Essays in Behavioural Economics

by

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Declarations

All chapters in this thesis contain original work. Chapters 1 and 2 are solely my own work, and incorporate comments and suggestions from my thesis supervisor, Robert Akerlof as well as other discussants. Chapter 1 is a revised version of my MRes dissertation [Yeo, 2014] submitted during the MRes/PhD programme at Warwick. Chapter 3 is jointly co-authored with Robert Akerlof and Hongyi Li. We jointly designed and conducted the experiment, and worked together to analyse the data.

Abstract

This thesis consists of three chapters. Chapter 1 looks at how esteem affects knowledge transfers. Motivated by Akerlof [2015], I examine in two separate models, how esteem — via individuals' choices of values — affects teaching and learning. In teaching, there is the following trade-off: prestige can be obtained if one is able to influence others to value one's expertise, but doing so reduces one's relative achievement, hurting one's pride. This leads to non-monotonicity of teaching in students' learning potential and teachers' ability. In learning, I analyse how social pressure affects learning given an option to "escape". I show that social pressure can be used to motivate individuals to learn and possibly value an activity. However, too much pressure causes those with lower relative potential to exhibit escapism due to increasingly negative esteem. Implications of the models are discussed.

Chapter 2 studies how workers' identities are relevant to incentive theory. In particular, I conduct the first experiment exploring the relationship between identity and optimal incentives. I construct workgroups which are either *homogeneous* or *heterogeneous* in members' identities and examine their productivity at a real-effort task under *tournament pay* and *team pay.* I find that in homogeneous workgroups, productivity is higher under team pay; in heterogeneous workgroups, on the other hand, productivity is similar under both incentive schemes. Team pay induces greater helping of peers — especially in homogeneous workgroups. Tournament pay induces higher personal effort — especially in heterogeneous workgroups. I also find that incentives influence workers' identities.

Chapter 3 uses a laboratory experiment to study competitions for power — and the role of patronage in such competitions. We construct and analyze a new game — the "chicken-and-egg game" — in which chickens correspond to positions of power and eggs are the game's currency. We find that power tends to accumulate, through a "power begets power" dynamic, in the hands of "lords." Other subjects behave like their vassals in the sense that they take lords' handouts rather than compete against them. We observe substantial wealth inequality as well as power inequality. There are also striking gender differences in outcomes — particularly in rates of lordship. In a second treatment, where we eliminate patronage by knocking out the ability to transfer eggs, inequality is vastly reduced and the "power begets power" dynamic disappears.

Chapter 1

Knowledge Transfers: Esteem and the Willingness to Teach and Learn

1.1 Introduction

"*Knowledge is power.*" Echoing this sentiment, Argote and Ingram [2000] emphasise that knowledge is the key to competitive advantage and dominance of firms/organisations. Knowledge is embedded within the members, tools, tasks and the various subnetworks within an organisation [Mcgrath and Argote, 2008] — transfers of such knowledge facilitate the smooth functioning of organisations and potentially lead to increasing returns.[1,2] Likewise, in educational institutions, knowledge transfers between peers can improve learning efficiency and reduce reliance on possibly overtaxed teachers.

Given the importance of knowledge transfers, I thus study the related processes of teaching and learning. More specifically, I examine in a theoretical model, how a less considered factor in economics — esteem — influences these processes, discussing its implications. I assume that decisions to teach others, or to learn are motivated not only by economic factors, but also the desire for esteem. Esteem is in turn determined by the activities/dimensions which individuals value. In particular, there is a tension between desires to be esteemed by others (*prestige*) and desires to stand out (*pride*).

[1] Knowledge should be distinguished from *information* in that it always involves some level of *know-how* in addition to *know-that* which usually characterises information. Information transfers may not involve a loss in advantages over others if recipients have no idea how to use the information.

[2] For example, knowledge transfers may result in shifts of focus to new and useful dimensions of work processes innovated on by others, and/or reducing time wasted in rediscovery of old innovations. Moreover, initial transfers may also seed the emergence of further useful knowledge in future.

I capture insights using a two-player, two period simultaneous move game for which there are 2 variations. In the teaching (learning) variation, one of them has a choice of teaching (learning) in the first period; this together with the learner's potential determines their relative abilities in two activities in the second period. In the second period, they play a simplified version of the value formation game (henceforth VFG) introduced in Akerlof [2015] in both variations. Specifically, both players make two choices. Firstly, they decide on which of two different activities (labelled academics and music) to put effort in; together with their ability in each, this determines their achievement in each activity. Secondly, they decide whether to value achievement at academics and/or music. In the learning variation, one of the players decides in addition whether to cut off interactions with the other.

Esteem is assumed to be conferred based upon *relative achievement* in their *valued activities*. Players always interact by default, conferring esteem as above unless one of them cuts off interactions with the other. In the following models, I assume that the non-learner/teacher has high enough academic ability such that he always chooses to value and focus on academics (the prevalent activity) in equilibrium. This allows me to focus on effects of the learner's choice of what to value.

In the teaching model, I analyse the tension between pride and prestige in transferring academic knowledge for two cases: one where teaching effort is discrete and the other continuous. I obtain results on the non-monotonicity of teaching effort in student's learning potential and teacher's ability in equilibrium. In particular, the willingness to teach is determined by the balance between the gain in prestige — when a student is willing to value academics ex-post being taught — and the loss in pride — from knowledge advantages being reduced. When student's academic potential or teacher's academic ability increases, the teacher is more likely to obtain prestige, but also experiences greater losses in pride. Effects on pride dominate when student's academic potential or teacher's academic ability are high.

In the learning model, I analyse how social pressure — modelled as an exogenous increase in the weight on conferred esteem — influences choices to undertake the prevalent activity, academics, and consequently learning and achievement in it. I show that depending on one's academic potential, exerting social pressure can have different effects. Social pressure matters for individuals who have intermediate levels of academic potential and are thus "undecided" on whether to focus on academics. For *intermediately low* levels of academic potential, learning choices and academic achievement are non-monotonic in the amount of social pressure. In contrast, for *intermediately high* levels of academic potential, more social pressure is always beneficial. These results are characterised by whether an individuals' academic potential allows him/her to be behind or ahead of the pack. In the former, social pressure increases desires to conform to others' academic values and obtain prestige, hence encouraging academic learning. However, pride is harmed since one is relatively behind. Eventually social pressure breaks the individual: as a coping mechanism, one avoids interaction to maintain one's pride. In the latter case, this does not occur because social pressure boosts pride given that one is relatively ahead.

The results obtained in this paper are relevant to how socio-economic incentives and interactions within organisations and schools may be structured so as to enhance knowledge transfers and in so doing, overall efficiency. In particular, individual-focused incentives, by creating excessive pride, may be detrimental to the sharing and receiving of knowledge. Social pressure on individuals to adhere to some (central planner's) desired way of doing things may also prove to be a blunt tool. It hints at how a *"collectivist" approach* to incentives and other approaches like the shaping of organisational culture may help enhance overall efficiency.

The chapter proceeds as follows. Section 2 discusses the related literature both outside and inside economics. Section 3 presents the baseline model which serves as the basis for the other extensions. Section 4 describes the teaching extension, first solving for the case of discrete and then continuous teaching effort. Section 5 analyses the learning extension with varying social pressure. Implications of each model are discussed at the end of Sections 4 and 5. Section 6 concludes. Longer proofs are relegated to Appendix A.1.

1.2 Related Literature

1.2.1 Esteem and Knowledge Transfers outside Economics

Outside economics, Henrich [2016] describes how the collective knowledge of communities embodied within practices, cultures, narratives and norms has led to the overwhelming success of our species. He stresses how sociality plays a key role, leading to knowledge being repeatedly refined and passed on through the ages via cultural/social learning. It has been emphasised that social learning continues to be an important mechanism for transfers of valuable knowledge within human society [Henrich and Gil-White, 2001] and organisations [Levin and Cross, 2004].

Related, is research which discusses how evolved status preferences and strategies continue to be an important mediator of social learning [Henrich and Gil-White, 2001; Tracy et al., 2010; Chapais, 2015]. These preferences, via the *desire for greater esteem*, motivate greater learning and engagement in activities which determine one's value and expert status, consequently providing economic advantages in the form of privileges and more deference from others.

Desire for esteem above is related to theories in psychology on self-efficacy

[Bandura, 1997] and self-evaluation maintenance [Tesser, 1988; Tesser and Cornell, 1991]. In self-efficacy theory, receiving acknowledgement improves perceptions of one's ability to complete tasks and reach goals, increasing one's esteem, especially when one values the task. In self-evaluation maintenance theory, agents' self-evaluation is affected by social comparison of achievement in activities relevant to their self-definition [Festinger, 1954]. A branch of literature discusses how these elements may be important in motivating knowledge sharing and learning.[3,4]

The two theories above also resemble a branch of psychology which examines pride, separating it into two facets: *authentic* and *hubristic* [Tracy and Robins, 2004, 2007]. Authentic and hubristic pride have been related to different status attaining strategies, the former *prestige*, while the latter *dominance* [Cheng et al., 2010; Tracy et al., 2010].[5] These two aspects of pride and their associated status strategies inspire the conflicting desires present within my models.

1.2.2 Esteem and Knowledge Transfers inside Economics

In my model, knowledge transfers are motivated by *self* and *conferred* esteem which depend on the values held by individuals. To the extent that values reflect one's adopted identity, my model is related to the identity economics literature [Akerlof and Kranton, 2000]. Influencing others' values through transferring knowledge is also related to economic models of cultural transmission [Bisin and Verdier, 1998, 2001] and persuasion [Kamenica and Gentzkow, 2011]; albeit with more real consequences in terms of ability.[6] More generally, my study is also related to the cultural economics literature that examines organisational/societal processes which affect economics outcomes. (For example, see: Guiso et al., 2006, 2008; Alesina and Giuliano, 2013; Collier, 2016; Garicano and Rayo, 2016.)

[3] Constant [1994]; Hall [2001]; Endres et al. [2007] discuss how self-efficacy and prestige is important in knowledge sharing communities, especially online ones where competition is more muted [McLure Wasko and Faraj, 2000; Chan et al., 2004; Lee and Jang, 2010]. Other studies provide evidence that the loss of power, status and/or self-esteem from sharing knowledge can result in possible knowledge hoarding [Tesser and Smith, 1980; Szulanski, 1996, 2000; Davenport and Prusak, 2000; Pemberton and Sedikides, 2001; Cabrera and Cabrera, 2002; Kelly, 2007; Webster et al., 2008; Ray et al., 2013]. On the same note, Garicano and Posner [2005] suggests that rents (in the form of career rewards) from controlling intelligence may be related to information hoarding in intelligence agencies. Passing on *information* in their case is disadvantageous because others possess the skills to use it; see footnote 1 for a related discussion.

[4] High social pressure and threats to self-esteem have been found be associated with burnout [Halbesleben and Ronald Buckley, 2006; Buunk et al., 2010] and subsequent deviant or self-defeating behaviour [Eskilson et al., 1986; Baumeister, 1997], with social comparison playing a role.

[5] Prestige-based status involves mutually beneficial, pro-social relations, with prestige being granted to those who are recognised and respected for their skills while dominance-based status is maintained through intimidation or coercion, possibly via the control of resources.

[6] In models of cultural transmission, values are influenced by strategic parental effort and/or societal norms. Models of persuasion usually instead involve signalling in the presence of incomplete information.

Esteem in my model is incorporated by including utility from social comparison: agents compare achievements with an endogenous socially determined reference point. This incorporates reference points from prospect theory [Kahneman and Tversky, 1979] and has been used in the literature on conspicuous consumption (e.g. Falk and Knell [2004]). The focus on the impacts of desires for *esteem* here also ties to economic studies which examine the impacts of desires for *social status* (see Frank, 1985; Heffetz and Frank, 2011). To the best of my knowledge, the effects on knowledge transfers have been covered to a lesser extent.

Knowledge transfers as tackled here are closely related to a body of literature on knowledge-based hierarchies which examines how specialisation of individuals with different knowledge levels and communication between them affects the (optimal) structure of organisations [Garicano, 2000; Garicano and Wu, 2012; Garicano and Rossi-hansberg, 2015]. While specialisation of knowledge is important, so are actual transfers of such knowledge because such specialists may leave and their unique knowledge lost: my study is thus complementary to such work.

Garicano and Rayo [2017] is one such paper which examines multi-period relational contracts governing the transfer of knowledge from experts to novices. In their model, experts, when choosing whether to transfer knowledge, face a trade-off between increasing the novice's ability to compensate the expert and the ability to retain the novice. They show that this can lead to inefficient, lengthy apprenticeships which worsen with negative externalities on the expert; this demonstrates knowledge hoarding to some extent. The teaching model in this paper provides a different mechanism — desires for esteem — by which knowledge hoarding may occur.

Lastly, the results from my learning model in this paper are closely related to the literature on goals and aspirations setting. In Wu et al. [2008] and Genicot and Ray [2017], aspiration failure occurs when levels are set too high, resulting in subpar outcomes due to frustration/demoralisation. With social reference points as aspirations, my model produces similar results, but instead via a choice of values and avoiding interaction: negative esteem from too high a comparison leads to "escapism" and undesirable results. My paper further adds to this by examining how social pressure moderates this relationship by magnifying conferred esteem.

1.3 Baseline

In this section, I outline the general structure of the baseline model. I solve for the pure-strategy Nash equilibria in this baseline, using it as a stepping stone for the teaching model in Section 4 and the learning model in Section 5.

1.3.1 Model Setup

The baseline model is a two-player simultaneous move game which is a simplified version of the VFG.[7] Both players ($i \in \{1, 2\}$) make two decisions: (1) which of two activities to focus on and put in effort ($e_{i1}, e_{i2} \in \{0, 1\}, e_{i1} + e_{i2} \leq 1$) and (2) whether to value achievement at those activities ($\theta_{i1}, \theta_{i2} \in \{0, 1\}$).[8] Both players are assumed to always interact in the model. Following the school example in Akerlof (2015), I refer to activity 1 as academics and activity 2 as music.[9] Players' achievements in these activities depends on their choice of effort and their innate ability in them. Academic ability of each individual is referred to as $\alpha_i \geq 0$, while musical ability of each is normalised to 1. Achievement is given by the product of ability and effort; academic achievement a_{i1} is thus $\alpha_i e_{i1}$ while musical achievement a_{i2} is e_{i2}.

Each player has the following utility function

$$U_i = E_i^i + \beta E_i^j$$

Utility is derived from esteem which comprises self-esteem E_i^i and conferred esteem E_i^j which can be positive or negative. $\beta > 0$ is the weight placed on esteem conferred from others.[10] This utility formulation may be interpreted as esteem being instrumental in the achievement of more real, pecuniary economic factors derived from status and power as mentioned earlier.

Esteem is derived/conferred from social comparison of one's achievement with others in their valued activities.[11] In particular, player i's esteem for player l (self/other) is given by

$$E_l^i = \sum_{s=1}^{2} \theta_{is}(a_{ls} - \overline{a_s})$$

[7] Being an extension of the VFG, the reader is referred to Akerlof [2015] for a discussion of the *baseline assumptions* of my model with regard to esteem and its relation to values and conformity.

[8] The simplifications were made so as to remove gaps in pure-strategy Nash equilibria where only mixed strategy Nash equilibria exist. These modifications are not essential to the results which follow in the teaching model, but simplify exposition. The binary choice of effort here leads to pure-strategy NE always existing. It can be treated as a normalisation over some baseline amount of effort in both activities where focusing means specialising in one activity more than another.

[9] Note that in the context of our teaching/learning models, the activities can also be taken to represent any dimension of skill/ expertise and consequent achievement from it.

[10] This could reflect idiosyncratic behavioural preferences: the desire for prestige relative to the personal pride, homophily norms in society which affect the respect (contempt) people confer to individuals with similar(different) values when interacting; or perhaps more economic factors like the visibility/emphasis of one's achievements within a social group.

[11] Linearity of esteem in relative achievement here is not so essential as our results only need that others valuing a dimension would raise tendencies to focus on it as well and not that others' effort would raise own effort. In a model with such effects, results should still hold, but may be amplified.

As in the VFG, players compare themselves to one another as well a background population of $n \geq 1$ agents whom have 0 achievement at both activities: under this assumption $\overline{a_1} = \frac{a_{11}+a_{21}}{n+2}$ and $\overline{a_2} = \frac{a_{12}+a_{22}}{n+2}$. Increasing n is analogous to decreasing the importance of social comparison between the two players.

Substituting terms into the utility function,

$$U_i = (\theta_{i1} + \beta\theta_{j1})(a_{i1} - \overline{a_1}) + (\theta_{i2} + \beta\theta_{j2})(a_{i2} - \overline{a_2})$$

The cost of effort is implicitly very small (0^+) such that one always puts effort in the activity which has the higher marginal return: $M_{i1} = (\theta_{i1} + \beta\theta_{j1})\frac{n+1}{n+2}\alpha_i$, $M_{i2} = (\theta_{i2} + \beta\theta_{j2})\frac{n+1}{n+2}$.

This leads to the same structure as in the VFG: Lemmas 1,2 and 3 there still hold; albeit with modification of some terms; these are listed in Appendix A.1. In equilibrium, players focus on exactly one activity and value at most one, in which they have positive relative achievement. When a player values and focuses on academics (music), I say that he is a scholar (musician).

1.3.2 Equilibria in Baseline Model

Here, I solve for the pure-strategy Nash-equilibria generally.

Proposition 1. ***Equilibria analogous to VFG***

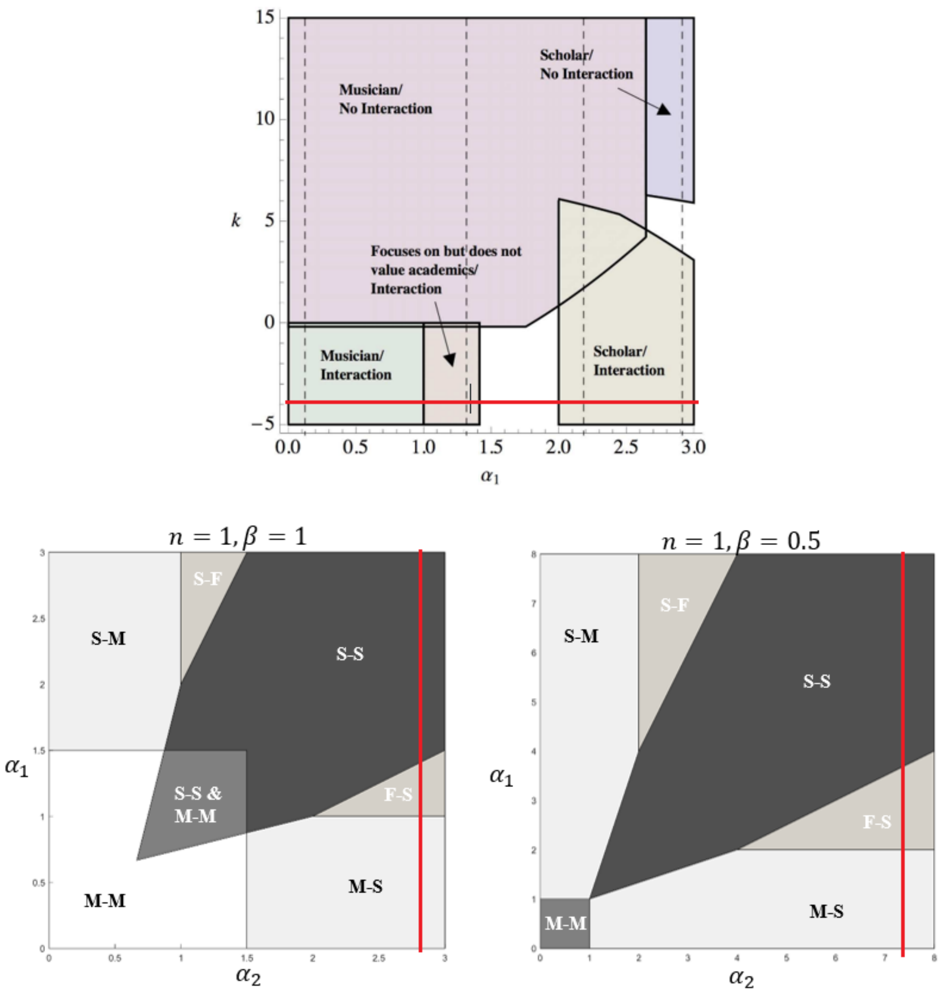
1. *When the players have low academic ability, equilibria exist for which both are musicians. Specifically, it requires* $\alpha_1, \alpha_2 \leq \beta + \frac{n}{n+1}$.

2. *When the players have high academic ability which do not differ by too much, equilibria exist for which both are scholars. Specifically, it requires* $\alpha_2 \geq \frac{1}{1+\beta} + \frac{\alpha_1}{(n+1)(1+\beta)}$, $\alpha_2 \geq \frac{\alpha_1}{n+1}$ ***and*** $\alpha_1 \geq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, $\alpha_1 \geq \frac{\alpha_2}{n+1}$.

3. *When one has relatively high academic ability, and the other has intermediate academic ability, equilibria exist for which the player with high academic ability is a scholar while the other focuses on academics, but does not value it. Specifically, this occurs for* $\frac{1}{\beta} \leq \alpha_1 \leq \frac{\alpha_2}{n+1}$, $\alpha_2 \geq 1 + \frac{\alpha_1}{n+1}$ ***or*** $\frac{1}{\beta} \leq \alpha_2 \leq \frac{\alpha_1}{n+1}$, $\alpha_1 \geq 1 + \frac{\alpha_2}{n+1}$.

4. *When one has relatively high academic ability, and the other has low academic ability, equilibria exist for which the high academic player is a scholar and the other is a musician. Specifically, this requires* $\alpha_1 \leq \frac{1}{\beta}$, $\alpha_1 \leq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, $\alpha_2 \geq \beta + \frac{n}{n+1}$ ***or*** $\alpha_2 \leq \frac{1}{\beta}$, $\alpha_2 \leq \frac{1}{1+\beta} + \frac{\alpha_1}{(n+1)(1+\beta)}$, $\alpha_1 \geq \beta + \frac{n}{n+1}$.

See Figure 1.1 for graphical illustrations of some equilibria.[12] As can be seen, I have a similar structure to that in Akerlof [2015] for which interaction costs $k = -\infty$, except that there are no gaps in pure strategy Nash equilibria.[13] As in his paper, the equilibria here reflect a tension between desires to conform, thus gaining conferred esteem and desires to stand out, thus obtaining self-esteem: closer to the 45-degree line, players thus tend to focus on the same activity. The reader is referred to the paper for a more detailed discussion of these results.



M: Musician, S: Scholar, F: Focuses on academics
Top: Equilibria in the VFM for high α_2, extracted from Akerlof [2015]
Bottom: Illustration of equilibria in this model.

Figure 1.1: Comparison of Equilibria

[12] Note that there are parameters for which there are multiple equilibria: e.g. overlaps of musician-musician and scholar-scholar equilibria when β is high enough and there are desires to coordinate.

[13] To see this, compare the top graph when interaction costs k are very low to the bottom graphs when α_2 is high as in the highlighted red lines.

1.4 Teaching

The model here is an extensive form game with two periods and where both the players make several choices. In the first period, Player 2 chooses whether to enter a teaching relationship with Player 1 and put in discrete or continuous teaching effort. In the second period, a two-player simultaneous move game as in the baseline model occurs.

I focus on the case where Player 2 has high enough academic ability such that he always values and focuses on academics in the second period — this is intuitive given that Player 2 is an academic mentor in this game.

I restrict attention to pure-strategy Nash equilibria from the second period and consequently pure-strategy subgame perfect equilibrium (SPE) of the extensive form game. This will be solved via backward induction.

1.4.1 Model Setup (Discrete Teaching Effort)

First Period

Player 2 has academic ability $\alpha_2 = \alpha$ and acts as a (peer) mentor here, making a discrete teaching choice $\lambda \in \{0, 1\}$. If $\lambda = 1$, a proportion $0 \leq \rho \leq 1$ of his academic ability is passed on to Player 1: $\alpha_1 = \rho\alpha$ in the second period, otherwise $\alpha_1 = 0$. This parameter ρ may be dependent on Player 1's innate ability and/or his receptivity toward the activity etc.; I call it his *learning potential*.

The discrete teaching decision implicitly assumes that there is some difficulty in adjusting effort which affects the transfer of knowledge; I relax this assumption later on. Teaching costs are assumed to be very small (0^+); allowing for larger teaching costs does not affect our results much. The decision to teach is based on the pure-strategy Nash equilibrium outcome in the second period when teaching; i.e. given academic abilities $\alpha_1 = \rho\alpha$ and $\alpha_2 = \alpha$, in comparison to not teaching i.e. $\alpha_1 = 0$ and $\alpha_2 = \alpha$, remembering that musical ability is always normalised to 1.

In addition, I assume that $\beta \leq 1$ such that Player 2's desire for prestige will not be so large such that teaching always occurs for a high enough learning potential of Player 1.

Second period

Given that Player 2 always focuses on academics and assuming that he teaches, there is a unique pure strategy Nash equilibrium (away from boundaries) in this period according to the following corollary of Proposition 1:

Corollary 1. ***Equilibria when Player 2 (with high academic ability) teaches***
Assume $\alpha_2 \geq \alpha^*$, such that Player 2 is always a scholar.[14] *If Player 2 teaches ($\alpha_1 = \rho\alpha_2 \leq \alpha_2$), then equilibria in the second period are as follows:*
If $\frac{\alpha_2}{n+1} < \frac{1}{\beta}$,

Player 1 is a musician when $\alpha_1 \leq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$

Player 1 is a scholar when $\alpha_1 > \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$

If $\frac{\alpha_2}{n+1} \geq \frac{1}{\beta}$,

Player 1 is a musician when $\alpha_1 \leq \frac{1}{\beta}$

Player 1 focuses on academics but does not value it when $\frac{1}{\beta} < \alpha_1 \leq \frac{\alpha_2}{n+1}$

Player 1 is a scholar when $\alpha_1 > \frac{\alpha_2}{n+1}$

1.4.2 Equilibria, Comparative Statics (Discrete Teaching Effort)

In order to solve for the subgame perfect equilibria, the following lemma is useful: it illustrates that Player 2 will only teach if it is possible to influence Player 1 to value academics and hence obtain positive esteem conferred by him.

Lemma 1. *If Player 2 teaches in equilibrium, Player 1 must be a scholar in that equilibrium.*

Proof. If Player 1 is not a scholar, there is no possible gain for Player 2 in teaching, which contradicts Player 2 teaching in equilibrium. ■

By Lemma 1, teaching only occurs in equilibria where Player 1 is a scholar, bearing in mind that Player 2 should have higher utility than if he were not to teach and Player 1 is a musician. The following proposition illustrates this.

Proposition 2. ***Teaching choices in equilibrium***
Assuming $\alpha_2 = \alpha \geq \alpha^*$, $0 < \beta \leq 1$, then there exists a (closed) range of Player 1's learning potential for which Player 2 chooses to teach in equilibrium. Specifically,
If $\frac{\alpha}{n+1} < \frac{1}{\beta}$,

Player 2 teaches in equilibrium for $\frac{1}{(1+\beta)\alpha} + \frac{1}{(n+1)(1+\beta)} \leq \rho \leq \frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}]$

If $\frac{\alpha}{n+1} \geq \frac{1}{\beta}$,

Player 2 teaches in equilibrium for $\frac{1}{n+1} \leq \rho \leq \frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}]$

Proof. The lower bounds on ρ in the 2 cases are derived from Lemma 1, which implies some minimum academic ability α_1, ex-post teaching for which Player 1 will choose to value academics . The upper bound (which might not be binding if > 1) is

[14] $\alpha^* = max\left\{\beta + \frac{n}{n+1}, \frac{1}{\beta+\frac{n}{n+1}}, \frac{n+1}{n}\right\}$. See Remark 1 in Appendix A.1 for a discussion on how this is obtained.

derived from a rationality constraint in which Player 2 needs to have higher utility from teaching than not. ■

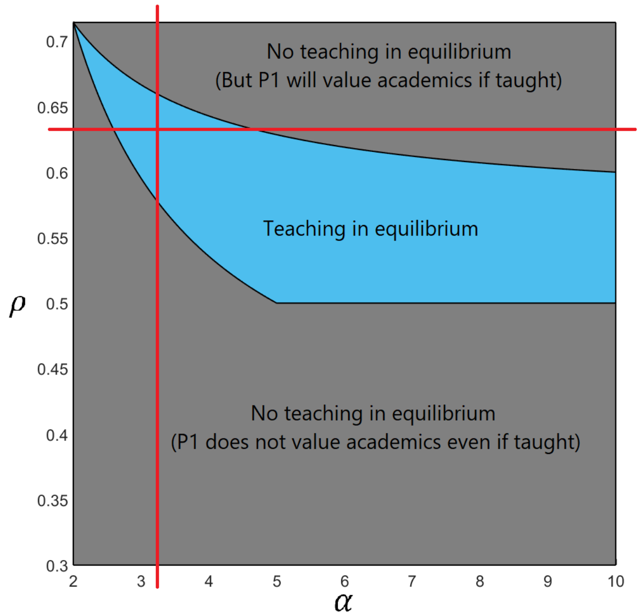


Figure 1.2: Equilibrium (Discrete Effort Model) for $n = 1, \beta = 0.4$.

Figure 1.2 illustrates an example of teaching equilibria over the α and ρ spaces. As can be seen, teaching is non-monotonic (see the red lines). The following corollary expands on this observation.

Corollary 2. ***Comparative Statics***
There exists a range of parameters for which the teaching decision is non-monotonic in α or ρ. In particular, assume that teaching equilibria do exist for the particular α or ρ chosen and that $\frac{(1-\beta)(n+1)}{\beta(n+1)^2-1} < \frac{n+1}{\beta}$, $\frac{n+1}{\beta} > \alpha^*$, $\frac{\beta}{1+\beta}[(n+1)+\frac{1}{\alpha}] < 1$ and $\rho > \frac{\beta}{1+\beta}(n+1)$.[15] Then,

1. *Holding Player 2's academic ability constant and increasing Player 1's learning potential: When learning potential is low $(\rho < \rho_l)$, Player 2 chooses not to teach. When it is intermediate $(\rho_l \leq \rho \leq \rho_h)$, Player 2 chooses to teach; Player 1's academic achievement is strictly increasing in this range. When it is too high $(\rho > \rho_h)$, Player 2 decides not to teach.*

[15]The four inequalities ensure that for some α low enough (but more than α^*) or ρ high enough, teaching does not occur; i.e. the lower and upper bounds for teaching are as illustrated in Figure 1.2 and we are in the zones of non-monotonicity. The corollary can then be proven by looking at Figure 1.2 and obtaining the bounds. This should hold for intermediate levels of β. If β is too high, then there might only exist a single threshold after which Player 1 teaches thereafter. See Remark 2 in Appendix A.1 for a further discussion on the conditions.

2. *Holding Player 1's learning potential constant and increasing Player 2's academic ability: When his academic ability is low enough ($\alpha < \alpha_l$), Player 2 does not teach. When it is intermediate ($\alpha_l \leq \alpha \leq \alpha_h$), he chooses to teach; Player 1's academic achievement is strictly increasing in this range. However, when it is too high ($\alpha > \alpha_h$), Player 2 decides not to teach.*

Specifically, $\rho_l = max\left\{\frac{1}{1+\beta}(\frac{1}{\alpha} + \frac{1}{n+1}), \frac{1}{n+1}\right\}$, $\rho_h = \frac{\beta}{1+\beta}[(n+1)+\frac{1}{\alpha}]$, $\alpha_l = \frac{1}{(1+\beta)\rho - \frac{1}{n+1}}$, $\alpha_h = \frac{1}{\frac{1+\beta}{\beta}\rho - (n+1)}$

Corollary 2 reflects the two conflicting desires of the mentor: Player 2 wants to teach in order to influence others to value his expertise and thus confer esteem to him — there is a desire for respect and prestige. On the other hand, teaching, by reducing relative achievement, hurts one's (self and conferred) esteem; it can be said to conflict with one's hubristic pride in own achievements. Thus, in general, decisions to teach (reflected in the bounds) would be affected by factors which influence others to value academics as well as those which influence relative achievement.

The non-monotonicity of teaching decisions is illustrated in Figure 1.3 where I graph the above relation.

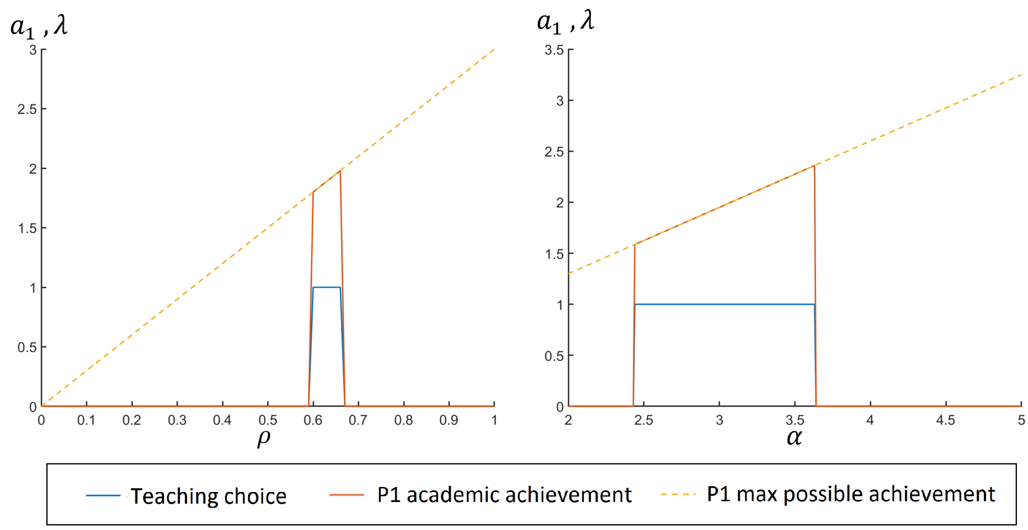


Figure 1.3: Comparative Statics for P1 Academic Learning Potential (ρ) and P2 Academic Ability (α) under Assumed Parameters.

When the ability of the mentor is fixed (left), he does not teach individuals with lower learning potential as even ex-post teaching, they will not come to value what they have learnt and he does not gain any esteem (from respect and prestige).

Individuals with high learning potential are also not taught as they pose a threat to one's pride and self-esteem, and also confer less respect. He does however teach individuals with intermediate learning potential as they value what he has taught, conferring more respect, and do not play a large threat to self-esteem.

Similarly, when the learning potential of the student is fixed (right), low ability mentors are not persuasive enough such that students value what is taught; teaching (and learning) hence does not occur. In addition, high ability mentors do not teach as they are the ones with large valuable pools of knowledge and stand to lose the most from teaching. Medium ability mentors are thus the ones with greater incentive to teach.

As can be observed, both lower and upper bounds are weakly decreasing in α and ρ. This is because the lower bounds are determined by Player 1's willingness to value academics. A higher (peer) mentor ability α raises the benefits of being taught and also increases the costs of valuing music instead, thus raising her willingness to value academics. The upper bound instead is determined by Player 1's benefits from teaching, which is decreasing in α because part of the higher ability translates into lower esteem after teaching as compared to when one does not teach. The same reasoning follows when examining increases in Player 1's learning potential ρ.

β and n affect the bounds as expected by influencing each individual's benefits from conformity: raising β and n raises such benefits, indirectly in the latter case by reducing the amount of direct social comparison between the two, thus encouraging more teaching (reducing lower bounds and raising upper bounds).

1.4.3 Discussion

The model here, by adapting the VFG, captures the pride and prestige motives in teaching. This provides a more nuanced view of how abilities of the knowledge recipient and knowledge sender affect decisions to teach (ρ and α comparative statics). It illustrates a selection bias in the kinds of individuals whom are taught and those who teach — knowledge is hoarded by refusing to teach when *learners' potential* and/or *own ability* is too low or high.

Via these processes, esteem could thus have important effects on the knowledge base of an organisation, and consequently efficiency. In particular, that higher ability students are avoided while intermediately lower ability individuals are taught could result in further repercussions for an organisation down the road. For example, the quality of leadership might be affected by the misallocation of talent and this could result in organisational dysfunction.

There are several pieces of evidence which are consistent with the mechanisms here. The knowledge management literature has found that the lack of recipients' learning potential or professional competence can negatively affect (pro-active) knowledge sharing by teachers [Szulanski, 1996; Zhang and Jiang, 2015]. Furthermore, Kang and Kim [2010] find that perceived expertise of the knowledge source positively affects knowledge transfers while Mugny et al. [2001] show that knowledge sources have less influence when the acceptance of knowledge realises a threat to recipients' self-esteem. These are consistent with a prestige motive for knowledge transfers in teachers and learners. Webb [1982] also find greater teaching/learning interactions between high and low ability individuals in heterogeneous learning groups — this evidence is consistent with pride discouraging teachers from transferring knowledge to higher ability individuals.

