5-2022

Essays on Delegation and Voter Preferences

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Essays on Delegation and Voter Preferences

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Economics

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by
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May 2022

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Abstract

Chapter 1 examines delegation and communication as strategies in coordination games with uncertainty and social preferences. I construct a model where other-regarding partners attempt to coordinate over a binary choice with privately known utilities. Players can choose to either communicate by signaling their preferences or delegate the choice entirely to their partner. I characterize equilibrium behavior under various assumptions on information transmission and coordination risk. If coordination is risky, there is a type of "first mover advantage" where the first player to communicate her own-preference guarantees her ideal outcome when communication is honest revelation. When preference signals are cheap talk, players cannot credibly communicate own-preferences to solve the coordination problem, leading to equilibria where one player always delegates. When coordination is not risky, the game becomes one of pure information transmission where communication is inhibited by strong other-regarding preferences.

Chapter 2 presents a model of decision making comparing expertise and altruism as rationales for delegating decision rights. I show that these rationales have different underlying motivations, leading to different predictions in equilibrium delegation. For expertise-driven delegation, a decision maker is more likely to delegate to experts who agree with him. However, this "ally principle" is not present in altruistic delegation. An altruistic decision maker is more willing to delegate to individuals with whom she disagrees.

Chapter 3 presents a theoretic model and the results of a subsequent laboratory experiment to understand voter preferences over leader characteristics. We develop a two-stage model of elections where agents with heterogeneous competence and pro-social preferences must elect a representative entrusted with resources whose growth depends on their competence, but can extract resources for private gain. Voter decisions are informed by observation of candidate competence and decisions in a preceding trust game. A three category representative typology emerges from the model, wherein incentives for performative trustworthiness by "crooks" are counter-balanced by opportunities for costly signaling by "fair" and "honest" candidates. We find support for the models predictions in treatments varying in leader compensation and compulsory contributions to public resources. Incentives for "performative trustworthiness" result in voters conditionally weighting their decisions towards competence while also serving as a costly signal to earn risk-minimizing voters' *benefit of the doubt*.

Dedication

I am nothing without my friends. Because of you all, the night will always be young.

Acknowledgments

I am eternally grateful for the help and guidance from my advisor, Patrick Warren, throughout my academic journey. My dissertation began as a mediocre term paper in your class and was subsequently shaped into something respectable by the Wednesday Warren Workshops and days spent solving PBEs on whiteboards. I look forward to continuing to improve my work in the WWW until you kick me out.

I would also like to thank my coauthors and committee members, Mike Makowsky and Wafa Orman, for inviting me onto their project which became my dissertation's third chapter. In addition to helpful comments and advice, you have given me my first experience collaborating on academic research, which I have no doubt will prove invaluable as I begin my career.

Many thanks to my committee member, Robert Fleck, as well as the participants in the Clemson Economics Public Choice Workshop for their help and comments the past five years.

I am beyond appreciative of my game theory professor, Chuck Thomas. Your class in my second year sparked my interest in theoretical economics and reignited my fire for economics in general. I know that if (when) I am ever struggling to solve a PBE or take a comparative static, you are the first person I will turn to. But most importantly, to me you serve as a goal post for my performance as a professor. You are the best teacher I have ever had, and I hope to one day be half teacher you are.

I am thankful for the camaraderie and friendships I have developed with my peers in the Clemson Economics PhD program. I would have never made it through first year if it weren't for the group study/problem set sessions on the chalkboard in Sirrine 420. I took that chalkboard with me, and I think about all of you whenever I use it.

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Chapter 1

"The Lovers' Dilemma:" Two-sided Uncertainty in Coordination Games

1.1 Introduction

Unlike standard coordination games with complete information like the battle of the sexes (BoS), when people attempt to coordinate on a decision, they may not know their partners' preferences. Additionally, when decisions are made in a social setting, the people involved often care about how their partners feel about the decision. For example, a husband may not know whether his spouse would rather pizza or tacos when trying to decide on dinner on a particular night. He may prefer pizza, but only if his spouse also prefers pizza. Communicating to each other their preferences may seem like a straightforward solution to the information problem, but other-regarding preferences and cheap talk make committing to honesty difficult. If a husband cares more about his spouse's preference than his own, he may want to lie and say he is indifferent. Oftentimes he may prefer to delegate the decision to his spouse entirely.

In this paper I construct a model where partners with social preferences attempt to coordinate over a binary choice with privately known own-preferences. Players can choose to either communicate and signal their preference or to delegate the choice entirely to their partner. Like classic models of information transmission (Crawford & Sobel, 1982; Milgrom & Roberts, 1982; Kreps & Wilson, 1982), players can better communicate when their utilities are more aligned. "Aligned utilities" in this model means that players care about themselves the same amount as their partners cares about them, and vice versa. Additionally, I show that the threat of coordination failure further limits the players' abilities to communicate, and players will always choose to delegate to avoid risky coordination.

Communication is first treated as honest revelation. When players can commit to honestly revealing their own-preferences, a type of "first-mover advantage" emerges in which the first player to reveal her own-preference is guaranteed her ideal outcome. After the first player reveals her own-preference, the second player will choose to communicate and coordinate only if their ideal outcomes are aligned. If they are not aligned, he delegates. In doing so, based on his sympathy he reveals enough information about his own-preference for the first player to choose her ideal outcome with certainty.

When communication is cheap talk, the first-mover advantage described above is not as strong. If an honest signal reveals that ideal outcomes are not aligned, the second player has an incentive to understate a relatively strong preference when he is selfless and to overstate a relatively weak preference when he is selfish. He does this to convince his partner that ideal outcomes are aligned when they actually are not. This incentive to lie causes a breakdown in the reliability of communication when there is risk of coordination failure, leading to equilibria in which either player 1 or player 2 always delegates.

This "Lovers' Dilemma" coordination game with two-sided uncertainty provides a general model of coordination behavior applicable to social decision-making involving family, friends, co-workers, or even strangers. Beyond social settings, the Lovers' Dilemma is applicable to joint decision-making when each person has private information that is payoff-relevant to both of them. Industrial organization applications include coordination problems across different departments in a firm, vertically integrated firms, or firms selling complementary goods. Public choice applications include coordination between connected governments and decision-making from altruistic leaders.

There are large potential gains from enriching the strategy space in coordination games to improve expected outcomes. Mixed strategy Nash equilibria in coordination games are generally inefficient, resulting in expected outcomes worse than either pure strategy Nash equilibrium. Despite mixing being the inferior equilibrium, experimental evidence from coordination games like the BoS have shown that it is what occurs in practice, and play often results in coordination failures even with complete information (Cooper et al., 1989).

Allowing for some form of communication between players prior to coordination is a common extension added to coordination models. Farrell (1987) first showed that Crawford & Sobel (1982) style cheap talk pre-communication of a player's action can improve the equilibrium probability of coordination in a BoS game, and Cooper et al. (1989) presents experimental evidence of this result. More recently, models and experiments have shown cheap talk communication of player types can improve the ex-ante probability of coordination in BoS games with incomplete information (Li et al., 2019; Hu et al., 2020).

Delegation is a less common extension. When coordinating on a group decision, delegating the choice involves an inherent trade-off. By delegating, a player guarantees coordination but gives up any influence over the chosen outcome. Aghion & Tirole (1997) model delegation to experts in principal-agent models. Experiments with delegation in voluntary-contribution public goods games show that delegating decisions to an altruistic trustee can improve coordination on giving (Corazzini et al., 2020; Makowsky et al., 2014). This paper is the first to model delegation and communication as competing strategies in a BoS style game.

In addition to contributing to the literature on delegation and communication in coordination games, this paper also contributes to the growing literature on strategic games with social preferences. Charness & Rabin (2002a) introduced social preferences in dictator games. Since then, social preferences have been incorporated into other types of strategic settings (Balafoutas et al., 2013). Gueye et al. (2020) apply social preferences specifically to coordination games in an experimental setting.

The rest of the paper is organized in the following way. Section 2 introduces and gives formal structure to the coordination game. Section 3 characterizes equilibrium behavior for both honest revelation and cheap talk communication when coordination is risky. Section 4 provides an example of communication with uncertainty and social preferences when coordination is not risky. Section 5 discusses the implications of the results and concludes.

1.2 Coordination with communication and delegation

The following model is an extension of the standard BoS game. Consider players 1 (she) and 2 (he) attempting to coordinate over options A and B. Before simultaneously choosing an option, players will have the opportunity to either communicate via some signaling method or to delegate the choice entirely to the other player. Specifics of the model are described below.

1.2.1 Preferences

Players' payoffs from coordination on option A are normalized to 0.[1] Letting $b_i \in [-1, 1]$ be player i's own-utility from option B, player i's payoff from coordination on option B is the sympathetic utility function

$$U_i = (1 - \alpha_i)b_i + \alpha_i b_j, \tag{1.1}$$

where $\alpha_i \in [0, 1]$ measures player i's relative sympathy. Player i is fully selfish when $\alpha_i = 0$ and fully selfless when $\alpha_i = 1$. For the remainder of this paper, a player's "preferred" outcome is A when $U_i < 0$ and B when $U_i > 0$, while a player's "own-preferred" outcome is A when $b_i < 0$, and B when $b_i > 0$. If the players fail to coordinate, they incur a punishment of $-\delta < -1$. Like traditional BoS games, failing to coordinate is worse than any coordinated outcome.

1.2.2 Timing and Actions

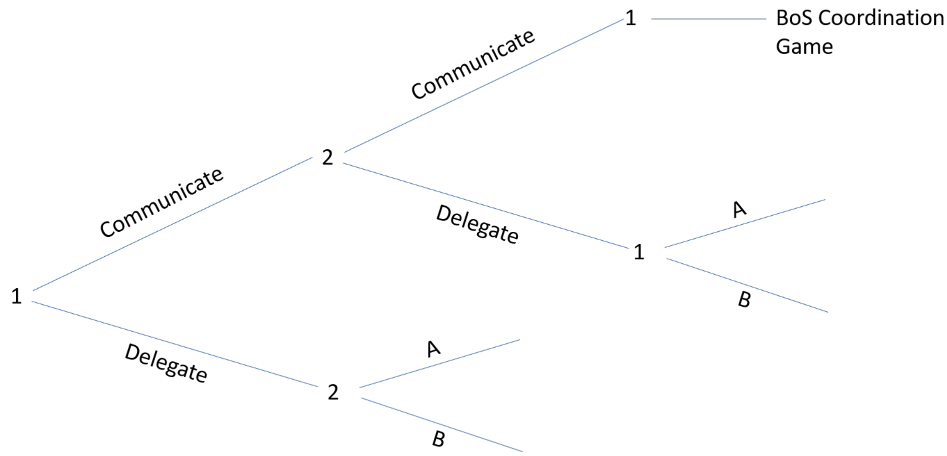
The formal timing of the game is described in the simplified game tree in Figure 1.1. First, player 1 either communicates to player 2 or delegates the choice. If player 1 delegates, player 2 chooses A or B. If player 1 communicates, player 2 either communicates or delegates the choice. If player 2 communicates, the players simultaneously choose A or B. If player 2 delegates, player 1 chooses A or B. Let $\mathcal{D}_i \subset [-1, 1]$ be the set of values of b_i for which player i delegates. Communication takes the following form. Player i sends some message $m_i(b_i) \implies b_i \in B_i(m_i) \subset [-1, 1]$. I analyze the model both when players can commit to honest revelation and when communication is cheap talk.

A strategy $s_1 \in S_1$ for player 1 specifies for all b_1 a message or delegation at his first information set and a choice of A or B if player 2 delegates or communicates. A strategy $s_2 \in S_2$ for

[1] Option A can be considered the "status quo." For binary choices with no status-quo, b_i can be considered player i's preference for option B over A.

player 2 specifies for all b_2 a choice of A or B if player 1 delegates, a message or delegation if player 1 communicates some message, and a choice of A or B if they reach the coordination stage.

Figure 1.1: Simplified game tree



1.2.3 Beliefs

The sympathy parameters α_1 and α_2 are commonly known, but own-preferences b_1 and b_2 are privately known. Player 2 is commonly known to believe b_1 is drawn from the density function $f(b)$ with support $[-1, 1]$ and distribution function $F(b)$, and player 1 is commonly known to believe b_2 is drawn from the density function $g(b)$ with support $[-1, 1]$ with distribution function $G(b)$. Player i's prior belief over b_j has expected value $\bar{b}_j$. Let $\hat{b}_j$ represent player i's posterior belief over b_j after strategy s_j.

1.2.4 Equilibrium concept

The appropriate equilibrium concept for this dynamic game of incomplete information is a perfect Bayesian equilibrium (PBE). Letting $u_i(s_i, s_j)$ represent the expected utility for player i given strategies s_i, s_j, a PBE of this game consists of a set of strategies $s^* = (s_1^*, s_2^*)$ and beliefs $(\hat{b}_1, \hat{b}_2)$ such that $u_i(s_i^*, s_j^*) \geq u_i(s_i, s_j^*)$ for all $s_i \in S_i$, $i = 1, 2$ given players' beliefs. Additionally, a PBE requires players to play rationally at each information set and beliefs to be consistent with the strategies played and Bayes' rule where possible.

1.2.5 Coordination

If neither player delegates, they must simultaneously choose either A or B. The payoff matrix for the coordination stage is described in Table 1. Ignoring the prior stages of the game, if the game represented by Table 1 was played as a static game with beliefs $\hat{b}_1, \hat{b}_2$, there are two pure strategy Bayesian Nash equilibria (PSNE) with the players choosing the same option (A,A and B,B) and a mixed strategy Bayesian Nash Equilibrium (MSNE) with the players randomizing over the options.

Table 1.1: Payoff matrix for the coordination stage.

