0 disapproval points, or 10 disapproval points, or some amount in between, it is up to you **(10 points for the most disapproval and 0 points for the least disapproval)**.

If a group member receives **more than half of** the maximum number of disapproval points available, then they will **first receive a strike** from the group. For example, if the group consists of 6 individuals, then the maximum number of disapproval points an individual can possibly receive is 50, i.e. this is equal to the number of other group members which is 5, multiplied by the highest possible amount of disapproval which is 10. Thus, when the group consists of 6 individuals in order for you to receive a strike from the group you would need to receive at least 26 disapproval points from the rest of your group.

The third column in the feedback screen identifies whether or not a group member has received a strike. Hence, the rest of your group will be informed about whether or not you have previously received a strike. Once you have received a strike you will remain on a strike for the remainder of the game unless you have been excluded. **The second time** a group member receives more than half of the maximum number of disapproval points available they will be **excluded** from the group. In other words, a group member must first receive a strike before being excluded from the group for the remaining periods of the game. See exclusion screen below.



Please note, once a group member has been excluded it is no longer possible for that group member to make contributions towards the Group Account.

The number of disapproval points required for receiving a strike and excluding individuals within the group for all group sizes is summarized in the following table:

Group size	**Number of disapproval points for strike/exclusion**
6	At least 26
5	At least 21
4	At least 16
3	At least 11
2	At least 6
1	N/A

Remuneration

Each Franc you withhold from the Group Account generates a payoff of 1 Franc to you (and to you alone). Each Franc you place in the Group Account generates a payoff of 0.4 Francs to every member of your group (including yourself). This payoff structure does not vary with respect to group size. The payoff for each group member from the Group Account is calculated in the same way. This means that each group member receives the same payoff from the Group Account. Hence, the payoff to you from the Group account is equal to 0.4 multiplied by **the total number** of Francs contributed by the group towards the Group Account.

While you are in the group your total payoff in each period is the sum of your payoff from what you withheld from the Group Account and your payoff from the Group Account. This can be expressed by the following:

Total Payoff = (10 − Your contribution to Group Account) + 0.4 × Total contribution to Group Account made by the Group

If you have been excluded from the group, you will simply earn **10 Francs** in each of the remaining periods of the game.

Your total payoff for this stage of the experiment will be the sum of your payoffs for each of the 10 periods.

Example

Suppose you contributed 6 Francs towards the Group Account and the total contribution made by all group members to the Group Account was 20 Francs. In this case each member of the group receives a payoff from the Group Account of 8 Francs, i.e. $0.4 \times 20 = 8$. You will also receive a payoff of 4 Francs for the amount of Francs you kept for yourself, i.e. the payoff for withholding 4 Francs is $4 \times 1 = 4$. So your total payoff will be 12 Francs, i.e. $8 + 4 = 12$.

Chapter 4

Mutual monitoring, approval motivation and fostering cooperation in teams

Mutual monitoring is generally perceived to positively influence the level of cooperation in teams. The intuition behind this claim is that mutual monitoring reduces the incentive to free ride by creating peer pressure. However, it is worth noting that individuals might only be responsive to peer pressure if they are sufficiently motivated to seek the approval of others. Martin (1984) defines approval motivation as the desire to produce positive perceptions in others and the incentive to acquire the approval of others as well as the desire to avoid disapproval. This study is the first to directly examine whether the efficacy of mutual monitoring in fostering cooperation is dependent on the degree of approval motivation within teams. A principal could potentially use this information to filter for agents who have a greater propensity to cooperate in teams operating in such an environment, e.g. recruiters looking to hire employees to work in open-plan office spaces.

Many researchers have proposed various approaches to alleviate the problem of free riding by fostering cooperation in teams. Fehr and Gächter (2000) were the first to provide experimental evidence to suggest that the inclusion of costly punishment can lead to higher levels of cooperation in a repeated prisoners dilemma game. Other researchers such as Hackett et al. (1994) and Ostrom et al. (1994) have shown how communication between team members can reduce the prevalence of free riding in teams. The current study focuses on mutual monitoring as a means to induce cooperation in teams.

Kandel and Lazear (1992) and Rege and Telle (2004) argue that subjecting team members to mutual monitoring will result in higher levels of cooperation in teams. However, Orr (2001) and Frey and Jegen (2001) highlight how mutual monitoring may indeed be ineffective as it may crowd out cooperation in teams. This study seeks to add to a growing body of literature focusing on what determines the efficacy of mutual monitoring in fostering cooperation in teams.

Carpenter (2007) asserts that the efficacy of mutual monitoring in fostering cooperation in teams is dependent on the size of the team. Whereas, research conducted by Alchian and Demsetz (1972), Croson (2001), Cason and Khan (1999), Andreoni and Petrie (2004), Rege and Telle (2004), Noussair and Tucker (2007), Ambrus and Greiner (2012) and Filiz-Ozbay and Ozbay (2014) illustrate how the efficacy of mutual monitoring in fostering cooperation in teams may depend on the type of monitoring that is permitted within teams. In contrast with the aforementioned research, the purpose of this study is to investigate whether the efficacy of mutual monitoring in fostering cooperation in teams is dependent on inherent character traits within teams, specifically, approval motivation.

In recent years a small set of researchers examined empirically whether the level of cooperation in teams may indeed depend on inherent character traits within teams. Al-Ubaydli et al. (2015) found evidence to suggest that an individual's IQ potentially serves as a useful predictor for the level of cooperation in a repeated prisoners dilemma game. Volk et al. (2012) conducted a study on the big five personality traits. They found that there was a strong correlation between an individual's degree of agreeableness and their revealed preferences over cooperation in a repeated public goods game. Fleming and Zizzo (2011) investigated whether an individual's degree of social desirability had an impact on their likelihood to cooperate in a repeated public good game. In their study they employed the Social Desirability Scale-17 (SDS-17) which is an updated version of the Marlowe-Crowne Social Desirability Scale (MCSD).[1] They found that individuals with a relatively low degree of social desirability behaved more cooperatively than individuals with a relatively high degree of social desirability. Fleming and Zizzo (2011) argue that social desirability is highly correlated with an individual's degree of conformity. They believe that individuals with high social desirability scores were quick to conform to a social norm which was to contribute a very small amount to the communal pot, and, once this social norm was established divergence from contributing low amounts was extremely rare. However, for individuals who received low social desirability scores conformity to a social norm of making relatively small contributions was not as strong, hence, contributions were much higher. Assuming that the SDS-17 scale is a valid proxy measure for approval motivation, Fleming and Zizzo's main finding is at odds with the theoretical prediction made by Holländer (1990) as well as the predictions made in the current study.

In contrast with the study conducted by Fleming and Zizzo (2011) this study uses the revised Martin-Larsen Approval Motivation (MLAM) scale to elicit individual preferences over approval. It is important to distinguish between Marlowe and Crowne's measure of social desirability and Martin and Larsen's revised measure of approval motivation. Many studies such as Allaman et al. (1972), Berger et al. (1977), Evans (1979), Millham (1974) and Thaw and Efran (1967) have suggested that social desirability is a measure of defensiveness rather than approval-seeking nature. The revised MLAM measure is believed to be more appropriate for this study as it provides more of a behavioural self-description of reactions to approval and disapproval in social settings. This study seeks to address whether the efficacy of mutual monitoring in fostering cooperation is dependent on the degree of approval motivation within teams.