1.4.4 Model Setup (Continuous Teaching Effort)

The previous formulation assumed that mentors can implicitly refuse outright to teach particular individuals and showed that selection effects are the primary cause of inefficiency in knowledge transfers. Here, I present an alternative setup which shows that the aforementioned results are robust to allowing for a continuous choice of teaching effort. It illustrates that similar tensions generate incomplete knowledge transfers. Period 1 of the previous model is modified as follows:

Let Player 1, the target student have academic *learning capacity* $0 \leq \zeta \leq 1$. Further, let $0 \leq \lambda' \leq 1$ now be the teaching effort of Player 2. Academic ability of Player 1 in Period 2 is then $\alpha_1 = \zeta\lambda'\alpha$.[16] When teaching effort is 0, Player 2 does not enter a teaching relationship with Player 1 and $\alpha_1 = 0$. Teaching costs are again assumed to be very small (0^+).

1.4.5 Equilibria, Comparative Statics (Continuous Teaching Effort)

The following lemma provides necessary and sufficient conditions for teaching:

Lemma 2. *Assume $\alpha_2 = \alpha \geq \alpha^*$, $0 < \beta \leq 1$, then for a given (α, ζ) pair:*

1. *Suppose that $\frac{\alpha}{n+1} < \frac{1}{\beta}$ and $\frac{1}{(1+\beta)\alpha} + \frac{1}{(n+1)(1+\beta)} \leq \frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}]$, Player 2 teaches if and only if $\zeta \geq \frac{1}{1+\beta}(\frac{1}{\alpha} + \frac{1}{n+1})$.*

2. *Suppose that $\frac{\alpha}{n+1} \geq \frac{1}{\beta}$ and $\frac{1}{n+1} \leq \frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}]$, Player 2 teaches if and only if $\zeta \geq \frac{1}{n+1}$.*

[16] Conditional on strictly positive teaching effort, $\zeta\lambda' \equiv \rho$ from earlier; i.e. learning potential is a function of (innate) learning capacity and teaching effort. The previous propositions concerning learning potential can then be applied. When strictly positive λ' is restricted to be 1 as in the discrete model, learning potential is the same as academic learning capacity.

Conditional on the existence of teaching equilibria (the second inequality on each line), if Player 2 teaches, it must be that Player 1's learning capacity is high enough. Conversely, when Player 1's capacity is high enough, Player 2 will teach with positive effort: the upper bound will no longer matter since Player 2 can decide to teach with lower effort to those with higher ζ such that effective learning capacity is less than ζ. In fact, he will teach the minimum amount such that Player 1 will value academics as shown in the below proposition.

Proposition 3. ***Teaching effort in equilibrium***

Assume $\alpha_2 = \alpha \geq \alpha^*$, $0 < \beta \leq 1$, and that teaching equilibria exist for a chosen α. Then there exists a threshold level of learning capacity after which teaching always occurs. In particular, for a given pair (α, ζ),

1. *Suppose that $\frac{\alpha}{n+1} < \frac{1}{\beta}$ and $\frac{1}{(1+\beta)\alpha} + \frac{1}{(n+1)(1+\beta)} \leq \frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}]$,*
   if $\zeta \geq \frac{1}{1+\beta}(\frac{1}{\alpha} + \frac{1}{n+1})$, then Player 2 teaches with effort $\lambda' = \frac{1}{\zeta(1+\beta)}(\frac{1}{\alpha} + \frac{1}{n+1})$

2. *Suppose that $\frac{\alpha}{n+1} \geq \frac{1}{\beta}$ and $\frac{1}{n+1} \leq \frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}]$,*
   if $\zeta \geq \frac{1}{n+1}$, then Player 2 teaches with effort $\lambda' = \frac{1}{\zeta(n+1)}$

Otherwise, $\lambda' = 0$.

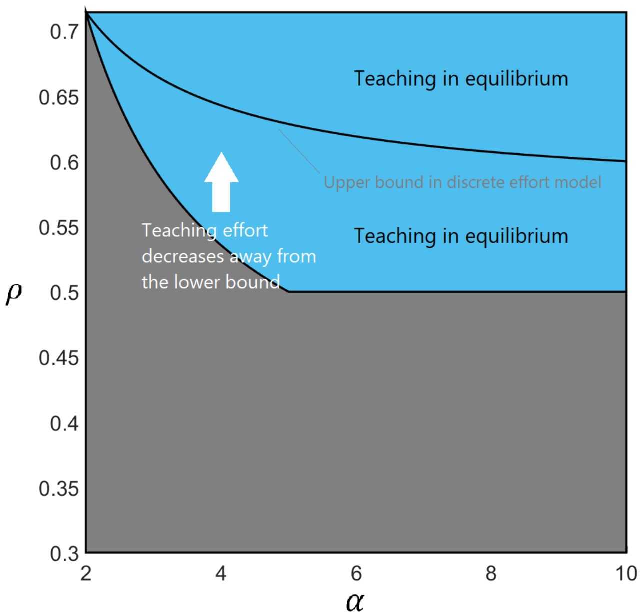


Figure 1.4: Equilibrium (Continuous Effort Model) for $n = 1, \beta = 0.4$

As before, the threshold at which Player 2 begins to teach (with full effort) is dependent on factors which affect Player 1's willingness to value academics and hence confer esteem to Player 2. There is no longer an upper bound on academic learning capacity, but beyond the threshold, teaching effort weakly decreases. In particular, a higher learning capacity and/or larger pool of academic knowledge of Player 2 weakly lowers the amount of teaching effort by Player 2. Figure 1.4 demonstrates the difference in equilibria for the continuous effort model given parameters similar to before as in Figure 1.3. The above discussion is also summarised in the below corollary where I examine the comparative statics, holding one of ζ and α constant and varying the other for some set of parameters.

Corollary 3. ***Comparative Statics***
There exists a range of parameters for which teaching effort is non-monotonic in α or ζ. In particular, assume that teaching equilibria do exist for the particular α or ζ chosen and that $\frac{(1-\beta)(n+1)}{\beta(n+1)^2-1} < \frac{n+1}{\beta}$, $\frac{n+1}{\beta} > \alpha^*$ and $\frac{\beta}{1+\beta}(n+1) > \frac{1}{n+1}$.[17] Then,

1. *Holding Player 2's academic ability constant and raising Player 1's academic learning capacity: When Player 1 has low enough learning capacity ($\zeta \leq \hat{\zeta}$), Player 2 does not teach. When Player 1's learning capacity is high enough ($\zeta > \hat{\zeta}$), Player 2 puts in teaching effort which strictly decreases as Player 1's learning capacity rises; Player 1's academic achievement is constant as his academic learning potential rises beyond the threshold.*

2. *Holding Player 1's academic learning capacity constant and raising Player 2's academic ability: When Player 2 has low enough academic ability ($\alpha \leq \hat{\alpha}$), Player 2 does not teach. When Player 2's academic ability is high enough ($\alpha > \hat{\alpha}$), he puts in teaching effort which weakly decreases as Player 2's academic ability rises. Player 1's academic achievement is strictly increasing as Player 2's academic ability rises along the range at which he is taught.*

Specifically, $\hat{\zeta} = max\left\{\frac{1}{1+\beta}(\frac{1}{\alpha} + \frac{1}{n+1}), \frac{1}{n+1}\right\}$, $\hat{\alpha} = \frac{1}{(1+\beta)\zeta - \frac{1}{n+1}}$

The non-monotonicity in teaching effort here reflects the similar conflicting incentives of a mentor as before and is illustrated in Figure 1.5.

Holding ability of the mentor constant (left), there is non-monotonicity of teaching effort in the students learning capacity. Similar to the previous model, at

[17] The first two inequalities ensure that for some α low enough (but more than α_h), teaching does not occur; i.e. the lower bound for teaching is as illustrated in Figure 1.2 and the downward sloping portion exists. The last inequality ensures that there is always some teaching equilibria for α high enough. The corollary can then be proven by looking at Figure 1.4 obtaining the lower bound, noting that teaching effort is decreasing away from it. This should hold for intermediate levels of β. See Remark 2 in Appendix A.1 for a further discussion. If the last inequality is violated, then teaching effort is still non-monotonic in α, but will discontinuously drop to 0 above some threshold. This reflects the large losses in esteem from teaching when own ability is high.

low levels of learning capacity, Player 2 is not willing to teach since Player 1 will not value academics anyway and he will not gain any respect. When it increases and reaches the threshold, Player 1 puts in full teaching effort to get Player 1 to value academics. However, as it increases further, teaching effort decreases since similar or more effort would only lower Player 2's esteem by harming relative achievement; pride here thus leads to the strategic hoarding of knowledge by Player 2. This is illustrated by the gap between academic achievement and maximum academic achievement which is not present in the discrete teaching effort model.

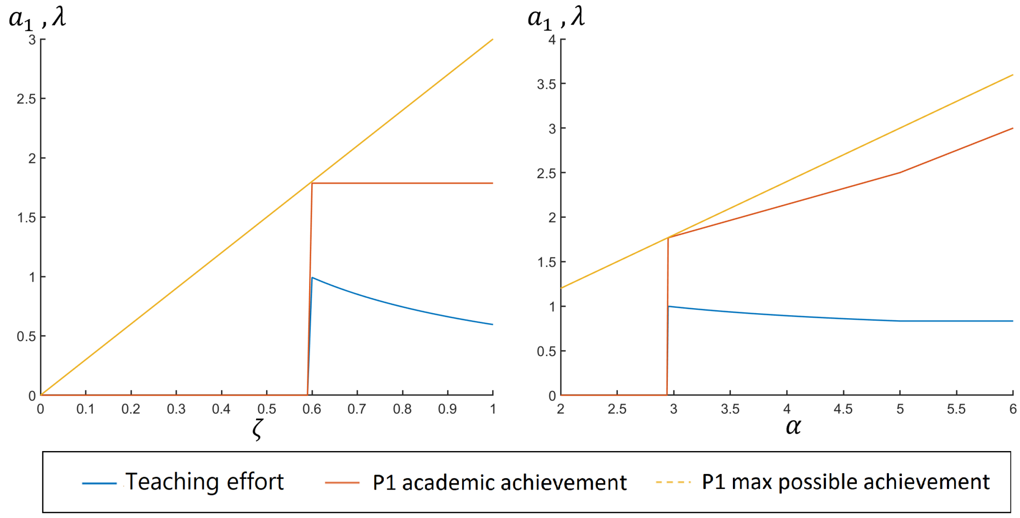


Figure 1.5: Comparative Statics for P1 Academic Learning Capacity (ζ) and P2 Academic Ability (α) under Assumed Parameters.

Likewise, holding learning capacity constant (right), low ability individuals do not teach as they are unable to influence the other to value what they teach. Past the threshold, there is a drop in teaching effort as Player 2's ability increases, however academic achievement still rises as the rise in his ability compensates the fall in teaching effort. There is however still knowledge hoarding as seen by the gap between actual and maximum possible academic achievement.

Since the threshold here again depends on Player 1's willingness to value academics, a similar reasoning as before can be applied to how β, α, ζ and n affect it. In particular, the academic capacity (ζ) threshold is weakly decreasing in β, α, n , while the α threshold is strictly decreasing in β, ζ, n. Figure 1.6 combines ζ comparative statics with a shift in α. It illustrates how a rise in teacher's ability, by raising student's willingness to value academics, weakly lowers the teaching threshold. When teaching effort is discrete, a similar looking figure would be obtained, just that the non-monotonicity would be step-wise as in Figure 1.3.

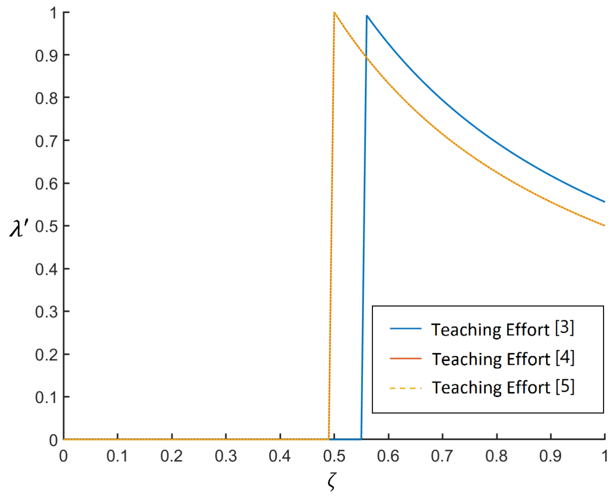


Figure 1.6: Comparative Statics for P1 Academic Learning Capacity (ζ) for Different P2 Academic Abilities ($\alpha = 3, 4, 5$)

1.4.6 Discussion

The continuous formulation introduces an additional mechanism for the hoarding of knowledge within organisations. In addition to the abilities of the student and mentor affecting incentives to teach, even if a teaching relationship is present (or enforced via centralised matching), the mentor still has an incentive to hoard some knowledge in order to maintain pride derived from being ahead in achievement. Besides the case where Player 1 is not taught when learning potential/capacity is too low (which is also present when teaching effort is discrete), there is an additional inefficiency here in that "slacking off" by Player 2 (the mentor) reduces Player 1's final ability. However, in contrast, individuals with high learning potential/capacity are taught with some positive effort when teaching effort is continuous.

This idea of discreteness of teaching effort can be interpreted as some characteristic of the knowledge involved in the transfer such that holding back is difficult once entering a teaching relationship. For example, tacit knowledge Polanyi [1966] and/or causal ambiguity [Uygur, 2013] means that the knowledge can be more easily held back and is not easily imitated when in a mentor-student relationship.

The continuous specification illustrates that when knowledge can be held back while teaching, then teaching relations may seem normal in that there is no bias in the kind of students which mentors (with a particular ability) are willing to teach (provided they have high enough learning capacity), although teaching effort will vary. In contrast, when knowledge is difficult to hold back and they have the freedom to choose, mentors will have a bias toward students with the lowest possible capacity whom will value their trade; this could thus result in the manifestation of "lackey type" mentor-student relations within an organisation.

The knowledge management literature mentions how characteristics of knowledge can affect the speed of knowledge transfers [Szulanski, 1996; Schilling and Kluge, 2009]. A comparison of the discrete and continuous models here instead implies that characteristics of knowledge can have an impact via the structure of teaching relations within an organisation. In particular, the model suggests that the distribution of ability can interact with the characteristics of knowledge to influence efficiency. For example, if everyone has high learning capacity, "discrete" knowledge may imply greater inefficiency due to the students not being taught at all. In contrast, "continuous" knowledge implies that at least some transfers of knowledge are present. This would have implications for human resource and team management or the organisation of classes and schools and may also be of interest in future research.

1.5 Learning under Social Pressure

In the previous two sections, I looked at how esteem on the part of mentors affected knowledge transfers. The flipside of this involves the willingness of learners to acquire knowledge. In Section 3, I noted that academic abilities needed to be close enough in order to encourage Player 1 to value or focus in academics (and thus learn). When abilities are far apart, learning and knowledge transfers will be hindered even when there are no problems in motivating teaching effort by mentors. One solution to this problem may be to increase the amount of pressure faced by Player 1 to achieve (relative) academic performance, although it is possible that he/she may choose to escape such pressure. In this section, I consider how desires for esteem affect decisions to learn under social pressure from an external entity (e.g. parents, teachers, managers), given the possibility of escaping such pressure at a cost.

1.5.1 Model Setup (Learning)

The main setup is similar to the (one-period) *baseline model* in Section 3. Social pressure here is modelled by a choice of the weight on conferred esteem (β). I assume that an external entity exerts social pressure $\beta > 0$ on Player 1 (the learner) while Player 2 faces constant social pressure $\beta_0 > 0$. To model escaping from such pressure, an additional decision is introduced where Player 1 is allowed to incur a fixed cost c to cut off interactions with Player 2, thus eliminating conferred esteem.

In particular,

$$U_1 = \begin{cases} (\theta_{11} + \beta\theta_{21})(a_{11} - \overline{a_1}) + (\theta_{12} + \beta\theta_{22})(a_{12} - \overline{a_2}) & \text{if P1 does not break up} \\ (\theta_{11})(a_{11} - \overline{a_1}) + (\theta_{12})(a_{12} - \overline{a_2}) - c & \text{if P1 breaks up} \end{cases}$$

$$U_2 = \begin{cases} (\theta_{21} + \beta_0\theta_{11})(a_{21} - \overline{a_1}) + (\theta_{22} + \beta_0\theta_{12})(a_{22} - \overline{a_2}) & \text{if P1 does not break up} \\ (\theta_{21})(a_{21} - \overline{a_1}) + (\theta_{22})(a_{12} - \overline{a_2}) & \text{if P1 breaks up} \end{cases}$$

An assumption: $c > \frac{n+1}{n+2}$ is made; this ensures that an equilibrium where Player 1 focuses on, but does not value academics exists. Again, I assume that Player 2 has high enough academic ability/potential (greater than Player 1) such that he always focuses on and values academics; this implies that *social pressure on Player 1 is effectively on academics only.*

This formulation can be conceived as a parent/teacher putting pressure on a child/student by emphasising his academic achievement relative to his peers. In an organisational context, this could reflect a manager trying to influence a particular employee to focus on some desired *prevalent work dimension* by emphasising his performance in it relative to other employees. Avoiding interaction here represents Player 1 running away from some obligations which have been set up in the environment; in our school example here, obligations refer to the focus on academic achievement. I refer to the act of doing so as "breaking up".

To keep up with the theme of learning and teaching within the school example in this paper, α_1 can be treated as Player 1's potential academic ability. In a *hypothetical* two-period game where Player 1 has 0 academic ability in the first period, α_1 can be considered to be his academic ability in the second period, conditional on choosing to learn in the first period (from an external teacher at a very small but positive learning cost: 0^+).

Learning will occur in the first period in a SPE if and only if Player 1 chooses to focus on academics (possibly valuing it) in the second period, conditional on learning in the first. This implies that not focusing on academics in the one-period baseline model is equivalent to choosing not to learn in the above hypothetical two-period game — I thus focus on results from the static game, but with interpretation as in the hypothetical two-period game described above.[18]

[18] The utility of valuing and focusing on music is independent of Player 1's academic ability. If Player 1 chooses not to focus on academics in the second period conditional on learning, not learning in the first period will give higher possible utility in the second since learning costs are very small but positive. The converse also holds: if he strictly prefers to focus on academics (possibly valuing it), utility ex-post learning in equilibrium must be strictly greater than that of valuing and focusing on music (and possibly breaking up). This utility is approximately equal to that if he chose not to learn as learning costs are infinitesimally small; thus he will choose to learn in Period 1 in SPE.

1.5.2 Equilibria, Comparative Statics (Learning)

In the below proposition, I solve for the pure-strategy Nash equilibria.

Proposition 4. ***Equilibrium with fixed break-up costs***
Suppose $\alpha_2 \geq \alpha_1$ and $\alpha_2 > \alpha^{**}$ such that Player 2 is always a scholar.[19] *In addition, assume that $c > \frac{n+1}{n+2}$, $\beta > 0$, $\beta_0 > 0$, then*

1. *There is an equilibrium where Player 1 is an a scholar when their (potential) academic abilities are close enough. In particular, this requires $\alpha_1 \geq \frac{\alpha_2}{n+1}$, $(1+\beta)(\frac{n+1}{n+2}\alpha_1 - \frac{\alpha_2}{n+2}) > \frac{n+1}{n+2} - c$, $\alpha_1 > \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$.*

2. *There is an equilibrium where Player 1 is a musician, but does not break up when he has low (potential) academic ability which is not that low relative to Player 2. In particular, this requires $\alpha_1 \leq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, $c > \frac{\beta}{n+2}\alpha_2$, $\alpha_1 \leq \frac{1}{\beta}$.*

3. *There is an equilibrium where Player 1 is a musician and chooses to break up when he has low (potential) academic ability which is very low relative to Player 2. In particular, this requires $c \leq \frac{\beta}{n+2}\alpha_2$, $\beta(\frac{n+1}{n+2}\alpha_1 - \frac{\alpha_2}{n+2}) < \frac{n+1}{n+2} - c$ and $(1+\beta)(\frac{n+1}{n+2}\alpha_1 - \frac{\alpha_2}{n+2}) \leq \frac{n+1}{n+2} - c$.*

4. *There is an equilibrium where Player 1 focuses on academics, but does not value it when Player 1 has intermediate (potential) academic ability relative to Player 2. In particular, this requires $\alpha_1 < \frac{\alpha_2}{n+1}$, $\beta(\frac{n+1}{n+2}\alpha_1 - \frac{\alpha_2}{n+2}) \geq \frac{n+1}{n+2} - c$, $\alpha_1 \geq \frac{1}{\beta}$.*

With the additional break-up choice, equilibria differ from the baseline model in that when there is too much negative conferred esteem, Player 1 chooses to break up instead of focusing on academics. This can be observed in Figure 1.7 where I illustrate equilibria for two different values of β. Equilibria along the red lines illustrate the aforementioned "aspirations failure" in that too high a social reference point discourages effort in academics. Of greater interest here however, is how changing social pressure affects the set of equilibria. It is easy to see that as $\beta \to 0^+$, the break up (musician) and focus equilibria will disappear while as $\beta \to \infty$, the non-break-up (musician) and focus equilibria will disappear. This hints at the possible non-monotonicity of learning in social pressure.

[19] $\alpha^{**} = max\left\{\beta_0 + \frac{n}{n+1}, \frac{n+1}{n}, \frac{1}{\frac{n}{n+1}+\beta_0}, \frac{1}{n+1}\right\}$, see Remark 3 in Appendix A.1 on how this is derived.

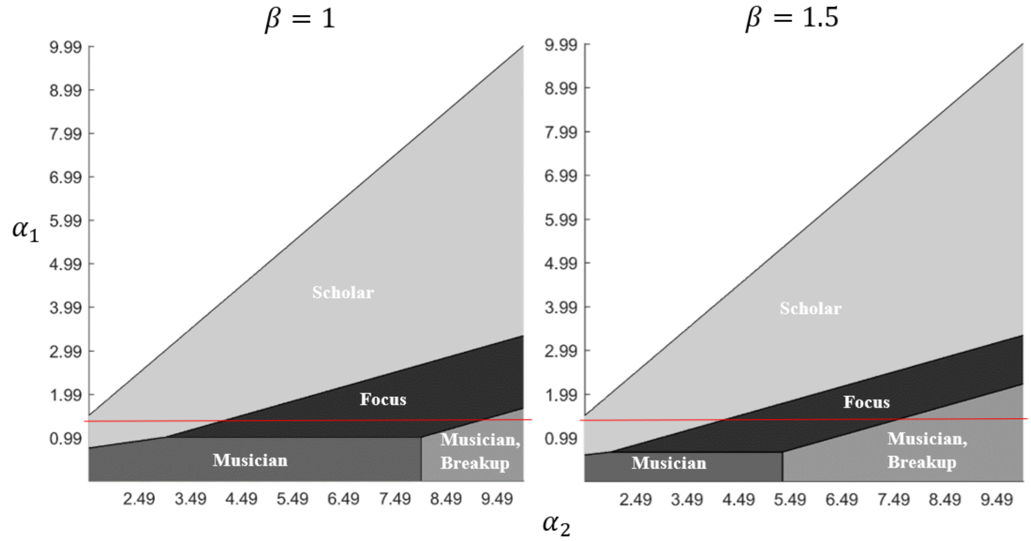


Figure 1.7: Raising Social Pressure, $n = 2, c = 2, \beta_0 = 0.5$.

Note that while pure strategy equilibria for Player 1 always exist (one of the strategies must be maximising), along the range of β, there exists pairs of α_2, α_1 where focus equilibria do not exist.[20] The following corollary describes the shifts in equilibria as social pressure changes.

Corollary 4. ***Comparative statics for changing*** β
Suppose $\alpha_2 \geq \alpha_1$ *and* $\alpha_2 > \alpha^{**}$ *such that Player 2 is always a scholar. In addition, assume that* $c > \frac{n+1}{n+2}$, $\beta > 0$, $\beta_0 > 0$, *then I have the following comparative statics for a fixed* (α_1, α_2) *with changing social pressure* β:

1. *When Player 1 has higher (potential) academic ability relative to others, but intermediate ability relative to Player 2 such that he does not always value academics , there exists a threshold level of social pressure* β_1 *after which he will switch from being a musician to being a scholar; i.e. choosing to learn. In particular, this requires* $(\alpha_1, \alpha_2) \in A$.

2. *When Player 1 has lower (potential) academic ability relative to others and intermediate ability relative to Player 2, there exist two threshold levels of social pressure* $\beta_2 < \beta_3$ *: the lower one at which he switches from being a musician to focusing on academics (choosing to learn), but not valuing it and the higher one at which he chooses to cut off relations and become a musician again (learning stops). In particular, this requires* $(\alpha_1, \alpha_2) \in C$.

[20]For example, when $n = 2, c = 1$. Taking the point $\alpha_1 = 1, \alpha_2 = 8$, the conditions in 4) require $\beta > 1$ and $\beta < 1/5$ which means that there is no level of social pressure such that a focus equilibrium exists for that point.

3. *When Player 1 has lower (potential) academic ability relative to others and low ability relative to Player 2, there exists a threshold level of social pressure β_4 at which he switches from being a musician to being a musician and breaking up; i.e. he never chooses to learn. In particular, this requires $(\alpha_1, \alpha_2) \in B \setminus C$.*

Specifically,
$A = \left\{(\alpha_1, \alpha_2) \in \mathbb{R}^2 | \alpha_1 > \frac{\alpha_2}{n+1}, \alpha_1 < 1 + \frac{\alpha_2}{n+1}\right\}$, $B = \left\{(\alpha_1, \alpha_2) \in \mathbb{R}^2 | \alpha_1 \leq \frac{\alpha_2}{n+1}\right\}$,
$C = \left\{(\alpha_1, \alpha_2) \in \mathbb{R}^2 | \alpha_1 \geq \frac{\alpha_2}{c(n+1)}, \alpha_1 \leq \frac{\alpha_2}{n+1}\right\}$
$\beta_1 = \frac{1}{\alpha_1}(1 + \frac{\alpha_2}{n+1}) - 1$, $\beta_2 = \frac{1}{\alpha_1}$, $\beta_3 = (1 - \frac{n+1}{n+2}c)/(\alpha_1 - \frac{\alpha_2}{n+1})$, $\beta_4 = \frac{(n+2)c}{\alpha_2}$

Part 1 of Corollary 4 implies that the ability of an external teacher (which translates into the potential ability of Player 1) matters because for high enough academic ability of Player 1, social pressure is always beneficial for learning as it increases the effective amount of conferred esteem (prestige) when focusing on the prevalent activity.

Part 2 of Corollary 4 demonstrates an important case where exerting more social pressure may not always result in greater learning given the possibility of avoiding interactions which influence esteem. Though it may work at intermediate levels, exerting even more pressure causes the individual to "break" and run away, disrupting learning. This is because these set of individuals are "ostracised" for lagging behind the pack in the prevalent activity. However, since they do not lag behind by much, intermediate social pressure encourages learning in order to reduce the amount of negative conferred esteem (by obtaining prestige from conformity), although they do not value the activity. High social pressure in contrast, leads to excessive negative esteem and this makes escapism more attractive.

Lastly, part 3 of Corollary 4 demonstrates that for those whom are lagging behind severely, social pressure will never influence them to learn as given the excessive negative esteem, they would rather choose to end social contact and escapism is always more attractive.

The changes in equilibria and academic achievement as social pressure on Player 1 rises are graphically illustrated in the top two graphs in Figure 1.8 for scenarios 1) and 2) which are of primary interest as there are shifts in Player 1's focus. Also, as can be noted in the bottom right hand figure, esteem net of any break up costs is weakly decreasing in social pressure when one's academic ability is relatively behind others: cutting of interactions and "running away" is a form of managing this negative esteem; after doing so, social pressure has no effect on esteem.

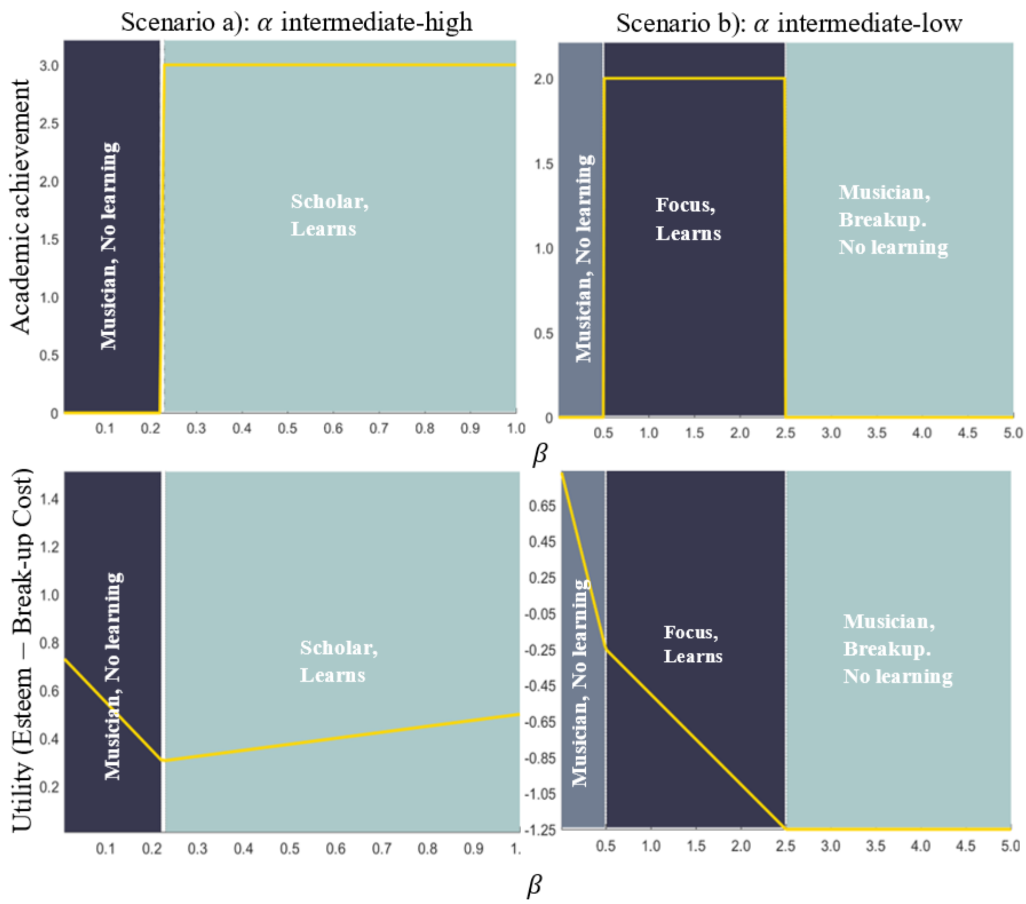


Figure 1.8: Representative Equilibria for Scenarios 1) and 2) in Corollary 4

1.5.3 Discussion

The learning model shows that social pressure can have mixed effects on learning decisions. A key factor is whether one potentially obtains negative or positive esteem from that activity (here academics) and thus can be influenced to value it. Moderate levels of social pressure may encourage learning if the individual is not lagging behind by too much. However, unless social pressure can encourage one to intrinsically value the activity, too much social pressure will eventually lead the individual to escape and "take up the outside option". These factors might thus provide an explanation for the mixed effects of increased parental expectations on academic performance found in the literature (see Yamamoto and Holloway, 2010). When one's potential ability is really low, social pressure can only make things worse, leading to segregation and negative coping behaviour. Escapism in the model is consistent with Eskilson et al. [1986] who find that excessive negative esteem brought about by parental pressure leads to deviant behaviour like vandalism, perhaps as a coping mechanism.[21]

The model suggests that these negative effects can occur even if one is potentially relatively better at the prevalent dimension (academics) than the other ($\alpha_1 > 1$) as long as α_2 is high enough. This is brought about by social comparison with significantly skilled others. Evidence in Buunk et al. [2010] where upward comparison leads to greater burnout amongst nurses with high social comparison orientation is consistent with this. It also suggests that when social comparison determines esteem, an individual's reference group is important in determining the effectiveness of social pressure in improving learning and achievement. This has implications for education policy in schools with reference to comprehensive versus selective tracks, or the composition of teams in firms/organisations.

Alternatively, the model also suggests that improving teaching skills and/or reducing relative gaps in ability or knowledge may be more effective since it potentially motivates the learner to intrinsically value such work, though it may be harder to implement in real-life. Relatedly, reducing social comparison in esteem may also have similar effects. Doing so may also be related to parenting techniques where inculcating values in children by effective teaching and positive discipline may work better than negative discipline (here through excessive comparisons with higher achieving individuals which are harmful to the child's self-esteem).

[21] In the model, agents choose to break up and focusing on music, but this can easily be extended to an exogenous harmful activity whether in organisations or schools, which helps "maintain one's self".

1.6 Conclusion

Esteem from pride and prestige plays an important role in influencing behaviour. It is derived and conferred based on aspects of life which individuals especially value. These values can be possibly influenced by being taught by others, or through external social pressure. In the context of a two-player, two-period game, I consider how such esteem processes affect the willingness to teach and learn.

The two teaching models highlight how esteem, while encouraging knowledge transfers through prestige, can also result in knowledge hoarding due to pride, albeit in different manners depending on the characteristics of knowledge. The adverse impacts of hubristic pride suggest that standard economic tools like individual performance incentives which create a culture of individualism and competition may have harmful side effects, potentially leading to resource misallocation and organisational dysfunction.

This seems to paint a grim picture; yet there are alternative measures, some less considered in an economic toolbox. In particular, the knowledge management/ organisational learning literature emphasises building up an organisational culture conducive to knowledge sharing [Nordhaug, 1994; De Long and Fahey, 2000].[22] One step towards doing so might be through the use of more group-based performance incentives [Bartol and Srivastava, 2002]. The presence of effective (anonymous) knowledge sharing sites and open source projects online is evidence of the possibility of such virtuous changes within organisations.

The learning model further highlights how esteem interacts with social pressure to affect learning choices. As before, the learning model illustrates the negative aspects of social comparison and hubris — if one's potential is relatively low, too much social pressure can be counter-productive. This is consistent with recommendations not to use too much pressure on children with respect to raising academic achievement for fear of such negative effects. It suggests that more effective teaching or structuring of peer groups may be better than solely using direct social pressure because these could lead to intrinsic valuation of the dimension and derived positive esteem.

The above issues highlight future avenues for research: How could incentives endogenously affect the knowledge sharing culture via the norms it generates? What kinds of (group) monetary/social incentives, interaction structures and (organisational) cultures are conducive to knowledge transfers? Understanding and addressing these issues would help in creating more effective learning institutions and organisations which are likely to benefit society as well.

[22] Theoretically, this could mean a greater weight on intrinsic, pro-social sources of esteem (i.e. authentic pride), with greater respect for others' expertise, as compared to the competitive social comparison aspect.

Chapter 2

Social Identity and Incentives in Workgroups

2.1 Introduction

There is a large literature in economics on optimal worker incentives. A factor which has received relatively little attention within this literature — but seems to be important in practice — is workers' identities. For instance, at Nucor Steel, where employees share a strong sense of common identity, group-based incentives comprise a large fraction of workers' compensation (66%).[1] By comparison, group-based incentives comprise less than 20% of overall earnings at US Steel, where employee identity is more fragmented [Byrnes and Arndt, 2006]. Relatedly, unlike individualist countries (e.g. US), collectivist countries (e.g. Japan) display a strong association between group-based incentives and organisational performance [Allen et al., 2004]. This gives reason to believe that workers' identities may interact with incentives, thus affecting their optimality.

In this paper, I conduct the first experiment exploring how workers' identities affect the functioning of different incentives. I systematically induce identities in the laboratory by assigning participants to one of two groups using a procedure similar to Chen and Li [2009]. They are then placed in workgroups which are either *homogeneous* or *heterogeneous* in members' identities. I examine productivity of

[1] A quote from a frontline supervisor exemplifies this: *"At Nucor, we're not 'you guys' and 'us guys'. It's 'all of us' guys. Wherever the bottleneck is, we go there, and everyone works on it."* [Byrnes and Arndt, 2006]. Employees even refer to each other as "teammates" [B Arthur, 1999]. Production employees at Nucor are organised into teams including maintenence workers and supervisors and have bonuses tied to team production which can be up to 200 percent of their base salary. This is in addition to earnings from a profit sharing program which further increases the team component of earnings [Sheridan, 1998; Vasanthi and Chowdary, 2009; Bakshi, 2015]. Boyd and Gove [2000] mention the dramatic differences of culture at competitors of Nucor, with workers having an "us vs them" mentality, fear and distrust.

each workgroup type under two different incentive schemes: *tournament pay* or *team pay*. Participants engage in a task where one's productivity depends on personal effort as well as help from fellow members in their workgroup.