		Player 2	
		A	B
Player 1	A	$0, 0$	$-\delta, -\delta$
	B	$-\delta, -\delta$	U_1, U_2

In the MSNE, players are randomizing over A and B to make their partner indifferent between choosing either option. Letting p_i represent the probability for which player i chooses option B,

$$p_i(-\delta) = p_i((1-\alpha_j)\hat{b}_j + \alpha_j b_i) + (1-p_i)(-\delta)$$

$$p_i = \frac{\delta}{(1-\alpha_j)\hat{b}_j + \alpha_j b_i + 2\delta}. \tag{1.2}$$

Player i's expected payoff from the MSNE is

$$p_j p_i((1-\alpha_i)b_i + \alpha_i b_j) + p_j(1-p_i)(-\delta) + (1-p_j)p_i(-\delta)$$

$$= -\frac{\delta^2}{(1-\alpha_i)b_i + \alpha_i b_j + 2\delta}. \tag{1.3}$$

An important proposition about player 2 follows immediately from Equation 1.3. To establish useful notation, notice that the discrete nature of the choice set allows player 2's equilibrium messaging strategy to be simplified. Ultimately, any message m_2 will fall into one of three types in equilibrium. Let m_2^A be the set of m_2 that result players coordinating on the PSNE {A, A}, m_2^B be the set of m_2

that result in coordination on the PSNE {B, B}, and m_2^X be the set of m_2 that result in the players playing the MSNE.

Proposition 1.1: *No PBE strategy s_2^* includes any m_2^X.*

Proof: See Appendix A.1.

The primary result of Proposition 1.1 is the players will never play the MSNE in any PBE. Player 2 would always rather delegate entirely than risk coordination failure in the MSNE, so any strategy dictating player 2 communicate when it leads to mixing is a non-credible threat. This limits player 2's viable strategy space, especially when players are more prone to mixing in the coordination stage. Therefore, the conditions under which each coordination equilibrium is played greatly affects equilibrium play in earlier stages. In light of this, I analyze equilibria under two different assumptions of coordination behavior. I first consider equilibria when players play the MSNE whenever there is a chance of conflict. I then relax this assumption and consider equilibria when there is no threat of coordination failure.

1.3 Equilibria when coordination is risky

To capture the risk of coordination failure observed in BoS games, I first consider equilibria under the following assumption on coordination play.

Assumption 1: *Given messages m_1, m_2, players will behave in the following way during the coordination stage. If $b_1 > -\frac{\alpha_1}{1-\alpha_1}\hat{b}_2$ and $b_2 > -\frac{\alpha_2}{1-\alpha_2}\hat{b}_1$, players will coordinate and play the PSNE $\{B,\ B\}$. If $b_1 < -\frac{\alpha_1}{1-\alpha_1}\hat{b}_2$ and $b_2 < -\frac{\alpha_2}{1-\alpha_2}\hat{b}_1$, players will coordinate and play the PSNE $\{A,\ A\}$. Otherwise, players will randomize and play the MSNE.*

Assumption 1 states that players will only play pure strategies when their messages reveal that there is a Pareto-dominant PSNE in the coordination stage. A Pareto-dominant PSNE exists when both players have the same preferred outcome. This occurs when the players' own-preferences are aligned or if one player is sufficiently selfish while the other is sufficiently sympathetic.

1.3.1 Honest revelation

Consider the case where communication from a player is both fully informative and always honest. Formally, communication takes the form $B_i(m_i) = b_i$ and players can fully commit to this messaging strategy by assumption. Under Assumption 1, the game with this information setting has the following strategies in any PBE.[2]

Proposition 1.2: *If s^* is a PBE with revelation and satisfies Assumption 1, the following is true of s^*.*

1. *Player 1 communicates for all b_1.*

2. *Following communication, player 2 communicates if $b_1 > -\frac{\alpha_1}{1-\alpha_1} b_2$ and $b_2 > -\frac{\alpha_2}{1-\alpha_2} b_1$ or if $b_1 < -\frac{\alpha_1}{1-\alpha_1} b_2$ and $b_2 < -\frac{\alpha_2}{1-\alpha_2} b_1$, and delegates otherwise.*

3. *If player 2 delegates and $\alpha_1 < 1 - \alpha_2$, player 1 chooses A if $b_1 < 0$ and B if $b_1 > 0$. If player 2 delegates and $\alpha_1 > 1 - \alpha_2$, player 1 chooses A if $b_1 > 0$ and B if $b_1 < 0$.*

4. *Off the equilibrium path, if player 1 delegates player 2 chooses A if $b_2 < -\frac{\alpha_2}{1-\alpha_2} \hat{b}_2(\mathcal{D}_1)$ and chooses B otherwise.*

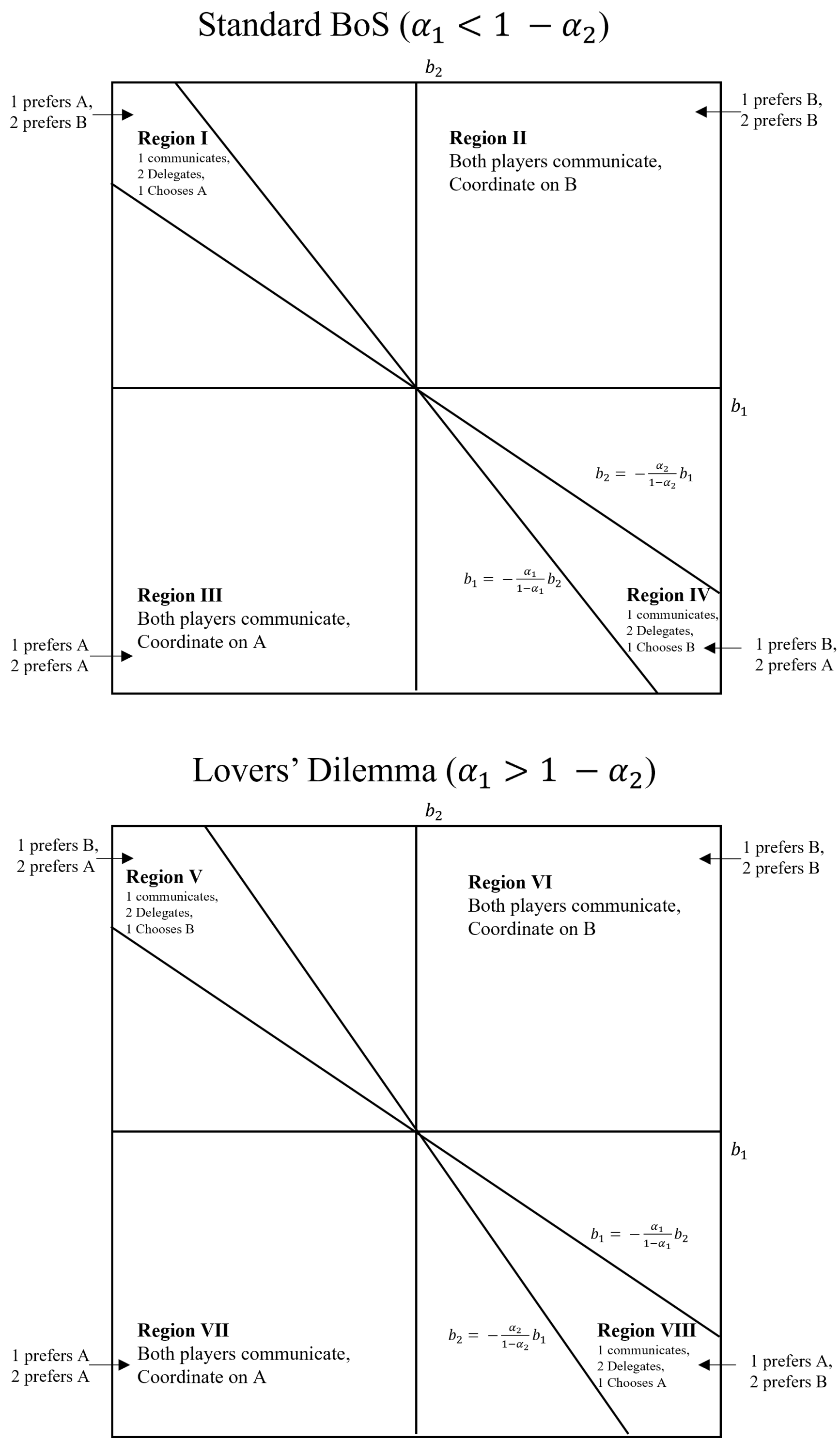
Proof: See Appendix A.2

The players' strategies are illustrated in Figure 1.2. The term "Lovers' Dilemma" is used to refer to when $\alpha_1 > 1 - \alpha_2$. In a Lovers' Dilemma, each player cares about herself less than her partner cares about her and cares about her partner more than her partner cares about himself. Unlike in a standard BoS setup, when preferred outcomes are not aligned in a Lovers' Dilemma (regions V and VIII), each player actually prefers the own-preference of her partner.

If player 1 communicates, player 2 now has complete information and knows whether or not they agree on their preferred outcomes. If they have the same preferred outcome (regions II, III, VI, and VII), player 2 will optimally communicate to player 1 and they can successfully coordinate by Assumption 1. If preferred outcomes are not aligned (regions I, IV, V and VIII), Proposition 1.1 requires player 2 to delegate to avoid playing the MSNE. Since sympathies are common knowledge, delegation from player 2 will reveal enough about b_2 for player 1 to learn, then choose, his preferred outcome over player 2's. For example, if player 1 reveals $b_1 > 0$ when $\alpha_1 < 1 - \alpha_2$ and player 2 delegates, then player 1 knows that they are in region IV and then optimally chooses B. This reveals a type of "first-mover advantage" when sympathies are common knowledge and preference signals are fully informative. The first player to reveal her own-preference will always receive her preferred outcome. However, this first-mover advantage is not as strong if talk is cheap.

[2]The PBE is unique up to information sets reached with positive probability. Here set $\mathcal{D}_1$ is empty and therefore Bayes' rule cannot be used, so any assumption on how player 2 updates his beliefs can be specified.

Figure 1.2: Equilibrium play with honest revelation and Assumption 1



1.3.2 Cheap talk communication

Now consider the case of cheap talk signals where players cannot commit to honesty. In this paper I focus on n-partition equilibria similar to those in Crawford & Sobel (1982). Formally, player i can choose to either delegate or send a message $m_i^k(b_i) \implies b_i \in [R_i^{k-1}, R_i^k]$, where $k = 1, ..., n$, $R_i^0 = -1$, and $R_i^n = 1$. However, when the coordination stage is played according to Assumption 1, cheap talk communication breaks down in equilibrium when players are not identical.

Proposition 1.3: *If s^* is a PBE with cheap talk, satisfies Assumption 1, and $\alpha_1 \neq 1 - \alpha_2$, then in it player 2 delegates following any m_1.*

Proof: See Appendix A.3.

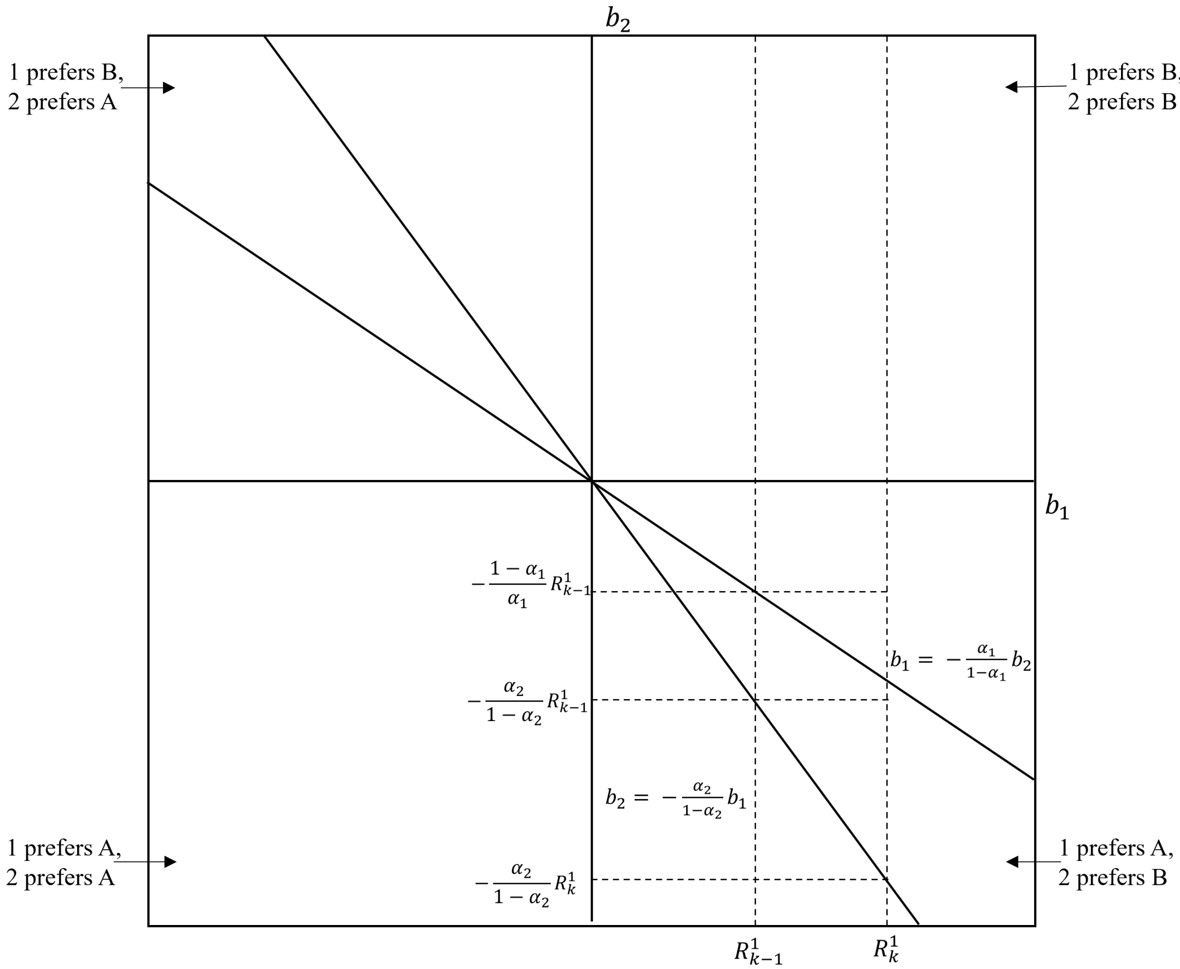
The intuition for Proposition 1.3 is straightforward. Figure 1.3 depicts a general cheap talk message m_1^k from player 1 in a Lovers' Dilemma game. After receiving the message, player 2 knows $R_1^{k-1} < b_1 < R_1^k$. If an equilibrium contains some m_2^A and m_2^B, any $b_2 > -\frac{1-\alpha_1}{\alpha_1} R_1^{k-1}$ must belong to a m_2^B since both players prefer option B, and any $b_2 < \frac{-\alpha_2}{1-\alpha_2} R_1^k$ must belong to a m_2^A since both prefer A. Player 2 must delegate if $\frac{-\alpha_2}{1-\alpha_2} R_1^k < b_2 < -\frac{1-\alpha_1}{\alpha_1} R_1^{k-1}$ by Proposition 1.1.