[1] See Stöber (2001) for a more detailed description of the SDS-17 scale.

4.1 Model

The theoretical framework adopted in this section is very similar to the one originally developed in Holländer (1990), however, adjustments to the model have been made where it was deemed necessary.[2] Assume each agent i within a team of n agents is initially endowed with $X > 0$ of a private good. An agent can either invest in the public good, $y_i \geq 0$, or withhold from contributing to the public good, $X - y_i$. We adopt the same approach as Sefton and Steinberg (1996) to model the extrinsic value, EV_i, for contributing towards the provision of the public good for agent i:

$$EV_i = b(X - y_i) - c(X - y_i)^2 + \frac{d}{n}\left(y_i + \sum_{j \neq i} y_j\right),$$

where $b, c > 0$ are parameters that characterize the value gained for an agent from withholding contributions to the public good, and $d > 0$ is the payment the group receives for each unit invested in the public good.

The degree of observability is represented by $M \in \{0, 1\}$. When team members are unable to observe the investment level of other members of their team $M = 0$ and when team members are able to observe the contribution level of other members of their team $M = 1$. For simplicity, suppose the following conditions hold; first, it is impossible for any member of the team to detect any other team member's investment level when their actions are unobservable, and, second, when behaviour is observable any action made by an agent within the team will be detected by the rest of the team with absolute certainty. By introducing this assumption it is possible to capture the probability of being detected by M, i.e. if $M = 1$, the actions of members of a team will be detected by the rest of the team with certainty, and if $M = 0$, the actions of members of a team will be detected by the rest of the team with a probability of zero.

[2] As opposed to Holländer (1990), we have chosen to adopt a non-linear public goods game structure similar to Sefton and Steinberg (1996). This structure allows for a simple derivation of a closed form interior solution. Moreover, we have included a more detailed specification of the costs and benefits associated with receiving disapproval and approval respectively. Specifically, we have included a variable representing the degree of observability and allowed for heterogeneity in approval preferences across agents.

Let $a_i \in \mathbb{R}$ reflect the degree of approval motivation for agent i and $r_i(y_{-i})$ represent a reference point for agent i to base their contribution decision on. For example suppose $r_i(y_{-i}) = \min(y_{-i})$. In this example agent i will only potentially incur a social cost (i.e. guilt) if they contribute less towards the provision of the public good than everyone else in their group, and they will only potentially incur a social benefit (i.e. pride) if they contribute more towards the provision of the public good than the lowest contributor in their team. For simplicity assume the intrinsic (social approval) value is linear with respect to y_i. Hence, the intrinsic value, IV_i, for contributing towards the provision of the public good for agent i can be expressed by the following:

$$IV_i = Ma_i(y_i - r_i(y_{-i}))$$

By combining the above expressions for EV_i and IV_i it is possible to construct the problem faced by the representative agent. Agent i faces the following problem:

$$\max_{y_i \geq 0} \; b(X - y_i) - c(X - y_i)^2 + \frac{d}{n}\left(y_i + \sum_{j \neq i} y_j\right) + Ma_i(y_i - r_i(y_{-i})).$$

After taking the first order condition with respect to y_i it is possible to derive the following condition for the strictly dominant level of investment in the public good:

$$y_i^* = \frac{2cX + \frac{d}{n} - b + Ma_i}{2c}.$$

From the previous expression for y_i^* it is possible to develop the following hypotheses.

Hypothesis 1: In the no observability setting the degree of approval motivation for an agent will have no effect on the contribution level made by that agent towards the provision of the public good.

Hypothesis 2: In the public observability setting the degree of approval motivation for an agent will have a positive effect on the contribution level made by that agent towards the provision of the public good.

The change in the amount contributed towards the provision of the public good by agent i with respect to the degree of observability can be measured by the following:

$$\Delta y_i = y_i^*(M = 1) - y_i^*(M = 0).$$

After some calculation we can express Δy_i as follows:

$$\Delta y_i = \frac{a_i}{2c}.$$

From the previous expression for Δy_i we can establish the following hypotheses.

Hypothesis 3a (Unconditional): The contribution made towards the provision of the public good by any agent will be greater when their contribution decision is made publicly observable.[3]

Hypothesis 3b (Conditional): Agents with a relatively high (low) degree of approval motivation will contribute more (less) towards the provision of the public good in the public observability setting than in the no observability setting.

The partial derivative of Δy_i with respect to a_i is as follows:

$$\frac{\partial \Delta y_i}{\partial a_i} = \frac{1}{2c} > 0.$$

The above finding provides motivation for the next hypothesis.

Hypothesis 4: The effect of mutual monitoring on contributions made towards the provision of the public good will be greater for agents with a higher degree of approval motivation.

[3]Hypothesis 3a is supported by Rege and Telle (2004), whereas hypothesis 3b is derived from the expression for Δy_i.

Figure 4.1 is a graphical representation of what the results could look like if there is evidence to support hypotheses 1, 2, 3 and 4.[4]

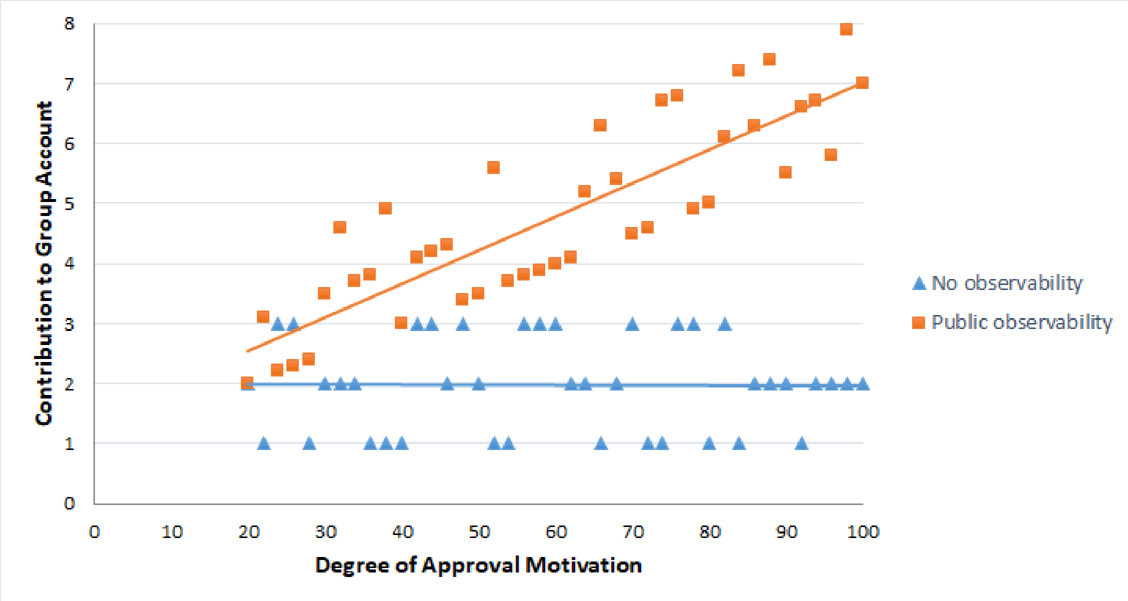


Figure 4.1: A graphical representation of the hypotheses

4.2 Experimental design and procedures

4.2.1 Stage 1 – Eliciting approval motivation

For the purpose of this study 64 subjects were recruited through the online recruitment system for economic experiments (ORSEE); see Greiner (2015) for more details. All participants were recruited from the University of Technology Sydney (UTS). Participants came from a variety of faculties including Business, Arts and Social Sciences, Engineering and IT. The experiment was conducted in the UTS Behavioural Lab. Subjects were paid on average 26 AUD (including the 10 AUD show-up fee). The experiment was run using the z-Tree software package developed at the Institute for Empirical Research in Economics at the University of Zurich; see Fischbacher (2007) for a description of the z-Tree program. At the beginning of each session every participant was required to fill out a questionnaire known as the revised Martin-Larsen Approval Motivation (MLAM) scale. A copy of the question-