Results are indicative that optimal incentives depend on workers' identities. I find that in homogeneous workgroups, productivity is higher under team pay. In heterogeneous workgroups, productivity is however similar across incentives. These productivity differences can be explained by the interaction between identities and incentives in influencing inputs. Generally, team pay encourages helping, while tournament pay encourages personal effort. However, team pay stokes greater help in homogeneous workgroups while tournament pay stokes greater effort in heterogeneous workgroups.

Results also suggest that incentives further influence and shape workers' identities. Utilising post experiment survey data, I find that under team pay, participants have a greater identification with their workgroup. This hints at a feedback process between incentives and identities which might be important in determining optimal incentives, especially in dynamic settings.

The structure of this chapter is as follows. Section 2 summarises the literature related to the paper. Section 3 describes the experimental design and procedures. This is followed by a simple model to generate predictions in Section 4. Section 5 talks about the experimental results, and Section 6 concludes with a discussion.

2.2 Related Literature

A body of literature has studied the effects of team pay and tournaments. (See Lazear, 2018 for a review.) Team pay has been shown to encourage cooperation [Lazear, 1989; Friebel et al., 2017], but it may also lead to free riding [Holmstrom, 1982; Van Dijk et al., 2001]. Tournaments have been shown to motivate personal effort [Lazear and Rosen, 1981; Bull et al., 1987], but they also potentially lead to sabotage of peers [Carpenter et al., 2010; Charness et al., 2013]. My paper contributes by examining the interaction with identity.

There is an existing experimental literature in economics on identity (see for example Goette et al., 2006; Mcleish and Oxoby, 2007; Heap and Zizzo, 2009; Goette et al., 2012; Butler, 2014).[2] A robust finding of this literature is that identity affects agent's preferences. For example, Chen and Li [2009] find that subjects are more charitable and reciprocal towards members of their ingroup.

[2] A psychology literature on identity starting with Tajfel et al. [1971] argues that group membership can influence behaviour. More recently, there has been a growing economics literature on identity beginning with Akerlof and Kranton [2000]. See Akerlof and Kranton [2010] for a summary.

Several papers have explored the impact of identity on productivity.[3] For instance, Hoff and Pandey [2006] find that, when identity is made salient, individuals of lower caste perform worse in a maze-solving task. Chen and Chen [2011] show that individuals exert higher effort in a minimum-effort game when paired with ingroup members. Kato and Shu [2016] find that common identity makes workers less competitive, while Hamilton et al. [2012] find that common identity stokes teamwork. While these papers vary identities, they do not vary incentives.[4] Hence, they do not speak to this paper's main question of how identities affect optimal incentives.

More closely related are papers by Hamilton et al. [2003] and Bandiera et al. [2005] who compare workers' productivity under a change in incentive regime. Hamilton et al. [2003] find a benefit of team pay while Bandiera et al. [2005] find a cost of relative pay when workers are "groupy".[5] A key contribution of my paper is to show that when both of these effects are present, the optimal incentive structure depends on workers' groupiness (or more specifically, workers' identities).[6] To the best of my knowledge, my paper is the first to cleanly demonstrate that optimal incentives may be influenced by workers' identities.[7]

Finally, there is some theoretical work which speaks to the issues in this paper. Most related is Huck et al. [2012] who show that a concern for others in the workgroup can raise the effectiveness of team performance pay — and decrease that of relative performance pay. Other work discusses how strong identification with an organisation's mission can reduce the need for high-powered incentives [Besley and

[3]More generally, this is related to the idea of *social incentives* and *job-meaning*. See Ashraf and Bandiera [2018] and Cassar and Meier [2018] respectively for a review of the related literature.

[4]Under relative pay, Kato and Shu find that workers at Chinese textile firms have higher productivity in the presence of more able out-group workers, but not in-group ones. Under team pay, Hamilton et al. find that workgroups at a garment factory in Napa, California are more productive when composed of a single (Hispanic) ethnicity; Afridi et al. [2018] find similar results in India.

[5]Hamilton et al. [2003] examine a switch from piece rates to team pay at a US garment factory. Bandiera et al. [2005] examine a switch from relative pay to piece rates at a UK farm. They have coarser measures of groupiness. Hamilton et al. [2003] use workers' implicit desires to form groups and find that earlier forming workgroups exhibit higher increases in productivity under team pay; Bandiera et al. [2005] use friendships amongst co-workers and find that workers with more friends amongst co-workers exhibit higher decreases in productivity under relative pay due to collusion.

[6]Another contribution of my paper is to identify the forces driving productivity differences: groupiness increases the desire to help co-workers but reduces the desire to compete against them. I identify these effects by measuring two kinds of work input: personal effort and help.

[7]Blazovich [2013] in the management accounting literature has a design which may in principal examine this, but is unable to draw conclusive results due to the low sample size. Experiments which examine how collectivism and individualism impact group versus individual incentives [Papamarcos et al., 2007; Naranjo-Gil et al., 2012] are also related to the extent that these traits affect identity [Chatman et al., 2019]. Other research has studied how identity influences the effectiveness of other (non-pecuniary) management schemes like imposing control [Masella et al., 2014; Riener and Wiederhold, 2016], punishment [Weng and Carlsson, 2015] and reporting structures [Towry, 2003].

Ghatak, 2005; Akerlof and Kranton, 2005, 2008; Henderson and Van Den Steen, 2015].[8]

2.3 Experimental Design

Participants perform a real-effort task in workgroups under a 2×2 between-subject design (see Table 2.1). One dimension is the identity composition of workgroups which is either *homogeneous* or *heterogeneous*. The other dimension is the incentive scheme faced by workgroups which is either a *tournament pay* or a *team pay* scheme. I utilise a novel computerised real-effort task. Workgroups' productivity at the task depends both upon personal effort of workgroup members and how much they help one another.

Workgroup Identity	Incentive scheme	Sample size
Homogeneous	Tournament Pay	72
Homogeneous	Team Pay	72
Heterogeneous	Tournament Pay	72
Heterogeneous	Team Pay	72

Table 2.1: Treatment Descriptions

The experiment consists of two stages. In the first stage, I induce identities in subjects. In the second stage, subjects are allocated to workgroups and engage in the real-effort task. After completing the experiment, subjects complete an online questionnaire.

2.3.1 Identity Inducement

To induce identities in subjects, I use a procedure similar to Chen and Li [2009]. Subjects review 5 pairs of paintings, each pair containing a painting by Paul Klee and another by Wassily Kandinsky. Without being told anything about the artists, they are asked to indicate which painting they prefer. Subjects are then categorised into two equal-sized groups — *Klee* and *Kandinsky* — according to their relative preferences within the session.[9]

[8] These papers however differ in their modelling of how identification occurs. Akerlof and Kranton [2005, 2008] view identity as being malleable within the organisation. Besley and Ghatak [2005] discuss how assortative matching of workers and organisations naturally occurs under competitive pressure from larger surplus in such matches. Henderson and Van Den Steen [2015] instead describe how workers self select into firms with pro-social purposes due to identity and reputation benefits.

[9] Chen and Li's procedure adapts the minimal group paradigm in Tajfel and Turner [1979] where subjects are assigned to groups based on absolute preferences. I do the same, but assign groups based

Subsequently, group members complete a joint task in order to build up the identity salience of their group. They are asked to individually guess the artists of a final pair of paintings after a 5-minute anonymous discussion with the members of their group.[10] If the majority of the group gets the correct answer, they are awarded 80 Experimental Currency Units (ECUs). Success or failure in this task is only revealed at the end of the experiment to avoid influences on their identity salience.

2.3.2 Production in Workgroups

Workgroups are of size 6. Subjects are randomly assigned to either a *homogeneous* workgroup (all members are Klee or all members are Kandinsky) or a *heterogeneous* workgroup (3 members are Klee and 3 members are Kandinsky). Subjects are given a real-effort task to complete with members of their workgroup. The task is divided into 4 rounds of 6 minutes.[11]

Real Effort Task with Cooperation

The real-effort task is a "decoding" task adapted from Charness et al. [2013]. Subjects receive a set of letters and a"code book" (a number-letter grid). The task involves finding the two digit number corresponding to each letter. Upon completion of a set, a subject receives a new set of letters to decode. The code book changes with each set. In each round, subjects obtain a score equal to the total number of sets completed.

During the round, a subject is equally likely to receive an "easy" or "difficult" question set. Easy sets contain 3 letters while difficult sets contain 7 letters. At the beginning of each round, subjects decide for each identity background — Klee and Kandinsky — whether they are willing to"help" workgroup members who receive difficult sets. Each time a subject receives a difficult set, the computer automatically requests for help from a random workgroup member (a "potential helper").[12] If the

on relative preferences instead. This ensures that groups are balanced in size which is important for subsequent assignment to workgroups. In particular, subjects are ranked by the number of times they prefer paintings by Paul Klee. The top (bottom) half is assigned to Group Klee (Kandinsky).

[10] The five pairs of paintings with fixed order are: 1A Gebirgsbildung, 1924, by Klee; 1B Subdued Glow, 1928, by Kandinsky; 2A Dreamy Improvisation, 1913, by Kandinsky; 2B Warning of the Ships, 1917, by Klee; 3A Dry-Cool Garden, 1921, by Klee; 3B Landscape with Red Splashes I, 1913, by Kandinsky; 4A Gentle Ascent, 1934, by Kandinsky; 4B A Hoffmannesque Tale, 1921, by Klee; 5A Development in Brown, 1933, by Kandinsky; 5B The Vase, 1938, by Klee. The last pair is: 6A Monument in Fertile Country, 1929, by Klee, and 6B Start, 1928, by Kandinsky. The inducement procedure was successful in increasing closeness to one's ingroup, see Table B.1, Column 1. While this may be due to interaction with their ingroup during the chat, Table B.1, Column 2 shows that a sizeable ingroup effect still remains after controlling for average messages sent and received.

[11] Subjects only know their own workgroup composition and are not informed of other possible workgroup compositions to avoid them guessing the intent of the study. They are also not informed of the exact number of rounds to avoid end-game effects.

[12] Subjects are informed of the helper's group, but cannot keep track of whom they have interacted

helper has indicated a willingness to help, the requester's question set is reduced in size by 3 letters; the helper's question set is increased in size by 1 letter — this implies that helping is efficient and that workgroups with higher cooperation should have lesser letters to decode on average. If the helper has not indicated a willingness to help, the requester is informed of the unsuccessful help request.

Workgroup Incentives

Subjects are paid differently under the tournament and team pay incentive schemes (see Table 2.2).[13]

Under the *tournament pay* scheme, which is adapted from Niederle and Vesterlund [2007], subjects are paid piece rates, based upon their *individual* scores in that round. Subjects whose scores rank higher within their workgroup receive better piece rates. (Ties in scores are broken at random.)

Under the *team pay* scheme, subjects are paid piece rates based upon their *workgroup's average* score in that round. The piece rate is common across all workgroup members. Thus, everyone receives the same payment.

Subjects are only given information about the pay that they are due, and other subjects' performance, at the end of the experiment.

Incentive Scheme	Piece Rate (ECUs)	Information Provided
Tournament Pay	[1st: 13, 2nd: 11.5, 3rd: 10 4th: 10, 5th: 8.5, 6th: 7] (Based on individual score)	Breakdown of individual scores
Team Pay	[Everyone: 10] (Based on workgroup's average score)	Total score of workgroup

Table 2.2: Details of Incentive Treatments

Rest payments

Since the task is short, subject only get moderately bored and fatigued. Following Vranceanu et al. [2015], I give subjects a small incentive to take breaks — in order to make the fatigue and boredom that subjects do experience more salient. The aim of this incentive is to mimic the shirking behaviour that would naturally arise in a longer task where fatigue has more time to set in.[14]

Subjects are given the option, after each set of letters they decode, to take a

with because there are ≥ 2 members from each group: this prevents reputation building.

[13]Note that the two incentive schemes have similar costs per unit output (10 ECUs) if there is no heterogeneity in productivity.

[14]Corgnet et al. [2015] also discuss how incorporating leisure into real effort tasks is important for uncovering incentive effects. Rest payments here can be considered a form of abstract leisure.

paid, 5-second rest. The payment for taking a rest is 2.5 ECUs. On average, rest payments were small compared to task payments (only 4.6%).

Outcome Variables

The experimental setup allows for the measurement of several outcome variables of interest. Individual productivity is measured as number of questions sets completed in each round. Their propensity to help is measured as the probability of helping a randomly selected group member in each round. Lastly personal effort is measured as the conversion rate of letters to numbers during each round.[15]

2.3.3 Procedures

The experiment was conducted at the Economics Lab at the University of Warwick from November 2017 to November 2018. Participants were recruited via the Warwick SONA system and were largely undergraduate and masters students from a variety of majors. In total there were 17 sessions with 288 participants divided between 48 workgroups; All sessions were programmed in z-Tree [Fischbacher, 2007].[16] The study was preregistered with the AEA RCT registry (AEARCTR-0002139).

At the beginning of each session, detailed printed instructions were provided to participants and read aloud to them (see Appendix B.3.1). This was followed by a quiz to test their understanding of the real-effort task, which needed to be answered correctly before they could proceed.[17] Subsequently, there were two non-incentivised practice rounds: a first round of 2 minutes to acquaint them with the user interface, and a second round of 3 minutes to practice the task (without the help and rest functions). The second practice round also served to measure their baseline ability approximately. The two stages of the experiment then followed.

At the end of each session, participants were asked to complete an online post-experiment survey covering questions on demographics, behaviour and perceptions about their groups and workgroups (see Appendix B.3.3). A summary of their payoffs was then shown; and subjects were paid based upon a randomly chosen round. The exchange rate was set at 100 ECUs for £2.5. Each session lasted around 75 minutes and participants earned £10 on average including a show-up fee of £3.

[15]More precisely, it is calculated as the total number of letters converted during the round divided by the total time taken to do so, *including rest*.

[16]Depending on attendance, sessions either had 18 or 12 participants. Those with 18 had either 3 heterogeneous workgroups or 1 heterogeneous and 2 homogeneous workgroups. Those with 12 had either 2 homogeneous workgroups or 2 heterogeneous workgroups. The treatments conducted were pre-randomised to balance the number of treatments across sessions. Figure B.1 illustrates that baseline characteristics of participants are roughly balanced across treatments.

[17]When asked how well they understood the instructions and the decoding task (on a scale from 1 to 7), over 90% of them stated an understanding of ≥ 5, mean = 6.0, standard deviation = 1.01.

2.4 Theoretical Framework

In this section, I present a simple model that illustrates how workers' identities can impact the relative effectiveness of team and tournament-based incentives.

Suppose each member of a workgroup of size N chooses an effort level e_i and a help level h_i. Each workgroup member's output (q_i) depends upon their own effort and the amount of help provided by peers: $q_i = e_i + \alpha\overline{h_{-i}}$, where $\overline{h_{-i}}$ denotes the average help level of peers and $\alpha > 0$ denotes the importance of help.

Each workgroup member is paid a wage $w_i = \bar{q} + \theta(q_i - \bar{q})$, where $\theta > 0$.[18] Observe that the wage scheme is more competitive when θ is greater. I will refer to the wage scheme as "team pay" if $\theta < 1$ and "tournament pay" if $\theta > 1$ (since w_i is increasing in peers' output when $\theta < 1$ and decreasing in peers' output when $\theta > 1$).

The utility of worker i is given by $U_i = w_i + \beta\overline{w_{-i}} - \frac{1}{2}e_i^2 - \frac{1}{2}h_i^2$, where β denotes i's altruism and $\overline{w_{-i}}$ denotes the average wage of peers. I assume, like Chen and Li [2009], that workers are more altruistic when they identify with their workgroup more strongly. I further assume that workers identify more with their workgroup when (i) their workgroup is more homogeneous, and (ii) the wage scheme is less competitive. Point (ii) corresponds to one of this paper's findings: that team pay leads workers to identify with their workgroup more strongly. Formally, I assume that β is a function of g (workgroup homogeneity) and θ: $0 \leq \beta(g, \theta) \leq 1$, with $\beta_g > 0, \beta_\theta < 0$.

Under a few parametric restrictions (see Appendix B.2 for details), this model yields the following four predictions.

Prediction 1. ***(Identity)*** *An increase in workgroup homogeneity (i) increases help and (ii) decreases (increases) effort under tournament (team) pay: h_i is increasing in g; e_i is decreasing in g when $\theta > 1$ and increasing in g when $\theta < 1$.*

When the workgroup is more homogeneous, workgroup members are more altruistic. Hence, they are more inclined to help their peers. They are more inclined to exert personal effort if is beneficial to peers ($\theta < 1$) but less inclined to exert personal effort if it is harmful to peers ($\theta > 1$).

Prediction 2. ***(Incentives)*** *An increase in the competitiveness of the wage scheme (i) decreases help and (ii) increases effort: h_i is decreasing in θ, e_i is increasing in θ.*

Intuitively, more competitive wage schemes reward helping peers less and individual effort more.

[18] By construction, the cost per unit output for the principal is always constant at 1, which implies that it is sufficient to focus on productivity here for optimality.

Prediction 3. ***(Identity* $\times$ *Incentives)*** *When the workgroup is more homogeneous, an increase in the competitiveness of the wage scheme (i) reduces help more and (ii) boosts personal effort less:* $h_{\theta g} < 0$ *and* $e_{\theta g} < 0$.

$h_{\theta g} < 0$ is the one prediction of the model that relies crucially on the assumption that β is a function of θ as well as g. In particular, it requires that $\beta_{\theta g} < 0$. This assumption means that the wage scheme and group composition have complementary effects on workers' identities — Section 2.5.4 provides some evidence in support of this. A corollary of Prediction 3 is as follows:

Prediction 4. *When the workgroup is more homogeneous, productivity under team pay increases relative to productivity under tournament pay:* $\frac{d}{dg}(q_{team} - q_{tourn}) > 0$.

This implies a threshold $\hat{g}$ where for $g > \hat{g}$, team pay outperforms tournament pay. The threshold is decreasing in the importance of help (α).

2.5 Results

I will start by examining workers' productivity and then decompose it into contributions from help and effort.[19] Several common features apply throughout: (1) error bars are 95% confidence intervals, (2) regressions control for session fixed effects with standard errors clustered at the workgroup level.

2.5.1 Productivity

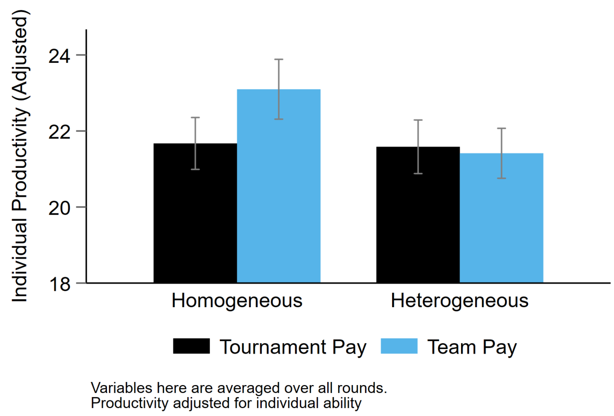


Figure 2.1: Productivity over Treatments

[19]Analysis focuses on the balanced round level panel data set (4 Rounds $\times$ 288 Participants= 1152 Observations). In some rounds, there were issues with the server which caused disconnections midway through, there is however still data for the round before the disconnections. Activity for the round was aggregated in these cases by adjusting for the fraction of time which the participants were connected. Overall, only 19 data points were affected: excluding them does not influence results.

Does identity interact with incentives to affect productivity? Figure 2.1 shows individual productivity in each treatment. In homogeneous workgroups, productivity is higher under team pay. In heterogeneous workgroups, by contrast, productivity is roughly the same under team and tournament pay. In fact, productivity is slightly higher under tournament pay (although not significantly so).[20]

Dep Var	Standardised Productivity
Team Pay	-0.077
	(0.076)
Homogeneous	0.111
	(0.081)
Team Pay × Homogeneous	0.374***
	(0.112)
Constant	0.274***
	(0.097)
Ability and Time Controls	✓
Observations	1152

* 0.10 ** 0.05 *** 0.01, Controls: Ability, 1/Round, Ability × 1/Round.

Table 2.3: Random Effects Regression: Productivity

Table 2.3 shows a regression corresponding to the figure. It illustrates that switching from tournament pay to team pay increases productivity by 0.37 standard deviations more in homogeneous workgroups compared to heterogeneous workgroups. This confirms Prediction 4 of the model. These results are suggestive that optimal incentives depend on workgroup identity.[21]

2.5.2 Help

Here, I examine the effects of identity and incentives on *help.* Figure 2.2 compares the probability of giving help in each treatment.

How does identity affect help? In homogeneous workgroups where concern for peers is greater, help should be more prevalent; see Prediction 1(i). Consistent with this prediction, observe that moving from a heterogeneous workgroup to a homogeneous workgroup increases helping (albeit less under tournament pay).[22] Table 2.4, Column 1 shows that, on average, helping is 16 percentage points higher in homogeneous workgroups.

[20] Under a Wilcoxon rank-sum test, comparing productivity under team and tournament pay, p=0.0160 and 0.8043 for homogeneous and heterogeneous workgroups respectively.

[21] On the cost side of profits, average cost per unit output under tournament pay (10.37) is slightly higher than under team pay (10) due to to heterogeneity in workgroup members' productivity.

[22] Comparing homogeneous to heterogeneous workgroups, Wilcoxon rank-sum test, p=0.0001.

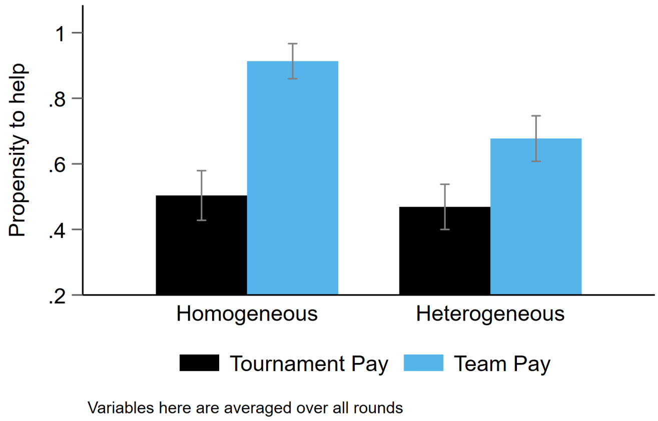


Figure 2.2: Propensity to Help over Treatments

How do incentives affect help? Helping should be greater under team pay, where rewards for helping are greater; see Prediction 2(i). Indeed, Figure 2.2 shows that switching from tournament to team pay increases helping.[23] Table 2.4, Column 1 shows that, on average, helping is 32 percentage points higher under team pay.

Dep Var:	Propensity to help	
Team Pay	0.319***	0.207***
	(0.031)	(0.047)
Homogeneous	0.160***	0.071
	(0.041)	(0.045)
Team Pay × Homogeneous		0.200***
		(0.060)
Constant	0.438***	0.475***
	(0.058)	(0.083)
Ability and Time Controls	✓	✓
Observations	1152	1152

* 0.10 ** 0.05 *** 0.01. Controls: Ability, 1/Round, Ability × 1/Round.

Table 2.4: Random Effects Regressions: Help

Does identity interact with incentives to affect help? Observe that switching from tournament pay to team pay has a much larger effect on help in homogeneous workgroups. In homogeneous workgroups, team pay increases helping by 41 percentage points; in heterogeneous workgroups, team pay increases helping by only 21 percentage points — the 20 percentage point difference is statistically significant (see Table 2.4, Column 2). This confirms Prediction 3(i) of the model, which says that monetary incentives to help are complementary with identity incentives.

[23] Using a Wilcoxon rank-sum test, comparing team pay to tournament pay, p=0.0000. Interestingly, those under tournament pay also felt that their help would be less beneficial for the workgroup; this

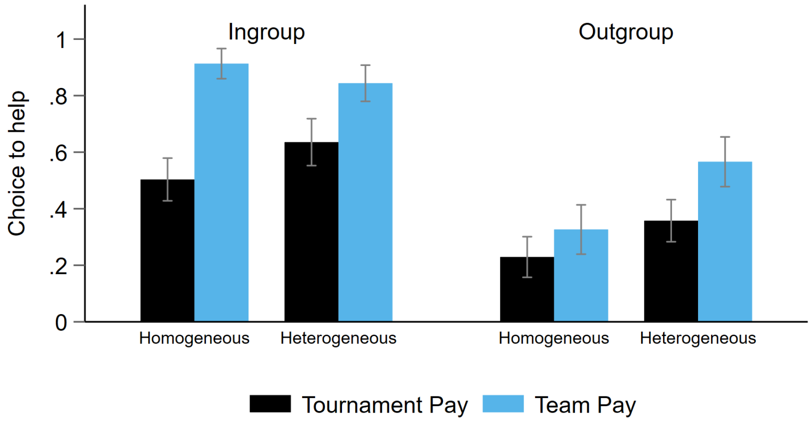


Figure 2.3: Ingroup and Outgroup Help over Treatments

Recall that participants choose both whether to help ingroup members and whether to help outgroup members. (In homogeneous workgroups, there are of course no outgroup members, but subjects still make hypothetical choices.) Figure 2.3 compares their willingness to help ingroup and outgroup members. Consistent with other work on ingroup bias, participants show a greater willingness to help ingroup members.[24] I estimate that homogeneous workgroups exhibit higher rates of help under both incentives largely due to the ingroup bias towards the higher share of ingroup members — this factor explains approximately 62 to 88 percent of differences within incentives.[25]

2.5.3 Personal Effort

Here, I examine the effects of identity and incentives on *personal effort*. Figure 2.4 shows personal effort in each treatment.

How does identity affect effort? Prediction 1(ii) says that under team pay, subjects in homogeneous workgroups who have a greater concern for peers should raise effort as it is beneficial to peers. Under tournament pay, subjects in homogeneous workgroups should instead lower effort as it is harmful to peers. Observe that

may be a form of motivated thinking. See Figure B.1.

[24]Comparing ingroup to outgroup help of each individual, Wilcoxon signed-rank test: p=0.0000. Regressions in Table B.3 which examine the choices to help in heterogeneous workgroups (where both ingroup and outgroup choices are relevant) also support this.

[25]Help provided can be decomposed into that toward the 2 ingroup members present in both homogeneous and heterogeneous workgroups [In-Help], and the remaining 3 members: ingroup (outgroup) ones in homogeneous (heterogeneous) workgroups [Other-Help]. I first simulate counterfactual levels of help for all combinations of In-Help and Other-Help under each incentive (see Table B.4). The proportion explained by workgroup composition is calculated as how much a change in Other-Help explains the difference between the highest and lowest counterfactual levels of help (see Table B.5).

under team pay, effort is somewhat higher in homogeneous workgroups. However, differences under tournament pay are negligible.[26] Likewise, Table 2.5, Column 2 shows that under team pay, moving from a heterogeneous workgroup to a homogeneous workgroup increases effort by 0.23 standard deviations; under tournament pay, there is no significant effect. There is thus only partial support for Prediction 1(ii); later, I present additional evidence which supports this prediction.

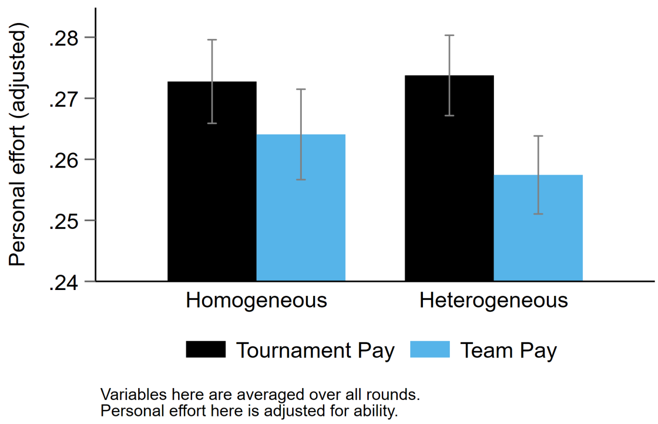


Figure 2.4: Personal Effort over Treatments

How do incentives affect effort? The model says that effort should be lower under team pay, where rewards for effort are lower; see Prediction 2(ii). Indeed, Figure 2.4 shows that personal effort is always lower under team pay.[27] Table 2.5, Column 1 shows that team pay results in a 0.27 standard deviation decrease in personal effort on average. These results suggest that if only personal effort contributed to productivity, then it would always be better to implement tournament pay.

Does identity interact with incentives to affect effort? Prediction 3(ii) says that team pay should result in a smaller drop in effort in homogeneous workgroups, where the care for others' rewards is greater. Indeed, Figure 2.4 shows that switching from tournament pay to team pay discourages effort less in homogeneous workgroups. In heterogeneous workgroups, team pay decreases effort by 0.39 standard deviations; in homogeneous workgroups, team pay decreases effort by 0.18 standard deviations (see Table 2.5, Column 2). The difference of 0.21 standard deviations is statistically significant, p=0.0908.

[26]Using a Wilcoxon rank-sum test to look at differences in personal effort, p=0.2276 under team pay, while p=0.9204 under tournament pay.

[27]Comparing effort under team pay and tournament pay, Wilcoxon rank-sum test: p=0.0003.

Dep var:	Standardised Personal Effort		Motivation: Match Effort
Team Pay	-0.271***	-0.389***	-0.452**
	(0.067)	(0.074)	(0.192)
Homogeneous	0.113		
	(0.074)		
Team Pay × Homogeneous		0.230**	0.480***
		(0.103)	(0.164)
Tournament Pay × Homogeneous		0.019	-0.301*
		(0.088)	(0.175)
Constant	0.541***	0.581***	-0.002
	(0.104)	(0.100)	(0.073)
Ability and Time Controls	✓	✓	
Observations	1152	1152	288

* 0.10 ** 0.05 *** 0.01, Cols 1-2: Random effects, Col 3: OLS. Motivation is standardised. Control variables: Ability, 1/Round and Ability × 1/Round.

Table 2.5: Regressions: Measures of Effort

Additional evidence for Prediction 1(ii)

The weak results for Prediction 1(ii) above may reflect a difficulty in measuring effort under piece rates.[28] To address this, I provide supplementary evidence using a survey measure of effort which reflects the extent to which participants feel motivated to *match others' effort.*[29] Table 2.5, Column 3 shows that in line with Prediction 1(ii), members of homogeneous workgroups are less (more) motivated to match others' effort under tournament pay (team pay) by approximately 0.30 (0.48) standard deviations. The difference of 0.78 standard deviations is also significant (p=0.002), which provides additional support for Prediction 3(ii).

Summary: Thus far, results have shown how workers' identities interact with incentives in production — heterogeneous workgroups display a higher variation of effort and a lower variation of help across incentives. I estimate that this leads to effort explaining a majority of 57% of productivity differences in heterogeneous workgroups. By contrast, effort only explains a minority of 26% in homogeneous workgroups.[30]

[28]The relatively short time scale of the experiment means that the task may feel less repetitive and thus participants do not adjust effort (via rest choices) that much given that they are being paid per question set. This might affect the tournament pay treatment especially, where choices to rest are relatively infrequent (13% under tournament pay compared to 25% under team pay).

[29]The measure of motivation to match others' effort was obtained from a principal component analysis of 2 survey variables, see Table B.2 for a description.

[30]I first simulate counterfactual productivity given all combinations of effort and help displayed under each incentive using the production function: Productivity=(360×Conversion rate of letters)/(Average letters per set); see Table B.6. Subsequently, for each workgroup type, I estimate the extent to which variation in help and personal effort across incentives contributes to productivity differences. With the lowest (highest) counterfactual productivity as a baseline, the explanatory power of each factor is calculated as how much an increase (decrease) in effort or help increases (decreases) productivity as a fraction of the difference between the highest and lowest counterfactual productivities. These two estimates (highest/lowest as baseline) are different due to non-linearity in

2.5.4 The Effect of Incentives on Identity

Most of this paper has focused on the impact of identity on monetary incentives. Here, I explore how incentives could have an impact on workgroup identification. To do so, I construct a measure of workgroup identification using a weighted average of their survey stated closeness to each identity group (Klee/Kandinsky). The weights are determined by the proportion of ingroup and outgroup members amongst the rest of their workgroup.[31]

Dep var: Workgroup Identification	Column 1	Column 2
Team Pay	0.337***	0.181**
	(0.096)	(0.088)
Homogeneous	0.601***	0.476***
	(0.112)	(0.139)
Team Pay × Homogeneous		0.280
		(0.187)
Constant	-0.509***	-0.457***
	(0.115)	(0.119)
Observations	288	288

* 0.10 ** 0.05 *** 0.01. Workgroup identification is standardised.

Table 2.6: OLS Regressions: Identification with One's Workgroup

Table 2.6 compares workgroup identification in each treatment. Column 1 shows that in addition to a positive effect of being in a homogeneous workgroup, there is also a positive effect of team pay. Column 2, shows some evidence of complementarity between team pay and homogeneous workgroups, although it is not significant at conventional levels (p=0.142).[32]. That team pay (which is cooperative in nature) has a positive effect on workgroup identification is consistent with other work which find that cooperative tasks can improve identification with others.[33]

the production function — I use the average of these. Results are shown in Table B.7.

[31]In homogeneous workgroups, workgroup identification = ingroup closeness. In heterogeneous workgroups, workgroup identification = 0.4 × ingroup closeness + 0.6 × outgroup closeness. See Table B.1 for an analysis of closeness to each identity group and Table B.2 for details about the elicitation of closeness.

[32]There are other survey questions related to workgroup identification. These measure participant's closeness to their workgroup during the decoding task, see Table B.2 for more details. Table B.8 shows that similar regressions also yield positive effects of team pay, although the direct impact of workgroup homogeneity is smaller. A complementarity between team pay and homogeneous workgroups also seems to build up over time.

[33]In the famous Robber's Cave study, Sherif et al. [1961] cooperative tasks helped resolve identity-based conflict in school children. Brown and Abrams [1986] also find that cooperative tasks lower perceptions of heterogeneity in identity. More recently, Rico et al. [2012] show that superordinate goals can help reduce feelings of division in heterogeneous teams.

2.5.5 Robustness

Here, I briefly describe some robustness checks of the results in Sections 2.5.1 to 2.5.3. Firstly, I conduct instrument variable regressions where the (group-level) identity treatment dummy is replaced with the aforementioned (individual-level) measure of workgroup identification. These regressions yield similar results which is reassuring (see Table B.9).[34] Secondly, I perform similar regressions separately for the first and second half of the decoding task; results show that effects are qualitatively similar over time. An exception is help where the effects of identity under tournament pay are stronger in the first half (see Tables B.10 and B.11).

2.6 Discussion

In this paper, I study the interaction between identity and incentives in workgroups. To the best of my knowledge, this paper is one of the first to examine in a fixed production setting, how worker productivity is affected by identity when it has positive (team pay) and negative (tournament pay) externalities. In addition, the real effort task used has multiple kinds of inputs — effort with opposite externalities under each incentive — and help with positive externalities under both incentives. This allows for a setup which — while stylised — still reflects a more general production process: this aids in the generalisability of results.

Overall, my results demonstrate that identity — even loosely formed ones in the lab — can influence the effectiveness of incentives. In real life, external factors like the social dynamics of the locale and/or internal factors like corporate culture may have even stronger influences on (the perceptions of) common identity amongst workers. This could then influence optimal incentives — even across firms with similar production processes. Studying the relationship between identity and incentive choices across firms may be of future empirical interest both independently and in relation to the literature on management and productivity differences across firms.[35]

Practically, these results also have implications for organisational design. They suggest that effective management involves purposefully designing performance incentives together with identity factors to optimise productivity. Organisations may engineer identity through team allocation, hiring decisions and/or training procedures

[34] Workgroup composition is used as an instrument for workgroup identification. This assumes that effects of workgroup composition only occur via workgroup identification.

[35] Bloom and Reenen [2007, 2010] examine management practices across firms and countries. Dessein and Prat [2018] review the literature on productivity differences between firms. In particular, identity factors examined here would fall under their classification of organizational capital.

while choosing compatible incentives.[36] Nucor is one company which has used this to great effect: workers share a strong common identity and high levels of team pay are used, perhaps resulting in one of the best labour productivity levels in the steel industry. This may be an (intentional) result of selective hiring/retainment of workers with specific attributes and a relatively flat organisational structure [Collins, 2001].