When $R_1^{k-1} > 0$, player 2 prefers option B for any b_1 in the message space when $\frac{-\alpha_2}{1-\alpha_2} R_1^{k-1} < b_2 < -\frac{1-\alpha_1}{\alpha_1} R_1^{k-1}$. Therefore, if any m_2^B exists in equilibrium, a player 2 with b_2 in this region can profitably deviate from delegation by sending that message. If $R_1^{k-1} < 0$, the upper bound of the necessary delegation region is $\frac{-\alpha_2}{1-\alpha_2} R_1^{k-1}$. However, there exists some $b_2 < \frac{-\alpha_2}{1-\alpha_2} R_1^{k-1}$ for which the expected payoff of delegating is less than the expected payoff of sending some m_2^B. Since player 2 must delegate here, there cannot be any m_2^B in equilibrium. Similar arguments rule out the possibility of any m_2^A in equilibrium, leaving delegation as player 2's only available action.

The players' inability to commit to honesty combined with the threat of coordination failure from Assumption 1 prevents player 2 from communicating even when preferences are aligned. He becomes a passive player in equilibrium, only affecting the outcome if player 1 chooses to delegate. Therefore, player 1's decision is either delegate or ultimately choose A or B. If player 1 delegates, player 2 will choose option B if $b_2 > \theta$, where

$$\theta = -\frac{\alpha_2}{1 - \alpha_2} \hat{b}_i. \tag{1.4}$$

Figure 1.3: Cheap talk signaling in a Lovers' Dilemma Game



Player 1 therefore chooses to delegate when the expected payoff from delegating is greater than both 0 and the expected value of choosing option B. This yields lower and upper bounds for $\mathcal{D}_1$. Player 1 delegates when

$$-\frac{\alpha_1}{1-\alpha_1}\frac{\int_\theta^1 b_2 g(b_2)db_2}{1-G(\theta)} < b_1 < -\frac{\alpha_1}{1-\alpha_1}\frac{\int_{-1}^\theta b_2 g(b_2)db_2}{G(\theta)}, \tag{1.5}$$

and communicates otherwise.

How player 1 partitions her communication regions in this case is irrelevant, as player 2 delegates regardless. Ironically, communicating does not generate any meaningful information for player 1's decision, while delegating to player 2 can provide him some information about b_1. As in the honest revelation setting, equilibrium play will always avoid coordination failure in the cheap talk setting. However, equilibrium play will sometimes fail to reach a Pareto-dominant outcome when players cannot commit to honesty.

Player 1 strictly benefits from being able to commit to revelation because she always gets her preferred outcome. Player 2's preferred information setting is unclear. Revelation guarantees his preferred outcome when it is Pareto-dominant, but he never receives his preferred outcome when the players disagree. When talk is cheap and player 1 is making her decision without learning about b_2, she may fail to choose a Pareto-dominant option. However, she could actually choose player 2's preferred outcome when preferences are not aligned, especially in a Lovers' Dilemma. For example, player 1 communicates and then chooses A when b_1 is sufficiently low. If it is the case where b_2 is high and the players are in a Lovers' Dilemma, player 1 chooses player 2's preferred outcome. Additionally, player 2 gets to make the decision under cheap talk when player 1 is relatively indifferent and selfless. This is particularly valuable to player 2 when he is relatively selfish and has a strong own-preference, as that lowers his risk of choosing the wrong option.

1.4 Relaxing Assumption 1

This section considers cheap talk communication equilibria under less punishing assumptions in the coordination stage. While the assumption that players default to the MSNE in the coordination stage when there is uncertainty over whether preferences align is supported by observed play of BoS games in experiments such as Cooper et al. (1989), relaxing Assumption 1 gives insight to the impact of uncertainty and social preferences in information transmission games. The only way to get communication from player 2 in equilibrium is when the coordination stage is played with the following assumption.

Assumption 2: *Given messages m_1, m_2, If $E_2[U_2] > 0$, players will coordinate and play the PSNE $\{B, B\}$. If $E_2[U_2] \leq 0$, players will coordinate and play the pure strategy $\{A, A\}$.*

To understand why Assumption 2 is the only situation where player 2 communicates in equilibrium, consider any equilibrium play in the coordination stage following m_1 and m_2. Proposition 1.1 still rules out any m_2^X strategies, so any message player 2 sends must result in coordination on either A or B. For any m_2^A to exist in equilibrium, it must be true that player 2 sends some m_2^A for all b_2 such that the expected value of option A is greater than the expected value of both delegation and option B, given player 1's message. Otherwise, there would be incentives to deviate for player

2. Likewise any equilibrium with m_2^B requires player 2 sending some m_2^B whenever the expected value of option B is greater than both the expected value of delegation and option A. Therefore, any cheap talk equilibrium with communication from player 2 will ultimately be player 2 "choosing" which PSNE on which they coordinate. By relaxing Assumption 1, this model becomes a problem of strategic information transmission with uncertainty and social preferences.

1.4.1 An example: Information transmission

For simplicity, I consider here a specification where player 2 cannot delegate to player 1. Then, as coordination play is entirely determined by player 2, the difference between "delegate" and "communicate" for player 1 is now arbitrary and can be ignored. A strategy for player 1 in this modified specification is then a set of messages $\{m^k\}_{k=1}^n$, where she sends message m^k if $b_1 \in [R^{k-1}, R^k]$. A strategy for player 2 can be expressed as a choice of A or B after receiving any message from player 1. For a tractable example, I assume density functions f, g are distributed uniformly over their supports.

Following message m_1^k, $\hat{b}_1 = \frac{R^{k-1}+R^k}{2}$, and player 2 will choose B when $b_2 > -\frac{\alpha_2}{1-\alpha_2}\frac{R^{k-1}+R^k}{2}$ and choose A otherwise. In equilibrium, player 1 must be indifferent from sending m_1^{k-1} and sending m_1^k at $b_1 = R^{k-1}$. Setting $E_1[U_1(R^{k-1})|m_1^{k-1}] = E_1[U_1(R^{k-1})|m_1^k]$ and solving for R^k yields

$$R^k = \gamma(R^{k-1} + R^{k+1}), \tag{1.6}$$

where $\gamma = \frac{\alpha_1\alpha_2}{4(1-\alpha_1)(1-\alpha_2)-2\alpha_1\alpha_2}$. With fixed $R^0 = -1$ and $R^n = 1$, the n-partition equilibrium exists if $R^k < R^{k+1}$, $k = 0..n-1$. The following propositions are made regarding various $n-$partition equilibria.

Proposition 1.4: *The $n = 2$ partition equilibrium exists for all α combinations, with $m_1 = [-1, 0]$ and $m_2 = [0, -1]$.*

Proof: If $n = 2$, then it is clear from Equation 6 that $R^1 = \gamma(-1 + 1) = 0$. ■

In other words, player 1 can always tell her partner which option she prefers, but not necessarily how strong her preference is, which differs from the Crawford and Sobel model where only the $n = 1$ partition (babbling) equilibrium is guaranteed to exist. This result is due to the simplifying assumptions made on prior beliefs, however it is still interesting as this example can represent a situation where players know nothing about their partner. Regardless of sympathies, the minimum amount of information strangers can communicate is the direction of their own-preference. Whether players can communicate anything about the strength of their own-preferences will depend on their relative sympathies.

Proposition 1.5: *Perfect communication ($n = \infty$ and $B(m)$ is singleton for all m) is possible if and only if $\alpha_1 = 1 - \alpha_2$.*

Proof: If $\alpha_1 = 1 - \alpha_2$, then $U_1 = U_2$ for all combinations of b_1 and b_2. Communicating b_1 perfectly to player 2 allows player 2 to choose the Pareto-optimal option with certainty. Consider perfect communication if $\alpha_1 \neq 1 - \alpha_2$. Player 1 wants B when $b_2 > -\frac{1-\alpha_1}{\alpha_1} b_1$, and 2 will choose B when $b_2 > -\frac{\alpha_2}{1-\alpha_2} m_1$. Therefore, player 1 then can profitably deviate by sending message m_1 such that $-\frac{1-\alpha_1}{\alpha_1} b_1 = -\frac{\alpha_2}{1-\alpha_2} m_1$, or $m_1 = \frac{(1-\alpha_1)(1-\alpha_2}{\alpha_1 \alpha_2} b_1 \neq b_1$. ■

It makes intuitive sense that identical players should be able to perfectly communicate to maximize information and guarantee the mutually optimal outcome, but any difference in their utility functions makes perfect communication impossible. This is consistent with Crawford and Sobel.

The derivation of the value of a general partition boundary R^k in a $n-$partition equilibrium as a function of α_1, α_2, k and n is given in Appendix A.4. While the general solution is too complex for tractable analysis and comparable statics, interesting results on the impact of sympathetic preferences on communication can be seen by analyzing specific $n > 2$ partition equilibria. Below I use the 3-partition equilibrium as an illustration.

1.4.1.1 3-partion equilibrium

With 3 partitions, player 1 can now signal indifference as well as the direction of her own-preference. Using Equation 1.6, the inner boundaries for the 3-partition equilibrium are $R^1 = -\frac{\gamma}{1+\gamma}$ and $R^2 = \frac{\gamma}{1+\gamma}$. Figure 1.4 shows a heatmap for the value of R^1 for all combinations of α_1, α_2. Above the $\alpha_1 = 1 - \alpha_2$ diagonal is the Lovers' Dilemma region and below is the standard BoS region. When $\alpha_1 = 1 - \alpha_2$, $R^1 = -\frac{1}{3}$ and $R^2 = \frac{1}{3}$, dividing the space evenly. In general, the 3-partition equilibrium exists if $-\frac{\gamma}{1+\gamma} < \frac{\gamma}{1+\gamma} < 1$, which is true when

$$\alpha_2 < \frac{2\alpha_1 - 2}{\alpha_1 - 2}. \tag{1.7}$$

This condition is not met in the black shaded region in Figure 1.4. The 3-partition equilibrium breaks down for high levels of sympathy.

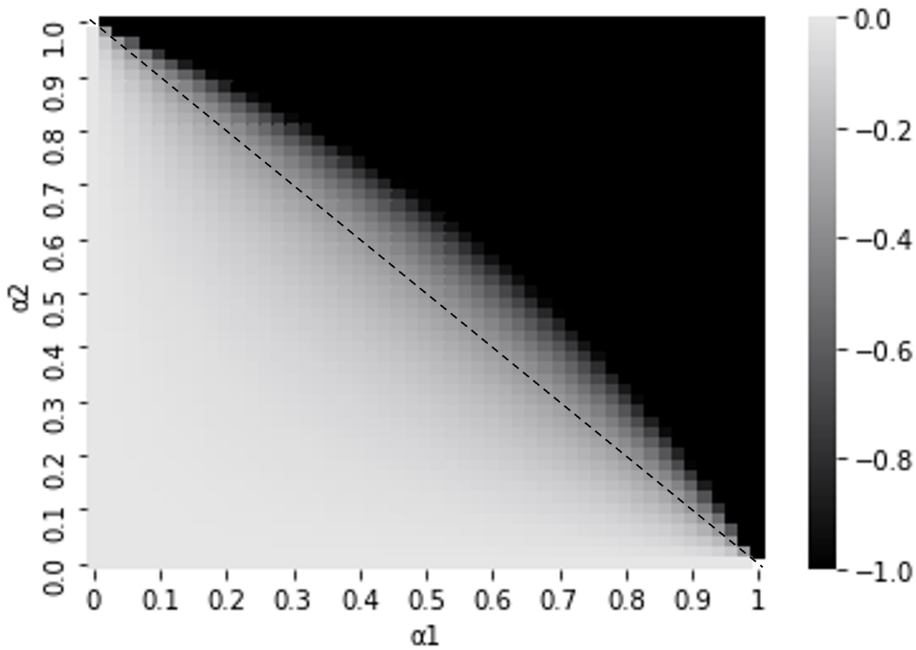
Taking the derivative of R^1 with respect to α_1 yields

$$\frac{\partial R^1}{\partial \alpha_1} = -\frac{1}{(1+\gamma)^2}\frac{\partial \gamma}{\partial \alpha_1},$$

$$= -\frac{1}{(1+\gamma)^2}\left(\frac{\alpha_2}{(4(1-\alpha_1)(1-\alpha_2)-2\alpha_1\alpha_2)^2}\frac{\alpha_1\alpha_2(4-2\alpha_2)}{4(1-\alpha_1)(1-\alpha_2)-2\alpha_1\alpha_2}\right), \tag{1.8}$$

which is negative if when $\gamma > 0$. The derivative with respect to α_2 is symmetric. Below the diagonal, as players become more selfish, $R^1(R^2)$ is increasing (decreasing), approaching 0. The middle partition shrinks while the outer ones grow, which means player 1 is more likely to signal a preference over indifference. Conversely, above the diagonal, as players become more sympathetic, $R^1(R^2)$ is decreasing (increasing). Higher sympathies cause player 1 to more often state indifference over stating a preference. While any departure from identical partners results in lower quality communication, much of the Lovers' Dilemma region cannot support any communication above the 2-partition equilibrium.