[4] Figure 4.1 was created by plotting two linear trend lines. The data points are errors which are uniformly distributed between -1 and 1 unit away from the linear trend lines.

naire can be found in section 4.6.[5] The revised MLAM scale provides a measure of an individual's degree of approval motivation.[6] It is important to highlight that participants were always required to complete the revised MLAM scale before playing the non-linear public good game. If subjects were instead given the opportunity to fill out the questionnaire after playing the non-linear public good game, the results may have been biased.[7] After completion of this stage of the experiment all subjects were required to participate in the second stage of the experiment which was run immediately after stage 1.

4.2.2 Stage 2 – The non-linear public good game

It is worth noting that participants only received instructions for the game played in stage 2 once they completed stage 1. A copy of the instructions is included in section 4.8. Each session in this stage of the experiment consisted of 1 one-shot version of the non-linear public good game.[8] After the subjects participated in the one-shot version of the game, they were required to complete a 10-period repeated version of the non-linear public good game. Stage 2 was a 2×1 between subject design, where the degree of observability varied between treatments. Participants were assigned to groups of 4. Each session contained 4 subjects. Table 4.1 illustrates the structural composition of each session within stage 2 of this experiment.

Table 4.1: Structure for stage 2

Session	**Treatment**	**Subjects per Session**
1 - 8	No observability	4
9 - 16	Public observability	4

The process involved in the non-linear public good game was the following. Subjects

[5] Filler questions were also included in the questionnaire utilized in stage 1 of the experiment. This measure was taken to address any priming issues that may have occurred otherwise. The filler questions are listed in section 4.7.

[6] Typically, response bias is a concern when eliciting survey responses without incentives. However, Baillon et al. (2020) provide evidence to suggest that responses to survey questions do not vary with respect to incentives.

[7] Rather than responding to the statements truthfully, participants might try to justify their behaviour in the game by submitting responses in a certain way.

[8] The reason for implementing both a one-shot and a repeated game is that Noussair and Tucker (2007) found that participants only respond positively to public observability when they play the one-shot version of the game.

were endowed with 8 tokens. Participants were required to simultaneously select a portion of their endowment to contribute to a Group account. The payoff ascribed to each subject was generated using the payoffs tables found in section 4.8.[9] The conversion rate used in this experiment was 1 ECU = 0.05 AUD. Subjects were paid based on the outcomes of the one-shot game and the repeated game. It is worth noting that subjects were only paid based on the outcome of one randomly chosen round within the repeated game. This measure was taken to address any potential wealth effects. As mentioned earlier subjects participated in one of 2 treatments. In both treatments subjects were provided feedback after each round outlining the following: the amount they chose to contribute towards the Group account in that round, their payoff for that round, and the amount that the other members of their group chose to contribute towards the Group account. Subjects who participated in the treatment with public observability were asked one at a time to announce the amount that they chose to contribute towards the Group account to the rest of their group. Note, subjects were only allowed to announce the amount they contributed to the Group account, and nothing else. Hence, participants realized how much the other members of their group chose to contribute to the Group account and how much they chose to keep for themselves.[10] Subjects who participated in the treatment with no observability were not required to make a public announcement relating to how much they chose to contribute towards the Group account. Therefore, subjects participating in this treatment were unable to correctly identify how much each individual within their group contributed towards the Group account.

4.2.3 Data and testing

After collecting all the data from stages 1 and 2 of the experiment it is possible to evaluate the validity of the predictions derived in section 4.1. From stage 2 we obtained 32 independent observations at the individual level for each treatment.[11]

[9] The values used in the payoffs tables are the same as in Sefton and Steinberg (1996). In this payoff structure the strictly dominant contribution level is 2 tokens and the Pareto optimal contribution level is 7 tokens.

[10] This design feature is essentially the same as in Rege and Telle (2004).

[11] It is worth noting that in order to achieve the recommended level of 80% power we should have at least 24 subjects in each treatment group. This number was generated by using data found

In the following section we test the validity of the derived hypotheses by running nonparametric tests.

4.3 Results

4.3.1 Measuring approval motivation

The following figure illustrates the distribution in approval motivation scores in both treatments.

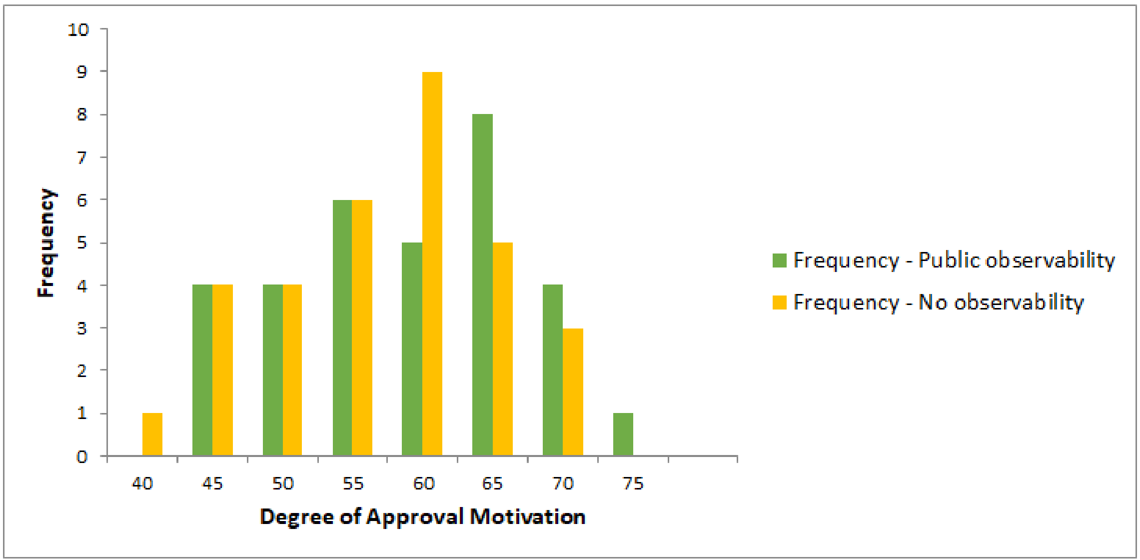


Figure 4.2: Distribution of approval motivation scores in both treatments

The results from running a Mann-Whitney U test confirm that the distributions are insignificantly different from each other.