Nevertheless, it should be emphasised that there is no simple "one size fits all" solution. The context of production has important influences on the relationship between identity and optimal incentives. A comparison of Figures 2.1 and 2.4 hints at this: tournament pay is optimal in both homogeneous and heterogeneous workgroups considering effort alone, but not when help is also relevant. This is also captured in the model by how $\hat{g}$, the homogeneity threshold is affected by α, the importance of help. A useful thought process would be to consider what kinds of inputs are relevant to production, and the kind of externalities these inputs impose on others under each incentive. This would determine how workgroup identity interacts with incentives to affect these inputs (and consequently productivity).

Lastly, I find that incentives also influence workers' identification with their workgroup. That incentives affect identity and that optimal incentives themselves depend on it implies a feedback mechanism with several important consequences. On one hand, it suggests that initial exogenous differences in social identities may be amplified, giving rise to a wider spread of incentives.[37] On the other hand, it also suggests that early mistakes in incentive choices might "lock" organisations into the wrong identity-incentive equilibrium, possibly resulting in large opportunity costs. Persistent differences between Nucor and other steel companies may reflect such a mechanism [Ghemawat, 1995]. Paying more attention to not only incentives, but also (long run) identity can help organisations avoid these costly adjustments.

[36] Relatedly, Akerlof and Kranton [2008] discuss how monitoring decisions, by affecting perceived organisational identity, can influence the optimal amount of individual compensation needed. Some possible (external) constraints on influencing identity (via other methods) include external social dynamics, high turnover, anti-discrimination laws etc.

[37] For example, an organisation which is initially more homogeneous might prefer less competitive pay. This amplifies perceived homogeneity and consequently the preference for less competitive pay.

Chapter 3

Lords and Vassals: Power, Patronage, and the Emergence of Inequality

3.1 Introduction

There are many real-world settings where agents compete for power: such as government, firms, and criminal enterprises. Winning such competitions requires a base of support; and such support is often obtained through patronage. Take Tammany Hall, for instance, which courted New York's newly arrived immigrants with jobs, social services, firewood, and coal. Likewise, the Medici plied Florence's prominent families with generous loans and sweetheart business deals; and gained favor with the general citizenry by building churches, giving to the arts, and distributing food to the poor.[1] This paper uses a laboratory experiment to study competitions for power — and the role of patronage in such competitions.

We construct and analyze a new game — the "chicken-and-egg game" — in which agents compete for power and can engage in patronage. In this game, (finitely-lived) chickens correspond to (finitely-tenured) positions of power and the eggs laid by chickens are the game's currency. The game is played by a group of subjects over multiple rounds. Each round, an election takes place to determine the owner of a newborn chicken. Each subject chooses whether to be a voter or run in the election as a candidate.[2] Prior to voting, candidates can pledge eggs from their existing stock of chickens to voters in return for their votes.

We run the chicken-and-egg game in the laboratory with groups of six subjects,

[1]See Golway [2014] on Tammany Hall and Hibbert [1974] on the Medici.

[2]Our experiment therefore relates to the literature on citizen-candidate models (see Osborne and Slivinski, 1996 and Besley and Coate, 1997).

who play for thirty rounds. Seven main results emerge.

First, power distributes unequally — and tends to accumulate in a single person's hands. The number of chickens reaches a steady state in round 6; from that point on, we refer to subjects who own at least 80 percent of chickens as "lords." Lords are extremely common, arising in 40 percent of all rounds. Other subjects, furthermore, tend to behave like their vassals — in the sense that they take lords' handouts the majority of the time, rather than run or vote against them.

Second, lords' power is relatively stable. 53 percent of lord tenures are 9 rounds or more. The average lord tenure is 10.1 rounds.

The emergence and stability of lords reflects a basic force at work in our setting that tends to concentrate power: powerful subjects (i.e., those with chickens) can pledge eggs to voters, which helps them win elections and amass more power. We estimate that winning an election increases the chances of winning future elections by anywhere from 12.8 to 16.6 percent.[3]

Third, lords' power is not perfectly stable. 24.9 percent of lord tenures are 4 rounds or less. In 52 percent of groups where a lord emerges, the first lord is toppled and replaced by another lord.

The fragility of lords reflects the presence of a countervailing force that tends to disperse power: a preference among voters for underdogs. We find that, after controlling for pledge size, candidates with more chickens receive fewer votes. Our post-experiment survey suggests that voters favor underdogs in part because they care about equity, and in part out of a desire to induce competitive elections, in which candidates have a strong incentive to pledge eggs.

Fourth, we observe substantial wealth inequality as well as power inequality. The wealthiest group member ends the game with 35.5 percent of all eggs on average. While there is considerable wealth inequality, it is less pronounced than power inequality because the powerful transfer eggs to the less powerful. Lords, for instance, give away 28.4 percent of their eggs on average. Such generosity may be a response to voters' propensity to topple lords — especially those who are stingy.

Fifth, some groups are substantially more unequal in power and wealth than others. For instance, in the top quintile of groups — as ranked by their wealth Gini coefficients — the wealthiest subject acquires 52.6 percent of total wealth, compared to 22.6 percent in the bottom quintile. We suspect that group differences are driven by different norms regarding what is fair. In line with this view, subjects in low-inequality groups vote for underdogs more often and report greater concern

[3] Relatedly, there is an empirical literature that measures incumbency advantage in various electoral settings. For example, Ansolabehere et al. [2000] estimate a 7-10% incumbency advantage in 1980s and 1990s US House elections (see also Gelman and King, 1990 and Levitt and Wolfram, 1997).

with equity in our post-experiment survey.

Sixth, in a second treatment, where we eliminate patronage by knocking out the ability to pledge eggs, inequality almost vanishes. Lords never arise and the wealthiest group member captures a much smaller share of the surplus (20.4 percent of all eggs, on average, compared to 35.5 percent in the baseline). Furthermore, we do not see a "power begets power" dynamic. In contrast to the baseline, winning an election does not increase the chances of winning subsequent elections — in fact, it slightly *reduces* the chances.

Finally, in our baseline treatment, there are striking gender differences in outcomes. Women are less powerful and less wealthy. In the tail of the distribution, the differences are particularly dramatic. For instance, women are lords only 32 percent as often as men. These differences in outcomes come about because of small gender differences in style of play, which are compounded by the game's "power begets power" dynamic.[4]

3.2 Literature Review

Most closely related to our paper is Acemoglu and Robinson's theory of the evolution of political institutions (see Acemoglu and Robinson, 2005, 2012). Acemoglu and Robinson (hereafter, AR) argue that political institutions determine the distribution of economic resources; and economic resources allow agents to shape future political institutions. A vicious cycle can develop where wealthy agents use their resources to amass power; they use their power, in turn, to amass more wealth.[5] Consequently, power and wealth can become concentrated in the hands of a few. A version of AR's vicious cycle arises in our baseline treatment.[6]

Altering one feature of our experiment — the ability to engage in patronage — eliminates vicious cycles. This finding is in line with AR's emphasis on "good institutions" as bulwarks against vicious cycles — and suggests that an effective way to reduce inequality may be to curtail patronage systems. The United States, for instance, introduced a series of reforms which were successful in addressing patronage: most notably, the Pendleton Act of 1883, which established a Civil Service Commission, and the Hatch Act of 1939 which forbid bribery of voters and

[4] We can attribute gender differences in outcomes to style-of-play differences — rather than gender discrimination — because subjects do not know the genders of other participants.

[5] Zingales [2017] makes a similar argument, with particular reference to political rent-seeking by large firms. Glaeser et al. [2003], likewise, point out that subversion of institutions by the wealthy — specifically, the courts — can exacerbate inequality.

[6] Acemoglu and Robinson's theory fits into a broader literature on institutions as a driver of growth and a determinant of inequality. See, for instance, Glaeser and Shleifer [2002], Rodrik et al. [2004], La Porta et al. [2008]; for a review of the literature, see Acemoglu et al. [2005].

restricted the political activity of government officials.

Importantly, while we allow certain institutions in our experiment to evolve (i.e., who holds power), we take others as fixed. In particular, we impose democratic elections. In so doing, we suppress a force that AR highlight as exacerbating vicious cycles: democratic institutions tend to erode when power and wealth are concentrated.[7] Even absent this force, we observe vicious cycles — an outcome that Acemoglu and Robinson [2008] refer to as "captured democracy."

The literature on clientelism is also concerned with vote buying by politicians (see Dixit and Londregan, 1996; Wantchekon, 2003; Stokes, 2011; and Robinson and Verdier, 2013 for a review of the literature). Issues that have been studied include (1) whether politicians buy votes from marginal or core supporters; (2) the policy consequences of clientelism; and (3) why clientelism is associated with poverty and inequality. Our experiment contributes to this literature by showing how clientelism can, over time, lead to concentration of power.

Our paper, of course, fits into an experimental literature on elections (see Palfrey, 2006 for a review). Topics studied include voter turnout, strategic voting, and candidate competition. Our experiment is the first, to our knowledge, to focus on political evolution and vicious cycles.

Finally, we contribute to a literature on inequality, where small differences in initial endowments can lead to large differences in outcomes. For instance, Frank and Cook [2010] argue that the emergence of winner-take-all markets has magnified differences in wealth between stars and other market competitors. Piketty [2014] suggests that a "capital begets capital" process can lead to the entrenchment of a rentier class. Cunha and Heckman [2007] make a "skills beget skills" argument: because of dynamic complementaries in skill formation, small differences in early childhood education can lead to large disparities in later outcomes. Akerlof and Holden [2016] develop a theory in which "social connections beget social connections," leading to the emergence of "movers and shakers" who command large rents. In our paper, inequality stems from a "power begets power" dynamic. Powerful "lords" emerge who play an outsize role in determining the distribution of income.

[7] Take, as an example, the newly formed republics of postcolonial Latin America — many of which modeled themselves explicitly on the United States, adopting presidentialism, bicameral legislatures, and supreme courts. Vicious cycles, nonetheless, led to the emergence of autocrats in most cases — such as Perón in Argentina and Getúlio Vargas in Brazil — who eroded democratic institutions (see, Levitsky and Ziblatt, 2018, Chapter 5). Perón, for instance, came to power through vote buying and dispensing political favors. Once in power, he packed the courts with loyal judges who helped keep him in power: by upholding, for example, the conviction of Ricardo Balbín, the leader of the main opposition party (see, Acemoglu and Robinson [2012], p. 330).

3.3 Experimental Design

Subjects in our experiment played a version of the "chicken-and-egg game." The game was played in groups of six over thirty rounds. Subjects were randomly allocated to groups and groups were assigned to either a "baseline treatment" or a "no pledge" treatment. All choices in the game were publicly observable; to preserve anonymity, subjects were given pseudonyms.

Baseline Treatment

In each round of the game, except the final one, an election takes place. The election winner is awarded a chicken, which lays two eggs per round for the next five rounds — or until the end of the game — and then "retires." Eggs are the game's currency and are converted to cash at the end of the experiment.

The outcome of each election is determined by a randomly-selected deciding voter. Candidates can pledge to give some of their eggs to the deciding voter if they win. Elections proceed as follows.

1. Each subject decides whether to be a candidate or a voter. The list of candidates is then publicly announced. In the event that there are no candidates — or no voters — the computer randomly allocates the chicken.

2. Candidates choose how many eggs to pledge to the deciding voter. Candidates can only pledge eggs out of their stock of "fresh eggs" (i.e., eggs laid in the current round). Candidates' pledges are then publicly announced.

3. Voters simultaneously cast votes for candidates. These votes are then made public, and the computer randomly (and publicly) selects a "deciding voter" whose vote determines the election winner.

4. Finally, the election winner gives the pledged amount to the deciding voter. Subjects keep the eggs that they do not give away and accumulate them over the course of the experiment.

In the final round, subjects simply collect the eggs laid by their chickens.

No-Pledge Treatment

The no-pledge treatment differs from the baseline in only one respect: candidates do not have the option to make pledges.

Procedural Details

The experiment was conducted at Nanyang Technological University in Singapore between August 2018 and September 2019 and was programmed in zTree (Fischbacher, 2007). Subjects were recruited by email from the undergraduate population. A total of 456 subjects participated in the experiment over 21 sessions.[8]

At the start of the experiment, subjects received written instructions, which were also read aloud, and played two non-incentivized practice rounds. At the end of the experiment, subjects were asked to complete a non-incentivized survey about their motivations during the experiment.[9]

Subjects' eggs were converted to Singapore dollars at the rate of 5 eggs to \$1. Subjects also received a \$5 show-up fee. The experiment lasted about 90 minutes and subjects earned an average of \$14.30.

Discussion

We will now take a moment to highlight several features of our design.

Elections. Power is acquired in our experiment through elections, so it is natural to think of the experiment as speaking to the democratic process. We like to think of voting in our experiment, though, as simply an act of fealty or support. Under this interpretation, the experiment speaks to a wide range of settings — not just those where power is contested through formal elections. The experiment might also speak, for instance, to military conflicts between warlords or power struggles within gangs.

Only fresh eggs can be used to make pledges. In our baseline treatment, only fresh eggs (eggs laid in the current round) can be used to make pledges. Consequently, power (chickens) — rather than wealth (eggs) — is what determines a subject's ability to pledge. This design choice highlights that many common forms of patronage (e.g., public-sector jobs) are only possible with political power; we recognize, of course, that the ability to engage in patronage depends upon both power and wealth in most political settings.

Chickens retire after five rounds. Chickens in our game have finite lifespans. Hence, a subject must continually win elections in order to hold onto power. A further implication is that, from round 6 onwards, there are always five living chickens, since each chicken "birth" is offset by a retirement. A subject's power can be measured, from round 6 onwards, by the number of chickens they own out of five.

[8] Randomization into treatments took place at the session level. There were 15 baseline-treatment sessions and 6 no-pledge-treatment sessions. Each session contained at least 3 groups (18 participants).

[9] In our first three baseline-treatment sessions, subjects received a different survey with more open-ended questions. The results we report in the paper come from the later version of the survey.

Fixed number of chickens and eggs. The game is zero-sum, with a fixed surplus of 270 eggs. As such, we will be principally interested in the division of this surplus. There is also a fixed amount of power allocated over the course of the game. We will also be interested in the distribution of this power.

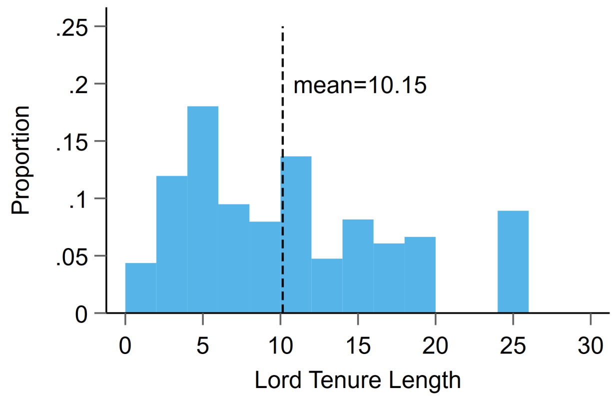
Deciding voter. We chose to have a deciding voter — who receives the entirety of the election winner's pledge — because it reduces strategic complexity. For instance, if the election winner's pledge were divided between the winner's supporters, voters would need to take into account the likely split of the pledge. If, additionally, there were plurality voting, voters would need to factor in each candidate's chances of winning.

3.4 Results of the Baseline Treatment

We will start by relating the findings of our baseline treatment, where candidates can pledge eggs to voters.

Emergence of Lords

Our first finding is that power tends to concentrate in the hands of a single person. From round 6 onwards, we refer to subjects as "lords" when they own at least four out of five living chickens. 87.2 percent of groups have a lord in at least one round. Across all groups, 40 percent of rounds have a lord.[10]



A tenure is defined as a continuous spell as a lord. Some subjects have multiple spells as a lord and therefore appear more than once.

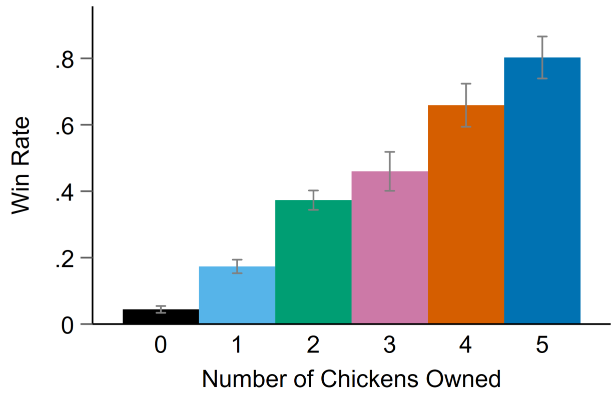
Figure 3.1: Distribution of Lord Tenures

[10]Figure C.1 shows that the prevalence of lords is more-or-less constant over the course of the game. There are two time trends of note in Figure C.1, though. First, candidates pledge slightly less in the final four rounds — most likely because the chickens-to-be-won are less productive (they lay eggs for less than five rounds). Second, there is a decline over time in the number of candidates.

Furthermore, power is relatively stable. Figure 3.1 shows how long lords tend to stay in power. Following Clark and Summers (1979), the distribution shown in Figure 3.1 is weighted by tenure length. While there are some short tenures, 53 percent of tenures are 9 rounds or more. The average lord tenure is 10.1 rounds.[11]

Why do lords emerge? We find that there is a "power begets power" dynamic in the game: that is, having power (i.e., chickens) makes it easier to win elections and acquire more power. We believe that this dynamic accounts for the emergence of lords.

Figure 3.2 provides some suggestive evidence of such a dynamic. It shows that having chickens is positively correlated with winning elections.[12]



Data in figure is from Rounds 6 - 29. Standard errors are clustered at the group level.

Figure 3.2: Power and Win Rates

We can exploit randomness in election outcomes to formally test whether such a dynamic exists. In some elections, several candidates receive the same number of votes; and one wins rather than the others purely due to chance. We find that winners of such "balanced" elections have a 12.8 percent higher win rate in subsequent rounds of the game than equally-popular losers (see Table 3.1).

Alternatively, we can use the first election to test for a "power begets power" dynamic. Since there is no prior history of play, it is (essentially) random which subject, among those who run, wins the first election. We find that first-round winners have a 16.6 percent higher win rate in subsequent rounds of the game than

[11]To understand why we weight by tenure length, consider the following example adapted from Clark and Summers (1979). Suppose there are 20 lords with tenures of one round and one lord with a tenure of 20 rounds. The mean lord tenure is only 1.9 rounds; however, half of all rounds with a lord are accounted for by a 20-round tenure. Hence, focusing on mean tenure underweights long tenures. Clark and Summers (1979) argue that a solution is to look at the distribution of tenures one would expect to observe in a given round. Weighting by tenure length accomplishes this.

[12]In an OLS regression of whether one won on number of chickens owned, the coefficient on number of chickens owned is positive and significant (p=0.000).

first-round losers (see Table 3.1). The only potential concern is that subjects may systematically vote for certain pseudonyms over others; but the results remain similar after including pseudonym fixed effects.

Dep var: Future win rate	Balanced Election	First Election	First Election
Won	0.128***	0.166***	0.164***
	(0.026)	(0.040)	(0.042)
Constant	0.202***	0.134***	0.154***
	(0.016)	(0.009)	(0.033)
Pseudonym fixed effects			✓
Observations	500	231	231

* 0.10 ** 0.05 *** 0.01, OLS with standard errors clustered at group level.
Balanced elections involve draws in votes for 2 candidates.

Table 3.1: Regressions: Winning and Future Win Rates (Baseline)

As one might expect given the game's "power begets power" dynamic, it is incredibly valuable to win the first election. First-round winners earn 35.7 more eggs than first-round losers on average; and first-round winners have a 55.6 percent chance of becoming lords, compared to 16.4 percent for first-round losers.[13]

Why does power beget power? Patronage is critical to the emergence of a "power begets power" dynamic. Indeed, we find that the dynamic vanishes completely in the no-pledge treatment (see Section 5). This result is intuitive. A chicken gives a subject eggs to pledge; and pledging eggs (presumably) helps a subject win further chickens. Indeed, in contested elections, we observe a positive correlation between winning and the amount pledged (see Table 3.2, Column 1). We also find that lords who pledge a larger share of their eggs have longer tenures (see Table 3.2, Column 2).

Dep Var:	Won Election	Tenure as a Lord
Amount pledged	0.621***	
	(0.043)	
Proportion pledged during tenure		8.615**
		(3.419)
Observations	3724	104

* 0.10 ** 0.05 *** 0.01, Column 1: conditional logit (Rounds 6 - 29), Column 2: OLS.
Standard errors clustered at group level.

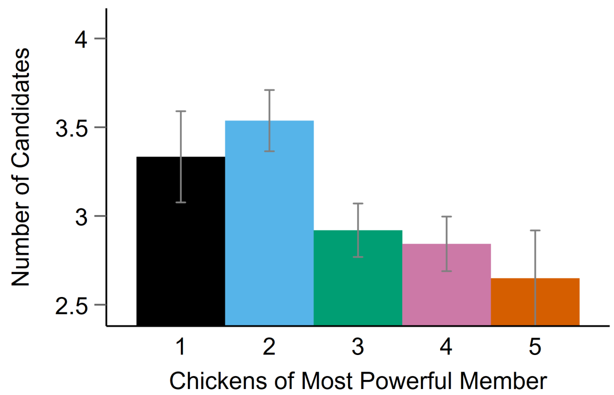
Table 3.2: Regressions: Patronage and Power

[13]The differences in earnings and in chance of becoming a lord are significant under a Wald test (p=0.000).

Emergence of Vassals

When a lord is present, other subjects tend to behave like "vassals": they vote for the lord rather than run or vote against the lord the majority of the time. On average, when a lord runs for election, 50.3 percent of other subjects vote for the lord, compared to 13.9 percent who vote for another candidate and 35.9 percent who challenge the lord. Vassal-like behavior makes it easier for lords to retain power, and thus reinforces the "power begets power" dynamic.

More generally, electoral competition is weaker when power is more concentrated. Figure 3.3 shows that there are fewer candidates, on average, when the most powerful group member has more chickens.[14]



Data in figure is from Rounds 6 - 29. Standard errors are clustered at the group level.

Figure 3.3: Power Concentration and Running Behaviour

Why do lords face few challengers? There is a strong economic case to be made for behaving like a "vassal." First, challengers rarely beat lords. In rounds where a lord is challenged, the lord wins 72.3 percent of the time. Second, lords give substantial handouts to subjects who vote for them: subjects who vote for a lord receive 1.04 eggs, on average. Subjects forgo the opportunity to partake of these handouts when they challenge a lord. Our post-experiment survey suggests that these economic considerations were at the forefront of subjects' minds (see Table C.1).

Fragility of Lords

Since "power begets power," one might expect lords to hold onto power indefinitely. However, we find that power is not perfectly stable. While Figure 3.1 shows that

[14] In an OLS regression of number of candidates on chickens of the most powerful group member, the coefficient on chickens of the most powerful group member is negative and significant (p=0.000).

some lord tenures are long, it also shows that many are short. 24.9 percent of tenures are 4 rounds or less. Furthermore, power often changes hands. The first lord to emerge is toppled and replaced by another lord in 52 percent of groups where at least one lord emerges.

Why is power fragile? One possibility is that lords lose power because they do not pledge enough — or do not run for election. We find that this is at most a small part of the story, however. Lords choose not to run only 4.4 percent of the time; and lords are out-pledged when they run only 0.8 percent of the time. In 82.9 percent of rounds where a lord's tenure ends, the lord runs for election and makes the (strictly) largest pledge. In these rounds, voters oppose the lord even though they lose eggs in that round by doing so.

Lords largely lose power, we think, because voters favor "underdog" candidates. We find, for instance, that owning chickens hurts — rather than helps — candidates after controlling for pledge size (see Table 3.3, Column 2). Subjects also indicated in our post-experiment survey that they were inclined to vote for underdogs. There appear to have been two reasons for this preference (see Table C.1).

Dep var: Voted for Candidate	Column 1	Column 2
Candidate's Number of Chickens	0.425***	-0.096***
	(0.024)	(0.036)
Candidate's Pledge		0.507***
		(0.043)
Candidate Made Largest Pledge		0.482***
		(0.094)
Observations	9464	9464

* 0.10 ** 0.05 *** 0.01, conditional logits (Rounds 6 - 29).
Standard errors clustered at group level.

Table 3.3: Regressions: Determinants of Votes

One reason was concern about equity. In our survey, subjects indicated that they sometimes voted against the candidate with the most chickens because they saw it as fair. Furthermore, subjects saw winning chickens as largely a matter of luck, which may have particularly inclined them to vote against lords.[15]

Subjects also had an economic rationale for supporting underdogs. In our survey, they indicated that they voted against the candidate with the most chickens because they thought competition would increase the size of pledges. We do, in fact,

[15]The average response was 6.6 out of 10 to the question: "To what extent do you think winning chickens was a matter of luck?" (see Table C.1). Consistent with our findings, Fehr and Schmidt [1999] have shown that people are willing to act against their economic interest for the sake of equity; and Alesina and Angeletos [2005] and Benabou and Tirole [2006] find that people are particularly concerned with equity when they see outcomes as due to luck.

find that candidates pledged more when competition was greater. Figure 3.4 looks at rounds where there is a single challenger to the leader. It shows that the largest pledge is strictly increasing in the challenger's size.[16]

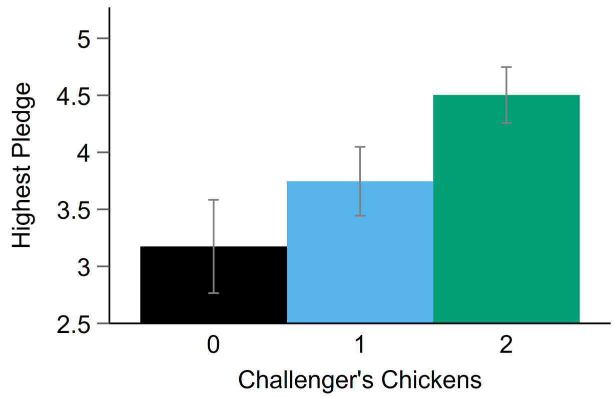


Figure restricts attention to Rounds 6 - 29 and to cases where the top 2 candidates own all five chickens. Standard errors are clustered at the group level.

Figure 3.4: Challenger Size and Pledging Behaviour of Leaders

Wealth Distribution

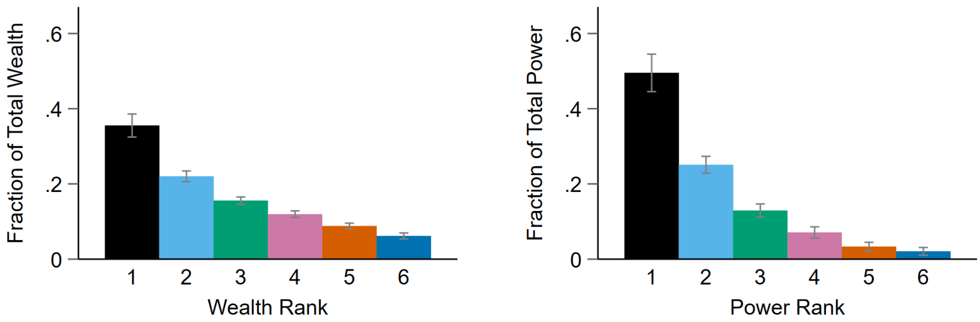
Considerable inequality — in power and wealth — emerge in our experiment. We measure a subject's power (wealth) by the total number of chickens won (eggs accumulated) over the course of the experiment. Figure 3.5 shows that, on average, the most powerful subject acquires 49.5 percent of total power — compared to 2.1 percent for the least powerful subject. The wealthiest subject acquires 35.5 percent of total wealth, compared to 6.2 percent for the least wealthy subject. The figure shows that, while wealth inequality is substantial, it is less pronounced than power inequality. Overall wealth inequality — as measured by the average group Gini coefficient — is 0.32, compared to 0.51 for power.[17]

Wealth inequality is less pronounced because the powerful transfer some of their eggs to the less powerful. For instance, lords give away 28.4 percent of their eggs on average. Figure 3.6 shows that, within groups, less-wealthy subjects obtain most of their eggs from transfers; in contrast, wealthy subjects obtain most of their eggs from their own chickens.[18] In the average group, transfers make up 41.3 percent of total earnings.

[16] In an OLS regression of highest pledge on challenger's size, the coefficient on challenger's size is positive and significant (p=0.000).

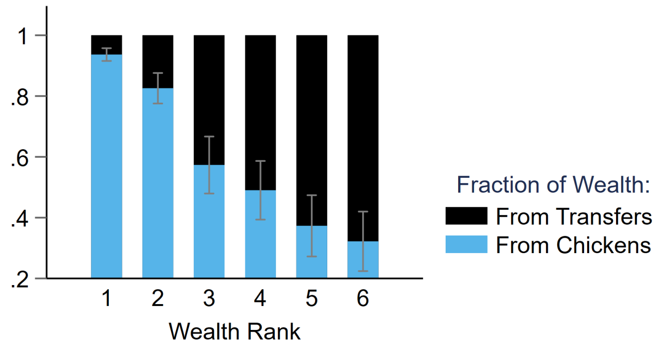
[17] A paired t-test shows that the difference is significant (p=0.000).

[18] In an OLS regression of fraction of wealth from chickens on wealth rank, the coefficient on



Standard errors are clustered at the group level. Ties in rank are broken at random.

Figure 3.5: Power and Wealth by Rank



Standard errors are clustered at the group level. Ties in rank are broken at random.

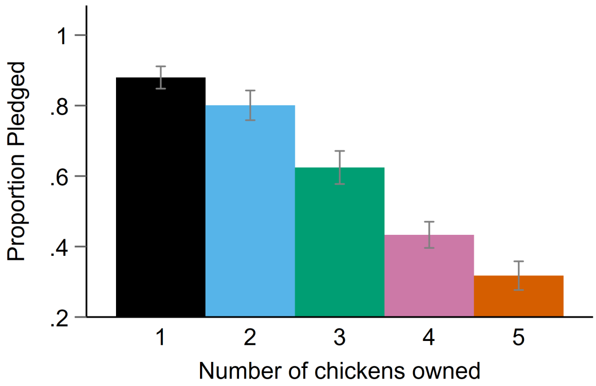
Figure 3.6: Sources of Wealth by Wealth Rank

Why do people give away eggs? Subjects may give away eggs because they consider it fair. Alternatively, they may give away eggs to acquire or retain power. Power may be its own reward; it may also, ultimately, lead to a higher egg payoff.

Figure 3.7 shows that subjects pledge a larger fraction of their eggs when they have fewer chickens.[19] If subjects were concerned solely with fairness, it seems natural that they would pledge a smaller fraction of their eggs when they have fewer chickens. Hence, Figure 3.7 provides suggestive evidence that subjects give away eggs, at least in part, because they value power. Likewise, our survey indicates that, while fairness was a concern, pledging was more driven by subjects' desire to win elections (see Table C.1).

wealth rank is negative and significant (p=0.000).

[19]In an OLS regression of proportion pledged on chickens owned, with standard errors clustered at the group level, the coefficient on chickens owned is negative and significant (p=0.000). The coefficient on chickens owned remains negative and significant (p=0.000) when we include individual fixed effects.



Data in figure is from Rounds 6 - 29. Standard errors are clustered at the group level.

Figure 3.7: Chickens Owned and Pledging Behaviour

Differences Across Groups

Some groups are substantially more unequal than others (see Figure 3.8). Suppose we rank groups by their wealth Gini coefficients. In the top quintile of groups, the average Gini coefficient is 0.47 and the wealthiest subject acquires 52.6 percent of total wealth (on average). In the bottom quintile, inequality is much lower: the average Gini coefficient is 0.15 and the wealthiest subject only acquires 22.6 percent of total wealth (on average).[20]

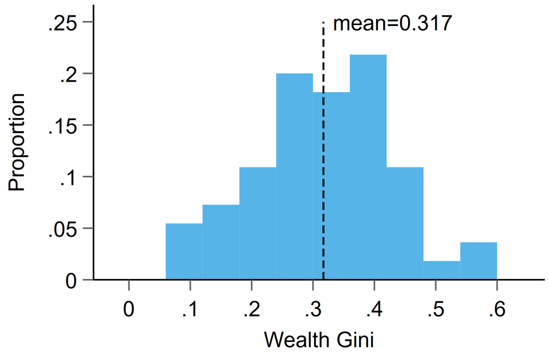


Figure 3.8: Distribution of Wealth Ginis

Groups in the bottom quintile achieve equal outcomes by distributing power equally rather than by transferring wealth. Figure 9 shows that wealth inequality and

[20]The wealth Ginis of the top and bottom quintiles are significantly different with a two-sided t-test (p=0.000); the power Ginis are also significantly different (p=0.000).

power inequality are highly correlated; it also shows that transfers are not particularly large in low-inequality groups (transfers are actually lower than in high-inequality groups).[21]

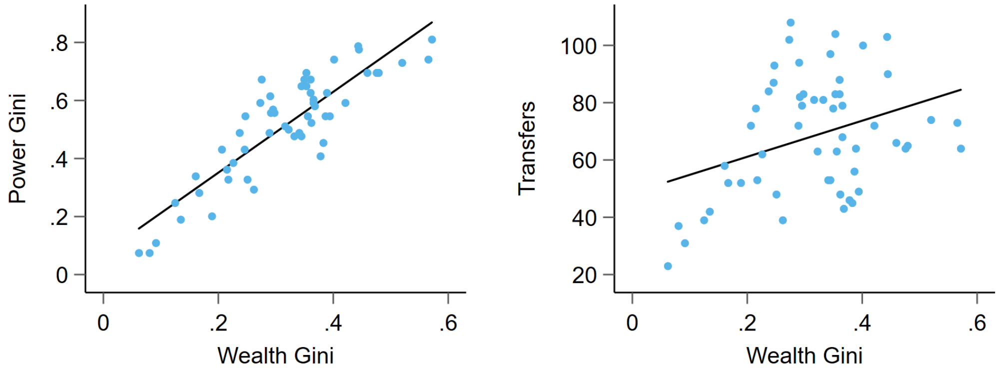


Figure 3.9: Correlations of Power Gini and Transfers with Wealth Gini

Why do groups differ? We suspect group differences are driven by different norms regarding what is fair. In line with this view, we find that voters show a greater preference for underdogs in low-inequality groups (see Table 3.4). We also find, in our post-experiment survey, that subjects in low-inequality groups are more concerned with fairness and less concerned with winning eggs (see Table C.2).

	Voted for candidate
Candidate's Pledge	0.590***
	(0.045)
Candidate Made Largest Pledge	0.538***
	(0.095)
Candidate's Number of Chickens	-0.720***
	(0.097)
Candidate's Number of Chickens × Group's Wealth Gini	1.540***
	(0.242)
Observations	9464

* 0.10 ** 0.05 *** 0.01, conditional logits (Rounds 6 - 29)
Standard errors clustered at group level.

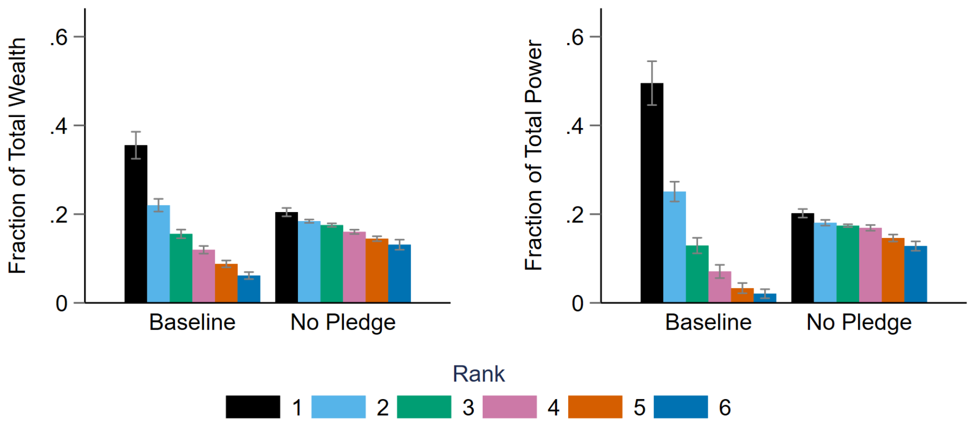
Table 3.4: Regressions: Group Heterogeneity in the Determinants of Votes

[21]In an OLS regression of the power gini on the wealth gini, the coefficient on the wealth gini is positive and significant (p=0.000). In an OLS regression of transfers on the wealth gini, the coefficient on the wealth gini is also positive and significant (p=0.008).

3.5 The Role of Pledges

We turn now to the results of the no-pledge treatment. Our theory is that patronage gives rise to a "power begets power" dynamic in the baseline treatment, which in turn generates inequality. The no-pledge treatment allows us to test this hypothesis. In the no-pledge treatment, we eliminate patronage by knocking out the ability to pledge eggs. If our hypothesis is correct, we should see less inequality in the no-pledge treatment; furthermore, the "power begets power" dynamic should disappear. This is indeed what we find.