Figure 1.4: Value of R^1 for the 3-partition equilibrium



This asymmetry about the diagonal is caused by the added risk communication entails in the Lovers' Dilemma. The only problem with communication below the diagonal is lack of credibility. As a player becomes more selfish, she is more inclined to overstate her preference. Otherwise, the worst communicating to a selfish partner can do is not influence his decision at all. However, for mutual relatively high sympathies, communication is undesirable when own-preferences are not aligned. For example, if player 1's own-preference is A and player 2's is B, a sympathetic player 1 might ultimately prefer option B. If player 2 is sympathetic enough to prefer A despite his own-preference, honest communication is risky for player 1. The reason much of the Lovers' Dilemma region cannot support a third partition is because if there is any message of indifference, player 1 would always deviate to sending that message.

1.5 Conclusion

This paper provides insight on how other-regarding preferences affect communication in coordination and information transmission games. In both settings, mutual high sympathies restrict players' ability to communicate. While motivated by issues in social decision making, the results of the model apply to principal-agent problems, business partnerships, and joint-ventures. Additionally, another interpretation of the Lovers' Dilemma could be the break-down of communication in codependent relationships. While many studies in the psychology literature document the difficulty codependent people have honestly communicating with others (Carson & Baker, 2009; Hall & Wray, 1989), to my knowledge this is the first paper documenting codependent behavior in a formal, strategic model. An immediate extension of the present model is to examine possible equilibria of a repeated version of the game. In a repeated setting, players have access to more sophisticated solutions to coordination, such as alternating delegation or alternating which PSNE on which they coordinate. If own-preferences are constant throughout each round, communication becomes both more valuable and riskier as players learn.

Chapter 2

Altruistic Delegation of Decision Rights

2.1 Introduction

While it is often assumed that an individual would consider the right to make a decision a valuable asset, people commonly give up decision rights to others voluntarily. Bosses delegate certain decisions to their subordinates. On the other hand, employees sometimes elect to escalate an issue and defer to their boss' opinion instead of making a decision on their own. When presented with multiple treatment options, a patient might defer to the decision of the doctor. Perhaps the most common form of delegation individuals experience everyday is the act of deferring a decision to a group-member in social situations. For example, when a couple is deciding where to go to dinner, one might delegate the decision to his spouse, saying something like, "I don't care, you pick."

The existing literature offers two similar explanations for delegation behavior. The first set of papers are principle-agent models where a principle considers delegating some decision rights to an agent in order to convince him to incur some costly effort to gain expertise on an issue (Aghion & Tirole, 1997; Bartling et al., 2014; Burdin et al., 2018). For example, a boss delegates authority to a subordinate to work harder, or a legislator can delegate full or partial decision power to a bureaucrat to encourage her to acquire knowledge on a specific policy (Gailmard & Patty, 2007). The benefit of delegation to the decision maker in these models is the generation of expertise without having to incur the cost of learning himself. As long as the "intrinsic value" of the decision right is lower than the cost of learning, the preferences of the principle and agent are relatively aligned, and delegation is a sufficient incentive for the agent to learn, a decision maker will optimally remain uninformed, delegate the decision right to his subordinate and rubber-stamp his decision.

The second set of papers assume expertise is exogenously determined and argue that decision makers may choose to delegate decision rights to a knowledgeable but biased expert (Li & Suen, 2004; Dessein, 2002; Alonso & Matouschek, 2008; Ambrus et al., 2021). There is some uncertain quality of the potential outcomes of a decision and the decision maker is either uninformed or less informed than the expert. Here the value of delegating comes from the ability of the expert to make the decision maker's preferred choice better than he can, as well as the proclivity of the expert to choose the decision maker's preferred choice given the quality.

The primary result of almost every model of delegation is the so-called "Ally Principle" (Bendor et al., 2001). Decision makers generally prefer to delegate to agents who have similar preferences as them. The value of delegating is directly related to how closely aligned the two are in terms of their biases. In all models of delegation the ally principle has been supported except for cases where commitment is not credible.

Additionally, in both sets of papers the decision maker's motivation for delegating comes from uncertainty on the quality of the options, so they are unable to explain delegation behavior where the outcomes have a perfectly known quality. I argue delegation of this nature can be explained by altruistic preferences in the decision maker. The existing delegation literature does not consider that the individuals in their models might care about each other's preferences, but in many of the examples they give the actors are socially connected. A boss and her subordinate likely have a relationship beyond the one decision in question and repeated interaction with each other makes them care about each other's outcome. Kőszegi (2006) shows that doctors exhibit altruism towards their patients and want to tailor their treatments to their patient's preferred options. Moreover, instead of altruism in the traditional sense, an individual's payoff can depend on the preferences for less emotional or even selfish reasons. For example, an employee might care more about his boss' preferred choice than his own because making the boss unhappy could have detrimental consequences for his future career prospects.

I consider a model where altruistic players' payoffs can depend on the preferences of others involved in a decision. If a decision maker is uncertain about his partner's preferences, he might be willing to delegate the decision right to his partner even if the quality of the options are perfectly known. The motivation for altruistic delegation is different than the existing expertise-based models. Instead of delegating because the expert can better choose the decision maker's preferred option, the value of altruistic delegation comes from the decision maker's ability to use delegation to signal indifference over the decision to induce his partner to choose *his* preferred option. Because of this, altruistic delegation does not follow the ally principle; an altruistic decision maker is more willing to delegate to someone who he thinks has different preferences than his own.

The rest of the paper is formatted in the following way. Section 2 presents a model of delegation with both altruistic preferences and choices with unknown quality and solves for equilibrium delegation behavior. Section 3 analyzes two specific cases of the model, pure expertise and pure altruism, to illustrate the difference in the motivations/value of delegation. Section 3 also looks at the how the ally principle holds up in each case by analyzing delegation behavior for different expert biases. Section 4 concludes.

2.2 A General Model of Delegation

The present model can be framed quite generally as one individual considering the delegation of some binary decision to another. However, to facilitate the comparisons of this model to the Li & Suen (2004) model of expertise-based delegation, I adopt their language of policy evaluation. Consider a game where a decision-maker (D) must choose between enacting some policy, not enacting, or delegating the decision to some "expert" (E). Each player has some privately known intrinsic utility from the policy $u_i, i \in \{D, E\}$. The utility from not enacting the policy is normalized to zero for both players, representing the status quo[1]. Unlike Li & Suen (2004), which have a policy with objectively positive or negative net benefits ex-post, D and E here can ultimately disagree on whether the policy ends up being good or bad.

Beliefs over a partner's utility are constructed in the following way. The utility of i is drawn from a density function $f_i(u)$ with support $[\underline{u}_i, \overline{u}_i]$[2] and distribution function $F_i(u)$. Then i's prior belief over u_j is

[1] If the context is changed from policy evaluation to simply choosing between two alternatives, u_i can be interpreted as i's preference (positive or negative) for one option over the other.

[2] The support can be $[-\infty, \infty]$.

$$\theta_j = \int_{\underline{u}_j}^{\overline{u}_j} u_j f_j(u_j) du_j. \tag{2.1}$$

To capture the value of expertise, the players' utilities from the policy can be affected by some objective quality shock. There is a chance the policy can be high-quality, and i receives additional utility h_i if the policy is enacted. The decision maker believes that the policy is high-quality with probability ρ. If D chooses to delegate, E receives a signal $s \in \{H, L\}$ about the quality of the policy, which is correct with probability $q \geq \frac{1}{2}$. Let $\pi(s)$ be E's belief that the policy is high quality after receiving signal s. Then beliefs update according to Bayes' Rule,

$$\pi(H) = \frac{\rho q}{\rho q + (1-\rho)(1-q)}, \tag{2.2}$$

and

$$\pi(L) = \frac{\rho(1-q)}{\rho(1-q) + (1-\rho)q}. \tag{2.3}$$

In this way E is weakly more knowledgeable than D over quality.

Unlike other models of delegation, I assume a player's payoff can depend the utility of his partner. Let α_i be i's level of altruism towards his partner. Then i's payoff from enacting the policy is

$$V_i = u_i + \alpha_i u_j \tag{2.4}$$

if the policy is low-quality, and is

$$V_i = u_i + h_i + \alpha_i(u_j + h_j) \tag{2.5}$$

if the policy is high-quality.

The timing of the game is the following. First, the D's and E's preferences and the quality of the policy are determined by their respective distributions. Then, D chooses to enact, not enact, or to delegate the decision right to E. If D does not delegate, the game ends and the players receive their payoffs. If D chooses to delegate, E receives signal s and decides.

The appropriate equilibrium concept for this dynamic game of incomplete information is perfect Bayesian equilibrium. Equilibria analyzed below will be ones in which D chooses to defer for some set of u_d. I first solve for E's best-response for some arbitrary delegation set. Then, given E's strategy I derive expressions for the bounds of D's delegation region.

2.2.1 E's best-response to delegation

Assume D uses a semi-separating strategy of the following form: delegate if $u_d \in \mathcal{D} \subset [\underline{u}_i, \overline{u}_i]$, and decide if not[3]. Then if D delegates, E believes D's utility of the policy is in $\mathcal{D}$. His updated belief over D's type is the conditional expectation

$$\tilde{\theta}_D = \frac{\int_{u_d \in \mathcal{D}} u_d f_d(u_d) du_d}{\int_{u_d \in \mathcal{D}} f_d(u_d) du_d}. \tag{2.6}$$

After receiving the quality signal, E chooses to enact the policy if his expected payoff of enacting is greater than zero and does not enact otherwise. If E receives the high signal ($s = H$), he enacts if

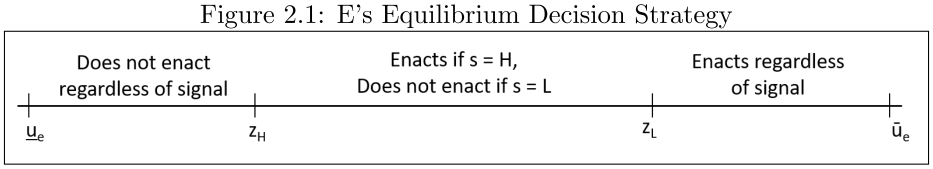
$$u_e > -[\alpha_e \tilde{\theta}_d + \pi(H)(h_e + \alpha_e h_d)]. \tag{2.7}$$

If E receives the low signal ($s = L$), he enacts if

$$u_e > -[\alpha_e \tilde{\theta}_d + \pi(L)(h_e + \alpha_e h_d)]. \tag{2.8}$$

Letting z_H and z_L respectively denote the right-hand sides of Equations 2.7 and 2.8, Figure 2.1 summarizes E's best-response to D's assumed strategy.

Figure 2.1: E's Equilibrium Decision Strategy



E's decision is straightforward and the comparative statics are intuitive. Based on his beliefs over D's utility from the policy and the quality signal, he enacts if his utility is above some threshold. He is more willing to enact the policy if he receives the high-quality signal ($z_H < z_L$). The region in which E's decision is dependant on his signal (enacts when $s = H$ and does not enact if $s = L$) is larger when he has more expertise. If E is altruistic ($\alpha_e > 0$), then he will be more willing to enact the policy the higher he believes D's utility of the policy is. As E becomes more altruistic towards

[3] It is not necessary to differentiate the types in which D enacts/does not enact here. It is only relevant to E's strategy whether D delegates or not.

D, he will enact more as long as D's quality-dependant expected utility is positive[4]. If it is negative, E is less likely to enact as he becomes more altruistic.

2.2.2 D's optimal delegation strategy

D will delegate when his expected payoff from delegating is greater than his expected payoff from both enacting the policy and not enacting the policy (zero). Let $\tilde{\theta}_{es} = \frac{1}{1-F_e(z_s)} \int_{z_s}^{\overline{u}_e} u_e f_e(u_e) du_e$ be the expected value of u_e given E enacts the policy after receiving signal s, let γ be the probability E enacts the policy given his strategy, γ_s be the probability E enacts the policy given he receives signal s, and γ_{HQ} be the probability E enacts and the policy is high-quality. Table 2.1 gives expressions for these probabilities. His expected payoff from delegating can then be written as

$$E[V_{d,\text{ delegate}}] = \gamma u_d + \alpha_d(\gamma_H \tilde{\theta}_{eH} + \gamma_L \tilde{\theta}_{eL}) + \gamma_{HQ}(h_d + \alpha_d h_e). \tag{2.9}$$

If this expected payoff is negative, D would prefer to choose to not enact the policy over delegating. Letting u_{LB} be the value of u_d for which $E[V_{d,\text{ delegate}}] = 0$, the following result is established.

Lemma 2.1: D will not delegate if $u_d < u_{LB}$.

Proof: See Appendix B.1.

This provides a lower bound for D's delegation region. If D's utility from the policy is sufficiently low, he is better off deciding to not enact himself over delegating the decision to E. If $u_{LB} < 0$, then there is a region of u_d where D's own-utility of the policy is negative yet it is beneficial for him to delegate for altruistic or expertise-based reasons.

D will not delegate if his expected payoff from choosing to enact it greater than choosing to delegate. If D enacts, he receives expected payoff

$$E[V_{d,\text{ enact}}] = u_d + \alpha_d \theta_e + \rho(h_d + \alpha_d h_e). \tag{2.10}$$

Letting u_{UB} be the value of u_d for which $E[V_{d,\text{ delegate}}] = E[V_{d,\text{ enact}}]$, the following result is established.

Lemma 2.2: D will not delegate if $u_d > u_{UB}$.

Proof: See Appendix B.2.

[4] For signal s, increasing α_e increases the region of enacting the policy if $\tilde{\theta}_e > -\pi(s)h_d$.