4.3.2 One-shot game

Subjects were categorized based on their approval motivation score. Establishing a cut-off point in the degree of approval motivation was necessary in order to categorize participants into two types. The cut-off point chosen in this study was a degree of approval motivation score of 60. In other words, an individual who received an approval motivation score strictly greater than 60 was assumed to have a high degree

in the appendix of Rege and Telle (2004).

of approval motivation, and an individual who received an approval motivation score less than or equal to 60 was assumed to have a moderate degree of approval motivation.[12] The below table outlines the mean and standard errors in individual contribution levels made towards the Group account in both treatments given their approval motivation type.

Table 4.2: Individual contributions in the one-shot game

	Degree of Approval Motivation			
	Moderate		**High**	
	Mean	SE	Mean	SE
No observability	4.21	0.35	4.88	0.52
Public observability	5.74	0.42	4.31	0.44

Table 4.3 provides a summary of the mean and standard errors in individual payoffs received from the one-shot game in the experiment. Note, the payoffs listed in the table are in AUD and do not include the fixed participation fee of 10 AUD.

Table 4.3: Individual payoffs

	Degree of Approval Motivation			
	Moderate		**High**	
	Mean	SE	Mean	SE
No observability	7.72	0.14	7.15	0.35
Public observability	7.62	0.22	8.30	0.24

The following figure provides a graphical representation of the results from the one-shot game which was played in the experiment.

[12]This cut-off point was chosen as it is a clear point of neutrality. If an individual responded neutrally to each statement in the revised MLAM scale, then they would receive an approval motivation score of 60.

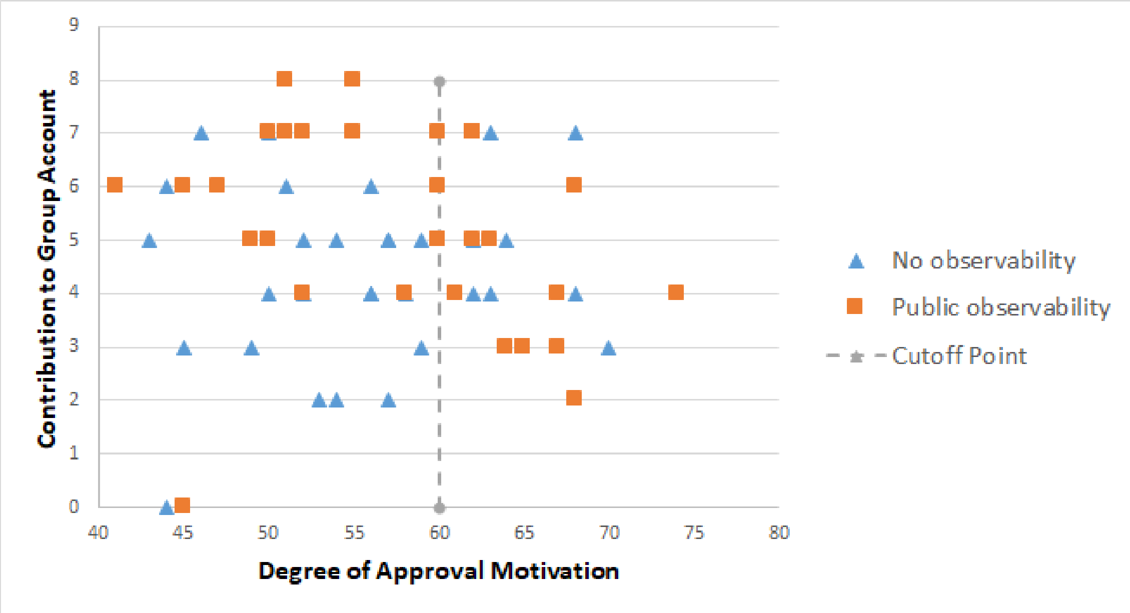


Figure 4.3: A graphical representation of the results from the one-shot game

It is evident from Figure 4.3 that there was no significant correlation between individual contributions made towards the Group account and the degree of approval motivation when behaviour was not observable. However, we can see in both Table 4.2 and Figure 4.3 evidence to suggest a negative correlation between individual contributions made towards the Group account and the degree of approval motivation when behaviour was publicly observable. It is possible to derive the following results by conducting several Mann-Whitney U tests on the one-shot data.

Result 1: *On average individuals contributed more towards the Group account when their contribution decisions were publicly observable.*[13]

Without separating out the approval types, the contributions made to the Group account in the one-shot game were higher at the 10% level in the public observability treatment than in the no observability treatment (Mann-Whitney U test, $n = m = 32$, p-value $= 0.06724$).

Result 2: *In the no observability treatment the degree of approval motivation for an individual did not have a significant effect on the contribution level made by that individual towards the Group account.*

[13] This result is in line with the finding generated in Rege and Telle (2004).

The contributions made to the Group account in the one-shot game for the highly approval motivated types were insignificantly different from the contributions made by the moderately approval motivated types in the no observability treatment. (Mann-Whitney U test, $n = 24$ and $m = 8$, p-value $= 0.4593$).

Result 3: *In the public observability treatment the degree of approval motivation for an individual had a negative effect on the contribution level made by that individual towards the Group account.*

The contributions made to the Group account in the one-shot game for the highly approval motivated types were significantly smaller than the contributions made by the moderately approval motivated types in the public observability treatment. (Mann-Whitney U test, $n = 19$ and $m = 13$, p-value $= 0.01468$).

Result 4: *Individuals with a high degree of approval motivation were unaffected by the treatment, whereas individuals with a moderate degree of approval motivation contributed significantly more towards the Group account in the public observability treatment than in the no observability treatment.*

The contributions made in the no observability treatment were significantly lower than the contributions made in the public observability treatment for the moderately approval motivated types. (Mann-Whitney U test, $n = 24$ and $m = 19$, p-value $= 0.00298$). The contributions made in the no observability treatment were insignificantly different from the contributions made in the public observability treatment for the highly approval motivated types. (Mann-Whitney U test, $n = 8$ and $m = 13$, p-value $= 0.3843$).

By combining results 2, 3 and 4 it is possible to obtain the following result.

Result 5: *The public observability treatment was more effective in inducing cooperative behaviour for moderately approval motivated individuals than for highly approval motivated individuals.*

The overall results do not change significantly when the cut-off point is changed to the median approval motivation score of 56. See section 4.9 for results with the median degree of approval motivation as the cut-off point. It is worth mentioning that hypothesis 1 is supported by result 2. However, based on results 3, 4 and 5 there appears to be little evidence to support hypotheses 2, 3 and 4. These surprising results are discussed in section 4.4 in more detail.

4.3.3 Repeated game

The below figure provides a graphical representation of the results from the repeated game which was played in the experiment. Figure 4 .4 depicts aggregate behaviour in each treatment, i.e. the means are calculated using data from both highly and moderately approval motivated individuals within each treatment (the bars represent standard errors).