Inequality is dramatically lower in the no-pledge treatment (see Figure 3.10). The average wealth Gini is 0.08 (versus 0.32 in the baseline) and the wealthiest group member captures just 20.5 percent of the total surplus on average (versus 35.5 percent in the baseline). The average power Gini is 0.08 (versus 0.51 in the baseline) and the most powerful group member captures just 20.2 percent of total power (versus 49.5 percent in the baseline). Furthermore, in the no-pledge treatment, we never see a lord, compared to 40 percent of rounds (87.2 percent of groups) in the baseline treatment.[22]



Standard errors are clustered at the group level.

Figure 3.10: Treatment Comparison: Power and Wealth by Rank

The "power begets power" dynamic is also absent in the no-pledge treatment. In fact, we find that winning an election *hurts* rather than helps in subsequent rounds — perhaps due to subjects' concern about equity. The winners of "balanced" elections win 6.9 percent less often in subsequent rounds of the game than equally-popular losers (see Table 3.5). Similarly, the first-round winner wins 1.3 percent less often in subsequent rounds of the game than first-round losers.

[22]These differences are all significant (p=0.000) under two-sided t-tests.

Dep var: Future win rate	Balanced Election	First Election	First Election
Won	-0.069***	-0.013	-0.012
	(0.016)	(0.009)	(0.009)
Constant	0.209***	0.168***	0.165***
	(0.009)	(0.002)	(0.007)
Pseudonym fixed effects			✓
Observations	260	95	95

* 0.10 ** 0.05 *** 0.01, OLS with standard errors clustered at group level.
Balanced elections involve draws in votes for 2 candidates.

Table 3.5: Regressions: Winning and Future Win Rates (No-pledge)

3.6 Gender Differences

There are large gender differences in outcomes in our baseline treatment (see Table 3.6). On average, women have only 84.7 percent of the wealth of men and only 70.4 percent of the power. The differences are particularly striking in the tail of the distribution. For instance, women are only 45.6 percent as likely as men ever to become lords and they are lords only 31.9 percent as often. In the no-pledge treatment, by contrast, there are no significant differences between the genders.

	Baseline			No Pledge		
	Female mean (sd)	Male mean (sd)	Difference b (p-value)	Female mean (sd)	Male mean (sd)	Difference b (p-value)
Wealth	41.467	48.971	-7.505***	44.333	45.549	-1.216
	(24.554)	(34.858)	(0.007)	(8.358)	(7.710)	(0.496)
Power	4.007	5.690	-1.683***	4.704	4.930	-0.226
	(4.160)	(6.377)	(0.002)	(0.944)	(0.799)	(0.246)
Was a Lord	0.147	0.322	-0.175***	0.000	0.000	0.000
	(0.355)	(0.469)	(0.000)	(0.000)	(0.000)	(.)
Rounds as	0.793	2.483	-1.689***	0.000	0.000	0.000
a lord	(2.400)	(5.085)	(0.000)	(0.000)	(0.000)	(.)

* 0.10 ** 0.05 *** 0.01, test of differences uses standard errors clustered at group level.

Table 3.6: Gender Differences in Outcomes

What accounts for differences in the baseline treatment? The differences in outcomes must be due to gender differences in style of play — rather than discrimination. Subjects cannot be discriminated against for their gender since they are only identified by gender-neutral pseudonyms — such as "Mushroom" and "Spinach."

While there are gender differences in style of play, they are small — and they seem to belie the dramatic gender disparities in outcomes. The most notable

	Female mean (sd)	Male mean (sd)	Difference b (p-value)
Run Rates			
Round 1	0.633	0.759	-0.125**
	(0.484)	(0.429)	(0.015)
Overall	0.492	0.547	-0.055**
	(0.199)	(0.231)	(0.035)
Proportion pledged conditional on running and†			
1 Chicken	0.854	0.905	-0.051*
	(0.240)	(0.189)	(0.058)
2 Chickens	0.774	0.839	-0.065*
	(0.201)	(0.188)	(0.053)
3 Chickens	0.540	0.610	-0.070**
	(0.173)	(0.239)	(0.046)
4 Chickens	0.342	0.409	-0.067*
	(0.124)	(0.171)	(0.061)
5 Chickens	0.306	0.287	0.019
	(0.128)	(0.157)	(0.68)

* 0.10 ** 0.05 *** 0.01, test of differences uses standard errors clustered at group level. †Data is from Rounds 6 - 29.

Table 3.7: Gender Differences in Style-of-play

style-of-play difference is that women run for election less often than men: 12.5 percent less often in the first round and 5.5 percent less often overall (see Table 3.7). This is probably not the only style-of-play difference, though, since women win less often when they run for election, controlling for number of chickens owned (see Table 3.8). For example, women with three chickens — who are on the cusp of becoming lords — have a win rate of only 42.8 percent, compared to 59.9 percent for men. Women in our sample pledge less than men (see Table 3.7), which we suspect is one reason for their lower win rates. Women with three chickens, for instance, pledge 54 percent of their eggs on average, compared to 61 percent for men.

Given the small size of the style-of-play differences, it is difficult to reach firm conclusions about what drives them. Nor does our survey offer any helpful clues: since the responses of men and women are very similar.[23] It is possible that women are less proactive than men about seizing power — just as other work has shown that women are less likely than men to seek out job promotions. For instance, in a laboratory experiment, Small et al. [2007] find that men are nine times more likely than women to ask for higher compensation (see also Babcock and Laschever, 2003; Dittrich et al., 2014; Leibbrandt and List, 2014; Card et al., 2015; Exley et al.,

[23]None of the survey responses are different at a 10-percent significance level under standard t-tests.

	Female mean (sd)	Male mean (sd)	Difference b (p-value)
Win rates conditional on running and			
0 Chickens	0.158	0.193	-0.035
	(0.224)	(0.266)	(0.299)
1 Chicken	0.319	0.304	0.014
	(0.320)	(0.318)	(0.770)
2 Chickens	0.410	0.522	-0.112**
	(0.351)	(0.340)	(0.037)
3 Chickens	0.428	0.599	-0.170**
	(0.382)	(0.363)	(0.035)
4 Chickens	0.460	0.661	-0.201**
	(0.398)	(0.280)	(0.044)
5 Chickens	0.650	0.719	-0.069
	(0.275)	(0.268)	(0.454)

* 0.10 ** 0.05 *** 0.01, test of differences uses standard errors clustered at group level. Data is from Rounds 6 - 29 and variables are averaged for each individual.

Table 3.8: Gender Differences in Win-rates

ming). Women have also been shown to shy away from competition (see Niederle and Vesterlund, 2011 for a review). For instance, Niederle and Vesterlund [2007] find that women — of equal ability to men — are less than half as likely to enter a tournament. One could interpret our findings in these terms. However, women do compete in our experiment: they run for election only slightly less often (14.3 times, on average, versus 15.9 times for men).

We believe that the game's "power begets power" dynamic explains why small style-of-play differences translate into large disparities in outcomes. For instance, because of the game's "power begets power" dynamic, it is quite important to run in the first round. We estimate that gender differences in run rates in the first round alone — while small — account for 11.1 percent of the total gender wealth gap.[24]

3.7 Conclusion

This paper uses a new game — the "chicken-and-egg game" — to study the political process. Our main finding is that patronage, through a "power begets power" dynamic, generates considerable inequality between individuals and between genders.

The chicken-and-egg game can easily be adapted to explore issues beyond

[24] If women increased their run rates in the first round by 12.5 percent — to the level of men — we would expect them to earn an additional $0.125 \times 29.1 \times 0.230 = 0.837$ eggs since: (i) women who win, rather than lose, the first election earn an additional 29.1 eggs, and (ii) women have a 23.0 percent chance of winning when they run. The overall gender wealth gap is 7.51 eggs, so 0.837 eggs constitutes 11.1 percent.

those focused on in this paper. For instance, one potential direction for future work could be to study non-zero-sum political conflicts where politicians destroy surplus in pursuit of power. Take, for instance, pork-barrel politics resulting in "bridges to nowhere," or destructive wars between feudal lords. Within the chicken-and-egg game, "bridges to nowhere" could be modeled as inefficient transfers from candidates to voters; wars could be introduced as a technology that gives candidates the ability to destroy others' chickens.

Given that political institutions are a key driver of development and a major determinant of the distribution of resources, it is critical to understand how they evolve and change. We believe that the time is ripe to study political evolution in the laboratory and we see the chicken-and-egg game as a promising vehicle for doing so.

Appendix A

A.1 Proofs

A.1.1 Lemmas Analogous to Akerlof (2015)

A.Lemma 1. *In equilibrium, players value activities ($\theta^*_{is} = 1$) if and only if achievement is above average.*

A.Lemma 2. *An equilibrium satisfies the following conditions:*

1. *If $M^*_{i1} \geq M^*_{i2}$, player i focuses on academics and does not value music. $e^*_{i1} = 1, e^*_{i2} = 0, \theta^*_{i2} = 0$.*

2. *If $M^*_{i1} < M^*_{i2}$, player i focuses on music and does not value academics. $e^*_{i1} = 0, e^*_{i2} = 1, \theta^*_{i1} = 0$.*

A.Lemma 3. *In equilibrium,*

1. *Players have positive self-esteem ($E^i_i \geq 0$). They have strictly positive self-esteem ($E^i_i > 0$) when they value either academics or music.*

2. *Player positively esteem one another ($E^j_i \geq 0$) when they hold the same values ($\theta^*_1 = \theta^*_2$). Their esteem judgements coincide ($E^1_i = E^2_i$). They have strictly positive esteem (for one another) when additionally, they (both) value academics or music.*

3. *Players negatively esteem one another ($E^j_i \leq 0$) when they hold different values ($\theta^*_1 \neq \theta^*_2$).*

A.1.2 Proposition 1

Proof. Note that both players will never focus on, but not value music as they are never behind in music when focusing on it under the model's assumptions.

In a Musician-Musician equilibrium,
When Player 1 deviates and values academics, $M_{11} = \frac{n+1}{n+2}\alpha_1$, $M_{12} = \frac{n+1}{n+2}\beta$.

If $\alpha_1 < \beta$, deviating is not a best response, since he will not focus on academics anyway, and he is never behind in music.

If $\alpha_1 \geq \beta$, then deviating to being an academic is the best response if $\frac{n}{n+2}(1+\beta) < \frac{n+1}{n+2}\alpha_1 - \frac{\beta}{n+2}$ or simplifying, $\alpha_1 > \beta + \frac{n}{n+1}$.

An analogous argument holds for Player 2. So we need $\alpha_1, \alpha_2 \leq \beta + \frac{n}{n+1}$.

In a Musician-Scholar equilibrium,
If $\alpha_1 > \frac{1}{\beta}$, Player 1 deviating to focusing on but not valuing academics is always a better response because $M_{11} = \frac{n+1}{n+2}\beta\alpha_1 > M_{12} = \frac{n+1}{n+2}$ in the M-S equilibrium.

If $\alpha_1 \leq \frac{1}{\beta}$, then focusing on, but not valuing academics is always worse than being a musician from above.

Further, Player 1 deviating to being an academic is the best response if $\frac{n+1}{n+2} - \frac{\beta}{n+2}\alpha_2 < (1+\beta)(\frac{n+1}{n+2}\alpha_1 - \frac{\alpha_2}{n+2})$ or equivalently, $\alpha_1 > \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$.

From before, Player 2 will deviate and become a musician if $\alpha_2 < \beta + \frac{n}{n+1}$.
So we need $\alpha_1 \leq \frac{1}{\beta}$, $\alpha_1 \leq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$ and $\alpha_2 \geq \beta + \frac{n}{n+1}$.

In a Scholar-Musician equilibrium,
By symmetry with above, we need $\alpha_2 \leq \frac{1}{\beta}$, $\alpha_2 \leq \frac{1}{1+\beta} + \frac{\alpha_1}{(n+1)(1+\beta)}$ and $\alpha_1 \geq \beta + \frac{n}{n+1}$.

In a Focus-Scholar equilibrium,
If $\alpha_1 < \frac{1}{\beta}$, then Player 1 being a musician is always a better response as $\beta(\frac{n+1}{n+2}\alpha_1 - \frac{\alpha_2}{n+2}) < \frac{n+1}{n+2} - \frac{\beta\alpha_2}{n+2}$, where the LHS term is utility from focusing on, but not valuing academics.

If $\alpha_1 \geq \frac{1}{\beta}$, then from above, focusing on, but not valuing academics is always better than being a musician. Further, Player 1 deviating to being an academic is the best response when relative achievement is positive or $\alpha_1 > \frac{\alpha_2}{n+1}$.

Since Player 1 does not value academics, Player 2 focusing on academics but not valuing it is dominated by valuing music which at least grants self-esteem. Deviating to being a musician is the best response if $\frac{n+1}{n+2} > \frac{n+1}{n+2}\alpha_2 - \frac{\alpha_1}{n+2}$ or simplifying,

$\alpha_2 < 1 + \frac{\alpha_1}{n+1}$.

Thus we need $\frac{1}{\beta} \leq \alpha_1 \leq \frac{\alpha_2}{n+1}$ and $\alpha_2 \geq 1 + \frac{\alpha_1}{n+1}$. Note that the last constraint is always satisfied for $0 < \beta \leq 1$ and when the first inequality holds.[1]

In a Scholar-Focus equilibrium,
By symmetry with the above, we need $\frac{1}{\beta} \leq \alpha_2 \leq \frac{\alpha_1}{n+1}$ and $\alpha_2 \geq 1 + \frac{\alpha_1}{n+1}$. Similarly, the last constraint is always satisfied for $\beta \leq 1$ and when the first inequality holds.

In a Scholar-Scholar equilibrium,
If $\alpha_1 < \frac{1}{\beta}$, remembering that being a musician is always a better response than focusing on but not valuing academics, we can compare the utilities of being a scholar vs a musician. Deviating to being a musician is the best response if $\alpha_1 < \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, which was derived in the M-S equilibrium.

If $\alpha_1 \geq \frac{1}{\beta}$, remembering that focusing on but not valuing academics is always a better response than being a musician, deviating to it is the best response when achievement is below average or $\alpha_1 < \frac{\alpha_2}{n+1}$.

The conditions are symmetric for Player 2. So for a Scholar-Scholar equilibrium, we need:
If $\alpha_1 < \frac{1}{\beta}$, $\alpha_1 \geq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, if $\alpha_1 \geq \frac{1}{\beta}$, $\alpha_1 \geq \frac{\alpha_2}{n+1}$. And
If $\alpha_2 < \frac{1}{\beta}$, $\alpha_2 \geq \frac{1}{1+\beta} + \frac{\alpha_1}{(n+1)(1+\beta)}$, if $\alpha_2 \geq \frac{1}{\beta}$, $\alpha_2 \geq \frac{\alpha_1}{n+1}$.

Drawing these out in a figure, we can see that it is equivalent to $\alpha_1 \geq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, $\alpha_1 \geq \frac{\alpha_2}{n+1}$ and $\alpha_2 \geq \frac{1}{1+\beta} + \frac{\alpha_1}{(n+1)(1+\beta)}$, $\alpha_2 \geq \frac{\alpha_1}{n+1}$. ■

A.1.3 Remark 1: α^* Threshold in Corollary 1

Proof. From the equilibrium conditions in Proposition 1, we can obtain the α^* threshold for which Player 2 always values academics when ahead of the other.

This is done by substituting Player 1's maximum possible ability, $\alpha_1 = \alpha_2$ into the relevant constraints $\alpha_2 \geq \frac{1}{1+\beta} + \frac{\alpha_1}{(n+1)(1+\beta)}$, $\alpha_2 \geq 1 + \frac{\alpha_1}{n+1}$, $\alpha_2 \geq \beta + \frac{n}{n+1}$, $\alpha_2 \geq \frac{\alpha_1}{n+1}$ and taking the maximum, noting that the last constraint always holds under the assumption: $\alpha_2 \geq \alpha_1$. ■

[1] If $\alpha_2 < 1 + \frac{\alpha_1}{n+1}$, then from the 1st inequality, we have $\alpha_1 < \frac{1}{n+1} + \frac{\alpha_1}{(n+1)^2}$ or simplifying: $\alpha_1 < \frac{n+1}{n(n+2)} < 1$ which contradicts that $\alpha_1 > \frac{1}{\beta} \geq 1$.

A.1.4 Corollary 1

Proof. Under the assumptions that $\alpha_2 \geq \alpha_1$, $\alpha_2 > \alpha^*$, we have that Player 2 is always a scholar. Hence we only need to focus on the conditions for Player 1 in the Musician-Scholar, Scholar-Scholar, and Focus-Scholar equilibria in Proposition 1.

The conditions are as follows:
Musician-Scholar: $\alpha_1 \leq \frac{1}{\beta}$, $\alpha_1 \leq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$.
Scholar-Scholar: $\alpha_1 \geq \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, $\alpha_1 \geq \frac{\alpha_2}{n+1}$
Focus-Scholar: $\frac{1}{\beta} \leq \alpha_1 \leq \frac{\alpha_2}{n+1}$

Observation: A point to note is that the linear constraints (1) $\alpha_1 = \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$, (2) $\alpha_1 = \frac{\alpha_2}{n+1}$ and (3) $\alpha_1 = \frac{1}{\beta}$ intersect at the point $(\alpha_2, \alpha_1) = (\frac{n+1}{\beta}, \frac{1}{\beta})$.
For $\alpha_2 < \frac{n+1}{\beta}$, (3) > (1) > (2).
For $\alpha_2 \geq \frac{n+1}{\beta}$ and (2) > (1) > (3).

Thus, when $\alpha_2 < \frac{n+1}{\beta}$, there is no Focus-Scholar equilibria, and the boundary for the transition for Musician-Scholar to Scholar-Scholar is $\alpha_1 = \frac{1}{1+\beta} + \frac{\alpha_2}{(n+1)(1+\beta)}$ as it binds under the observation.

When $\alpha_2 \geq \frac{n+1}{\beta}$, there are Focus-Scholar equilibria, and the conditions and observation above give two (ordered) boundaries: $\alpha = \frac{1}{\beta}$ and $\alpha_1 = \frac{\alpha_2}{n+1}$, the former for the transition between Musician-Scholar and Focus-Scholar; the latter for the transition between Focus-Scholar and Scholar-Scholar equilibria. ∎

A.1.5 Proposition 2

Proof. By Lemma 1 and Corollary 1, we need $\rho\alpha > \frac{1}{1+\beta} + \frac{\alpha}{(n+1)(1+\beta)}$ when $\frac{\alpha}{n+1} < \frac{1}{\beta}$ and $\rho\alpha > \frac{\alpha}{n+1}$ when $\frac{\alpha}{n+1} \geq \frac{1}{\beta}$ in order for Player 1, the student to value academics when taught. This gives the lower bounds for teaching.

The upper bound is obtained by comparing the utility of Player 2 when teaching and the student values academics: $(1+\beta)(\frac{n+1}{n+2}\alpha - \frac{\rho\alpha}{n+2})$ with the utility when not teaching and the student values music: $\frac{n+1}{n+2}\alpha - \frac{\beta}{n+2}$.
I.e. we need: $(1+\beta)(\frac{n+1}{n+2}\alpha - \frac{\rho\alpha}{n+2}) > \frac{n+1}{n+2}\alpha - \frac{\beta}{n+2}$.[2] ∎

[2]Notice that when $\beta = 1$, the upper bound for ρ: $\frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}] \geq 0.5 \times (n+1) \geq 1$ for $n \geq 1$ and it is increasing in β. I.e. it will not bind when $\beta > 1$. This qualifies the assumption $\beta \leq 1$.

A.1.6 Lemma 2

Proof. For fixed α, it is easy to see that teaching equilibria exist in the continuous teaching effort case exist if and only if teaching equilibria exist in the discrete teaching effort case. This comes from learning potential ρ in the discrete case being equal to the product of teaching effort λ' and academic learning capacity ζ in the continuous case.

If teaching equilibria do not exist in the discrete teaching effort case, this means there is no learning potential of Player 1 at which Player 2 willing to teach. Hence, there is no combination of $\lambda'\zeta$ for which Player 2 will want to teach in the continuous case. Conversely, if teaching equilibria exist in the discrete case for some ρ, then any combination of $\lambda'\zeta = \rho$ is an equilibria in the continuous case. This gives the qualifying conditions in Lemma 2.

In addition, teaching occurs if and only if academic capacity is high enough such that Player 1 values academics given full teaching effort; I.e. ζ must satisfy the lower bound in Corollary 1. If the lower bound is not satisfied, Player 1 will never value academics for any teaching effort, hence Player 2 will not each. If the lower bound is satisfied, since we are assuming that equilibria exist (both in the discrete and continuous case by above), then there exists some positive teaching effort $\lambda' \leq 1$ such that $\lambda'\zeta$ lies in the boundaries given for ρ in Corollary 1 and hence there is a teaching equilibrium for that particular (α, ζ) pair. ∎

A.1.7 Proposition 3

Proof. From Lemma 2, we know that teaching equilibria exists for the pair (α, ζ) under the assumed parameters. Also, it is easy to see that conditional on Player 1 valuing academics in equilibrium, a higher teaching effort only lowers esteem benefits since relative achievement falls; Player 2 thus chooses the minimum teaching effort such that Player 1 will value academics: $\lambda'\zeta = \frac{1}{1+\beta}(\frac{1}{\alpha} + \frac{1}{n+1})$ for $\frac{\alpha}{n+1} < \frac{1}{\beta}$ and $\lambda'\zeta = \frac{1}{n+1}$ for $\frac{\alpha}{n+1} \geq \frac{1}{\beta}$ ∎

A.1.8 Remark 2: Conditions for Non-monotonic Equilibria

Non-monotonic equilibria in the continuous teaching effort model

A sufficient condition for this is that the *intersection* between the upper and lower bounds in the conditions for $\frac{\alpha}{n+1} < \frac{1}{\beta}$ in Proposition 2, to actually lie to the left of $\alpha = \frac{n+1}{\beta}$ such that the downward sloping lower bound portion exists as in Figure 1.2.

Furthermore, to ensure that at least some part of the downward sloping portion occurs at levels of α at which Player 2 is always an academic, $\frac{n+1}{\beta} > \alpha^{**}$.

The intersection point is where $\frac{1}{(1+\beta)\alpha} + \frac{1}{(n+1)(1+\beta)} = \frac{\beta}{1+\beta}[(n+1) + \frac{1}{\alpha}]$ or simplifying: $\alpha = \frac{(1-\beta)(n+1)}{\beta(n+1)^2-1}$.

The required conditions are thus $\alpha = \frac{(1-\beta)(n+1)}{\beta(n+1)^2-1} < \frac{n+1}{\beta}$ and $\frac{n+1}{\beta} > \alpha^{**}$.

If in addition, the upper bound is higher than the lower bound as α tends to infinity: $\frac{\beta}{1+\beta}(n+1) > \frac{1}{n+1}$, then equilibria in which there is strictly positive teaching effort will always exist for all α high enough; otherwise teaching and hence achievement will discontinuously drop to 0 at some upper bound of α.

Non-monotonic equilibria in the discrete teaching effort model

For the model with discrete teaching effort choice, it is further required that there are regions of ρ where teaching is not feasible; i.e. the upper bound: $\frac{\beta}{1+\beta}[(n+1)+\frac{1}{\alpha}] < 1$.

Lastly, to be in the non-monotonic region as we vary α, the point ρ chosen must be greater than the upper bound when α tends to infinity which is $\frac{\beta}{(1+\beta)}(n+1)$ (otherwise Player 2 might always teach for ρ high enough).

A.1.9 Remark 3: α^{**} Threshold in Proposition 4

Player 2 only has 2 feasible strategies: valuing music or valuing academics. As before, strategies where he only focuses but does not value an activity are ruled out because he is assumed to be always (weakly) ahead in ability for each activity.

α^{**} is the level of α_2 such that for any strategy of Player 1 (i.e. valuing music, valuing academics, focusing on academics, valuing academics and breaking up, valuing music and breaking up etc.), Player 2 will always choose to value academics for α_1=α_2, the maximum academic ability of Player 1 given our assumptions. See Remark 1.

A.1.10 Proposition 4

Proof. Remember that musical ability is normalised to 1 such that focusing on music but not valuing it will never occur. Then there are 6 possible strategies for Player 1: i) valuing music, ii) valuing music and breaking up, iii) valuing academics, iv) valuing academics and breaking up, v) focusing on but not valuing academics and vi) focusing on but not valuing academics and breaking up.

Since Player 2 is always an academic by assumption, strategies iv) and vi) are ruled out because they are always dominated by some other strategy. iv) is dominated by either ii) when potential relative academic achievement is negative and by iii) when potential relative academic achievement is positive. vi) is dominated by ii).

Utilities of Player 1 in the relevant cases are as follows:
In the musician-scholar equilibrium, $U_1 = \frac{n+1}{n+2} - \frac{\beta}{n+2}\alpha_2$
In the musician-scholar, break up equilibrium, $U_1 = \frac{n+1}{n+2} - c$
In the scholar-scholar equilibrium, $U_1 = (1+\beta)(\frac{n+1}{n+2}\alpha_1 - \frac{1}{n+2}\alpha_2)$
In the focus-scholar equilibrium, $U_1 = \beta(\frac{n+1}{n+2}\alpha_1 - \frac{1}{n+2}\alpha_2)$

The inequalities in Proposition 4 are obtained by comparing the utility in each equilibrium with the rest. ■

A.1.11 Corollary 4

Proof. The key point to take note here is that as β changes, the type of equilibrium (as numbered in Proposition 4) from a particular point cannot switch back and forth between the same kinds of equilibria since their constraints vary monotonically with β. Also, for a given β there is a unique equilibrium away from boundaries.

In particular, one key threshold is $\alpha_1 = \frac{\alpha_2}{n+1}$ which determines whether Player 2 is able to obtain positive esteem from being a scholar.

When $(\alpha_1, \alpha_2) \in A$, there are only 2 potential equilibria: (1) and (2) (some constraints in equilibria (3) and (4) are violated when $\alpha_1 > \frac{\alpha_2}{n+1}$). As $\beta \to 0^+$, they choose to be a musician, but do not break up as there is not enough incentive to switch to academics as another is already focusing on it (by $\alpha_1 < 1 + \frac{\alpha_2}{n+1}$). As β rises, there will be a switch to being an academic which continues hence after.

When $(\alpha_1, \alpha_2) \in C$, there are 3 potential equilibria (2), (3) and (4). Only the conditions in (2) are satisfied as $\beta \to 0^+$ while only the conditions in (3) are satisfied as $\beta \to \infty$. When $c > \frac{n+1}{n+2}$, equilibria (4) exists for some intermediate β: this comes from the conditions in Proposition 4. Combining the fact that equilibria are monotonic, we thus get Corollary 4b).

When $(\alpha_1, \alpha_2) \in B \setminus C$, these individuals have 2 potential equilibria (2) and (3). Only the conditions in (2) are satisfied as $\beta \to 0^+$ while only the conditions in (3) are satisfied as $\beta \to \infty$. Given that equilibria only change once, there must be some threshold level β at which this occurs.

To obtain the thresholds, it should be noted that the equilibria will always follow the pattern as in the figure below and the relevant boundaries are the 5 lines:
1) $\alpha_1 = \frac{\alpha_2}{n+1}$
2) $\alpha_1 = \frac{1}{1+\beta}(1 + \frac{\alpha_2}{n+1})$
3) $\alpha_1 = \frac{1}{\beta}(1 - \frac{n+2}{n+1}c) + \frac{\alpha_2}{n+1}$
4) $\alpha_2 = \frac{c(n+2)}{\beta}$
5) $\alpha_1 = \frac{1}{\beta}$

Points A and B are always the intersection of 1), 2) ,5) and 3), 4), 5) respectively. Further point A is always strictly to the left of point B under the assumption $c > \frac{n+1}{n+2}$. These points fully characterise the equilibria for given c, n and β in that they determine the vertices of the equilibrium areas in the Figure below.

Thus, the threshold in the first scenario (Musician to Scholar) is thus characterised by boundary 2). The lower and upper thresholds in the second scenario (Musician to Focus to Musician, Breakup) are characterised by boundaries 5) and 3) respectively. Lastly, boundary 4) characterises the threshold in the third scenario (Musician to Musician, Breakup). ■

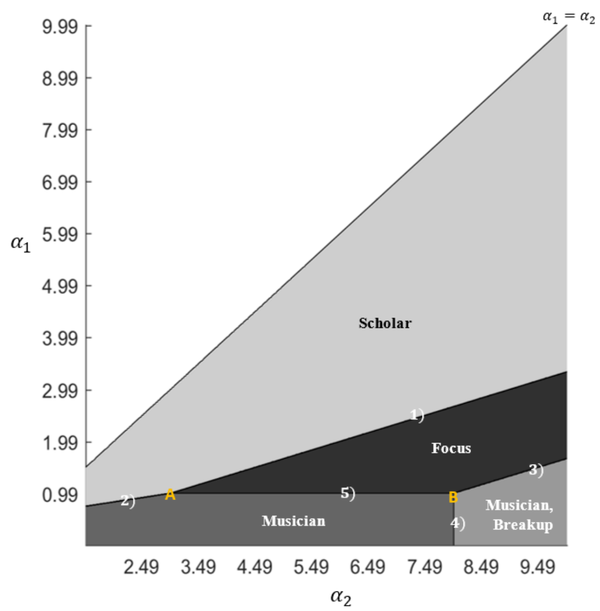


Figure A.1: Thresholds for Changes in Equilibria

Appendix B

B.1 Supplementary Analysis

Dep Var: Closeness to each Identity Group	Column 1	Column 2
Team Pay	0.207***	0.207***
	(0.074)	(0.074)
Ingroup	0.970***	0.851***
	(0.064)	(0.133)
Ingroup × Avg Messages Sent		0.242**
		(0.094)
Ingroup × Avg Messages Received		-0.015
		(0.020)
Constant	-0.639***	-0.639***
	(0.091)	(0.096)
Observations	576	576

* 0.10 ** 0.05 *** 0.01. Closeness to identity group is standardised.

Table B.1: Random Effects Regressions: Closeness to each Identity Group

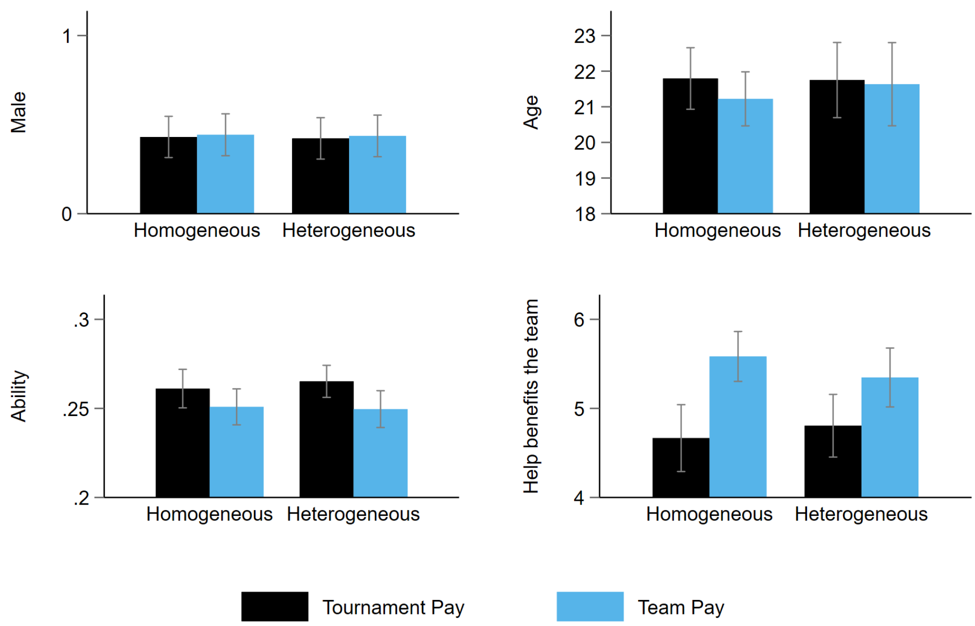


Figure B.1: Treatment Comparison of Relevant Survey Variables

Understand Task
How well did you understand the instructions and the decoding task in Part 2?
[1: Did not understand at all - 7: Understood it very well]

Task Interest
Please tell us how you felt about the decoding task in Part 2? (Groups here refer to KLEE/KANDINSKY) [1: Very boring - 7: Very interesting]

Help Benefits the Team
With respect to the decoding task, how do you think YOUR provision of help to others will affect the TOTAL score of the team? (4 = no effect on total score)
[1: Total score decreases - 7: Total score increases]

Motivation: Match Effort
I felt worried about taking breaks during each round because others on my team might be putting a lot of effort. [1: Strongly disagree - 7: Strongly Disagree]
I felt that I had to put in my best effort into the decoding task to match the effort of others on the team. [1: Strongly disagree - 7: Strongly Agree]

Closeness to each Identity Group
Please select the option which best describes your feeling toward the KLEE (KANDINSKY) group after Stage 1 of the experiment. [IOS scale]

Closeness to Workgroup (Beginning and End)
Please select the option which best describes your feelings toward your 6-person workteam at the *beginning*(*end*) of Stage 2 of the experiment. [IOS scale]

IOS scale

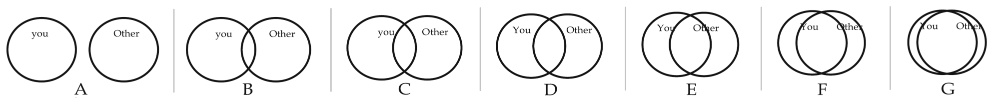


Table B.2: Description of Relevant Survey Variables

Dep var: Chose to help	Random Effects	Panel Probit	Panel Logit
Ingroup	0.278***	1.148***	1.983***
	(0.029)	(0.097)	(0.176)
Team Pay	0.246***	1.114***	1.931***
	(0.056)	(0.308)	(0.537)
Constant	0.354***	-0.578*	-1.004*
	(0.073)	(0.337)	(0.568)
Observations	1152	1152	1152

* 0.10 ** 0.05 *** 0.01. Regressions control for Ability, 1/Round and Ability × 1/Round. Subsample of heterogeneous workgroups.

Table B.3: Regressions: Choices to Help Ingroup/Outgroup Members

Input / *Incentive*	Hom In-Help Hom Other-Help	Hom In-Help Het Other-Help	Het In-Help, Hom Other-Help	Het In-Help, Het Other-Help
Team Pay	0.913	0.705	0.885	0.677
	(0.017)	(0.018)	(0.013)	(0.022)
Tourn Pay	0.503	0.416	0.556	0.469
	(0.030)	(0.019)	(0.021)	(0.023)

Standard errors approximated by delta method.

Table B.4: Simulated Counterfactual Levels of Help under each Incentive Type

	Team Pay	**Tournament Pay**
Proportion explained by differences in workgroup composition	0.882	0.624

Values indicate the proportion of help differences explained by there being 3 ingroup members in homogeneous workgroups versus 3 outgroup members in heterogeneous workgroups.

Table B.5: Proportion of Counterfactual Help Differences Explained by Workgroup Composition

Input / *Workgroup*	Team-Pay Help, Team-Pay Effort	Team-Pay Help, Tourn-Pay Effort	Tourn-Pay Help, Team-Pay Effort	Tourn-Pay Help, Tourn-Pay Effort
Homogeneous	23.107	23.866	21.072	21.763
	(0.196)	(0.194)	(0.200)	(0.189)
Heterogeneous	21.338	22.690	20.390	21.681
	(0.179)	(0.186)	(0.177)	(0.182)

Standard errors approximated by delta method.

Table B.6: Simulated Counterfactual Productivity in each Workgroup Type

	Homogeneous workgroups	**Heterogeneous workgroups**
Proportion explained by effort	0.259	0.574
Proportion explained by help	0.741	0.426

Table B.7: Proportion of Counterfactual Productivity Differences Explained by Variation in Help and Effort across Incentives

Dep Var: Closeness to Workgroup	At the Beginning		At the End	
Homogeneous	0.037	0.080	0.001	-0.212
	(0.166)	(0.194)	(0.139)	(0.155)
Team Pay	0.399***	0.453***	0.401***	0.134
	(0.134)	(0.138)	(0.100)	(0.137)
Homogeneous × Team Pay		-0.097		0.479**
		(0.223)		(0.201)
Constant	-0.421***	-0.439***	0.123	0.212
	(0.060)	(0.052)	(0.259)	(0.308)
Observations	288	288	288	288

* 0.10 ** 0.05 *** 0.01. Closeness to workgroup is standardised.