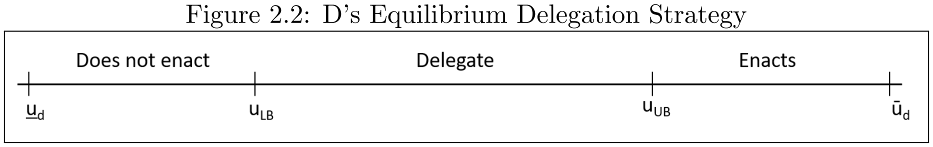
This provides an upper bound for D's delegation region. If D's utility from the policy is sufficiently high, he is better off deciding to enact himself over delegating the decision to E. If $u_{UB} > 0$, then there is a region of u_d where D's own-utility of the policy is positive yet it is beneficial to delegate for altruistic or expertise-based reasons.

Table 2.1: Expressions for relevant probabilities

Probability	*Expression*
γ_H	$(1 - F_e(z_H))(\rho q + (1-\rho)(1-q))$
γ_L	$(1 - F_e(z_L))(\rho(1-q) + (1-\rho)q)$
γ	$\gamma_H + \gamma_L$
γ_{HQ}	$\rho q(1 - F_e(z_H)) + \rho(1-q)(1 - F_e(z_L))$

Using Lemmas 2.1 and 2.2, D's optimal strategy is summarized in Figure 2.2. A perfect Bayesian equilibrium for this model is then D not enacting if $u_d < u_{LB}$, delegating if $u_{LB} < u_d < u_{UB}$, and enacting if $u_d > u_{UB}$; E enacting if $u_e > z_s$, and not enacting otherwise; with the beliefs and updating processes described previously in this section.

Figure 2.2: D's Equilibrium Delegation Strategy



2.3 Delegation motivations and the Ally Principle under expertise vs altruism

While the expressions for the equilibrium bounds of delegation in the general model are too complex to provide any informative comparative statics, some insights about the differences between expertise-driven and altruistic delegation can be gained by looking at the cases of pure expertise and pure altruism. In this section I analyze both pure cases and discuss D's motivation for delegating in each case. To illustrate these motivations, I show how D's delegation behavior changes as E becomes more altruistic.

Additionally, I look at how E's bias towards enacting/not enacting impacts the types of D that choose to delegate for each case. The Ally Principle predicts that decision makers are more willing to delegate to individuals who share the same bias. Since D and E do not know each other's preferences, for the sake of this analysis E will be considered more "biased" towards enacting the greater his θ_e, and vice versa. In this way E's bias is measured as the distance his expected utility is from zero. While the pure expertise case follows the Ally Principle, a purely altruistic D prefers to delegate to an E who disagrees with him.

2.3.1 Pure expertise

In the case of pure expertise, both α_d and α_e are 0. For simplicity assume D is uninformed ($\rho = 0.5$) and E has perfect expertise ($q = 1$). If E is delegated to, his decision does not depend on D's delegation strategy. After receiving signal s, E enacts if $u_e > -h_e$ if he gets the high quality signal and enacts if $u_e > 0$ if he gets the low signal. The lower bound for D's delegation region in this case is

$$u_{LB} = -\frac{\gamma_{HQ}}{\gamma} h_d = -h_d \frac{1 - F_e(-h_e)}{[1 - F_e(-h_e)] + [1 - F_e(0)]}, \tag{2.11}$$

and the upper bound is

$$u_{UB} = -h_d \frac{\rho - \gamma_{HQ}}{1 - \gamma} = -h_d \frac{F_e(-h_e)}{1 + F_e(-h_e) + F_e(0)}. \tag{2.12}$$

Without altruism, a change in E's expected utility has no direct effect on the D's payoff and therefore no direct effect on his delegation strategy. The value of delegating comes from both the ability to and the likelihood of the expert choosing the outcome the decision maker prefers. Notice that the delegation region in the pure expertise case will always be between $-h_d$ and 0. In other words, D only delegates when his preferences are quality-dependent: when he would rather enact the policy only if it is high-quality and would prefer the policy not be enacted if it is low-quality. However, even an E with perfect knowledge about quality may not always listen to the signal. D wants to delegate to E more when his decision strategy is more signal-dependant. Since D only delegates when his preference is quality-dependent, an "ally" for D is an E with quality-dependent preferences. Therefore, the more likely E's utility is in the range $[-h_e, 0]$, the better an ally he is to D. An ideal E for a self-interested D is one where $q = 1$, $z_H = \underline{u}_e$ and $z_L = \overline{u}_e$. In the absence of altruism, the following Proposition is made for an uninformed D and expert E.

Proposition 2.1: If α_d, $\alpha_e = 0$, $\rho = 0.5$, and $q = 1$, then any increase in $[F_e(0) - F_e(-h_e)]$

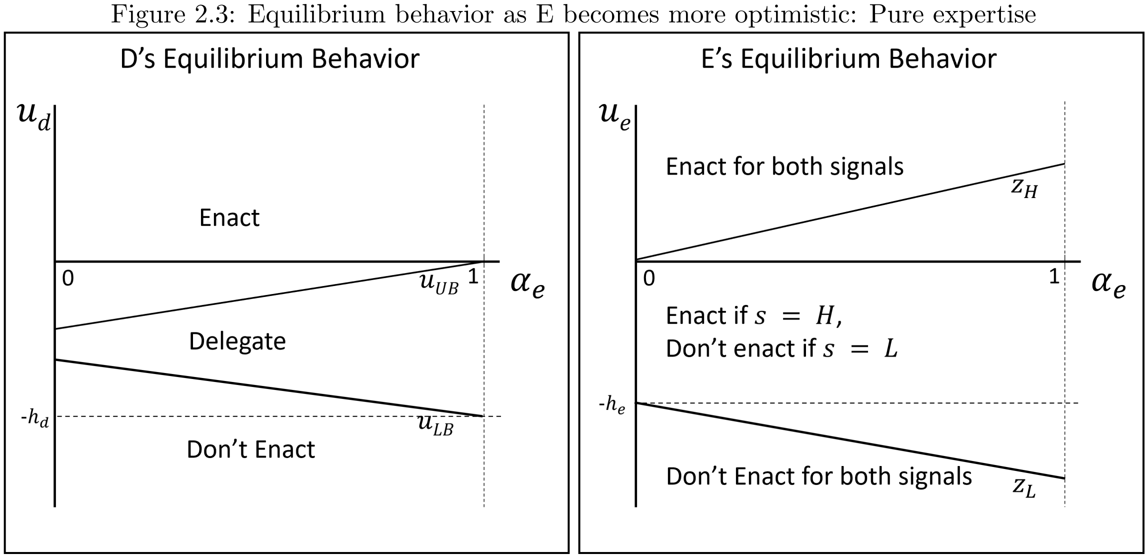
will decrease u_{LB} and increase u_{UB}.

Proof: See Appendix B.3.

Expertise-driven delegation here follows the ally principle. D is more willing to delegate the more likely he thinks E agrees with him. This is consistent with the story in Li & Suen (2004) and the rest of the expertise-based delegation literature that expertise is more valuable when an expert and decision maker are closely aligned. If E is not a perfect expert, as he becomes more knowledgeable (q increases), the value of delegating increases. E is both more likely to both get the correct signal - therefore less likely to make a mistake - and then listen to his signal and enact when he gets the high signal and not enact when he gets the low signal.

D's motivation in the pure expertise case is that E is able to more accurately choose the option that D prefers than D himself can. This motivation is easy to see when looking at how the players' behavior changes as E becomes altruistic while D remains self-interested. As shown in Figure 2.3, as α_e increases, E is more likely to enact if he gets the high signal (z_H decreases) and is more likely to not enact if he gets the low signal (z_L increases). Since E knows D will only delegate when D's preference is quality-dependent, E is going to listen to his signal more often if he cares about D's utility. With E moving closer to D's ideal expert as E becomes more altruistic, D will become more willing to delegate on both sides (u_{LB} decreases and u_{UB} increases).

Figure 2.3: Equilibrium behavior as E becomes more optimistic: Pure expertise



2.3.2 Pure altruism

In the pure altruism case, there is no unknown quality of the policy, and E is no longer an "expert" on anything other than his own utility. Since he receives no quality signal, E's strategy will simply be to enact if $u_e > z$, where $z = -\alpha_e \tilde{\theta}_d$. Let $\hat{\theta}_e = \frac{1}{F_e(z)} \int_{\underline{u}_e}^{z} u_e f_e(u_e) du_e$ be E's expected utility of enacting the policy given his strategy tells him to not enact. Then, the upper and lower bounds for delegation can be written as

$$u_{LB} = -\alpha_d \tilde{\theta}_e, \tag{2.13}$$

and

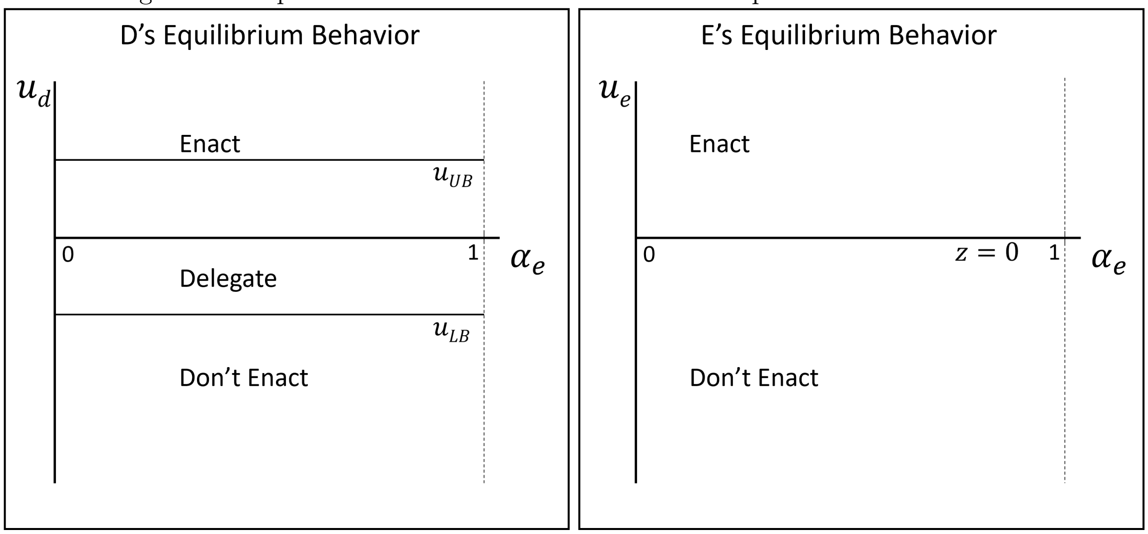
$$u_{UB} = -\alpha_d \hat{\theta}_e. \tag{2.14}$$

It is easy to show that $\hat{\theta}_e \leq \theta_e \leq \tilde{\theta}_e$ and therefore always a region where the decision maker would choose to delegate in the pure altruism case. Moreover, altruistic preferences and uncertainty over E's utility is sufficient to see delegation behavior in equilibrium. Unlike previous delegation models, it is not necessary for there to be any unknown quality of the options.

While expertise-driven delegation was motivated by E's ability to better select D's preferred option than D himself, a purely altruistic D uses delegation as a way to induce E to choose his own preferred option. D delegates to avoid the risk of choosing an option that E dislikes a lot. D uses his delegation strategy to force E's updated expectation of D's utility to be close to zero, signalling to E that he is relatively indifferent between enacting and not enacting. A particularly illustrative example of this motivation is shown in Figure 2.4. Figure 2.4 shows the change (or lack of change in this case) in E's and D's equilibrium behavior as E becomes more altruistic when D is altruistic ($\alpha_d > 0$), there is no unknown quality, and u_d and u_e are uniformly distributed with an expectation of 0. E's degree of altruism is irrelevant here because if D is delegating, E's updated belief over D's type is that $u_d = 0$. Therefore E will just enact if he prefers enacting and not enact if he prefers not enacting.

To understand altruistic delegation's relation to the ally principle, a more specific definition of "bias" is needed. D's belief over E's type is determined by the underlying distribution F_e. If this distribution changes in a way that causes θ_e to increase, $\tilde{\theta}_e$ will increase or not change, but the effect on $\hat{\theta}_e$ will depend on how F_e changes. Similarly, a change causing θ_e to decrease will cause $\hat{\theta}_e$ to

Figure 2.4: Equilibrium behavior as E becomes more optimistic: Pure altruism



decrease or not change, but the effect on $\tilde{\theta}_e$ will depend on how F_e changes. If we further specify the definition of a more biased E towards enacting a policy as his θ_e being higher as well as both $\tilde{\theta}_e$ and $\hat{\theta}_e$ being higher, then we can see how bias in E affects D's delegation strategy[5].

Proposition 2.2: *in the absence of expertise, u_{LB} and u_{UB} decrease as $\hat{\theta}_e, \tilde{\theta}_e$ increase.*

Proof: Obvious.

The pure altruism case does not follow the ally principle. As E becomes more biased towards enacting(rejecting) a policy, both u_{LB} and u_{UB} decrease(increase). More extreme "experts" are only delegated to by decision makers who are extreme in the opposite direction. In other words, a more extreme decision maker is less willing to delegate to someone he agrees with and more willing to delegate to someone he disagrees with. This suggests that altruistic delegation more often occurs when D believes preferences are conflicting, unlike delegation for expertise which is more valuable when D believes preferences are aligned.

2.4 Conclusions

This paper seeks to fill a gap in the existing delegation literature. While in existing models delegation was always driven by some unknown quality of the available choices, it is common to see

[5]While it is possible that changing the distribution in a way that increases θ_e could actually decrease $\hat{\theta}_e$, or decreasing θ_e could result in a higher $\tilde{\theta}_e$, I think it is reasonable to call a more biased expert one where these conditional expected values move in the same direction as θ_e.

decision makers delegate in situations where they perfectly know how they feel about the options. I present altruism as an alternative explanation for delegation and show that altruistic preferences and uncertainty over the utilities of others are sufficient conditions for relatively indifferent decision makers to delegate. Unlike expertise-driven delegation or using decision rights as an incentive to induce effort, altruistic delegation contradicts the ally principle. Altruistic decision makers are more willing to delegate to someone when they think they disagree with them.