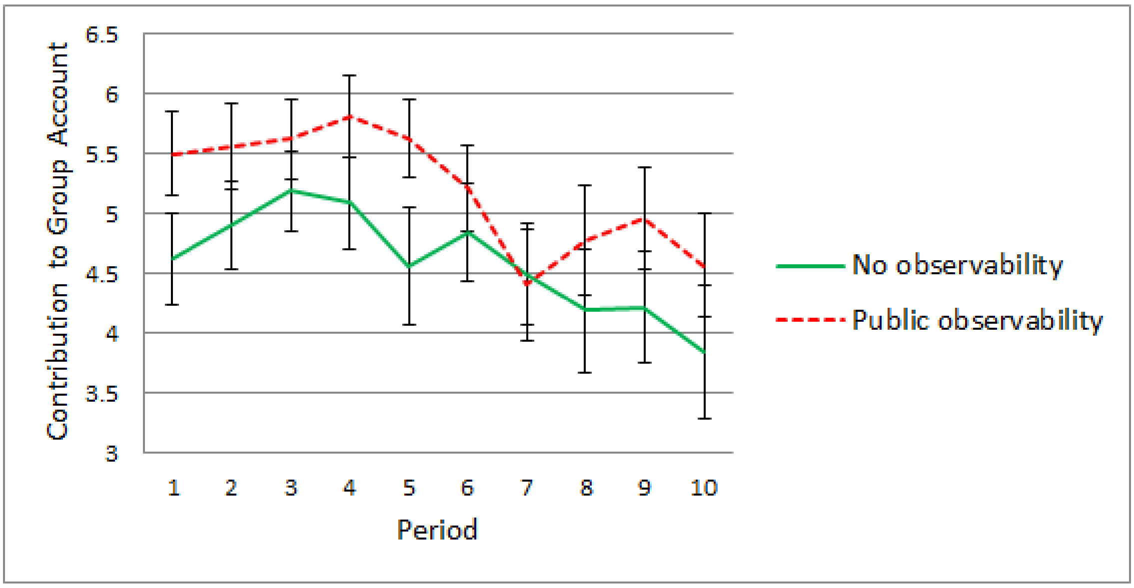


Figure 4.4: Aggregating approval motivation types

From Figure 4.4 we can see that public observability seems to have had a significant positive effect on cooperation in the first 5 periods, however, in the latter 5 periods the effect dissipated. This finding can be summarized as follows.

Result 6: *On average individual contributions made towards the Group account were initially positively affected by the public observability treatment, however, this effect deteriorated over time.*

Figures 4.5 and 4.6 separate the results from the repeated game for each approval motivation type (the bars represent standard errors).

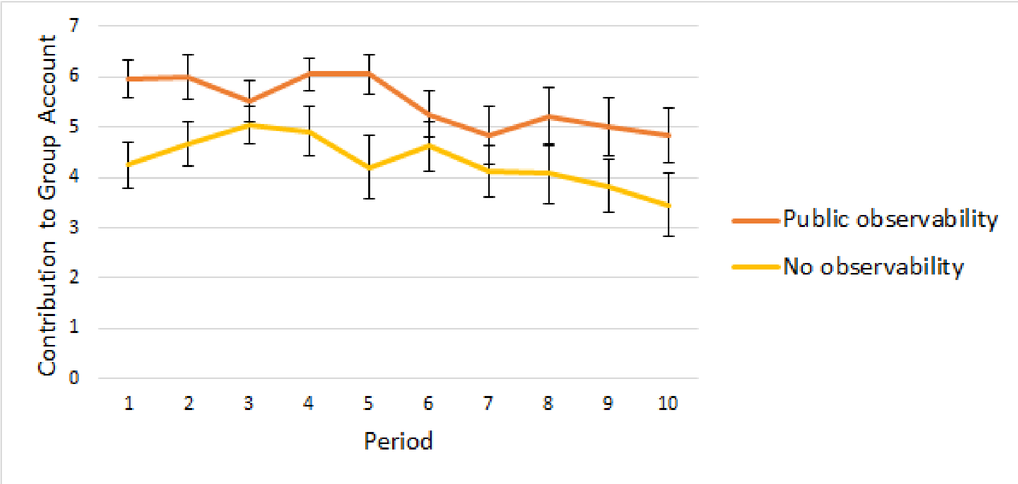


Figure 4.5: Moderately approval motivated types

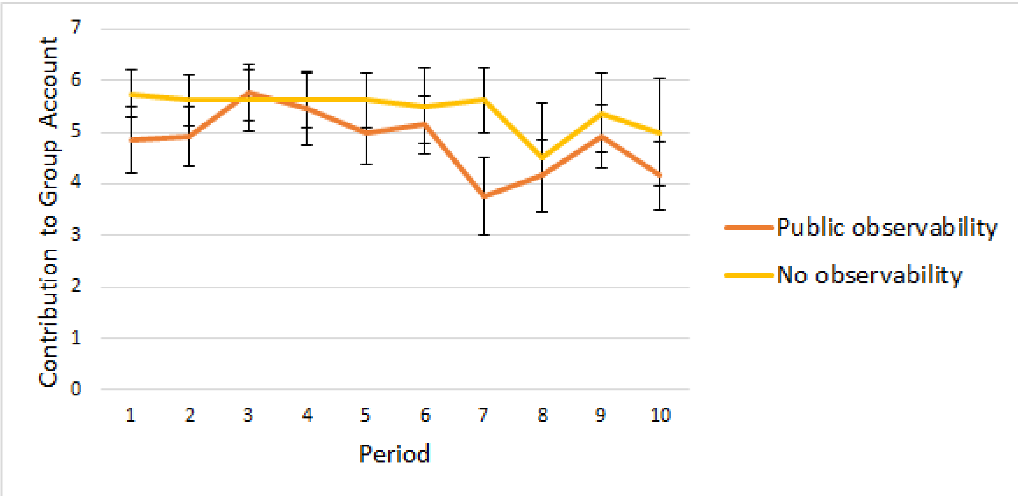


Figure 4.6: Highly approval motivated types

From Figure 4.5 we can see that for the moderately approval motivated types public observability seemed to have a significant positive effect on cooperation throughout the repeated game, however, for the highly approval motivated types the effect of public observability was not statistically significant. This finding can be summarized as follows.

Result 7: *For moderately approval motivated individuals the public observability treatment had a sustained positive effect on contributions made towards the Group account. However, for highly approval motivated individuals public observability had* *no significant effect on their contribution decisions throughout the course of the game.*

We investigate whether individual level contributions towards the Group account in the repeated game were affected by public observability or the degree of approval motivation by testing the following Tobit model:[14]

$$C_{it} = \beta_0 + \beta_1 PO + \beta_2 HA + \beta_3 PO \times HA + \varepsilon_{it},$$

where C_{it} represents the contribution made towards the Group account by individual i in period t in the repeated game, PO is a dummy representing the public observability treatment, HA is a dummy representing whether an individual is highly approval motivated, and ε_{it} is an error term which satisfies the necessary assumptions of the Tobit model. The following table summarizes the coefficient estimates obtained from this specification.

Table 4.4: Individual level contributions in the repeated game

Variable	Periods 1 - 5		Periods 6 - 10	
Pub. obs.	0.848***	1.449***	0.371	0.963**
	(0.257)	(0.309)	(0.343)	(0.416)
High approval		1.059**		1.500***
		(0.408)		(0.555)
Pub. obs. × High approval		-1.883***		-2.019***
		(0.546)		(0.736)
Constant	4.859***	4.591***	4.296***	3.918***
	(0.181)	(0.206)	(0.244)	(0.279)
No. of observations	320	320	320	320
Prob > χ^2	0.001	0.000	0.001	0.023

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Pooling moderately and highly approval motivated individuals together, it is evident from columns 1 and 3 in Table 4.4 that public observability had a positive effect on individual contributions in the first half of the game, however, this effect dissipated in the latter half of the game. The coefficient estimates for the public observability treatment dummy in columns 2 and 4 indicate that moderately approval motivated participants responded positively to public observability across all

[14] The lower bound for individual contributions was 0 and the upper bound 8.

periods. In contrast, the coefficient estimates for the dummy representing highly approval motivated participants and the interaction term suggest that the highly approval motivated participants did not respond strongly to public observability.[15] To summarize, the coefficient estimates provide further support for results 6 and 7.