Table B.8: OLS Regressions: Closeness to Workgroup

Dep Var:	Standardised Personal Effort	Motivation: Match Effort	Probability of Giving Help	Standardised Productivity
Team Pay	-0.337***	-0.044	0.228***	-0.029
	(0.076)	(0.137)	(0.034)	(0.084)
Tournament × β	0.069	-0.469	0.175*	0.273
	(0.189)	(0.324)	(0.091)	(0.191)
Team Pay × β	0.302**	0.634***	0.357***	0.638***
	(0.131)	(0.204)	(0.056)	(0.136)
Constant	0.608***	-0.241*	0.615***	0.393***
	(0.118)	(0.142)	(0.092)	(0.112)
Observations	1152	288	1152	1152

* 0.10 ** 0.05 *** 0.01. β is measure of workgroup identification based on relevant workgroup members: β_{self} (Columns 1-3), β_{all} (Column 4). Controls not shown here. Column 2 uses IV, others use Panel IV.

Table B.9: Robustness: IV Regressions

Dep Var:	Standardised Personal Effort	Probability of Giving Help	Standardised Productivity
Team Pay	-0.369***	0.183***	-0.432
	(0.082)	(0.055)	(0.348)
Tournament Pay × Homogeneous	0.033	0.109**	0.799**
	(0.089)	(0.054)	(0.402)
Team Pay × Homogeneous	0.224**	0.263***	2.270***
	(0.110)	(0.054)	(0.511)
Constant	0.020	0.572***	21.605***
	(0.125)	(0.095)	(0.477)
Observations	576	576	576

* 0.10 ** 0.05 *** 0.01. Controls for Ability.

Table B.10: Robustness: Random Effects Regressions for First Half

Dep Var:	Standardised Personal Effort	Probability of Giving Help	Standardised Productivity
Team Pay	-0.410***	0.231***	-0.323
	(0.079)	(0.051)	(0.466)
Tournament Pay × Homogeneous	0.004	0.032	0.281
	(0.099)	(0.053)	(0.468)
Team Pay × Homogeneous	0.235**	0.277***	2.456***
	(0.107)	(0.058)	(0.613)
Constant	0.435***	0.506***	22.821***
	(0.099)	(0.075)	(0.543)
Observations	576	576	576

* 0.10 ** 0.05 *** 0.01. Controls for Ability.

Table B.11: Robustness: Random Effects Regressions for Second Half

B.2 Proofs

Substituting values into the utility function,

$$U_i = \Big(1 - \frac{\beta}{N-1}\Big)\Big[\bar{q} + \theta(q_i - \bar{q})\Big] + \frac{\beta}{N-1}N\bar{q} - \frac{1}{2}e_i^2 - \frac{1}{2}h_i^2$$

From the first order conditions,

$$e_i = \Big[1 + (N-1)\theta + \beta(1-\theta)\Big]\frac{d\bar{q}}{de_i}$$

$$h_i = \Big[1 - \theta + \frac{\beta}{N-1}(N-1+\theta)\Big]\frac{d\bar{q}}{dh_i}$$

The following parametric restrictions give sufficient conditions for the predictions in the text to hold — $\forall\, \theta, g$:

$$\Big[(N-1) - \beta + (1-\theta)\beta_\theta\Big] > 0 \tag{B.1}$$

$$\Big[-\beta_g + (1-\theta)\beta_{\theta g}\Big] < 0 \tag{B.2}$$

$$\Big[\beta_g + (N-1+\theta)\beta_{\theta g}\Big] < 0 \tag{B.3}$$

In particular these would hold for $\beta_{\theta g} < 0$ with magnitude small enough relative to β_g and N large enough (assuming that all partials have a positive upper bound). Intuitively, changing incentives has a direct effect on choices and an indirect effect via identity. In cases where these are in opposite directions, conditions as above are needed to guarantee monotonicity. Proofs for the above are shown below.

B.2.1 Prediction 1

Proof.

$$\frac{de_i}{dg} = \Big[\beta_g(1-\theta)\Big]\frac{d\bar{q}}{de_i}$$

$$\frac{dh_i}{dg} = \Big[\frac{N-1+\theta}{N-1}\beta_g\Big]\frac{d\bar{q}}{dh_i}$$

$\frac{de_i}{dg} > 0 \Leftrightarrow \theta < 1$ because $\beta_g > 0$.
$\frac{dh_i}{dg} > 0\ \ \forall\, \theta$ because $\frac{N-1+\theta}{N-1} > 0,\ \beta_g > 0.$ ■

B.2.2 Prediction 2

Proof.

$$\frac{de_i}{d\theta} = \Big[(N-1) - \beta + (1-\theta)\beta_\theta\Big]\frac{d\bar{q}}{de_i}$$

$$\frac{dh_i}{d\theta} = \Big[-1 + \frac{\beta}{N-1} + \frac{N-1+\theta}{N-1}\beta_\theta\Big]\frac{d\bar{q}}{dh_i}$$

$\frac{de_i}{d\theta} > 0$ if $\Big[(N-1) - \beta + (1-\theta)\beta_\theta\Big] > 0 \ \ \forall\theta, g.$
$\frac{dh_i}{d\theta} < 0 \ \ \forall\, \theta, g$ because $\beta < 1, \ \frac{N-1+\theta}{N-1} > 0, \ \beta_\theta < 0.$ ∎

B.2.3 Prediction 3

Proof.

$$\frac{de_i}{d\theta dg} = \Big[-\beta_g + (1-\theta)\beta_{\theta g}\Big]\frac{d\bar{q}}{de_i}$$

$$\frac{dh_i}{d\theta dg} = \frac{1}{N-1}\Big[\beta_g + (N-1+\theta)\beta_{\theta g}\Big]\frac{d\bar{q}}{dh_i}$$

$\frac{de_i}{d\theta dg} < 0$ if $\Big[-\beta_g + (1-\theta)\beta_{\theta g}\Big] < 0 \ \ \forall\, \theta, g.$
$\frac{dh_i}{d\theta dg} < 0$ if $\Big[\beta_g + (N-1+\theta)\beta_{\theta g}\Big] < 0 \ \ \forall\, \theta, g.$ ∎

B.2.4 Prediction 4

Proof.

$$\Delta \equiv q_{team} - q_{tourn} = (e_{team} - e_{tourn}) + \alpha(h_{team} - h_{tourn})$$

Prediction 3 implies $\frac{d(e_{team}-e_{tourn})}{dg} > 0$ and $\frac{d(h_{team}-h_{tourn})}{dg} > 0$. Hence, $\frac{d}{dg}(q_{team} - q_{tourn}) > 0$. Assuming that $q_{tourn} - q_{team} > 0$ when $g = 0$, this also implies a threshold of $\hat{g} > 0$ where $q_{tourn} - q_{team} < 0$ for $g > \hat{g}$.

The implicit function $\Delta = 0$ defines the threshold $\hat{g}$ as a function of α. Utilising the implicit function theorem, it is easy to see that $\frac{d\hat{g}}{d\alpha} = -\frac{d\Delta}{d\alpha}/\frac{d\Delta}{dg} < 0$.

∎

B.3 Supplementary Material

B.3.1 Instructions

Welcome to the experiment.

Please remain silent throughout the course of the experiment and refrain from using any communication devices, otherwise we may be forced to stop the experiment. **If you have any questions at any point, please raise your hand and an experimenter will come over to see you.**

In this experiment, there will be 2 stages and you will earn money based on your performance in each stage. Please read the instructions below carefully.

The experiment will be conducted in an anonymous fashion. You will not be able to discover others' exact identities, neither will others be able to discover your exact identity. Rest assured that your anonymity will be strictly preserved.

In the experiment, your payoffs will be in Experimental Currency Units (ECUs). At the end of the experiment, your earnings will be converted into Pounds according to the rate: **100ECU: £2.5.** This will be added to your **show up fee of £3**. Information about your earnings in each stage will only be provided at the end of the experiment. You will be paid your earnings privately and confidentially at the end of the experiment after completing a questionnaire.

If you need to write down anything, please use the paper and pen provided. Please do not write anything on this instruction sheet.

Stage 1

In the first stage, you will be shown five pairs of paintings sequentially. Each pair contains a painting by Paul Klee and another by Wassily Kandinsky. They are abstract artists from the last century. You will not be informed of the artist of each painting. For each pair, you will be asked which painting you prefer. **Your preferences relative to others in the session will then be used to classify you into one of two groups: i.e. Group Klee and Group Kandinsky.** This means that the more times that you have indicated preference for paintings by Klee (Kandinsky) relative to others, the more likely you will be assigned to Group Klee (Kandinsky).

For easier identification, **Group Klee will be represented by the colour blue** while **Group Kandinsky will be represented by the colour red** throughout the experiment.

Subsequently, you will be shown a final pair of paintings, one by Klee and the other by Kandinsky for which you have to guess the artist of each painting. To help in answering the question, you will have a 5 minutes discussion (subject to restrictions) with members of your group (**Klee** or **Kandinsky**); you will be able to refer to the past pairs of paintings during the discussion. Subsequently, you will be asked to answer individually. Your answer as well as the answers of others in your group (**Klee** or **Kandinsky**) will determine your payment in this stage:

If the majority of your group members get the answer right, then you will obtain a payment of 80 ECUs.

You will then move on to Stage 2 of the experiment.

Stage 2

Team Assignment

In the second stage, you will be randomly allocated to a work-team consisting of 6 members and play several rounds of a decoding task. Given the random allocation, your team members may or may not belong to the same group (**Klee** or **Kandinsky**) as you. You will be notified of your work-team's composition at the beginning of the second stage. Note that your team members will always be the same in every round.

The Decoding Task

In this task, you will have to solve sets of decoding questions in each round of 6 minutes. There will be opportunities to help others on your work-team, as well as to take (paid) breaks during the round. This will be described in detail below.

1) Solving question sets

Each question set involves converting several letters into numbers using a provided table. See Figure 1.

There will be two different kinds of question sets in the task which occur with equal chance:

1. An ***easy*** question set with **3 decoding questions *(represented by ~)***.
2. A ***difficult*** question set with **7 decoding questions *(represented by !)***.

To complete a question set, use the provided table **(1)** to convert the letters into numbers, filling the answers in the corresponding boxes **(2)**. Then, submit your answers by clicking either of the submission buttons **(3)**.

Correct answers are denoted by an **O** while incorrect or incomplete answers are denoted by an **X**. If all submitted answers are correct, you will earn 1 point and the next question set (and a new table) will automatically appear. **Your score (4) at the end of the round will thus be the total number of question sets you have completed correctly.** Your time left in the round is shown on the top right **(5)**.

2) Taking breaks

Depending on which button is used to submit your answers in **(3)**, you can choose to take a break for 5 seconds before receiving the next set of questions.

If you click the **"Submit and Rest"** button, and provided your answers are all correct, then **you will receive the next question set after a 5 second rest period** where the Task screen will be temporarily blanked out; this is shown in Figure 2.

For each break taken, you will be paid 2.5 ECUs.

(Note that this rate is equivalent to 1.75 ECUs for 3.5 seconds: the average time taken to convert 1 letter into a number using the table in past experiments.)

If you click the **"Submit"** button, and provided your answers are all correct, then **you will receive the next question immediately**.

The total number of times rested during the round is shown under your score (6).

Figure 1: The decoding task

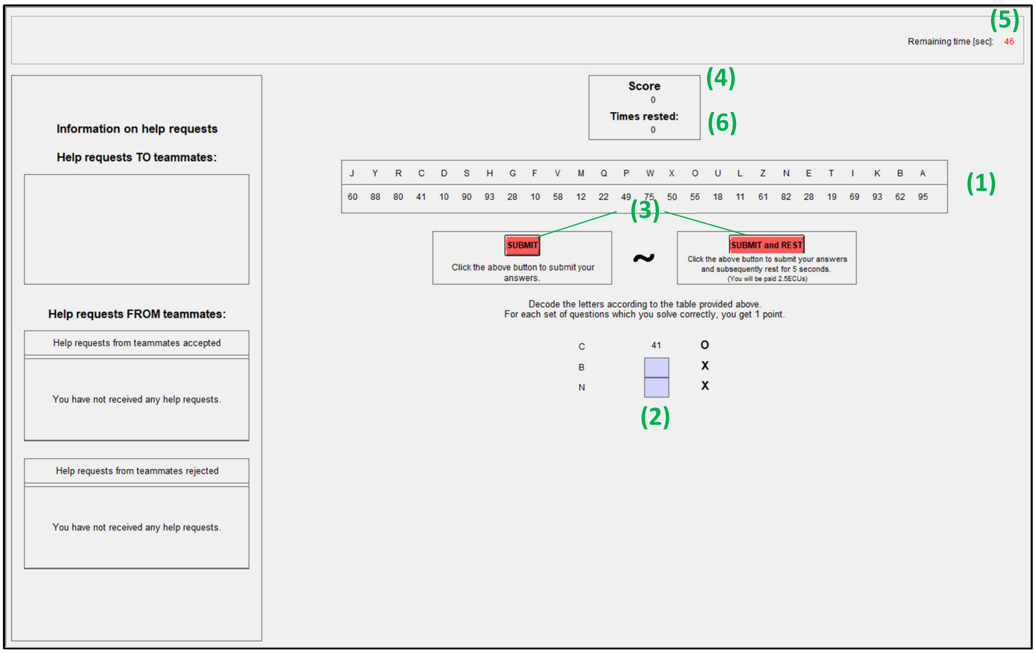
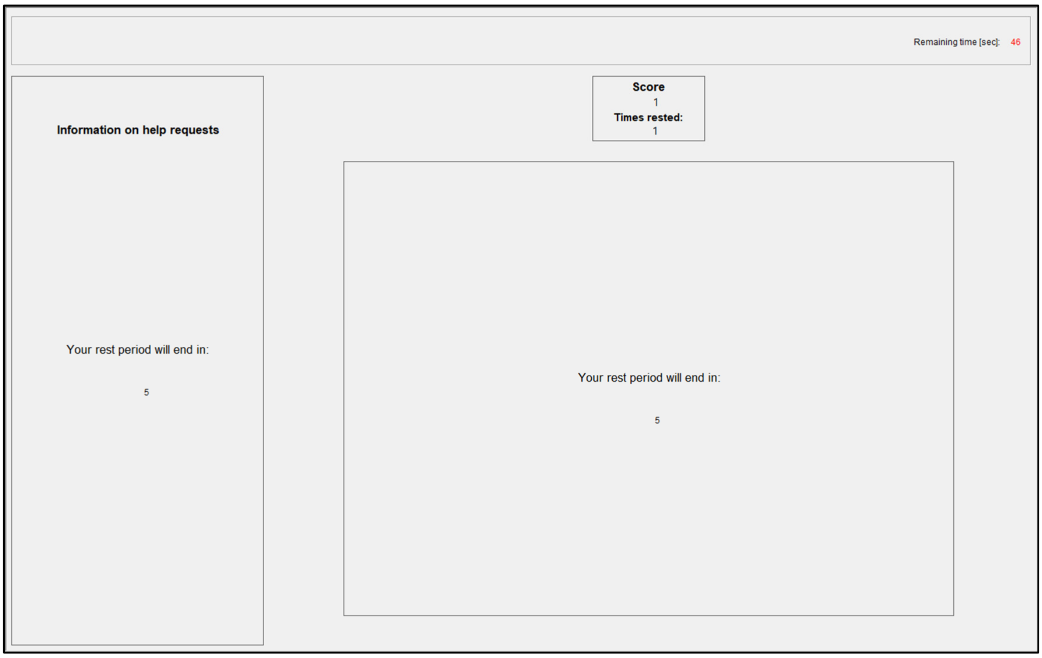


Figure 2: After clicking the submit and rest button



3) <u>Help Requests to Teammates</u>

If you receive a difficult question set of 7 questions, you will automatically send a help request after 3 seconds to a random teammate whose group (**Klee** or **Kandinsky**) you will be informed. See the left side of Figures 3a/b.

Note that you can continue solving the question set before the help request is sent out.

If the teammate **accepts your help request**, you will be notified and the **number of questions you have to solve will be reduced by 3**. Accepting your help request means that **your teammate will have to solve 1 extra question**. See the top right of Figures 3a/b.

If the teammate **rejects your help request**, you will be notified as well, but the **number of questions will not be reduced**. Rejecting your help request means that **your teammate will not have any extra questions.** See the bottom right of Figures 3a/b.

Figure 3a: Help request to **KLEE** group

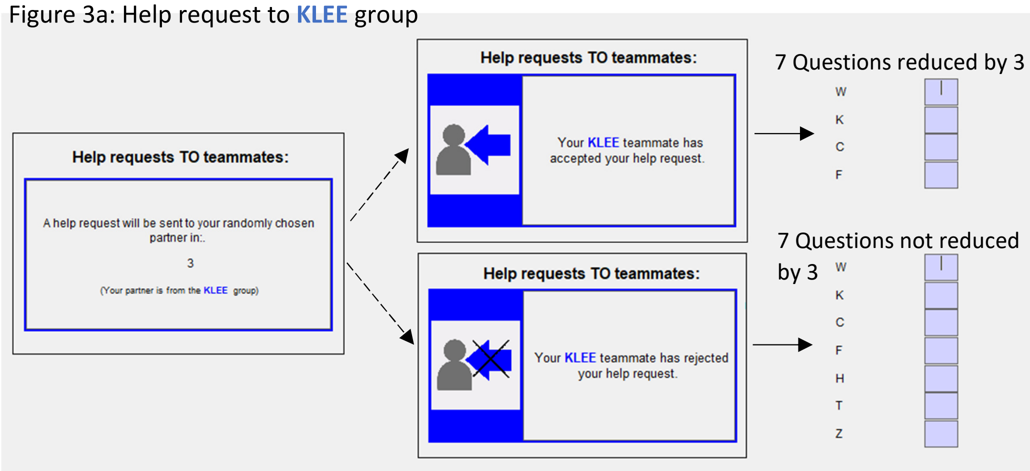
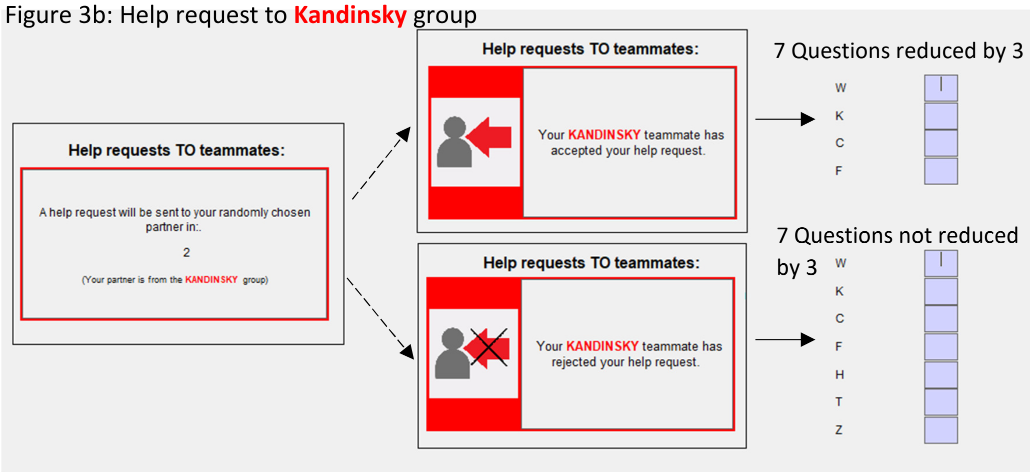


Figure 3b: Help request to **Kandinsky** group



4) Providing Help

At the beginning of each round, you will be asked to decide whether you want to provide help to your teammates during the round **(7)**.

In particular, you will be asked for your helping decision in two cases: 1) when the requester belongs to the **Klee** group and 2) when the requester belongs to the **Kandinsky** group.

See Figure 4.

This decision will then apply to all help requests sent to you during that round. As mentioned, each help request accepted during a question set means that you have to solve 1 extra question; this will appear automatically during the question set. See Figure 5.

Figure 4: Deciding on how much help to give

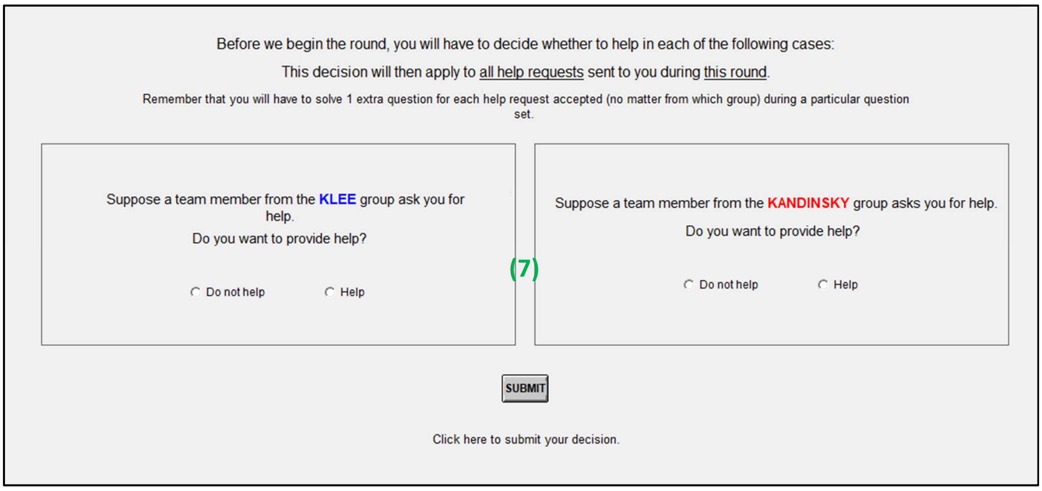
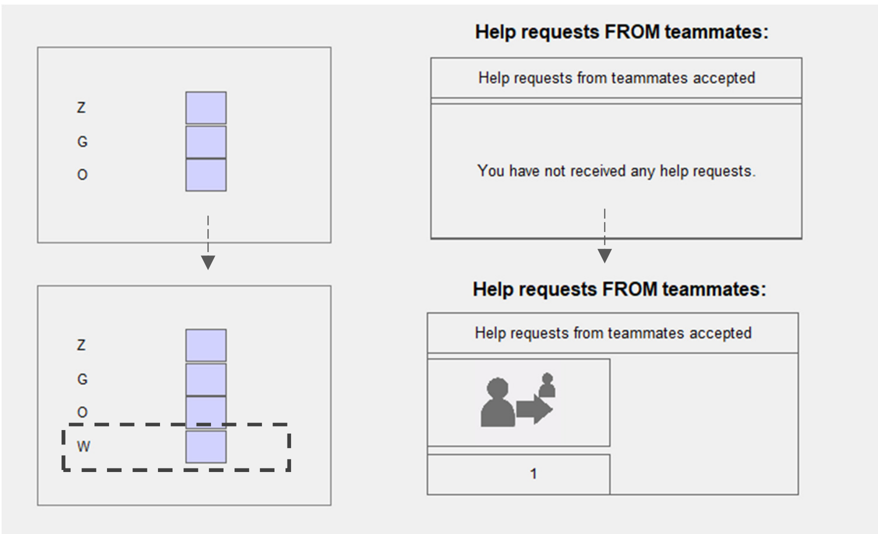


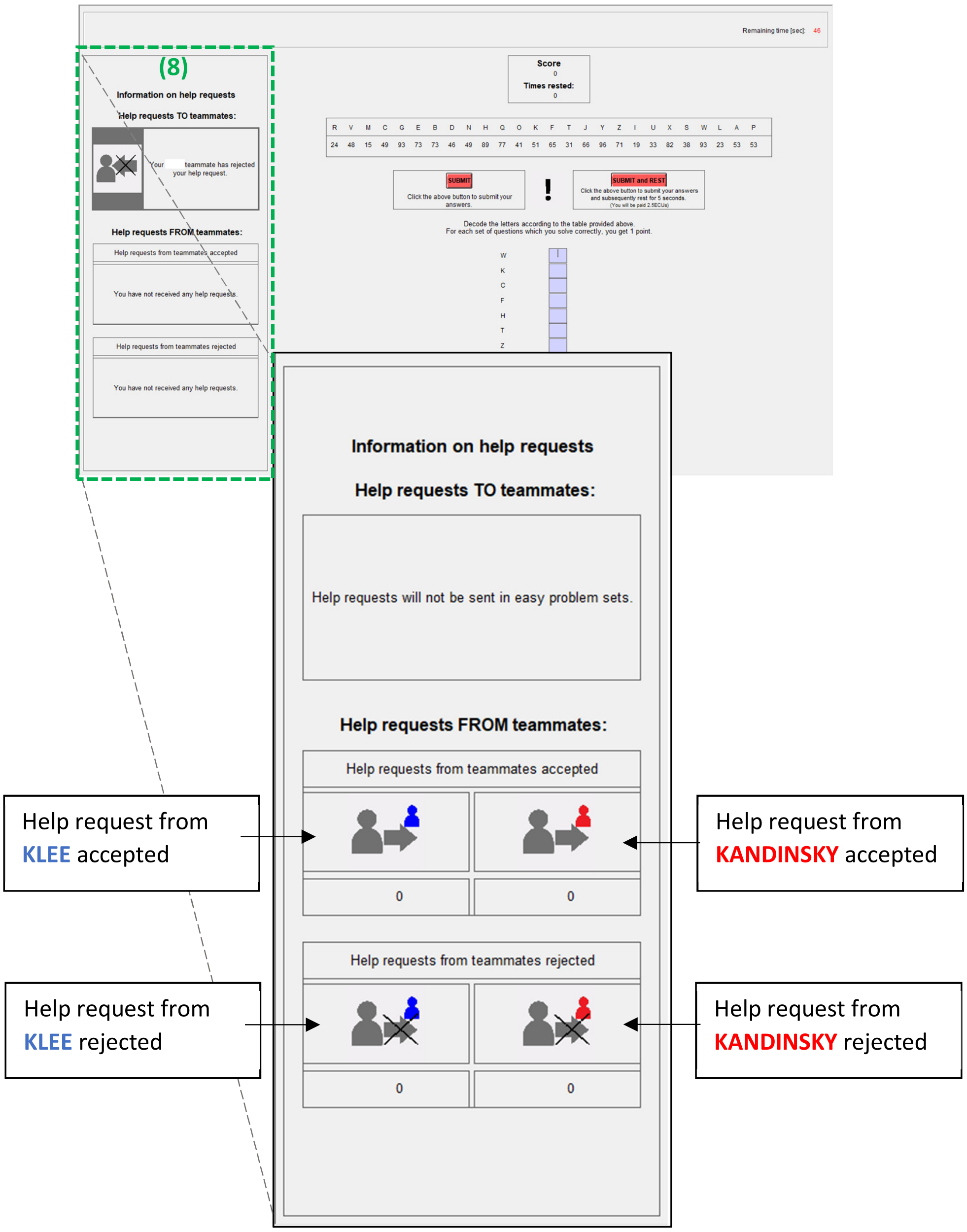
Figure 5: What happens when help requests are accepted



5) Information about Help requests

For your interest, a provided sidebar on the left (8) will show you the number of times you have accepted or rejected help requests from your teammates (in each group) during the ongoing question set. **Relevant icons and numbers will pop up once you have received a help request during the ongoing question set**: these are described in Figure 6 below. If help requests are received during a rest period, you will see these icons immediately after your rest period ends. **Information on help requests to teammates (i.e. the displays in Figure 3) are also located here.**

Figure 6: Information on help requests



6) <u>Earnings</u>

Your task payment in each round will **depend on your performance as well as your teammates' performance** during the round. You will be notified of the exact payment scheme at the beginning of the second stage.

Note that members of your work-team will receive the exact same payment scheme as you.

Your total payment in each round will be calculated as the sum of your *task payment* and the *"rest" payment* (number of breaks taken × 2.5 ECU).

Out of the several rounds in the second stage, only 1 will be randomly chosen to make up your final payment.

We have now come to the end of the instructions. There is a hard copy of the instruction sheet in case you need to refer to it again. If you have any questions please raise your hand and we will attend to you privately.

If not, we will now have a short quiz to test your understanding of the Stage 2 instructions. You will have to answer all questions correctly to proceed.

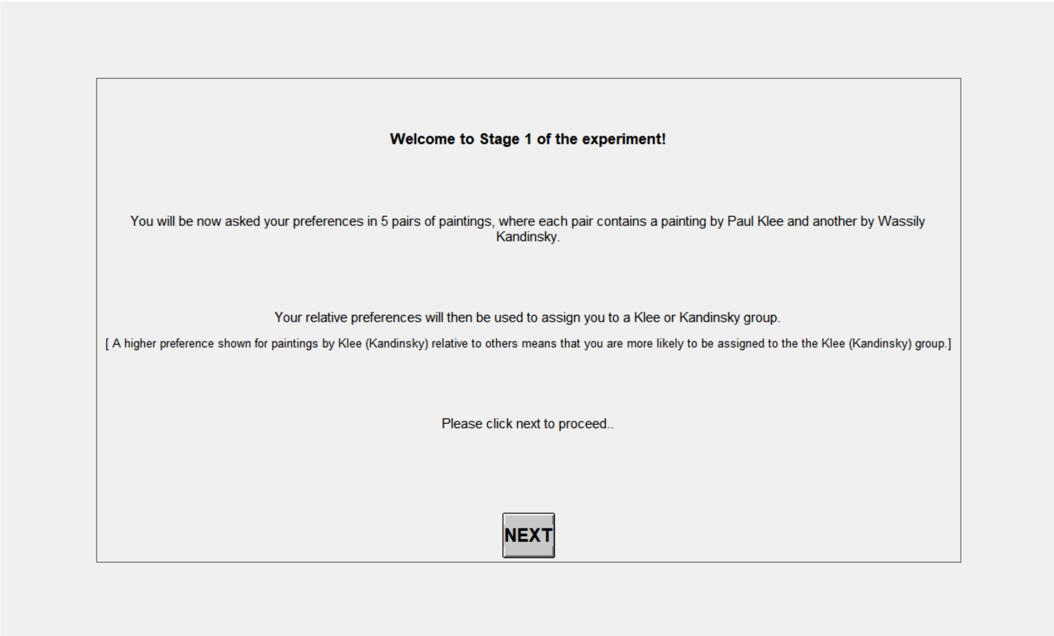
Following the quiz, we will have 2 practice rounds for the Stage 2 decoding task:

In the first practice round, you will have 2 minutes to experience the user interface of the game; **This will be done with simulated partners, so there will not be any real interactions.**

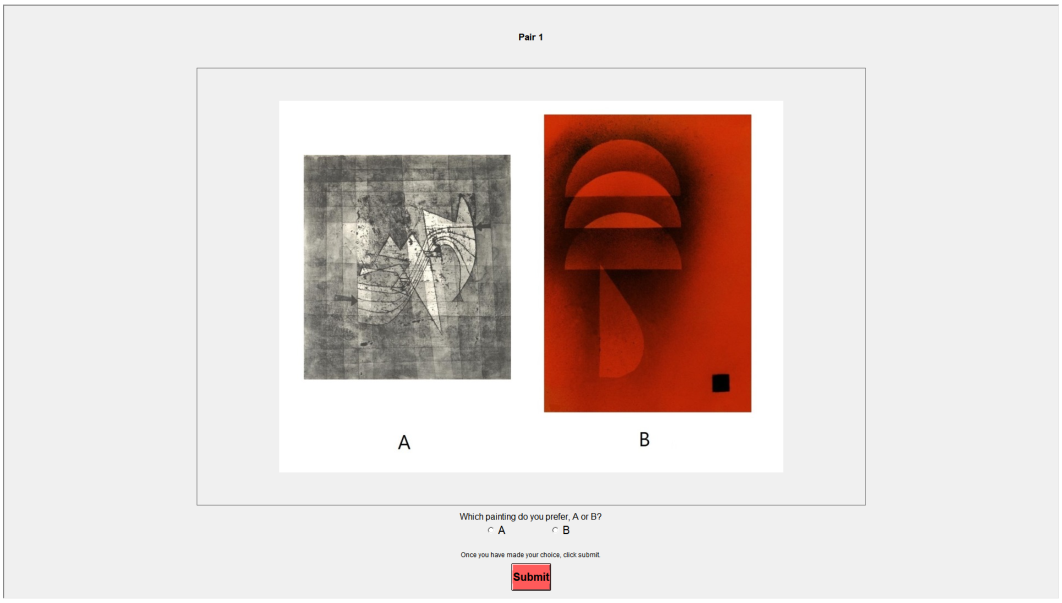
In the second practice round, you will have 3 minutes to practice completing the decoding task. **Note that the helping and resting mechanisms will be unavailable during the second practice round.**

After the 2 practice rounds, we will then begin Stage 1 of the experiment proper.