"Altruism" as depicted in this model can interpreted in a number of ways. Many decisions affecting groups involve people who will truly care how the decision affects their partner, such as household and other types of social decision making. On the other hand, someone can be "altruistic" for selfish reasons, like an employee caring about her superior's opinion because it affects her promotion chances. The framework in this paper is flexible enough to model decision delegation in situations like automobile manufacturer contracts with dealerships or franchisee-franchisor relationships, where instead of altruism, α_i can represent the fraction of ownership of some some jointly shared asset.

Two potential extensions of the altruism model in this paper could offer interesting insight into delegation behavior. First, the present model does not allow the players to communicate. The only way D can inform E about his preferences is through his delegation strategy. In reality, especially with social/household group decisions, it is likely that the group may talk about their preferences with each other. Allowing D to communicate something about his preferences to E when he delegates might yield some implications about honesty in group decision making.

Second, it is not uncommon for someone who has been delegated to to refuse the decision right and delegate back to the original decision maker. Moreover, social decisions like choosing a restaurant can often devolve into an Alphonse-Gaston style back and forth of "I don't care, you decide." The present model, like the existing delegation literature, is a one-shot game. Extending the framework in this paper to a repeated game, allowing both players to delegate endlessly, could better explain delegation behavior in social or household settings.

Chapter 3

Voting for Crooks: Theory and Laboratory Evidence

3.1 Introduction

Why do we vote for candidates we don't trust? Perhaps the simplest answer is that rationally ignorant voters prefer virtuous candidates, but given limits on their time and resources, they can be deceived at minimal cost to the candidates. However, in the long-term context of a 60-year decline in public trust in elected representatives (Chanley et al., 2000; Van der Meer, 2017; Webster, 2018; Thomson & Brandenburg, 2019) it is surprising that the political marketplace has been unable to supply a candidate attribute for which there is, at least ostensibly, significant demand. Conversely, there may be a lack of demand for trustworthiness—*unvirtuous*, yet skillful, candidates may in fact be preferred for their superior willingness and capacity to siphon off resources from the public largess, acting as proxies to acquire rents on voters' behalf. Such an explanation, however, implies a considerable amount of duplicity in voters who are broadly persistent in their preferences for more trustworthy candidates (Woon & Kanthak, 2019; Besley, 2005, 2006; Funk, 1996). Neither story, that of voter myopia nor avarice, offers a satisfying explanation.

In this paper we develop a model, which we subsequently test in a laboratory experiment, in which voters prefer leaders who are both competent and trustworthy, but incentives to gain access to public resources via deception limit candidate ability to credibly signal their virtue. The resulting equilibrium behavior leave voters with little option but to weight their preferences towards the capacity that leaders can credibly demonstrate, namely their competence in growing the the group's pool of resources. Predictions eliminating any weighting towards candidate trustworthiness, however, are partially mitigated by voter and candidate incentives to pursue second-best channels through which costly signaling bounds equilibria to be, at least minimally, inclusive of trustworthiness. Voters may never be able to find the candidate of ideal talent and virtue, but under the right conditions they may be able to suss out most of the crooks while identifying the candidates sufficient to the task.

In our model group member outcomes depend on both the *competence* of an elected representative in deploying resources and their *trustworthiness* not to extract those resources for their own private benefit. The representative chosen will be entrusted with resources taken from each member. The representative then has the opportunity to take any portion of the entrusted resources for his own private gain. Any group resources not taken by the representative will grow in accordance with the representative's investment *competence* before being redistributed evenly to the constituent members.[1] In making their electoral decisions, voters have two key pieces of information about each candidate. First, they are able to observe the decisions made previously within a classic *trust game*, revealing their willingness return resources entrusted to them absent interpersonal communication or punishment incentives. Second, they are able to observe their capacity for growing entrusted resources derived from their performance in an *investment game*. How agents weight these two pieces of observable information in their ordered preferences over candidates will depend on, the relative importance that voters place on each attribute and the credibility that each observable holds as a signal of the true underlying candidate attribute in question, and their idiosyncratic beliefs of optimism/pessimism towards others.

Agents in our model are characterized by utility functions with both private and social preferences, where social preferences take the form of inequity aversion. Agents are heterogeneous in two dimensions: their aversion to payoff inequity and the amount group resources can grow if they are elected the representatives (their *competence*). While immediate intuition might predict voters to weight their choices towards trustworthiness given the expectation that selfish agents

[1]The group account is effectively a classic linear public goods game, with the important differences that i) contributions are involuntary (i.e. taxes) ii) the representative can take any portion for themselves, iii) the growth rate within the group account is a function of the representatives individual investment aptitude.

will maximally extract public resources,[2] in equilibrium our model predicts voter decisions to to be weighted towards the observed investment competence of candidates. The key constraint on voters is the nature of information gleaned from observed behavior in the trust game. The value of this information is limited by incentives to "perform" trustworthy behavior in order to win an election for subsequent private gain. While there exists a minimal threshold for observed behavior in the trust game *necessary* for receiving votes, there is not amount of generosity in the trust game *sufficient* to eliminate the risk associated with any candidate. Further, the model predicts that for any observed behavior in the trust game, the risk of maximal embezzlement by a given candidate is always decreasing with their competence in managing resources. Candidates who prefer to win an election for themselves may return super-normal amounts in the trust game, which we refer to as "costly signaling", but this signaling can never entirely remove the risk for voters of embezzlement. Instead, it can changes the "benefit of the doubt" that voters must give a candidate in order to vote for them. The minimum benefit of the doubt a candidate needs to be given decreases with both the amount returned in the trust game *and* their investment competence.

Our model generates comparative statics on the equilibrium behavior of leaders to both the level of citizens‘ compulsory contribution to the public fund (taxes) and leader compensation. The model predicts that higher contribution levels, generating a larger pool of resources available to the leader, results in higher rates of embezzlement at both the intensive and extensive margin. Higher leader pay, on the other hand, improves leader behavior in our model.

We tested our model in a laboratory experiment. Subjects were assigned investment competence attributes based on their ranked results in a series of payoff-salient mathematical tasks. They then made decisions in a series of trust game-representative game couplets, each identical to our model, each time randomly matched with other anonymous participants. We find that subjects cannot effectively differentiate trustworthy candidates from bad actors, leading to voter rankings strongly favoring competence as a criteria, subject to a minimal necessary level of giving. We find consistent support for our model's predictions regarding compulsory member compensation's impact of leader behavior, however our results on leader pay contrast our predictions.

[2]In a previous experiment by Galeotti & Zizzo (2018), voters were informed of the competence generating group payoffs and their actual rates of embezzlement. In this setting of perfectly observed past trustworthiness by uncompensated group decision-makers, voters preferred trustworthiness to competence.

3.2 Voter preferences over leadership attributes

Risking stating the obvious, leaders matter. When Jefferson (Adams & Jefferson, 1925) referred to his hope for a "natural aristocracy" of the talented and virtuous, he was joining other thinkers, including Montesquieu and Rousseau, in favoring democratic elections specifically because they believe that it would select for a superior ruling class born of noble attributes rather than noble blood lines (Besley, 2005). Who is selected into positions of power and influence will always remain key determinants of welfare outcomes for the population subject to their governance. This is not to say that choice of leaders is more important than the institutions they operate within, but to dismiss the election outcomes as trivial consequence of coins flipped on the knife edge of the median voter would be folly. Absent costless monitoring and punishment, outcomes will always remains in part dependent on the individual preferences and abilities of leaders and how they choose to execute their duties.[3] Similarly, it is an accepted tenant of political economy that the institutions governing how leaders are selected are critical determinants of which candidates succeed within democratic elections. Regardless of the institutions in question, however, the preferences of voters over candidate policy positions and attributes will always, with little in the way of exception, remain of first-order importance.[4]

The quality of any leader is estimable in countless dimensions, but it is without too much trepidation that we will here reduce it to trustworthiness and competence (Besley, 2005). Trustworthiness implies both honesty and safety in granting access to resources, the latter being more easily translated into classic economic dilemmas. Competence reflects ability to execute appointed tasks in a manner that maximizes welfare. It is without controversy that we can theorize a world where candidates for group representation vary in both their trustworthiness and competence. Similarly, we can comfortably theorize that the voters who weigh the evidence of candidate quality will themselves vary in which attribute they consider more important and how much credence they give the evidence of either.

The notion that the quality of a leader depends on her ability to perform the job for which she is elected is by no means novel. Besley et al. (2011) find historical evidence that economic

[3]The question *Quis custodiet ipsos custodes*, or how to monitor and enforce good behavior at the highest levels of power, is nearly 2,000 years old and unlikely to be reconciled here. But at least one feasible answer is to elect individuals we hope might monitor themselves.

[4]When weighing candidates, most models of voter rankings reduce candidates to two sets of dimensions—policy positions and candidate quality, the latter often referred to as candidate *valence* attributes.

growth is higher when leaders are more educated. Gagliarducci & Nannicini (2013) find that better paid political leaders perform better, and that this effect is driven by the selection of more skilled candidates for office.

There are contexts where trustworthiness (broadly conceived) might be considered to be a net negative by candidates. In the oft zero-sum games of inter-state and inter-caste resource acquisition and rent-seeking, voters in several Indian parliamentary districts have consistently shown preferences for heavy-handed criminals willing extract resources on their behalf (Vaishnav, 2017). Woon & Kanthak (2019) find that laboratory subjects vying in an election lie not because they don't have a preference against lying, but because they expect high levels of dishonesty from the other candidates and that they expect voters will discount all statements accordingly.

3.3 A Two-Stage Election Model

In this section we describe a two-stage election model, comprising a pre-election *trust game* and an *representative game*. This model will serve as the foundation for our theoretic analysis and experimental design. In each stage, players are endowed with 10 "tokens." The number of tokens a player has at the end of each stage will determine her monetary payout for that stage. Token balances from prior stages do not affect balances of future stages.

3.3.1 The Trust game

In the trust game (Johnson & Mislin, 2011), players are put into pairs and assigned the role of "sender" or "receiver." The sender chooses an amount $t_s \leq 10$ of her endowment to transfer to the receiver. That amount is then multiplied by 3, and the receiver then chooses an amount $t_r \leq 10 + 3t_s$ to transfer back to the sender. The token payoff from the trust game for the sender is then

$$\pi_s = 10 - t_s + t_r, \tag{3.1}$$

and the token payoff for the receiver is

$$\pi_r = 10 + 3t_s - t_r. \tag{3.2}$$

3.3.2 The Representative Game

In the representative game, players are assigned to groups of n, within which one member is elected as the representative. The other players are required to contribute $c \leq 10$ to a group fund. The representative then chooses how much of the group fund to place into her private account and how much to invest. Any amount invested then grows by the value of r_{rep} assigned to the representative, and is then evenly distributed to the group members. The representative always gets a flat fee of b regardless of her decisions, but does not receive a share of the investment returns. The token payoff for the representative is then

$$\pi_{rep} = 10 + b + (n-1)ce, \tag{3.3}$$

and the token payoff for the group members is

$$\pi_i = 10 - c + c(1-e)r_{rep}, \tag{3.4}$$

where e is the fraction of the fund the representative embezzles, and r_{rep} is the return rate on the invested money. Players' return rates will be determined via an investment game in the experiment, but the model treats competencies as being exogenously determined and commonly known.

3.4 Theory and Predictions

A standard model, comprised of purely selfish agents (i.e., $U_i = \pi_i$), yields straightforward Nash Equilibrium predictions. Agents will neither send nor return funds in the trust game. Voter preferences in the representative game are moot, as the representative will inevitably transfer all group funds into her private account. These predictions have consistently run counter to the observed evidence, supporting a richer model inclusive of social preferences alongside preferences for private gain (Chaudhuri, 2011). Employing a utility function similar to (Charness & Rabin, 2002b) and (Makowsky et al., 2014), the agents in our model will be characterized by both private and social preferences, and these preferences will remain consistent when they are acting as either constituent voters or elected trustees. Consider players within our model that in each stage maximize the utility function

$$U_i = (1 - \lambda_i)\pi_i + \lambda_i \min[\pi_i, \pi_{-i}], \tag{3.5}$$

where $\lambda_i \in [0, 1]$ characterizes player i's inequity aversion, and π_{-i} is the set of payoffs other than player i.

We assume prior beliefs over player types are characterized in the following way. Let $\overline{r}$ be the commonly held expected value of representative competence. We allow for heterogeneity in players' optimism/pessimism about their peers. Formally, player i believes that each λ_{-i} is an independent draw from density function $f_i(\lambda)$ with distribution function $F_i(\lambda)$. From these assumptions we discuss equilibrium behavior and generate testable predictions for our experiment.

3.4.1 Equilibrium in an isolated trust game

Consider 2 players playing the trust game in isolation. We are only concerned with trustworthiness, not trust, so we will treat the sender's behavior as exogenous and simply say the sender transfers amount t_s to the receiver. The receiver chooses t_r to maximize U_r. The following Lemma is established characterizing optimal receiver behavior.

Lemma 3.1: *In an isolated trust game where a sender sends t_s, a receiver will return $t_r = 2t_s$ if $\lambda_r \geq \frac{1}{2}$, and returns $t_r = 0$ if $\lambda_r < \frac{1}{2}$.*

Proof: See Appendix C.1.

Therefore, the maximum amount the receiver will ever return is $t_r = 2t_s$, or the amount that will make $\pi_s = \pi_r$. While players in our model do not play the trust game as a stand-alone game, the behavior described in Lemma 3.1 is an important benchmark voters use in updating their beliefs when considering candidates to vote for.