4.4 Discussion

4.4.1 Summary

The first result established in the previous section was that individuals on average contributed more towards the Group account when their contribution decisions were made publicly observable. This result is in line with the finding made by Rege and Telle (2004). However, in this study the treatment effect was only statistically significant at the 10% level. It is worth noting that this might simply be a result of having a relatively small data set. In the previous section we also found little evidence to suggest any correlation between an individual's degree of approval motivation and the contributions made towards the Group account in the no observability treatment. This result is consistent with the first hypothesis derived in section 4.1. The rationale behind this result is that participants were not provided approval incentives in the no observability treatment. Hence, there should not be any significant difference in behaviour across individuals with respect to their degree of approval motivation.

As mentioned in the previous section results 3, 4 and 5 are somewhat surprising. The anticipated correlation between the degree of approval motivation and individual contributions made towards the Group account was positive. However, the results generated from the experiment suggest the opposite was true. The public observability treatment appeared to have a significantly stronger effect on individuals with relatively low approval motivation scores. Whereas individuals who attained relatively high approval motivation scores seemed to be unaffected by the public observability treatment.

[15] We confirm this is the case by conducting a Wald test on the coefficient estimates.

The results from the repeated game setting were consistent with the results from the one-shot game. Firstly, on average individuals did appear to respond positively to the public observability treatment for the first 5 periods of the game. However, the treatment effect dissipated in the latter half of the game. After separating the results for each approval motivation type, the evidence suggests that the public observability treatment had a sustained positive effect on cooperative behaviour for moderately approval motivated individuals. In contrast, highly approval motivated individuals did not appear to be affected by the public observability treatment. These results are somewhat at odds with the findings made by Noussair and Tucker (2007). They found evidence to suggest that the treatment effect derived in Rege and Telle (2004) was simply due to the one-shot nature of the game which was played. However, in this study the positive effect that public observability had on individual contributions was sustained even in a repeated game setting for certain types of individuals, namely, the moderately approval motivated individuals.

4.4.2 Possible explanation

The results generated from the experiment may be due to other factors. Hence, it might be worthwhile to identify whether individual contributions are correlated with factors aside from approval motivation. To determine this the following Tobit model was tested:[16]

$$C_{it} = \beta_0 + \beta_1 PO + \beta_2 HA + \beta_3 PO \times HA + \sum_{k=4}^{5} \beta_k X_k + \sum_{j=6}^{10} \beta_j P_j + \varepsilon_{it},$$

where C_{it} represents the contribution made towards the Group account by individual i in period t, PO is a dummy representing the public observability treatment, HA is a dummy representing whether an individual is highly approval motivated, X represents covariates such as gender and major, P are personality traits included in the big five personality test, and ε_{it} is an error term which satisfies the necessary assumptions of the Tobit model.[17] The following table summarizes the coefficient

[16] The lower bound for individual contributions was 0 and the upper bound 8.

[17] Participants were required to fill out a demographics survey at the end of each session. Thus, we were able to obtain information on gender and major. The filler questions included in stage 1

estimates obtained from this specification.

Table 4.5: Factors influencing individual level contributions

Variable	One-shot game		Repeated game	
Pub. obs.	1.615***	1.473***	1.216***	1.136***
	(0.536)	(0.474)	(0.259)	(0.268)
High approval	0.691	0.678	1.257***	1.334***
	(0.707)	(0.630)	(0.344)	(0.357)
Pub. obs. × High approval	-2.183**	-1.947**	-1.935***	-1.640***
	(0.945)	(0.854)	(0.459)	(0.483)
Extroversion		0.0175		-0.001
		(0.156)		(0.088)
Agreeableness		-0.096		0.094
		(0.143)		(0.081)
Conscientiousness		-0.059		-0.075
		(0.122)		(0.069)
Neuroticism		-0.323***		-0.200***
		(0.117)		(0.642)
Openness		-0.040		0.176**
		(0.150)		(0.085)
Male		0.551		-0.058
		(0.474)		(0.268)
Econ major		-1.176**		-0.713***
		(0.480)		(0.272)
Constant	4.184***	7.365***	4.262***	3.969***
	(0.354)	(1.912)	(0.173)	(1.078)
No. of observations	64	63	640	630
Prob > χ^2	0.023	0.003	0.000	0.000

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

From Table 4.5 we can see that individuals made higher contributions in the public observability treatment than in the no observability treatment. Specifically, highly approval motivated individuals were less responsive to the treatment than moderately approval motivated individuals. We can also see that neuroticism had a negative impact on contributions. This result is consistent with the findings made by Lönnqvist et al. (2011) and Guo et al. (2018). Table 4.5 indicates that the impact of public observability on contributions for the highly approval motivated individuals is moderated by neuroticism, i.e. when neuroticism is included in the estimation the absolute value of the coefficient for the interaction term decreases.

Next we seek to identify whether an individual's degree of approval motivation is

of the experiment were taken from the big five personality test.

correlated with some of these other personality traits. In order to determine whether other personality traits are correlated with the degree of approval motivation the following Tobit model was tested:[18]

$$AM_i = \beta_0 + \sum_{k=1}^{3} \beta_k X_k + \sum_{j=4}^{8} \beta_j P_j + \varepsilon_i,$$

where AM_i represents the degree of approval motivation for an individual, X represents covariates such as gender and major, P are personality traits included in the big five personality test, and ε_i is an error term which satisfies the necessary assumptions of the Tobit model. The following table summarizes the coefficient estimates obtained from this specification.

Table 4.6: Factors influencing approval motivation

Variables	(1)	(2)	(3)
Extroversion		-1.701**	-1.790**
		(0.704)	(0.705)
Agreeableness		-0.089	0.039
		(0.646)	(0.657)
Conscientiousness		0.457	0.318
		(0.558)	(0.577)
Neuroticism		1.497***	1.707***
		(0.473)	(0.508)
Openness		-0.326	-0.251
		(0.712)	(0.712)
Male	-0.517		2.697
	(2.119)		(2.063)
Econ major	-4.031		-3.821*
	(2.510)		(2.215)
Constant	57.220***	59.718***	58.151***
	(1.361)	(8.269)	(9.011)
Observations	63	64	63
Prob > χ^2	0.229	0.004	0.004

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

From models 1 and 3 it is evident that an individual's degree of approval motivation is not correlated with any of the demographic factors such as gender or whether the participant was an economics major.[19] However, the coefficient estimates derived

[18]The lower bound for the approval motivation score was 20 and the upper bound for the approval motivation score was 100.

[19]Although the coefficient estimate for economics major in model (3) is statistically significant

from models 2 and 3 suggest that an individual's degree of approval motivation is negatively correlated with extroversion and positively correlated with neuroticism.[20] In other words, individuals who have a strong desire to seek the approval from others may also be highly neurotic and relatively introverted. It might be the case that neuroticism crowded out an individual's inclination to respond positively to the approval incentives provided in the public observability treatment. This could potentially explain why the highly approval motivated participants did not respond to the approval incentives provided in the public observability treatment. In contrast, the moderately approval motivated participants did not share these anti-social tendencies, and, as a result they did respond positively to the public observability treatment.