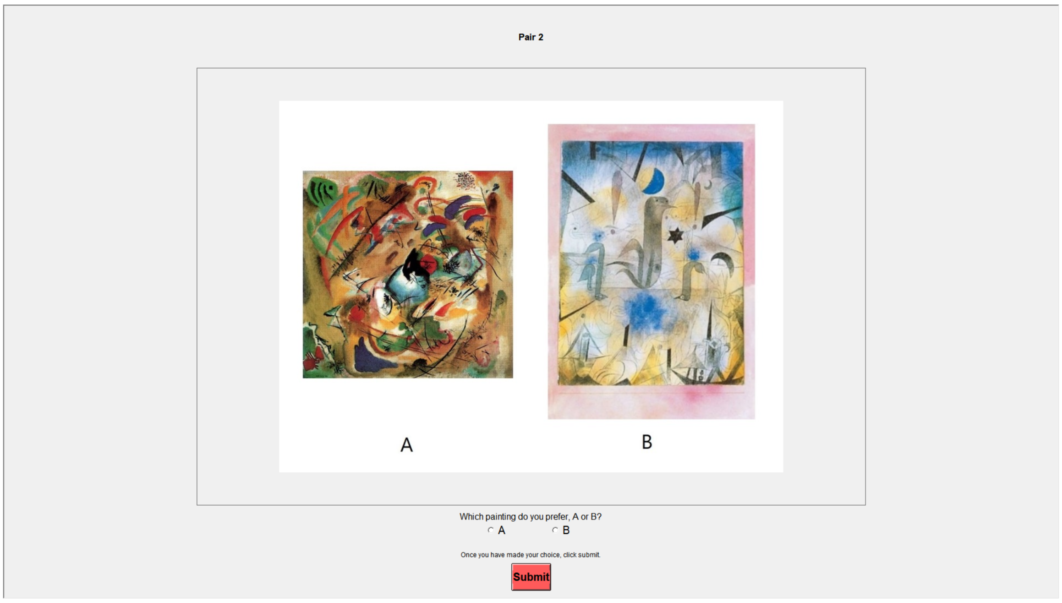
B.3.2 Screenshots



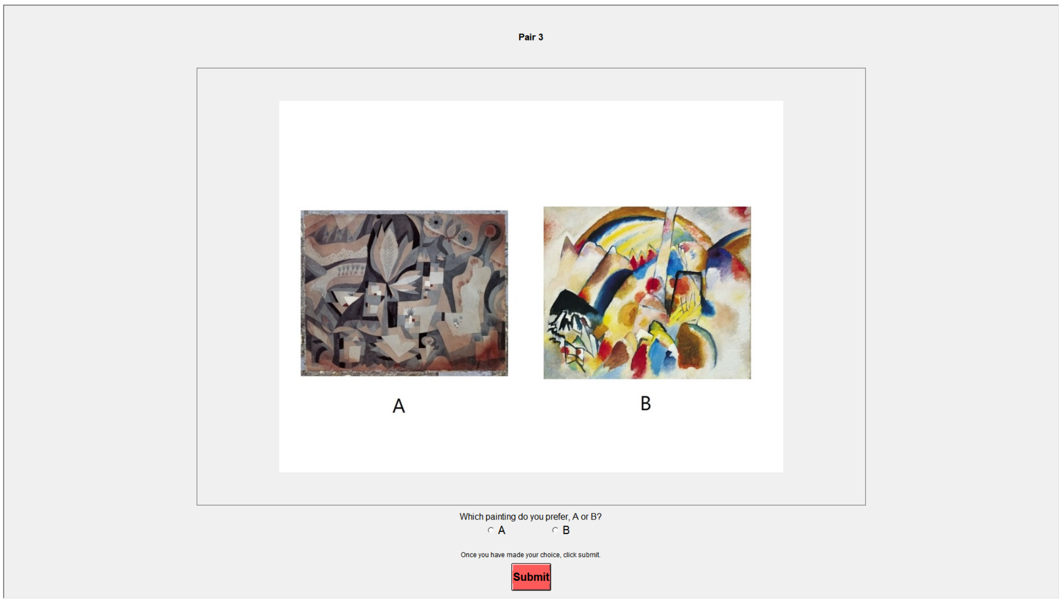
Stage 1: Start Screen



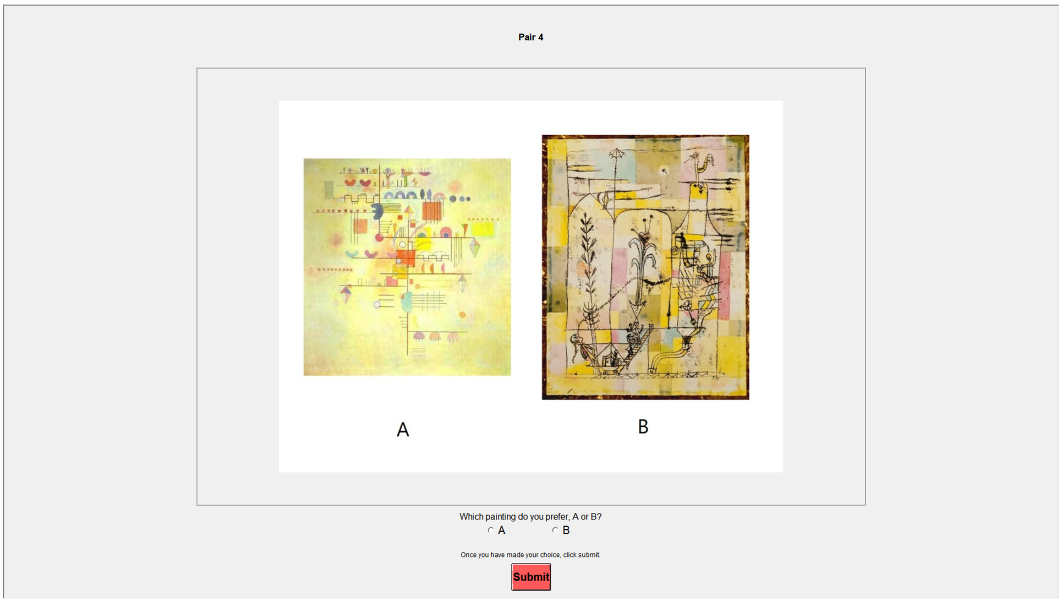
Stage 1: Pair 1



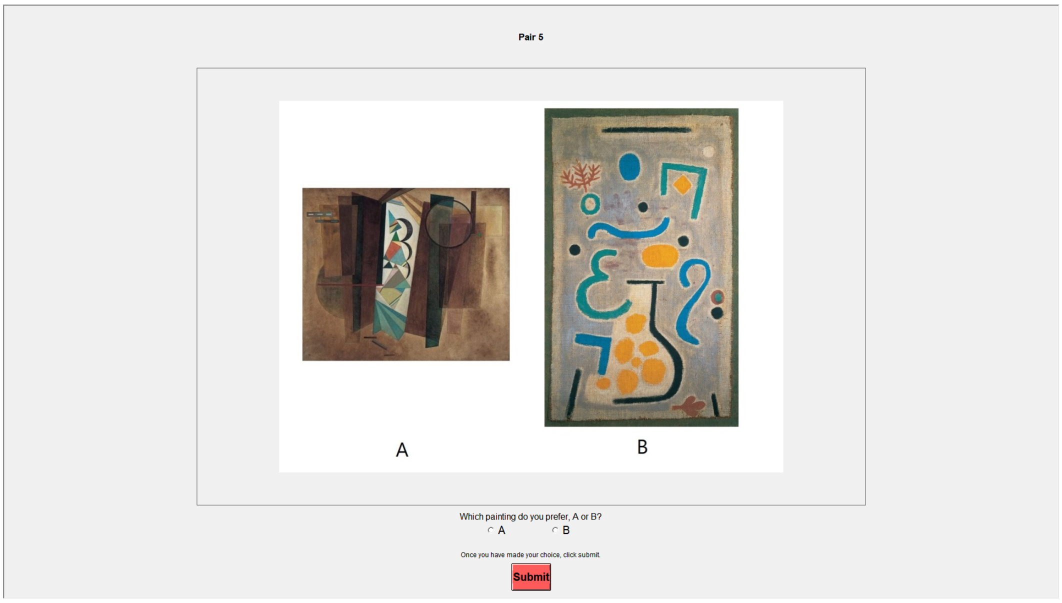
Stage 1: Pair 2



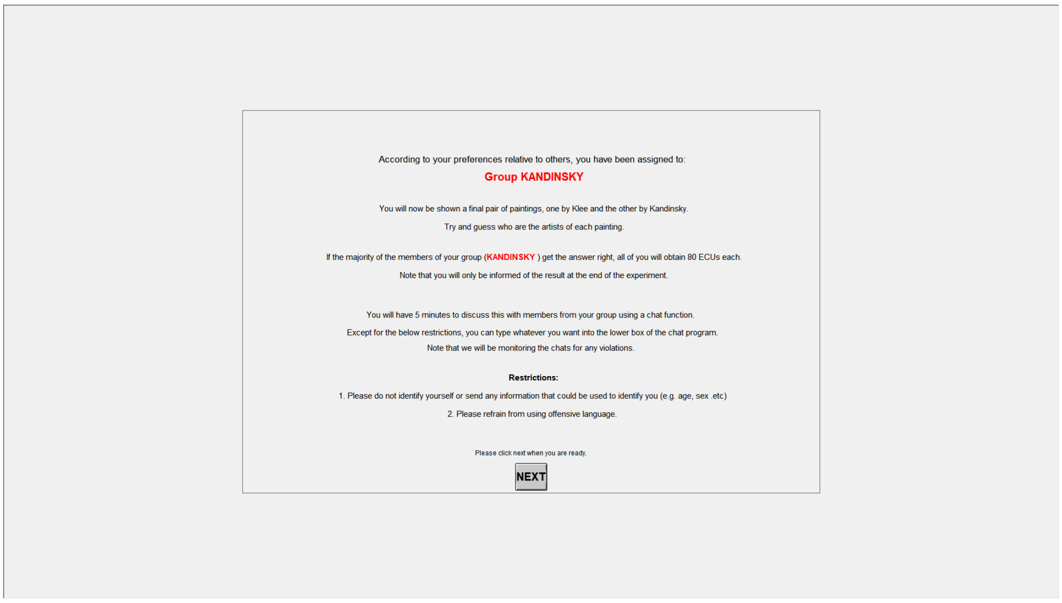
Stage 1: Pair 3



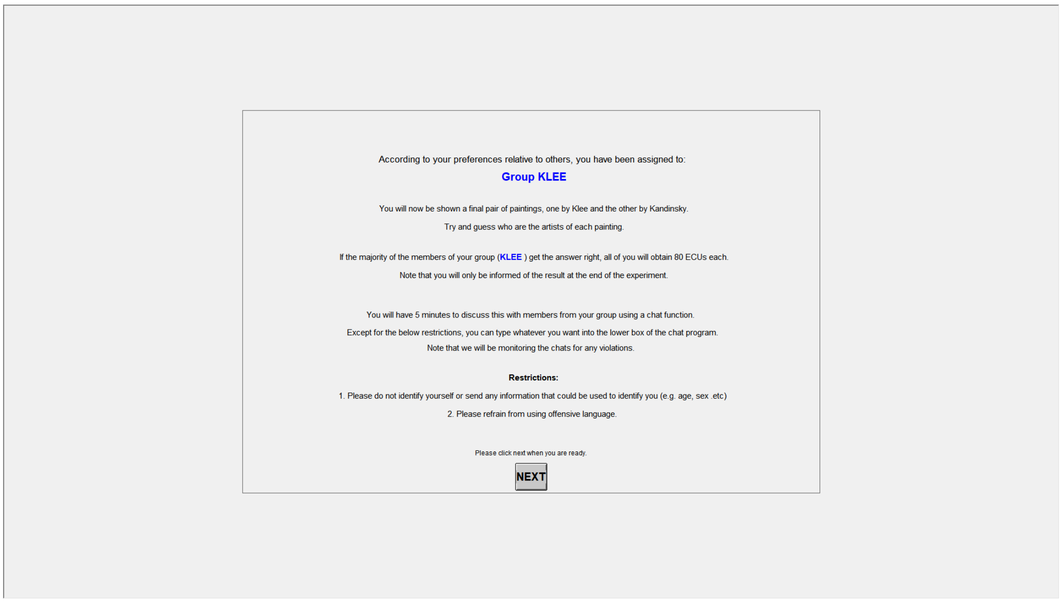
Stage 1: Pair 4



Stage 1: Pair 5



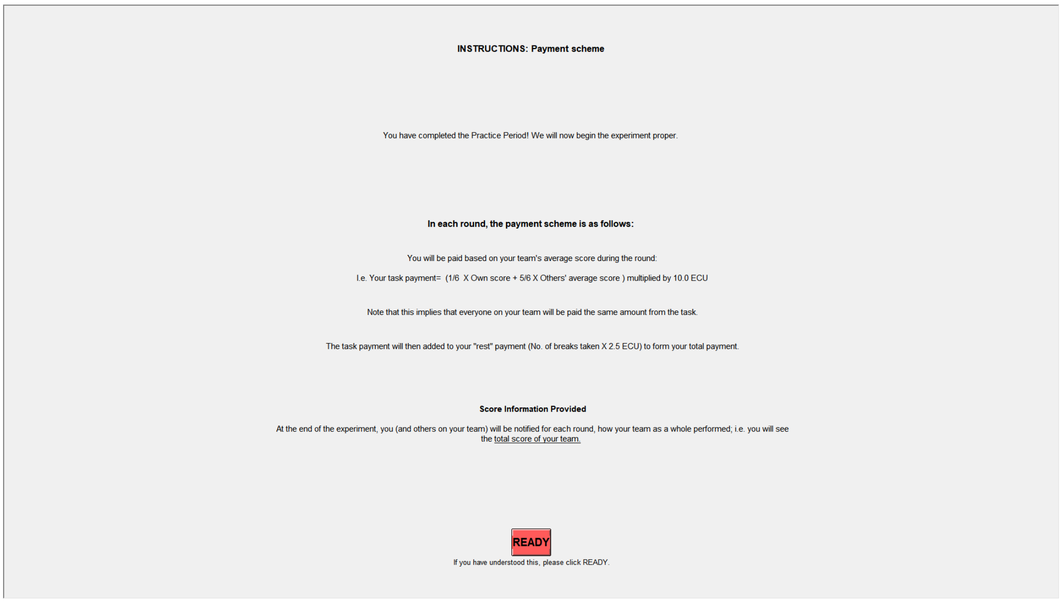
Stage 1: Group allocation, Kandinsky



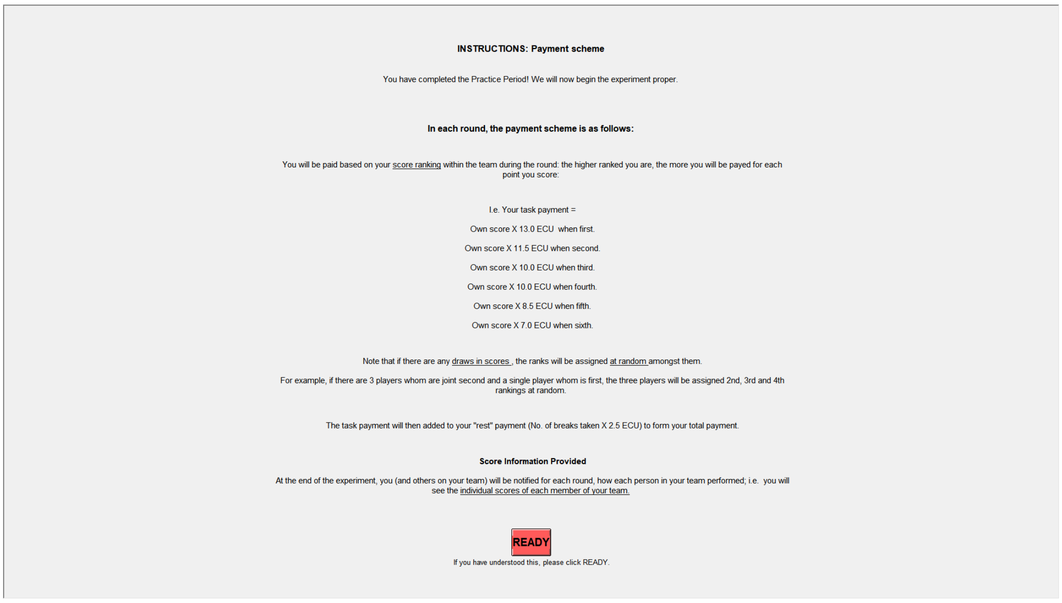
Stage 1: Group allocation, Klee

Stage 1: Pair 6, Discussion

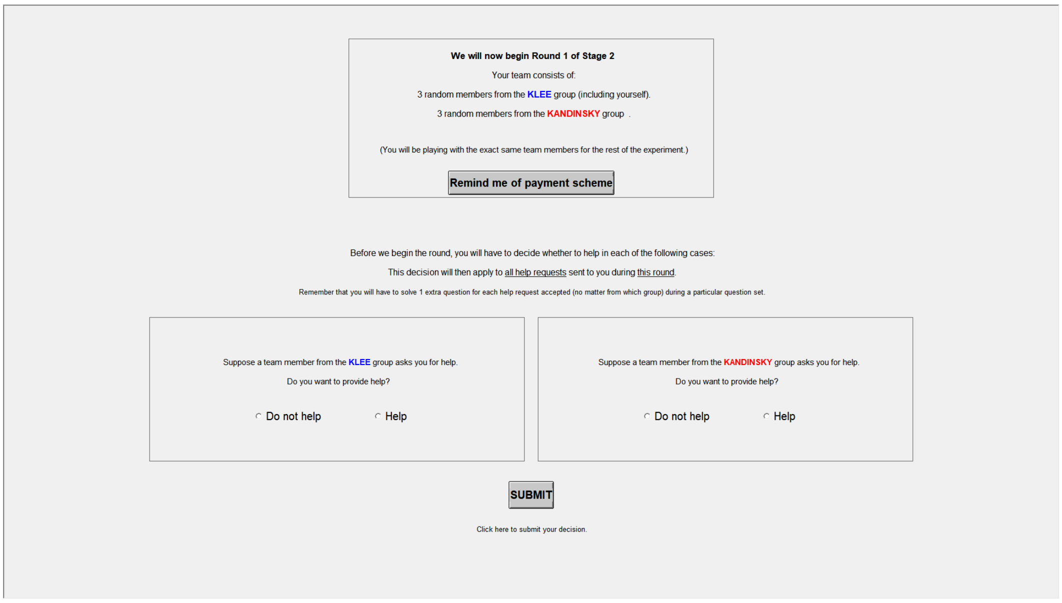
Stage 1: Pair 6, Answer



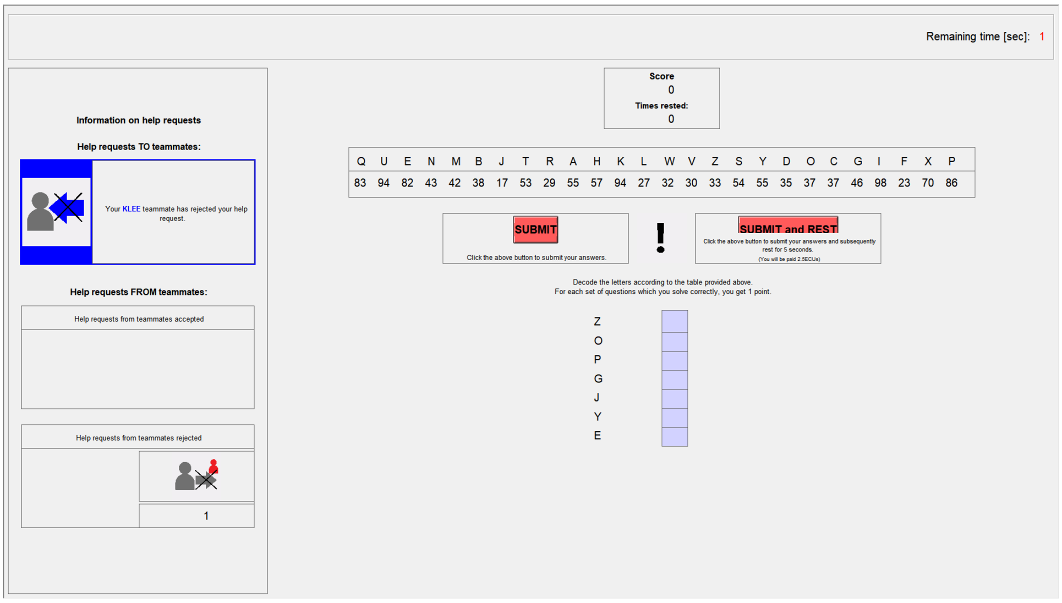
Stage 2: Team Pay Instructions



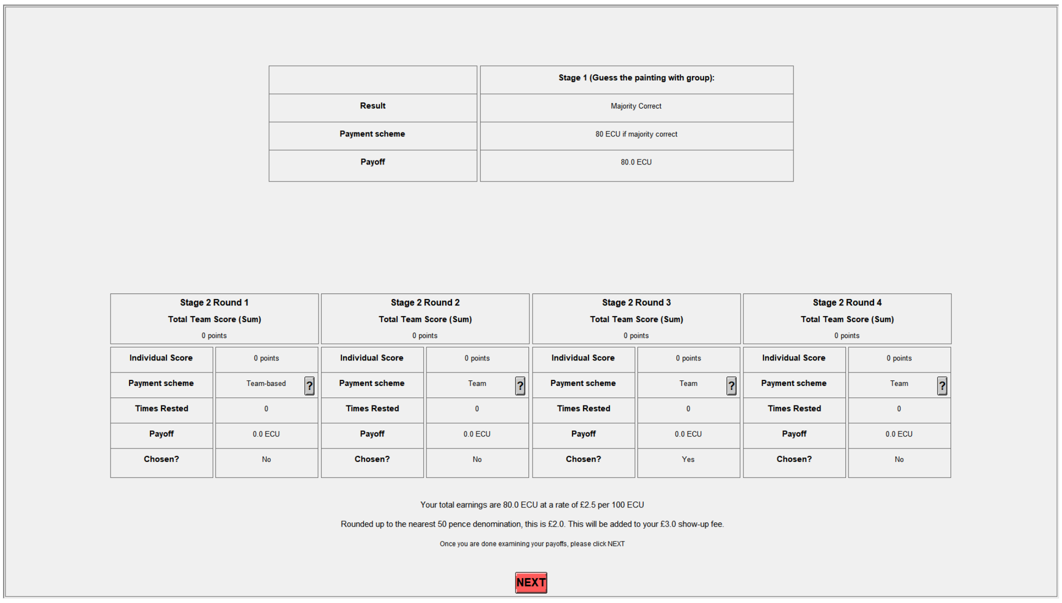
Stage 2: Tournament Pay Instructions



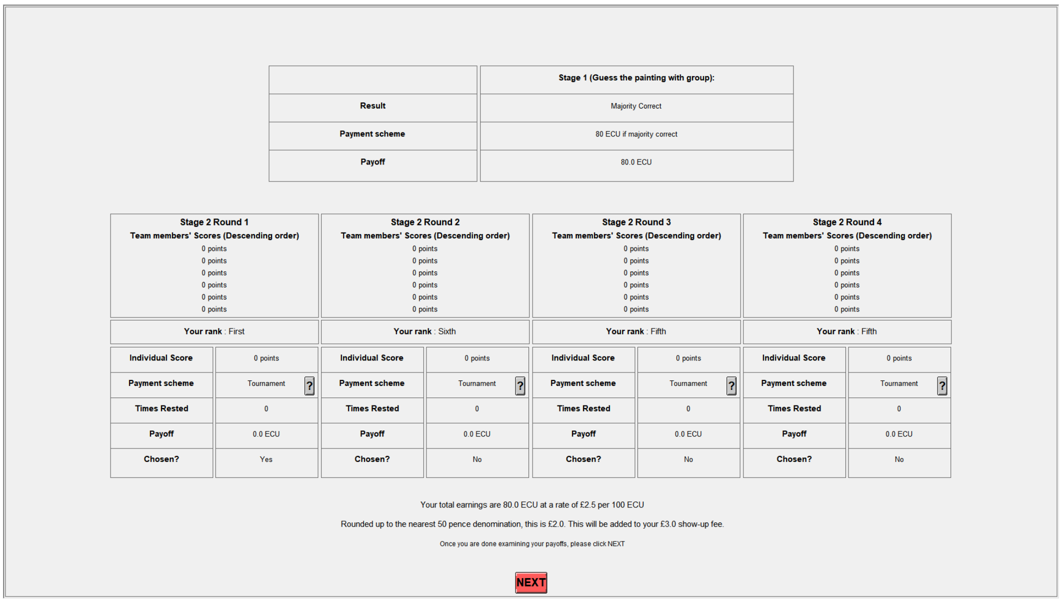
Stage 2: Help Screen



Stage 2: Game Screen



Stage 2: Payment screen, Team Pay



Stage 2: Payment screen, Tournament Pay

B.3.3 Post-Experiment Survey

Demographic questions

What is your age? (If you would prefer not to answer, please leave it blank.)

What is your year of study? [*1st Year, 2nd Year, 3rd Year, 4th Year, Postgraduate*]

What is your course of study?

What is your nationality?

What is your gender? [*Male, Female, I'd prefer not to answer, Other*]

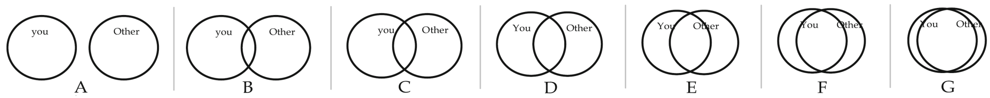
Stage 1 questions

Please rate how closely attached you felt to your own group (KLEE/KANDINSKY) throughout the experiment. [*1: Not at all - 7: Very attached*]

How familiar are you with the artist Wassily Kandinsky and his work?
[*1: Not at all familiar - 7: Very familiar*]

How familiar are you with the artist Paul Klee and his work?
[*1: Not at all familiar - 7: Very familiar*]

The following questions refer to your feelings after Stage 1 of the experiment.
Please select the option which best describes your feelings toward the *KLEE* group after Stage 1 of the experiment.
Please select the option which best describes your feelings toward the *KANDINSKY* group after Stage 1 of the experiment.



Stage 2 questions

How well did you understand the instructions and the decoding task in Stage 2?
[*1: Did not understand at all - 7: Understood it very well*]

Please tell us how you felt about the decoding task in Stage 2?
[*1: Very Boring - 7: Very Interesting*]

Please select the option which you feel is most likely to be the ranking of your scores within the team. [*First, Second, Third, Fourth, Fifth, Sixth*]

How stressful did you feel the decoding task was? [*1: Not stressful at all - 7: Very stressful*]

Please tell us your preferred team composition (I.e. which group KLEE/KANDINSKY the other 5 members come from) if you had a choice? [*5 Klee; 4 Klee, 1 Kandinsky; .... 5 Kandinsky*]

Please enter a monetary amount (ECU equivalent between 0 and 20) which best describes your value of solving an additional question set during the decoding task.

In solving a single set of 3 decoding questions, how do you think your own group will perform relative to the other group on average? (Groups here refer to KLEE/KANDINSKY).
[*1: Much worse (slower on average) - 7: Much better (faster) on average*]

Items were randomised within the section.

Stage 2 questions (continued)

If you could choose not to ask for help from teammates during the task, to what extent would you want to do so? [*1: Do not want to ask for help - 7: Want to ask for help*]

Please rate as below how you think others on your team felt about helping others during the decoding task. [*1: Irritated to be asked for help - 7: Pleased to be able to help*]

Please rate as below how you felt about helping others during the decoding task.
[*1: Irritated to be asked for help - 7: Pleased to be able to help*]

Please rate as below how much effort you felt you were putting into the decoding task.
[*1: Not much effort - 7: A lot of effort*]

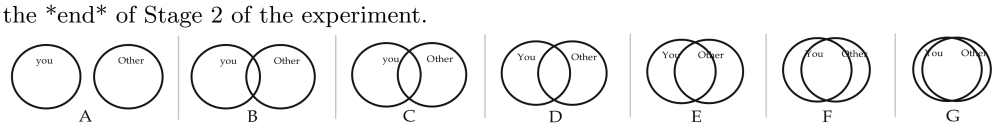
With respect to the decoding task, how do you think taking breaks will affect your total payment?
[*1: Total payment decreases - 7: Total payment increases*]

If there was a round where you chose to help during the decoding task, why did you do so? (Multiple choice) [*I wanted to encourage others to help; I wanted to have a higher payoff; I wanted to gain others' respect; Helping others is the right thing to do; I felt pressured by my teammates to help; Not applicable (I never helped); Other:*]

Please select the statement which best describes how you would feel about providing help in the decoding task if others on your team were more cooperative.
[*I would be glad to provide help as well; It would not affect my helping decisions, helping is not important to me here; It would not affect my helping decisions, helping is important to me no matter what others do; I would feel pressured to provide help as well; Other:*]

With respect to the decoding task, how do you think YOUR provision of help to others will affect the TOTAL score of the team? (4 = no effect on total score)
[*1: Total score decreases - 7: Total score increases*]

Please select the option which best describes your feelings toward your 6-person workteam at the *beginning* of Stage 2 of the experiment.
Please select the option which best describes your feelings toward your 6-person workteam at the *end* of Stage 2 of the experiment.



Items were randomised within the section.

Stage 2 questions (agree/disagree)

The questions here concern your experiences during the decoding task in Stage 2. Please tell us how much you agree with the following statements (4 = Neither Agree nor Disagree).
[*1: Strongly Disagree - 7: Strongly Agree*]

I would continue working together with the same team members even if I could choose to join another team.

I felt that I was playing for myself throughout the decoding task.

I felt that I was playing as a team throughout the decoding task.

I felt pressured by *myself* to provide help.

I felt pressured by my *teammates* to provide help.

I valued being able to help others during the decoding task.

I felt that others on my team valued being able to help others during the decoding task.

I felt that helping others during the task is the right thing to do.

I felt that others on my team believed that helping others is the right thing to do.

I felt upset when others on my team did not provide help.

I felt that others on my team would be upset if I did not provide help.

If I received help from a teammate, I felt (would be) appreciative towards them.

I felt that others on my team would be appreciative of an individual whom provided help.

I felt (would feel) bad if I did not provide help to others on my team because it goes against *MY* values.

I felt (would feel) bad if I did not provide help to others on my team because it goes against *OTHERS* values.

I felt that my help requests were causing trouble for my teammates.

The helping choices of others affected my decision of whether to help.

I felt that others on my team would be upset if I did not put in effort into the decoding task.

I felt that I had to put in my best effort into the decoding task to match the effort of others on the team.

I felt worried about taking breaks during each round because others on my team might be putting a lot of effort.

Items were randomised within the section.

Appendix C

C.1 Supplementary Analysis

	Mean Response (SD)
Pledging strategies ranked by importance	
(1) I pledged eggs because I wanted to win elections.	7.409 (2.989)
(2) I pledged eggs because I was concerned with fairness.	4.424 (3.440)
Voting strategies ranked by importance	
(1) I voted for the candidate who pledged the most eggs.	6.432 (2.873)
(2) I voted against the candidate with the most chickens because I thought more competition would increase pledges to voters.	5.652 (3.327)
(3) I voted against the candidate with the most chickens because it was the fair thing to do.	4.924 (3.211)
(4) I voted for candidates who pledged a large share of their eggs, even if they did not pledge the most.	4.811 (3.252)
(5) I voted for candidates who voted for me in the past.	4.436 (3.600)
(6) I was easily bored so I voted more or less randomly.	2.443 (2.976)
Running strategies ranked by importance	
(1) I chose whether to be a candidate or voter depending on what I thought would get me the most eggs.	6.833 (2.791)
(2) I sometimes chose to vote because I wanted to support/oppose a particular candidate, even when I thought it would not get me the most eggs.	5.523 (3.514)
(3) I sometimes chose to be a candidate because I wanted to oppose someone I wanted to see lose, even when I thought it would not get me the most eggs.	4.674 (3.519)
(4) I sometimes chose to vote because I felt it was unfair to be a candidate too often or win too many chickens.	4.580 (3.719)
(5) I was easily bored so I chose whether to be a voter or a candidate more or less randomly.	2.466 (2.965)
Luck?	
To what extent do you think winning chickens was a matter of luck?	6.614 (2.826)

Responses are on a likert scale from 0 to 10.

Table C.1: Survey Results (Baseline)

	Wealth Gini
Group voted based on winning eggs	0.032***
	(0.011)
Group voted based on fairness	-0.026**
	(0.011)
Constant	0.234**
	(0.091)
Observations	44

* 0.10 ** 0.05 *** 0.01, Group level OLS.

Table C.2: Correlation between Survey Responses and Inequality (Baseline)

	Mean Response (SD)
Voting strategies ranked by importance	
(1) I voted against the candidate with the most chickens because it was the fair thing to do.	6.976 (3.525)
(2) I voted for candidates who voted for me in the past.	6.720 (3.340)
(3) I was easily bored so I voted more or less randomly.	1.632 (2.441)
Running strategies ranked by importance	
(1) I sometimes chose to vote because I wanted to support/oppose a particular candidate.	6.432 (3.342)
(2) I chose whether to be a candidate or voter depending on what I thought would get me the most eggs.	6.256 (3.255)
(3) I sometimes chose to vote because I felt it was unfair to be a candidate too often or win too many chickens.	6.064 (3.512)
(4) I sometimes chose to be a candidate because I wanted to oppose someone I wanted to see lose	3.504 (3.585)
(5) I was easily bored so I chose whether to be a voter or a candidate more or less randomly.	1.336 (2.016)
Luck?	
To what extent do you think winning chickens was a matter of luck?	5.256 (2.932)

Responses are on a likert scale from 0 to 10.

Table C.3: Survey Results (No-Pledge)

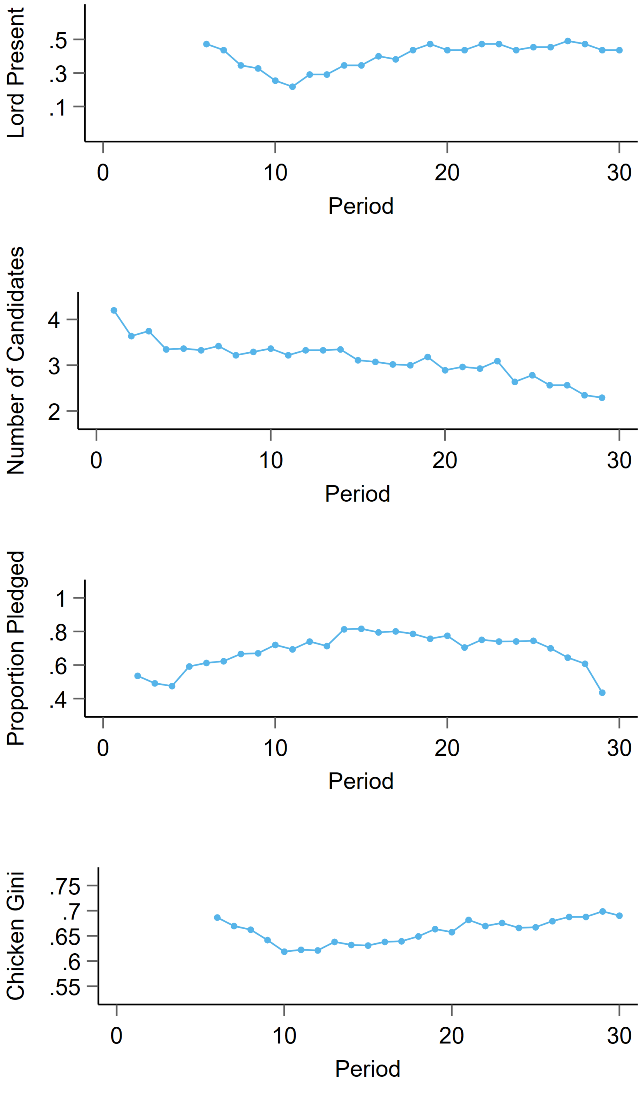


Figure C.1: Time Trends

C.2 Supplementary Material

C.2.1 Instructions (Baseline)

Ground Rules

Welcome to the experiment. Please read the instructions below carefully.

Communication between participants is not allowed. Also, please refrain from using any communication devices. If you have any questions at any time, please raise your hand and an experimenter will come over to see you.

If you need to write anything, please use the paper and pen provided. Please do not write anything on this instruction sheet.

Groups and Privacy

The computer will randomly assign you to a group of *six* participants. You will interact only with the participants in your group. The computer will randomly select an ID for you, such as "Cabbage" or "Potato." You will keep the same ID throughout the experiment.

Your decisions in the experiment will be anonymous, and your anonymity will be strictly preserved. Participants will interact with each other using only their IDs. For example, you may learn that "Cabbage has voted for you"; but you will not be told the real name of "Cabbage."

Chickens and Eggs

In this experiment, you may win *chickens* that lay *eggs* for you. You may give some of your eggs to other participants. At the end of the experiment, your eggs will be converted into dollars at the rate of 5 eggs to $1.

Rounds

The experiment will consist of 30 rounds.

In each round, except the final round, an election will take place. The winner of the election receives a chicken. Chickens lay eggs for five rounds, and then retire.

Your Coop and Your Basket

Your chickens live in your chicken *coop*. At the start of each round, each of your chickens lays two eggs in the coop. You may give some of these eggs to other participants.

At the end of the round, the eggs in your coop are transferred to your egg *basket*.

Details of Elections

In each round except the final round, there is an election to determine who will win a chicken. You will have a choice whether to 1) be a candidate in the election or 2) a voter in the election. One voter will be selected at random by the computer to be the *deciding voter*. The election outcome will be determined by the deciding voter's vote.

The election will proceed as follows:

Step 1: If you are a candidate, you may pledge to give some eggs from your coop to the deciding voter if he/she votes for you.

Step 2: If you are a voter, you will choose whom to vote for after observing the candidate's pledges. The computer will then randomly select the deciding voter.

Step 3: At the end of the election, the election winner's pledge will be transferred to the deciding voter's basket.

If nobody chooses to be a candidate or nobody chooses to be a voter, the computer randomly allocates the chicken to one participant.

Final Round

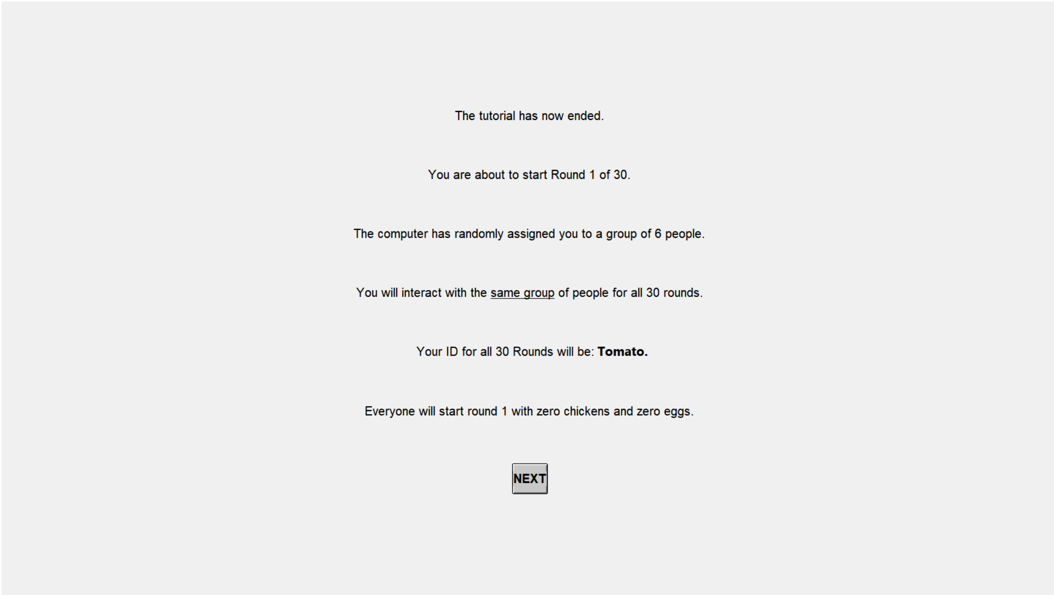
In the final round, there is no election. Each chicken's eggs are immediately placed in its owner's basket.