3.4.2 Behavior in the Representative game

Once elected, the representative chooses to embezzle fraction e^* to maximize

$$U_{rep} = (1 - \lambda_{rep})\pi_{rep} + \lambda_{rep} \min[\pi_{rep}, \pi_{member}], \tag{3.6}$$

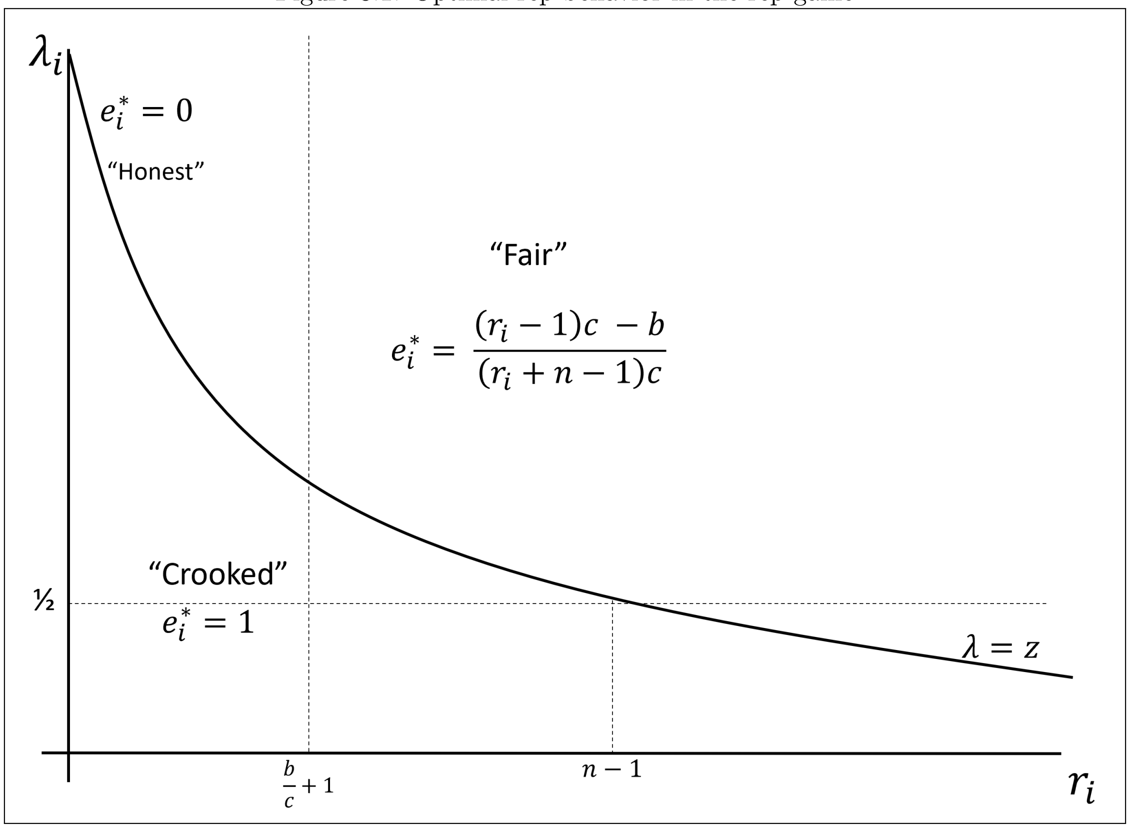
with $\pi_{rep} = 10 + b + ec(n-1)$ and $\pi_{member} = 10 - c + (1-e)r_{rep}c$. The following lemma characterizes a representative's optimal behavior.

Lemma 3.2: *A representative will embezzle everything ($e = 1$) if $\lambda_{rep} < \frac{n-1}{r_{rep}+n-1}$. If $\lambda_{rep} > \frac{n-1}{r_{rep}+n-1}$, the representative will embezzle $e = \max[0, e^*]$, where $e^* = \frac{(r-1)c-b}{(r+n-1)c}$.*

Proof: See Appendix C.2.

Figure 3.1 describes a representative's optimal behavior for a given λ, r. Letting $z = \frac{n-1}{r+n-1}$, we call a candidate with return rate r "crooked" if $\lambda < z$ and embezzles the entire group fund. We call a candidate "honest" if she embezzles nothing. We call a candidate with a λ above the z-threshold that is sufficiently competent "fair," as she embezzles just enough to where $\pi_{rep} = \pi_{member}$. For a fair representative, e^* can be considered her "fee." It can be shown that $\frac{\partial e^*}{\partial r} > 0$, so a more skilled fair representative charges a higher fee. However, despite this, $\frac{\partial \pi_{member}}{\partial r} > 0$, so members prefer a more skilled representative even with her higher fee, given she is fair. Lemma 3.2 yields the following testable predictions for our experiment.

Figure 3.1: Optimal rep behavior in the rep game



Prediction 3.1: *Whether a player is crooked (embezzles everything) or honest/fair does not vary with c or b.*

Remarks: The model predicts a representative will embezzle everything if $\lambda > \frac{n-1}{r+n-1}$, which does not depend on the representative's salary or the size of the public fund. Therefore, we expect to see players consistently act either honest/fair or crooked in each round of the experiment.

Prediction 3.2: *The fraction embezzled, e^*, from a fair representative is increasing with c.*

Prediction 3.2a *The fraction of representatives who are honest (embezzle nothing) is decreasing in c.*

Remarks: Increasing member contributions increases π_{member} when the representative is fair. Therefore, a fair representative must embezzle a larger share to keep $\pi_{rep} = \pi_{member}$. Similarly, increasing c shrinks the pool of honest representatives, and we expect to see some relatively low-skilled representatives go from embezzling nothing to embezzling e^*.

Prediction 3.3: *The fraction embezzled, e^*, from a fair representative is decreasing with b.*

Prediction 3.3a *The fraction of representatives who are honest (embezzle nothing) is increasing in b.*

Remarks: Increasing representative pay increases π_{rep} and does not directly affect π_{member}. Therefore, a fair representative will embezzle a smaller share to keep $\pi_{rep} = \pi_{member}$, with some becoming honest.

Ignoring any signaling behavior in the trust game for a moment, higher competence makes a candidate more appealing for two reasons. First, as noted above, a group member's payoff from an honest representative is increasing in r despite e^* increasing. Second, not only does a more competent rep make more for the members if she's honest, but she is also more likely to be honest. For a given competence level, the probability that a candidate will be an honest rep is $Pr(\lambda > z|r) = 1 - F_i(z)$, which is increasing in r. Because she commands a higher fee, the threshold inequity aversion value for a more competent rep is lower. Therefore, in the absence of any trust game signaling, voters would always vote for the candidate with the highest r.

3.4.3 Costly Signaling and Deceit

If we restrict the range of r to $[0, n-1]$, it is clear that for any candidate to be considered for the position of rep, she must return at least $t_r = 2t_s$ in the trust game, as no honest/fair representatives have a $\lambda < \frac{1}{2}$. Thus, returning $2t_s$ in the trust game is a necessary condition to receive votes in the representative game. However, it is not a sufficient signal to convince voters of honesty/fairness for two reasons. First, it is clear from Figure 3.1 that there are crooked candidates with λ's above $\frac{1}{2}$ for $r < n - 1$. Second, as we will show in the following paragraphs, crooked candidates with $\lambda < \frac{1}{2}$ might have an incentive to return $2t_s$ in the trust game to deceive voters.

Consider a potential candidate's marginal benefit of becoming the representative. It is simply the difference between her utility of being the rep and her expected utility of being a group member:

$$MB_{i,rep} = U_{i,rep} - E[U_{i,member}]. \tag{3.7}$$

A player's utility of being the representative depends on whether she is a crooked or fair/honest candidate. A fair/honest representative will embezzle e^* such that she earns exactly as much as the group members, leading to utility $U_{f/h,rep} = 10 + b + e^*(n-1)c$. Notice that the utility of being the representative for a fair/honest candidate is not dependent on λ. For a crook, however, the utility of being the rep does depend on λ: $U_{c,rep} = (1-\lambda)(10 + b + (n-1)c) + \lambda(10 - c)$. Notice that the most selfish crooks have the highest utility of being the rep.

The pre-trust game expected utility of being a group member depends on the candidate's beliefs over the behavior of the would-be representative. The expected payoff from being a group member for player i is

$$E[\pi_i(member)] = 10 - c + (1 - F_i(\overline{z}))((1 - \overline{e}^*)\overline{r}c), \tag{3.8}$$

where $\overline{e}^*$ and $\overline{z}$ are the values of e^*, z when $r = \overline{r}$, and the probability $F_i(\overline{z})$ is a player's ex-ante degree of pessimism about her peers. If the expected marginal benefit is greater than the utility cost of sending $t_r = 2t_s$ for a crook, then the crooked candidate will be willing to give $t_r = 2t_s$ in the trust game to deceive voters into believing she is fair/honest. Since voters do not observe λ, only r and t_r, voters could be deceived and cast their votes for this crooked candidate if she is sufficiently competent.

Since giving $2t_s$ is not enough to signal honesty or fairness, is there any amount that an aspiring representative can transfer such that the cost is sufficient to signal she is not crooked? Clearly, for signaling to be believable, the expected marginal benefit of the honest or fair candidate must be greater than the expected marginal benefit of a crooked candidate for a given r. A crooked candidate cannot have more to gain from being the representative than a fair/honest candidate, otherwise he would always be able to give more in the trust game. Therefore, we can make the following proposition.

Proposition 3.1: *If candidates are perfectly homogeneous in their beliefs about others, regardless of their optimism or pessimism, then no amount of t_r is sufficient to signal trustworthiness.*

Proof: See Appendix C.3.

This begs the question: is there any state of the world where costly signaling could work, or do crooks always have more to gain via signaling to deceive voters? It immediately follows from Proposition 3.1 that signaling is never possible if crooks are more pessimistic than fair/honest candidates. Let $F_c(\overline{z})$ be the probability which a crooked candidate expects his peers to be crooked, and $F_{f/h}(\overline{z})$ similarly be a fair/honest candidate's degree of pessimism. Then, the only crooks a fair/honest candidate can prove she is not via costly signaling are the ones for which

$$MB_{f/h,rep} > MB_{c,rep},$$

$$\lambda > \frac{c(n-1)(1-e^*) - (F_{f/h}(\overline{z}) - F_c(\overline{z}))(1-\overline{e}^*)\overline{r}c}{nc+b}. \tag{3.9}$$

Substituting $1 - e^* = \frac{nc+b}{(r+n-1)c}$ yields

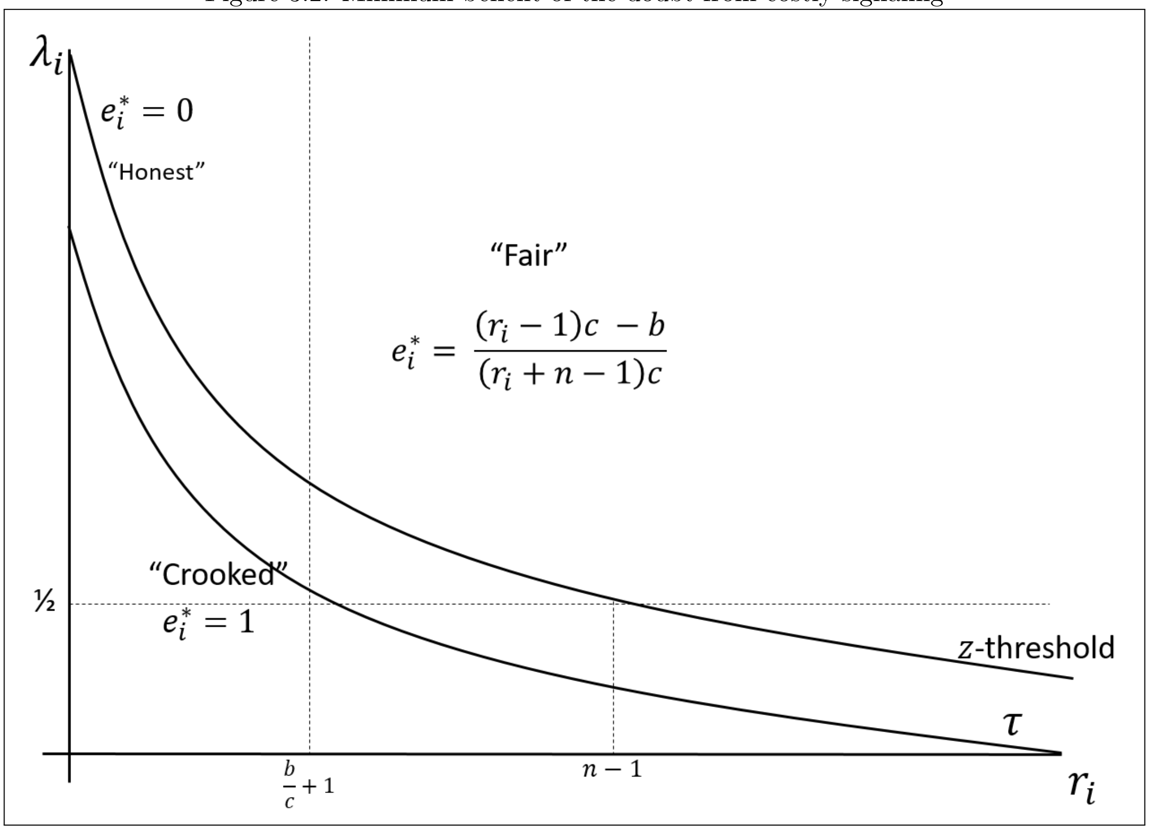
$$\lambda > \frac{n-1}{r+n-1} - \frac{(F_{f/h}(\overline{z}) - F_c(\overline{z}))\overline{r}}{\overline{r}+n-1}. \tag{3.10}$$

Letting τ be the RHS of Equation 3.10, we can describe the signaling ability of a fair/honest candidate with competence r. If $\tau > z$, then a fair/honest candidate can prove nothing by sending $t_r > 2t_s$. If $\tau \leq 0$, then the fair/honest candidate can use costly signaling to prove he will be a fair or honest representative by giving $t_r = MB_{c,rep}$ for $\lambda = 0$. If $0 < \tau < z$, then a fair/honest candidate has partial signaling power. There is no amount that a candidate can transfer in the trust game sufficient to credibly signal they will not be a crook; there are no riskless candidates in this case. A candidate *can*, however, feasibly reduce the subjective risk that they will be a crook by transferring an amount $t_r > 2t_s$. Specifically, by sending $t_r = MB_{c,rep}$ for $\lambda = \tau$, a candidate credibly signals that her λ is either greater than z (she is fair/honest) or less than τ. In this manner, τ represents the "benefit of the doubt" that a candidate must enjoy to receive a vote from a group member.[5]

[5] In still plainer language, as τ is lowered, it gives greater leeway to the voter to embrace, in choosing a candidate, that: "Sure, this candidate is probably selfish, but they will only be a crook if they are *really, really* selfish."