It is worth noting that Fleming and Zizzo (2011) derived a result which resembles the negative correlation found in this study. More specifically, Fleming and Zizzo (2011) found a negative correlation between an individual's response to approval incentives and their degree of social desirability. They believe that individuals with high social desirability scores were quick to conform to a social norm which was to contribute a very small amount to the communal pot, and, once this social norm was established divergence from contributing low amounts was extremely rare. However, for individuals who received low social desirability scores conformity to a social norm of making relatively small contributions was not as strong, hence, said contributors were more responsive to approval incentives. Based on the results from the repeated game this phenomenon did not appear to be prevalent in the current study.

4.5 Conclusion

The findings from this study provide evidence to suggest that on average individuals tend to contribute more towards the Group account when they participated in the public observability treatment. This result is in line with the findings made in Rege

at the 10% level, the estimates obtained in model (1) suggest that this correlation is somewhat spurious.

[20]This result is supported by other studies investigating the correlation between prosocial motives and the big five personality traits e.g. Carlo et al. (2005) and Erez et al. (2008).

and Telle (2004). The predictions made in the theoretical section of this chapter suggest that the efficacy of mutual monitoring in fostering cooperation should positively depend on the degree of approval motivation within teams. However, the results generated from the experiment provide evidence to support the contrary. This may be due to neuroticism crowding out an individual's inclination to respond positively to the approval incentives provided in the public observability treatment. Clearly there appears to be some evidence to suggest that the efficacy of mutual monitoring does depend on the degree of approval motivation within teams in some way. Hence, developing a more effective way to measure an individual's responsiveness to approval incentives might be worthwhile.

4.6 Items for the revised Martin-Larsen Approval Motivation (MLAM) Scale

1. Depending upon the people involved, I react to the same situation in different ways.
2. I would rather be myself than be well thought of.
3. Many times I feel like just flipping a coin in order to decide what I should do.
4. I change my opinion (or the way that I do things) in order to please someone else.
5. In order to get along and be liked, I tend to be what people expect me to be.
6. I find it difficult to talk about my ideas if they are contrary to group opinion.
7. One should avoid doing things in public which appear to be wrong to others, even though one knows that he is right.
8. Sometimes I feel that I don't have enough control over the direction that my life is taking.
9. It is better to be humble than assertive when dealing with people.
10. I am willing to argue only if I know that my friends will back me up.
11. If I hear that someone expresses a poor opinion of me, I do my best the next time that I see this person to make a good impression.
12. I seldom feel the need to make excuses or apologize for my behaviour.
13. It is not important to me that I behave "properly" in social situations.
14. The best way to handle people is to agree with them and tell them what they want to hear.
15. It is hard for me to go on with my work if I am not encouraged to do so.
16. If there is any criticism or anyone says anything about me, I can take it.
17. It is wise to flatter important people.

18. I am careful at parties and social gatherings for fear that I will do or say things that others won't like.

19. I usually do not change my position when people disagree with me.

20. How many friends you have depends on how nice a person you are.

Note: Response categories: Strongly Disagree (1), Disagree (2), No Opinion (3), Agree (4), Strongly Agree (5). Items 2, 12, 13, 16 and 19 are reverse scored.

4.7 The Big Five Personality Test (filler questions)

1. I feel comfortable around people. (Extroversion)
2. I feel little concern for others. (Agreeableness)
3. I am always prepared. (Conscientiousness)
4. I get stressed out easily. (Neuroticism)
5. I have a rich vocabulary. (Openness to Experience)
6. I don't talk a lot. (Extroversion)
7. I am interested in people. (Agreeableness)
8. I leave my belongings around. (Conscientiousness)
9. I am relaxed most of the time. (Neuroticism)
10. I have difficulty understanding abstract ideas. (Openness to Experience)

Note: Response categories: Strongly Disagree (1), Disagree (2), No Opinion (3), Agree (4), Strongly Agree (5).

4.8 Instructions

Stage 1

At the beginning of each session subjects were required to fill out a questionnaire which was a composition of the questions found in sections 4.6 and 4.7. At the end of each session subjects were asked to fill out a short survey relating to demographics.

Stage 2

[NOTE: These instructions are for the Public Observability treatment, but those for the No Observability treatment are very similar.] You are now participating in an economic experiment. If you read the following instructions carefully, you can, depending on your decisions and the decisions of others, earn a considerable amount of money. It is therefore very important that you read these instructions with care. The currency used in this experiment is Experimental Currency Units (ECU), where 1 ECU = 0.05 AUD. If you talk, laugh, exclaim out loud etc. without receiving permission you will be asked to leave the experiment. Should you have any questions please ask us.

Task

You are part of a group of 4 individuals. In the beginning of this period you and every other member of your group will be endowed with 8 tokens. You must decide how to allocate your tokens between a Private Account and a Group Account. Your allocation decision must be in whole token form, i.e. allocating 2.5 tokens to the Group Account and 5.5 tokens to the Private Account is not possible. Each person in the group has a Private Account and is making a similar decision on how to allocate their tokens. However, there is only one Group Account for the entire group. Once you have decided how much of your endowment to contribute to the Group Account you will receive feedback on your computer screen relating to your contribution as well as the contributions made by the other members of your group towards the Group Account. You will also receive feedback relating to your payoff in ECU and AUD. After everyone has had a chance to look at the feedback screen

I will write all of the contributions on the white board and you will be asked one at a time to announce to the other members of your group how much you decided to contribute towards the Group account. You will only be allowed to announce the size of your contribution e.g. "6" or "4". Any other communication is strictly prohibited. Thus, the other participants will learn how much you have contributed to the Group Account and how much you have kept for yourself. Likewise, you will learn what each of the other participants chose to do.

Remuneration

Each token you place in the Private Account generates a payoff to you (and to you alone), and each token you place in the Group Account generates a payoff to every member of your group. Your total payoff in this period is the sum of your payoff from the Private Account and your payoff from the Group Account. Payoffs for the two accounts are listed in the 'Payoffs Tables' on the next page.

The payoff of each group member from the Group Account is calculated in the same way. This means that each group member receives the same payoff from the Group Account.

Example

Suppose you contributed 6 tokens towards the Group Account and the total contribution made by all group members to the Group Account is 20 tokens. In this case each member of the group receives a payoff from the Group Account of 100 ECU. You will also receive a payoff of 50 ECU for the amount of tokens you kept in your Private Account, i.e. the payoff for keeping 2 tokens in your Private Account is 50 ECU. So your total payoff will be $50 + 100 = 150$ ECU. Recall, 1 ECU = 0.05 AUD, hence, in this example your payoff will be $0.05 \times 150 = 7.5$ AUD.