Payment

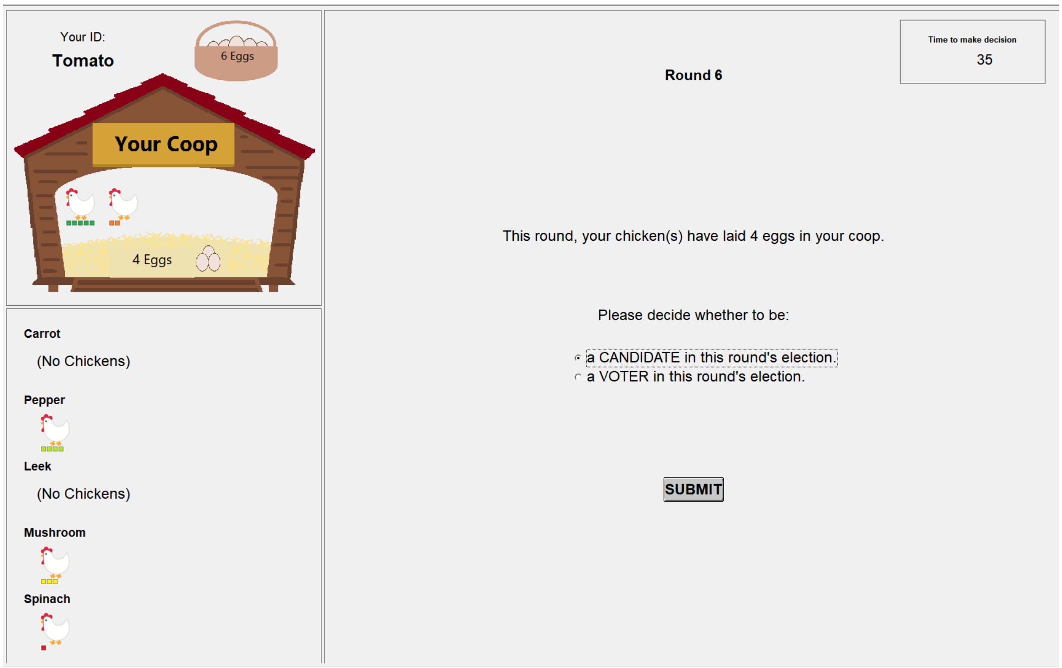
At the end of the experiment, the eggs in your basket will be converted into dollars at the rate of 5 eggs to $1. You will also receive a show-up fee of $5. You will be paid privately and confidentially.

You will be asked to fill in a short questionnaire before being paid.

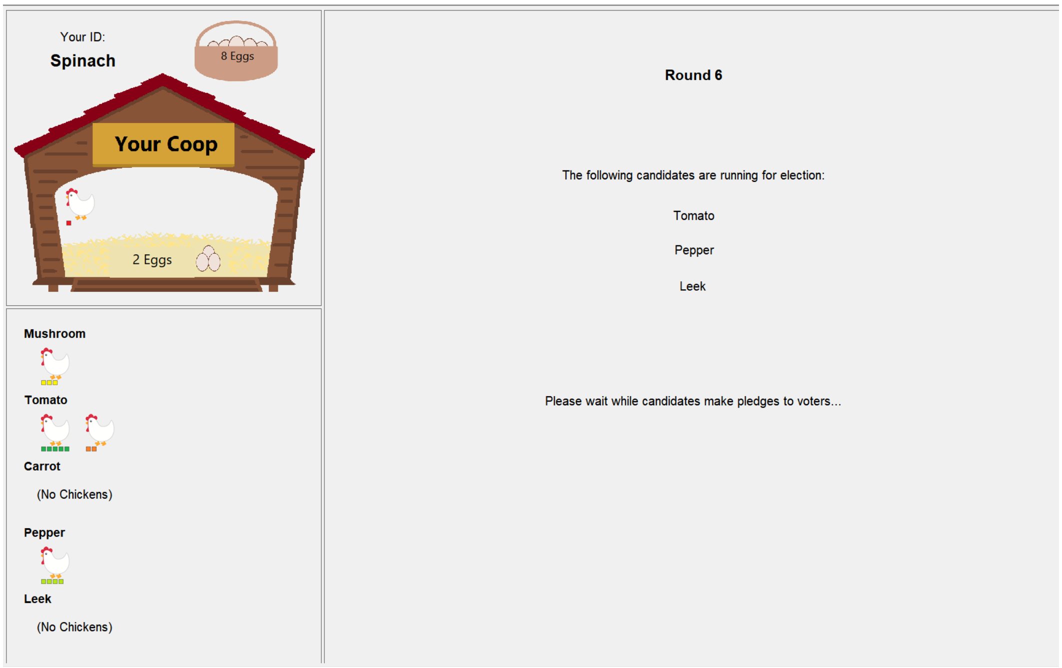
C.2.2 Screenshots (Baseline)



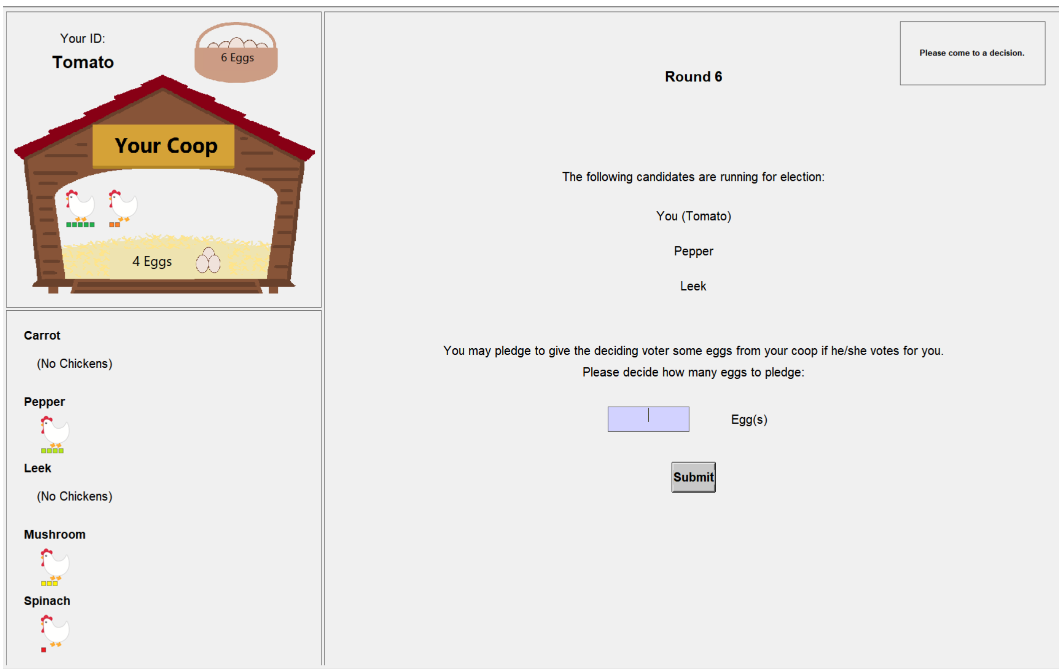
Start Screen



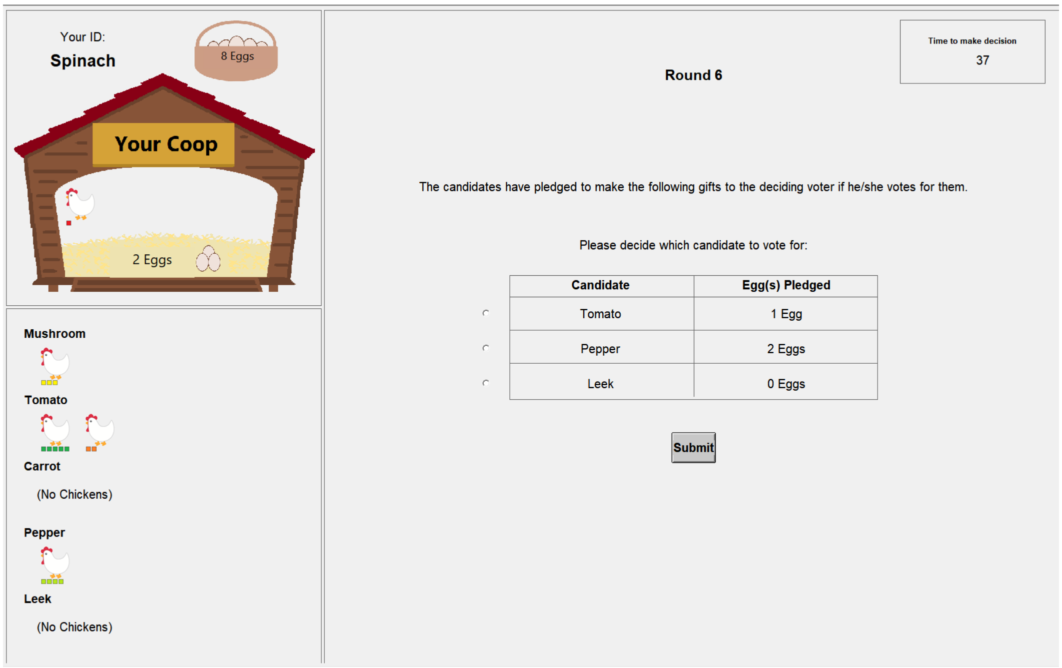
Screen 1



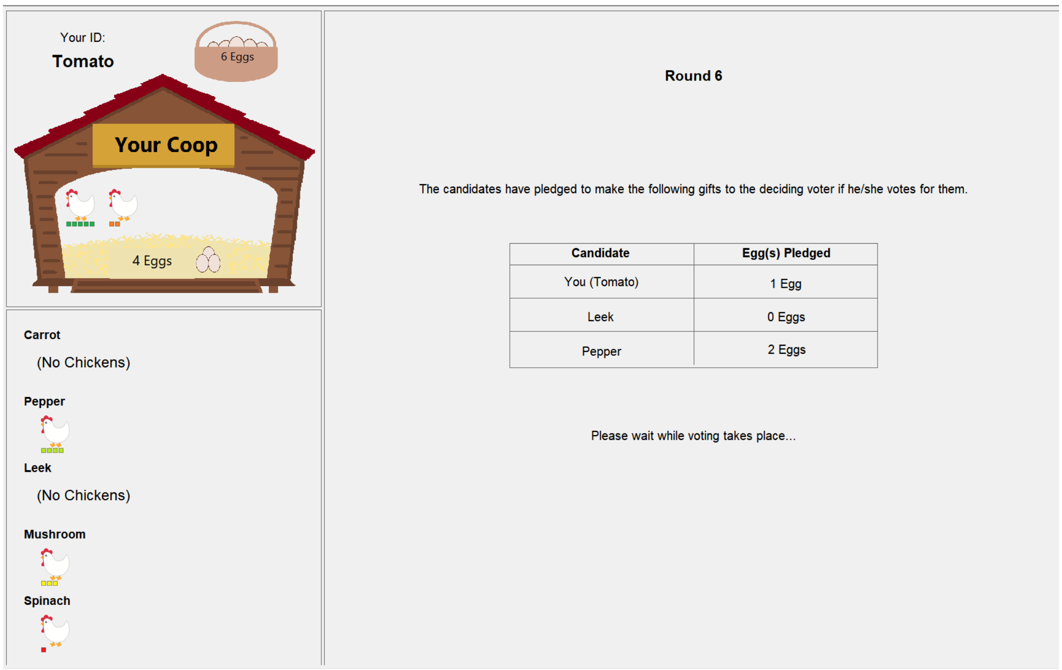
Screen 2 (Voter)



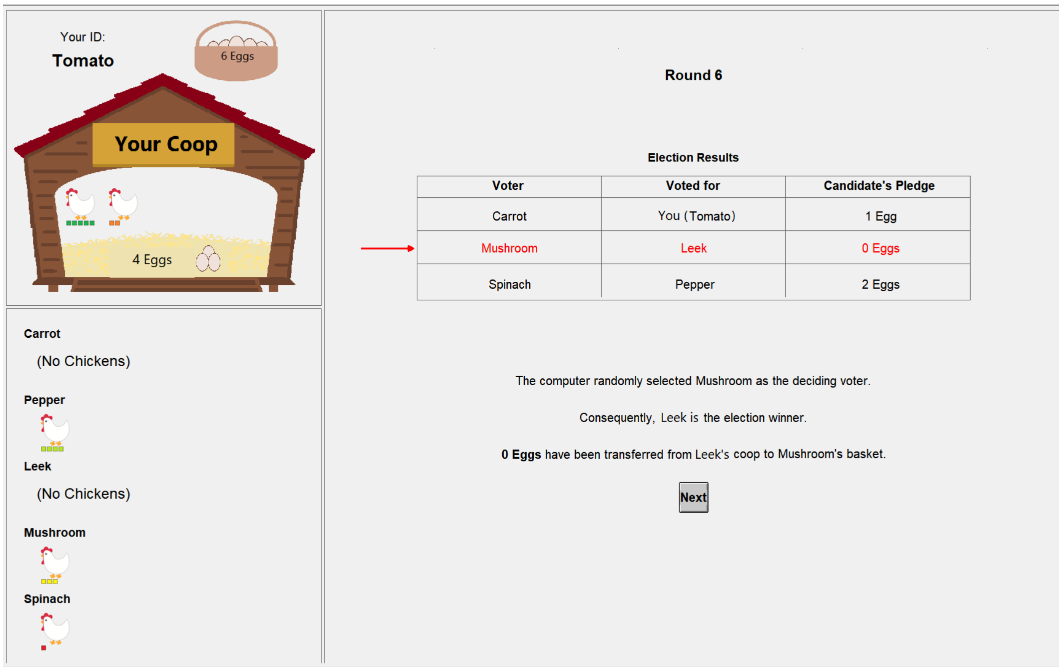
Screen 2 (Candidate)



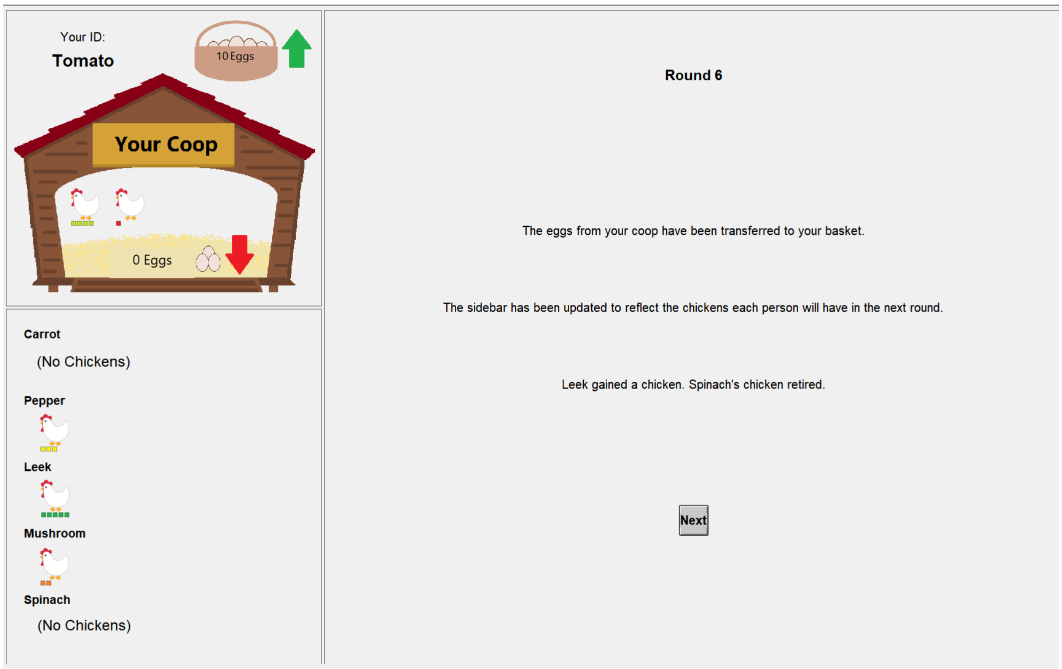
Screen 3 (Voter)



Screen 3 (Candidate)

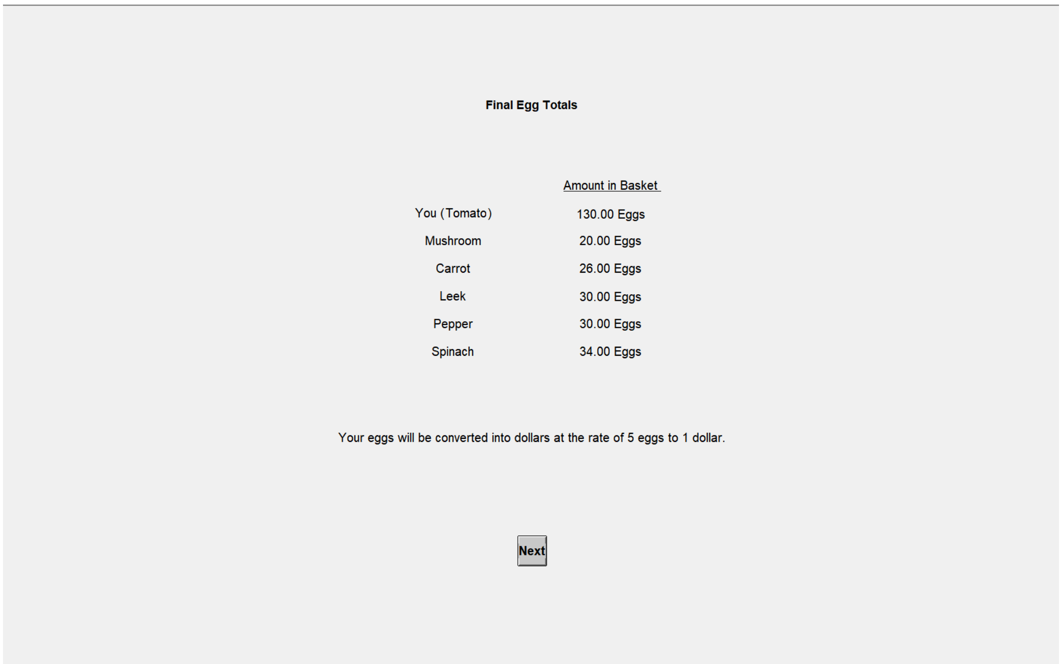


Screen 4



Screen 5

End Screen 1



Final Egg Totals

	Amount in Basket
You (Tomato)	130.00 Eggs
Mushroom	20.00 Eggs
Carrot	26.00 Eggs
Leek	30.00 Eggs
Pepper	30.00 Eggs
Spinach	34.00 Eggs

Your eggs will be converted into dollars at the rate of 5 eggs to 1 dollar.

Next

End Screen 2

C.2.3 Instructions (No Pledge)

Ground Rules

Welcome to the experiment. Please read the instructions below carefully.

Communication between participants is not allowed. Also, please refrain from using any communication devices. If you have any questions at any time, please raise your hand and an experimenter will come over to see you.

If you need to write anything, please use the paper and pen provided. Please do not write anything on this instruction sheet.

Groups and Privacy

The computer will randomly assign you to a group of *six* participants. You will interact only with the participants in your group. The computer will randomly select an ID for you, such as "Cabbage" or "Potato." You will keep the same ID throughout the experiment.

Your decisions in the experiment will be anonymous, and your anonymity will be strictly preserved. Participants will interact with each other using only their IDs. For example, you may learn that "Cabbage has voted for you"; but you will not be told the real name of "Cabbage."

Chickens and Eggs

In this experiment, you may win *chickens* that lay *eggs* for you. At the end of the experiment, your eggs will be converted into dollars at the rate of 5 eggs to $1.

Rounds

The experiment will consist of 30 rounds.

In each round, except the final round, an election will take place. The winner of the election receives a chicken. Chickens lay eggs for five rounds, and then retire.

Your Coop and Your Basket

Your chickens live in your chicken *coop*.

At the start of each round, each of your chickens lays two eggs. These eggs are put in your *basket*.

Details of Elections

In each round except the final round, there is an election to determine who will win a chicken. You will have a choice whether to 1) be a candidate in the election or 2) a voter in the election.

If you choose to be a voter, you will cast a vote for one of the candidates. The computer will then randomly select a *deciding voter*. The election outcome will be determined by the deciding voter's vote.

If nobody chooses to be a candidate or nobody chooses to be a voter, the computer randomly allocates the chicken to one participant.

Final Round

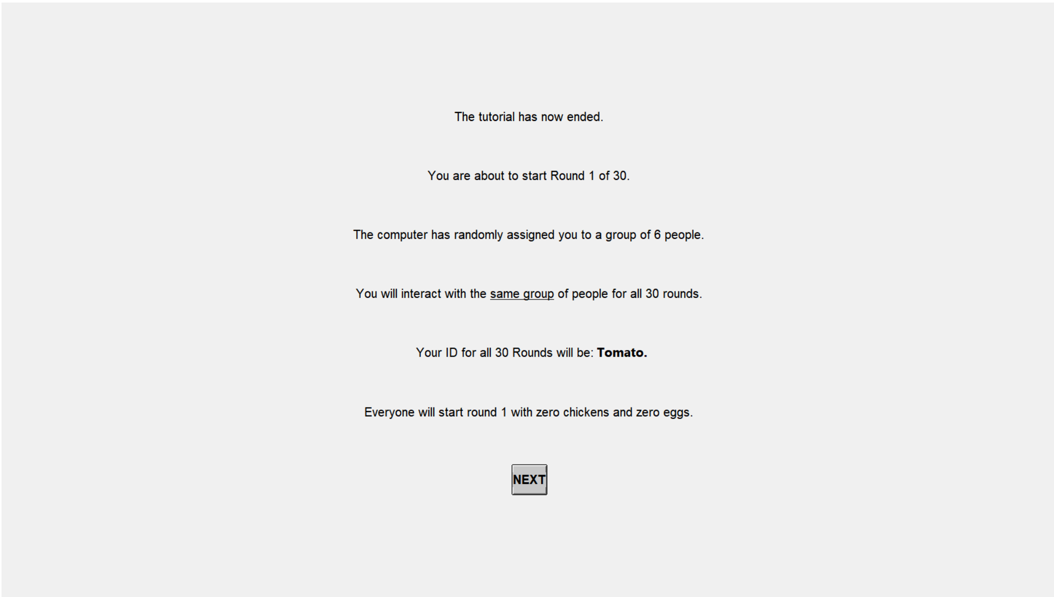
In the final round, there is no election. You will simply receive the eggs laid by your chickens.

Payment

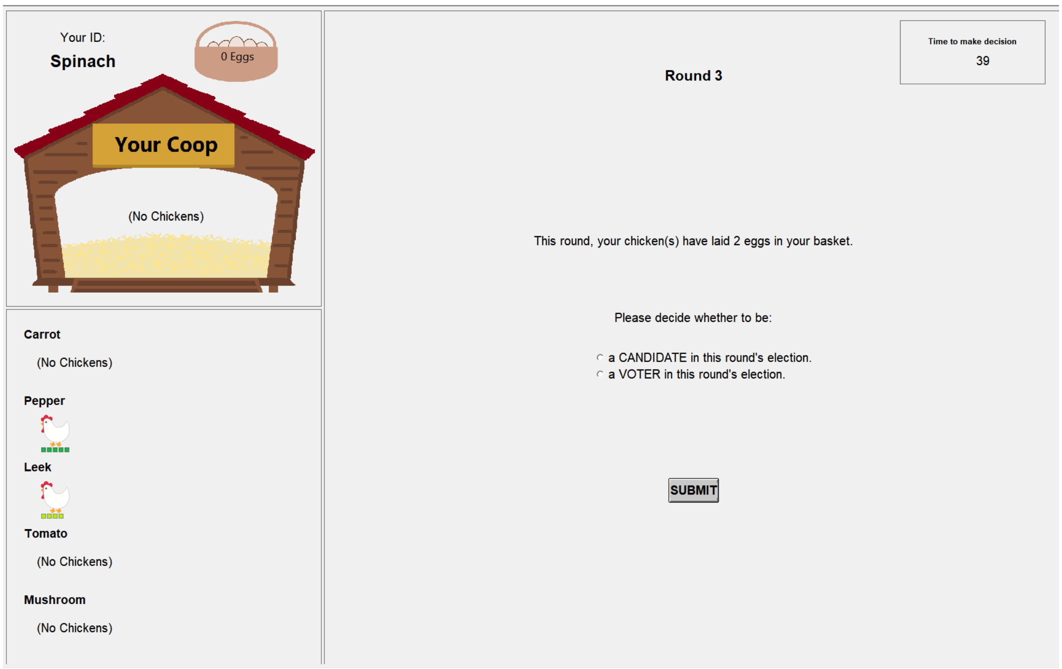
At the end of the experiment, the eggs in your basket will be converted into dollars at the rate of 5 eggs to $1. You will also receive a show-up fee of $5. You will be paid privately and confidentially.

You will be asked to fill in a short questionnaire before being paid.

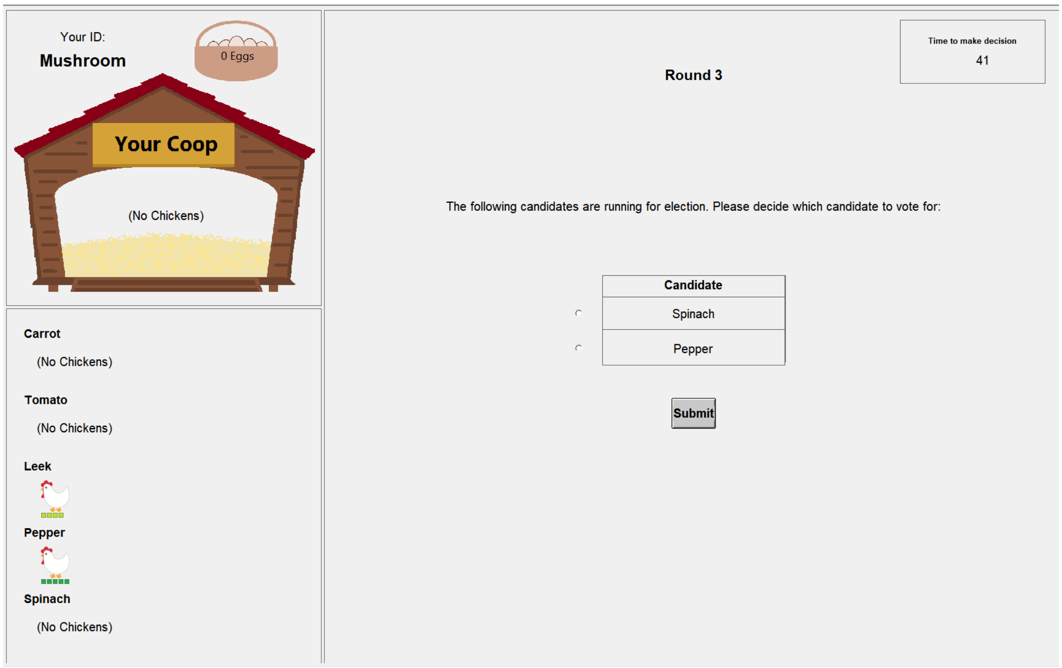
C.2.4 Screenshots (No Pledge)



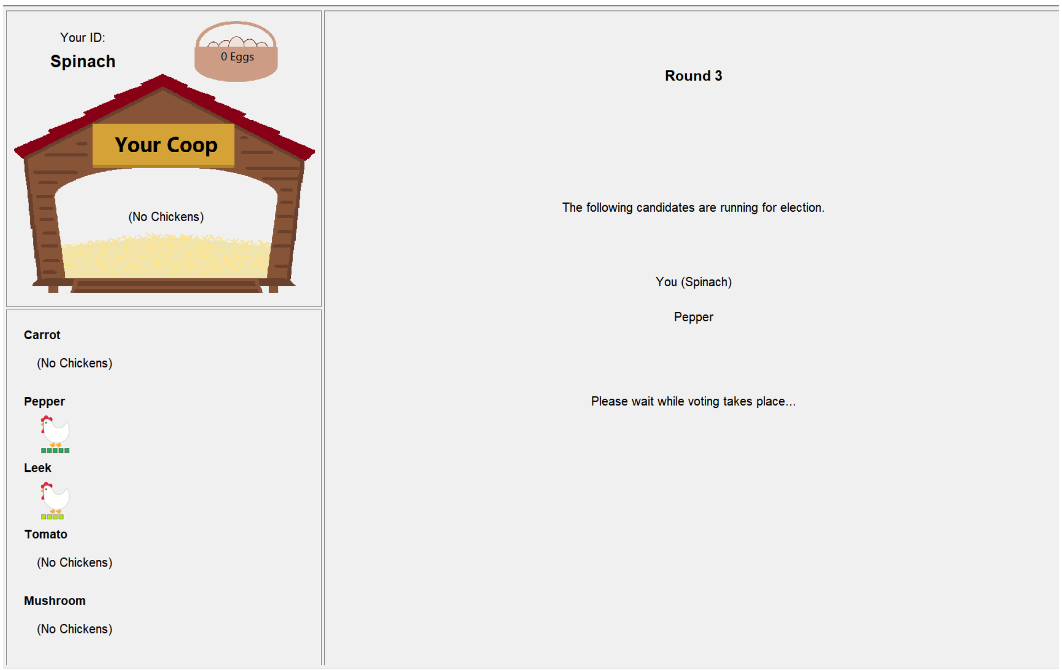
Start Screen



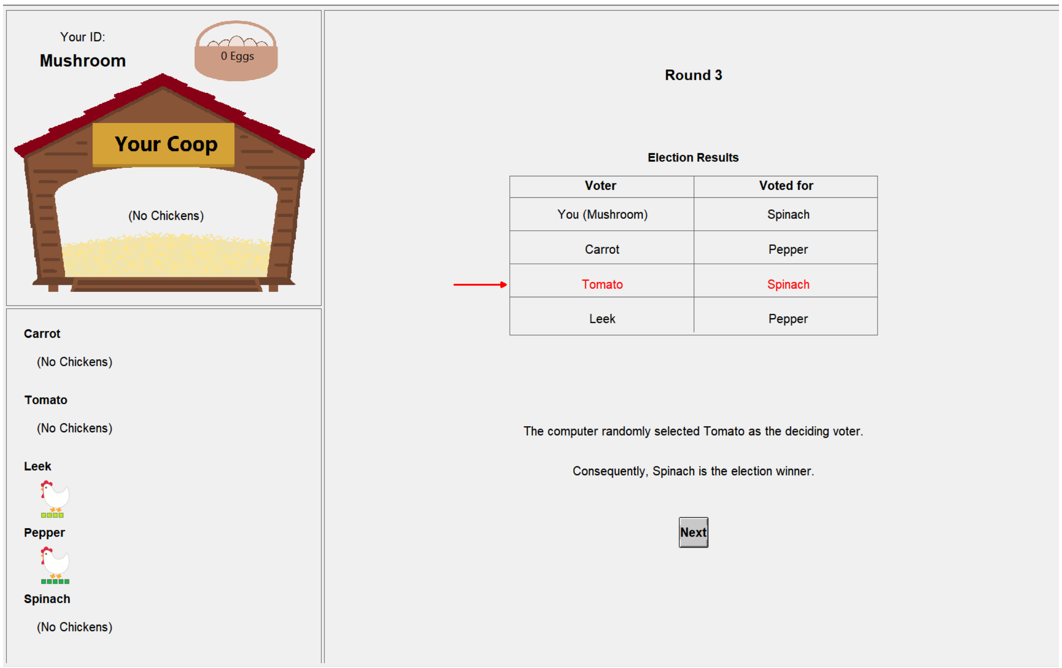
Screen 1



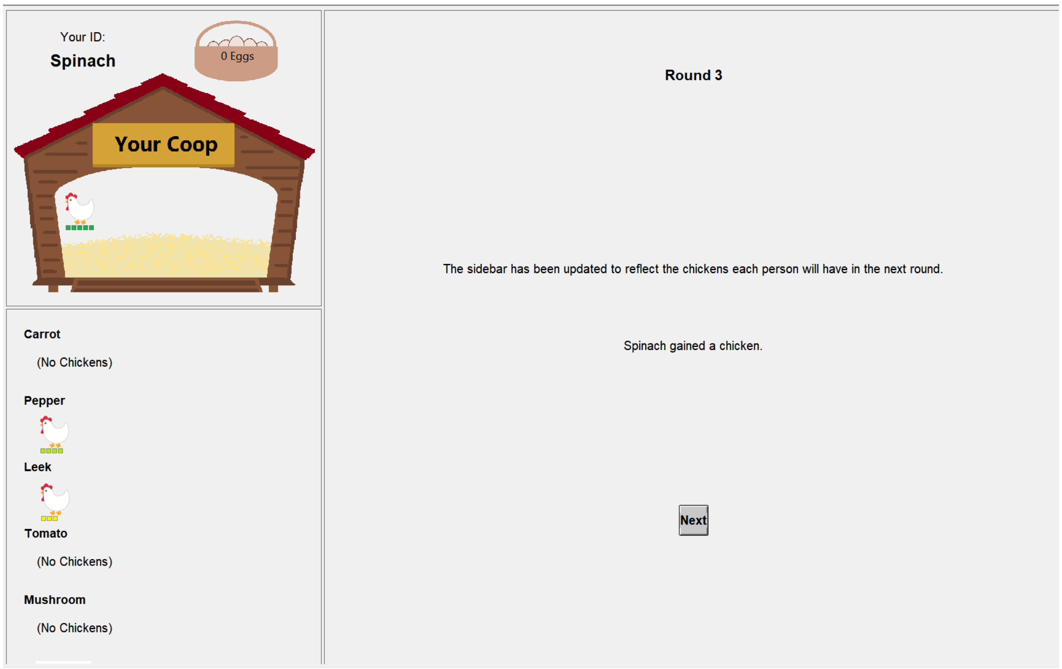
Screen 2 (Voter)



Screen 2 (Candidate)



Screen 3



Screen 4

C.2.5 Post-Experiment Survey

Demographic questions

What is your age? *(If you would prefer not to answer, please leave it blank.)*

What is your year of study? [*1st Year, 2nd Year, 3rd Year, 4th Year, Postgraduate*]

What is your nationality?

What is your course of study?

What is your gender?
[*Male, Female, I'd prefer not to answer, Other (Please describe if you wish)*]

Voting behaviour*

How well do the following statements describe the strategies you followed as a voter? *Note if you never voted, please indicate how you think you would have voted.* [*0: Not well at all - 10: Extremely well*]

(B) I voted for the candidate who pledged the most eggs.

(B) I voted for candidates who pledged a large share of their eggs, even if they did not pledge the most.

(B) I voted against the candidate with the most chickens because I thought more competition would increase pledges to voters.

I voted against the candidate with the most chickens because it was the fair thing to do.
I voted for candidates who voted for me in the past.

I was easily bored so I voted more or less randomly.

Are there other strategies you followed? If so, please describe below.

Pledging behaviour*

How well do the following statements describe your reasons for pledging eggs when you were a candidate? *Note: if you were never a candidate, please indicate how you think you would have pledged.*
[*0: Not well at all - 10: Extremely well*]

(B) I pledged eggs because I was concerned with fairness.

(B) I pledged eggs because I wanted to win elections.

(B) Are there other reasons you pledged eggs? If so, please describe below.

Running behaviour*

How well do the following statements describe your reasons for choosing whether to be a candidate or a voter in each round? [*0: Not well at all - 10: Extremely well*]
I chose whether to be a candidate or voter depending on what I thought would get me the most eggs.

I sometimes chose to vote because I felt it was unfair to be a candidate too often or win too many chickens.

(NP) I sometimes chose to vote because I wanted to support/oppose a particular candidate.

(B) I sometimes chose to vote because I wanted to support/oppose a particular candidate, even when I thought it would not get me the most eggs.

(NP) I sometimes chose to be a candidate because I wanted to oppose someone I wanted to see lose.

(B) I sometimes chose to be a candidate because I wanted to oppose someone I wanted to see lose, even when I thought it would not get me the most eggs.

I was easily bored so I chose whether to be a voter or a candidate more or less randomly.

Are there other reasons why you chose to be a candidate or voter? If so, please describe below.

(B): only for baseline treatment. (NP): only for No Pledge treatment.
*Order of questions within section was randomised.

Miscellaneous questions

To what extent do you think winning chickens was a matter of luck?
[*0: Not Luck - 10: Mostly Luck*]

How much do you value having authority over other people? [*0: Not at all - 10: A lot*]

Was there anything unclear about the instructions?

Disadvantageous inequity aversion

In each row below, you will have to choose between hypothetical allocations of experimental Coins between yourself and another. Please select for each row, which option you prefer.

(1) Option A: You: 12.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(2) Option A: You: 11.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(3) Option A: You: 10.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(4) Option A: You: 9.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(5) Option A: You: 8.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(6) Option A: You: 7.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(7) Option A: You: 6.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(8) Option A: You: 5.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(9) Option A: You: 4.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins
(10) Option A: You: 3.5 Coins, Other: 15 Coins	Option B: You: 10 Coins, Other: 26 Coins

Advantageous inequity aversion

In each row below, you will have to choose between hypothetical allocations of experimental Coins between yourself and another. Please select for each row, which option you prefer.

(1) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(2) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(3) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(4) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(5) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(6) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(7) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(8) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(9) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins
(10) Option A: You: 18.5 Coins, Other: 9 Coins	Option B: You: 17 Coins, Other: 5 Coins

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