Table 4.7: Payoffs Tables

Tokens in Your Private Account	**Your Earnings From Your Private Account**	**Tokens in Group Account**	**Total Group Earnings**	**Your Share of Group Earnings**
0	0	0	0	0
1	38	1	20	5
2	50	2	40	10
3	60	3	60	15
4	69	4	80	20
5	77	5	100	25
6	83	6	120	30
7	87	7	140	35
8	90	8	160	40
		9	180	45
		10	200	50
		11	220	55
		12	240	60
		13	260	65
		14	280	70
		15	300	75
		16	320	80
		17	340	85
		18	360	90
		19	380	95
		20	400	100
		21	420	105
		22	440	110
		23	460	115
		24	480	120
		25	500	125
		26	520	130
		27	540	135
		28	560	140
		29	580	145
		30	600	150
		31	620	155
		32	640	160

4.9 Changing the cut-off point

Here the median approval motivation score of 56 is incorporated as a cut-off point. The below table outlines the mean and standard errors in individual contribution levels made towards the Group account in both treatments given their approval type.

Table 4.8: Individual contributions in one-shot game

	Degree of Approval Motivation			
	Moderate		**High**	
	Mean	SE	Mean	SE
No observability	4.20	0.51	4.53	0.32
Public observability	5.86	0.54	4.61	0.36

Table 4.8 provides a summary of the mean and standard errors in individual payoffs received in the experiment. Note, the payoffs listed in the table are in AUD and do not include the fixed participation fee of 10 AUD.

Table 4.9: Individual payoffs

	Degree of Approval Motivation			
	Moderate		**High**	
	Mean	SE	Mean	SE
No observability	7.84	0.18	7.59	0.26
Public observability	7.35	0.19	8.13	0.22

The following figure provides a graphical representation of the results from the one-shot game which was played in the experiment.

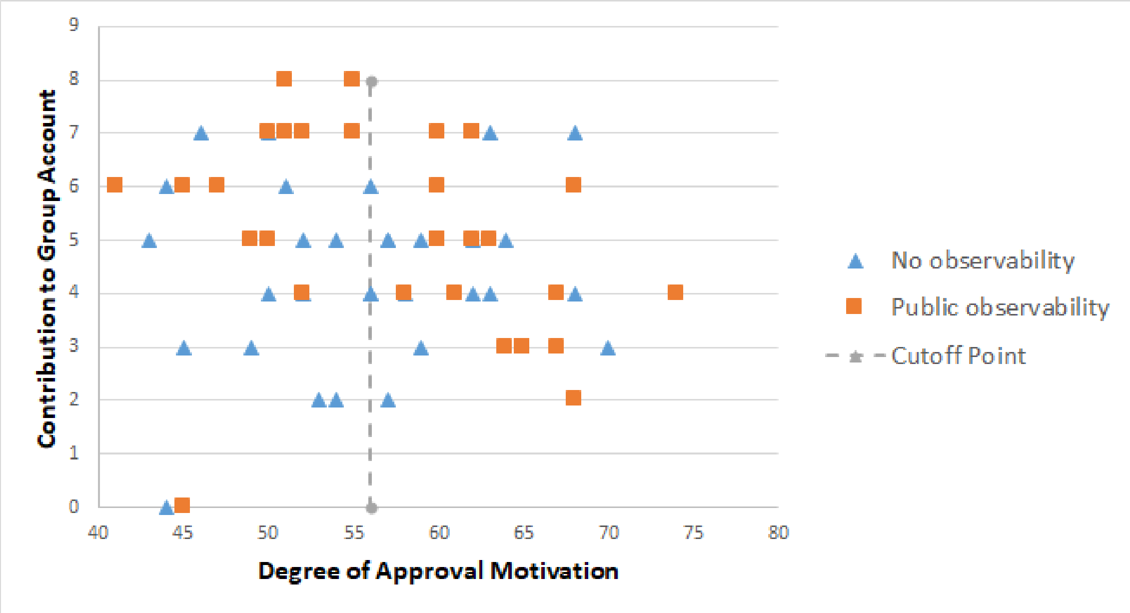


Figure 4.7: A graphical representation of the results from the one-shot game

Chapter 5

Concluding remarks

In Chapter 2 we developed a multi-stage contest design where heterogeneous agents faced the prospect of promotion and the threat of demotion from one stage to the next. We illustrated theoretically that when agents are homogeneous in ability, the principal is better off pooling agents in one division. However, when abilities are heterogeneous, the principal is better off assigning agents to separate divisions based on ability level, while allowing for agents to be promoted and demoted after each stage of play. The experimental results provided support for the use of promotion and demotion in multi-stage contests when abilities were heterogeneous. In contrast with the theoretical predictions, we did not find significant differences in total effort between the pooled contest and the contest with promotion and demotion when abilities were homogeneous. These findings have direct policy implications for management practices in a variety of settings e.g. organizations, education and sport. In order to elicit higher effort among employees, we recommend that the manager subdivides employees based on ability and implement some form of promotion and demotion, if they observe a sufficiently high level of heterogeneity in abilities.

In Chapter 3 we provided a comparison between a two-strike exclusion policy and a zero-tolerance exclusion policy as a means for fostering cooperation in groups. The results from our experiment suggest that group members tend to cooperate more after receiving a strike. However, requiring group members to issue strikes to one another prior to exclusion seemed to be less effective than allowing for exclusion without prior receipt of strikes. Individuals were less cooperative under the two-strike regime as they only faced the threat of exclusion after they received a strike. Consequently, the zero-tolerance approach commonly utilized by US companies to dismiss employees for poor performance may indeed be the most effective and efficient form of exclusion for fostering cooperation in groups.

In Chapter 4 we sought to determine whether the efficacy of mutual monitoring in fostering cooperation was dependent on the degree of approval motivation within teams. The hypotheses developed in the theoretical section provide support for the notion that individuals will be more responsive to mutual monitoring if they possess a higher degree of approval motivation. However, the results generated from the experiment suggest that the efficacy of mutual monitoring in fostering cooperation is negatively correlated with the degree of approval motivation within teams. Considering the production setting, a principal could potentially use the findings of this study to screen for agents who have a greater propensity to cooperate in teams, e.g. recruiters seeking to hire workers in open-plan office spaces.

The remainder of the present chapter discusses future areas for research. In Chapter 2 we investigated promotion and demotion in multi-stage contests by developing and experimentally testing a simple theoretical model. However, the model can be extended in several ways. The contests consisted of three stages, although, in many situations the duration of the game may be longer. It would be worthwhile studying how varying the number of stages in the game determines the efficacy of promotion and demotion in multi-stage contests. In Chapter 2 the principal assigns agents to one of two divisions based on their ability. In reality the principal may choose to allocate agents across more than two divisions. Developing a theoretical framework where the principal can select the number of divisions could be an interesting direction for future research.

In Chapter 3 participants who received strikes remained on a strike for the remainder of the game. Essentially, being on a strike is equivalent to being on probation. Many companies impose different lengths of probation. In future it would be interesting to vary the number of periods participants remain on a strike for. This design feature would enable us to determine whether the length of probation affects the level of cooperation in groups. Such research would be relevant to policy makers in the area of management and human resources.

In Chapter 4 participants were placed into either a no observability or public observability treatment exogenously. In future it would be interesting to observe the effects of allowing group members to decide which setting to interact in. It might be the case that groups will behave more cooperatively simply due to the fact that they have been given the opportunity to decide which setting to operate in. Given the fact that office-space structure is an important issue currently experienced by many companies, it would be worthwhile to examine whether allowing employees to decide their own office-space structure would result in more or less desirable outcomes for the firm.

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