Put in a narrative context, a voter examining a candidate will ascertain the candidate's risk of being crooked such that "Candidate i will only be a crook if their underlying selfishness, $1-\lambda_i$, is worse than λ_τ. As a candidate increases the amount they return in the trust game, t_r, they lower their implied value of τ, and in turn reduce the probability of being a crook ($\int_0^\tau f(\lambda)$). The expression for τ can be rewritten as $\tau = z - (F_{f/h}(\overline{z}) - F_c(\overline{z}))(1-\overline{z})$. Notice that costly signaling is only possibly (in any meaningful capacity) if $F_{f/h}(\overline{z}) > F_c(\overline{z})$, or fair/honest candidates are more pessimistic than crooked candidates. Figure 3.2 shows how τ varies with r.

Figure 3.2: Minimum benefit of the doubt from costly signaling



3.5 Experiment Design

We test the predictions of our model within a laboratory setting where voluntary participants made compensation-salient decisions in a series of games designed to explicitly replicate the sub-games and overall theoretic structure of our model. Participants first played an investment game from which both earned direct rewards and were assigned investment "return factor" attributes, which served as analogues to player "competence" r in our model and affected outcomes controlled by them in subsequent games. Subsequent to to the investment rounds, participants played a series of Trust and Election games identical in structure to those in our model. Participants remained anonymous to each other within the experiment at all times and at no point were able to communicate with each other. Prior to the data-generating decisions subjects were provided with hard copies and were read the instructions, followed by a series of quizzes within which correct answers yielded payoffs. A full copy of the instructions and the quizzes can be found in Appendix C.4.

3.5.1 Investment portfolio round

In the investment game subjects were asked to algebraically solve a series of simultaneous equations under a 5 minute time constraint. The equations were presented in random order for each subject. The solutions to each pair show the rate of return and the probability of a positive return for five separate investments. Subjects had to allocate a 10 token endowment over the five investments. One was designed to be much better than the others — it had a return factor of 2.5 with a probability of 1. Two of the others had return factors and probabilities of 1 and 0.5, one had a return factor of 1.5 and a probability of 0.5, and one had a return factor of 2 and a probability of 0.5. Subjects' portfolio return was then calculated, and based on their rank ordering of the amount earned, subjects were assigned an r value which determined how much group resources would grow if they were the "leader" in the *representative* game. The top 5 earners were assigned an r value of 2.6, the next 5 were assigned 2.1, the next 5 were assigned 1.6, and finally the bottom 5 were assigned $r = 1.1$.

3.5.2 Trust game

Following the investment portfolio round, subjects were randomly matched into pairs and played two rounds of the classic trust game — once as sender and, subsequent to being randomly re-matched with another player, once as receiver. Each subject was endowed with 10 tokens. The sender could choose any amount from 0 to 10 to send to the receiver, and any amount sent was tripled. The receiver could then send back any amount they chose.

3.5.3 Random leader selection

After the first iteration of the trust game, subjects played the representative game with random leader selection. To maximize the efficient use of experimental resources, and because subject beliefs and expectations are an important feature of our theoretical model, each representative game was conducted using the strategy elicitation method introduced by Fischbacher et al. (2001). They were first asked their choices as leader – how much of the group account they would invest, and how much they would keep for themselves. They were then shown an anonymized screen with the other members of their group listed as A, B, and C. For each person, they were shown how much that person was sent in the trust game, and how much they returned, as well as their r based on their rank in the investment portfolio game. For each group member, subjects were asked to enter their beliefs about how much that person would keep for themselves as representative, and the probability that person would keep the entire amount. Next, a representative was randomly chosen in each group and subjects were told their role and payoff.

3.5.4 Elected leaders

Next, subjects played five rounds of the following sequence: two rounds of the trust game, once as sender and once as receiver; followed by the representative game. However, instead of the leader being selected randomly, subjects voted for a representative. The elicitations were identical to the random leader selection round, but before the belief elicitation about other players, subjects were shown a screen with the amount each person was sent in the trust game and their r, and asked to rank their choice of representative. We used a Borda rule of voting to better elicit the relative intensity of subject preferences across candidates – a winner was the subject in each group with the lowest sum of ranks, with ties broken randomly. Payoffs were then assigned based on the choices made by the eventual winner of the election. Finally, at the end, subjects completed a demographic and political survey.

3.5.5 Treatment Design

To test the model's comparative statics predictions, we employed a 2-by-2 treatment design, varying both the compulsory contribution to the group account (c) and the base payment to the elected representative (b).

Table 3.1: Experiment Treatment matrix

$b = 5,\ c = 4$	$b = 5,\ c = 9$
$b = 8,\ c = 4$	$b = 8,\ c = 9$

Our experiment also benefits from within-session variation as groups first find their representatives chosen randomly before democratically choosing them in subsequent rounds. A round of random elections serves two purposes. First, it allows for the observation of within-subject variation when electoral aspirations might provide incentive to change their behavior or engage in deceitful signaling of trustworthiness. Second, it allows for comparisons of group outcomes when representatives are elected democratically relative to outcomes when elections are random, which is unto itself an historically interesting question(Levy, 1989).[6]

3.6 Results

We first report our observations of voter preferences over candidate competence and trust game behavior. Second, we compare subjects' observed actions to the testable predictions of our model. Our experiment finds support for our predictions on tax rates (compulsory contribution c), but our results regarding representative compensation b contrast our predictions. We then report our observations of subjects' expectations of their fellow group members.

Table 3.2 presents summary statistics of our subjects' trust game and representative game behavior. On average, subjects return less than the "fair" 200% in the trust game, and only 15% of subjects give more than the fair amount. The average percent embezzled is 41%, however we observe many subjects at either extreme, with 11% of subjects embezzling the entire public fund 12% embezzling nothing.

[6]The most common means of acquiring political power have, historically, been through hereditary birthright, violence, random lots, and democratic election. Within our model and experiment we abstained from examining the first two. Athens famously selected its representatives via random lots from its full citizens. Even in this seemingly random selection mechanism, however, Athens was keenly aware of the dangers of incompetent leaders—those selected were rigorously reviewed for disqualifying flaws in character or capacity (Besley, 2005; Manin, 1997)

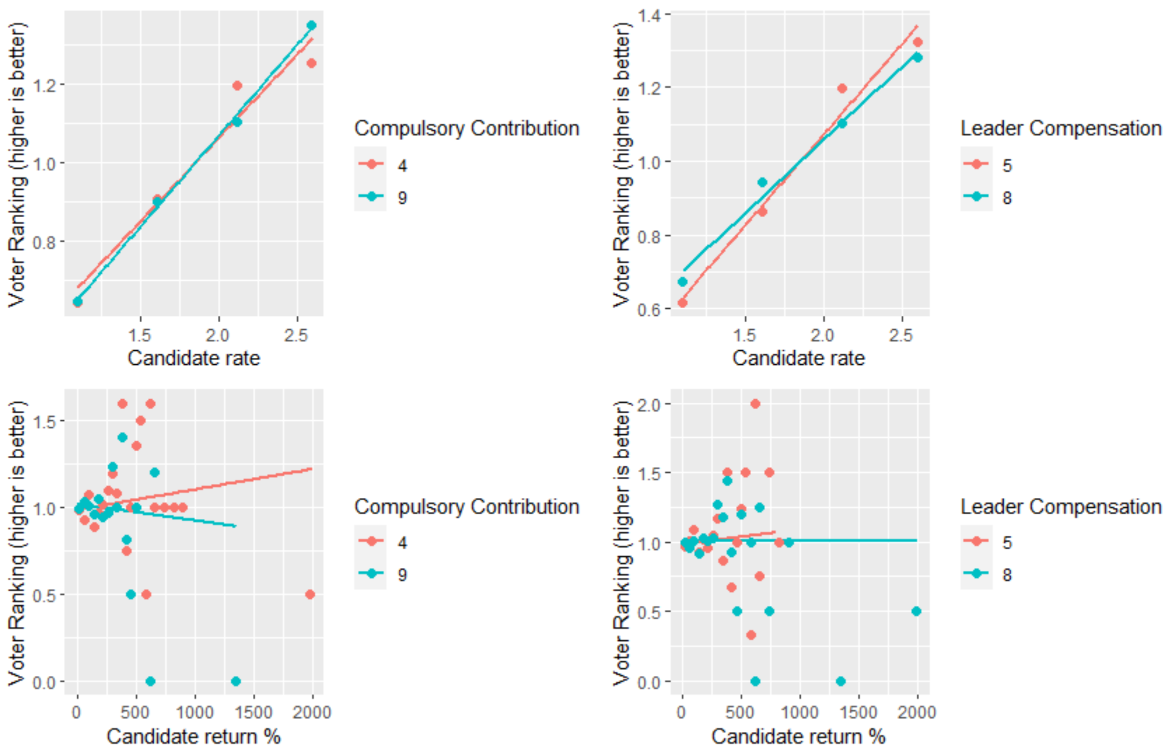
Table 3.2: Summary statistics

Statistic	Min	Median	Max	Mean	St. Dev.
Percent returned in trust game	0.000	157.143	633.333	154.810	71.843
Returned > 200%	0	0	1	0.115	0.319
Percent Embezzled	0.000	37.037	100.000	41.989	30.882
Embezzled 100%	0	0	1	0.114	0.317
Embezzled Nothing	0	0	1	0.126	0.332
Total Earnings	1.000	12.665	45.000	14.398	8.610
Female	0	0	1	0.338	0.473

3.6.1 Voter Preferences: Trust and Competence

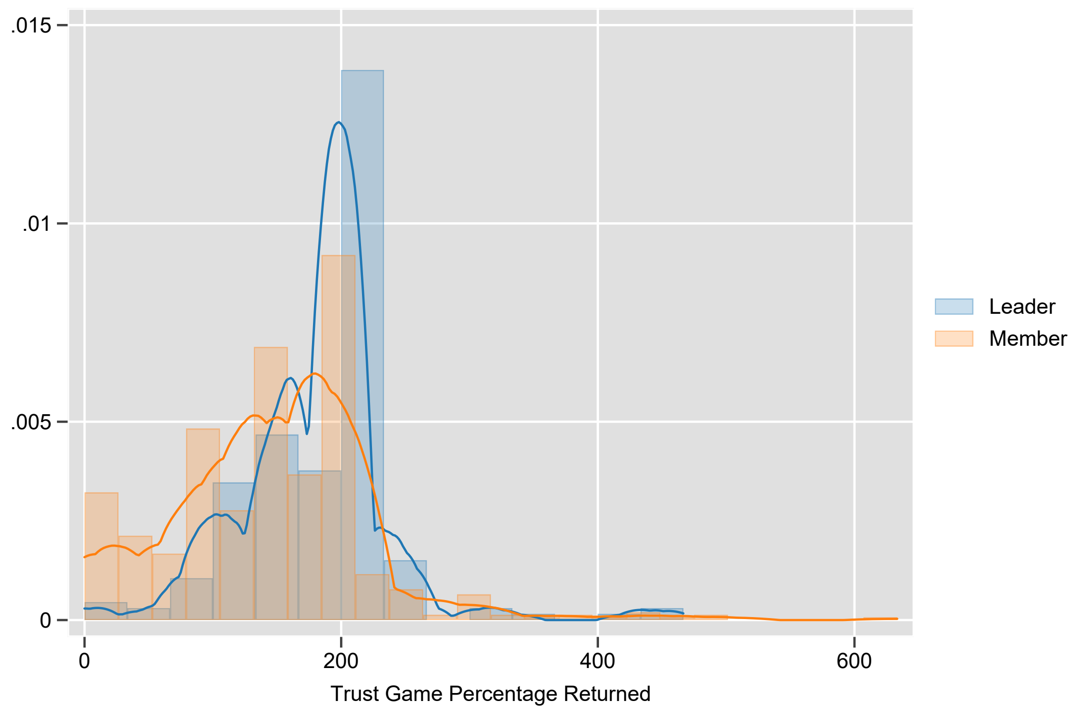
Figure 3.3 shows binscatters of the average voter ranking for candidates based on their return rates and trust game behavior over our treatments on leader compensation and compulsory member contribution. Candidates with higher return rates are consistently ranked higher than candidates with lower rates. Conversely, the percent returned in the trust game has no significant impact on voter rankings. Neither treatment significantly affects these relationships. Voters consistently respond more to a candidate's ability than to their displayed honesty.

Figure 3.3: Voter preferences over competence and trust game behavior



However, a candidate's behavior in the trust game does impact her likelihood of getting elected. Figure 3.4 shows histograms of the percentage returned in the trust game for candidates who ultimately were elected leader and those who were not in the following election. While both groups have a modal return percentage of 200%, successfully elected candidates are more likely to return the "fair" amount in the trust game. Table 3.3 presents Mann-Whitney tests on trust game behavior between elected leaders and group members. Successful candidates return more in both absolute and percentage terms.

Figure 3.4: Trust game behavior: Percent returned in Elected leader rounds



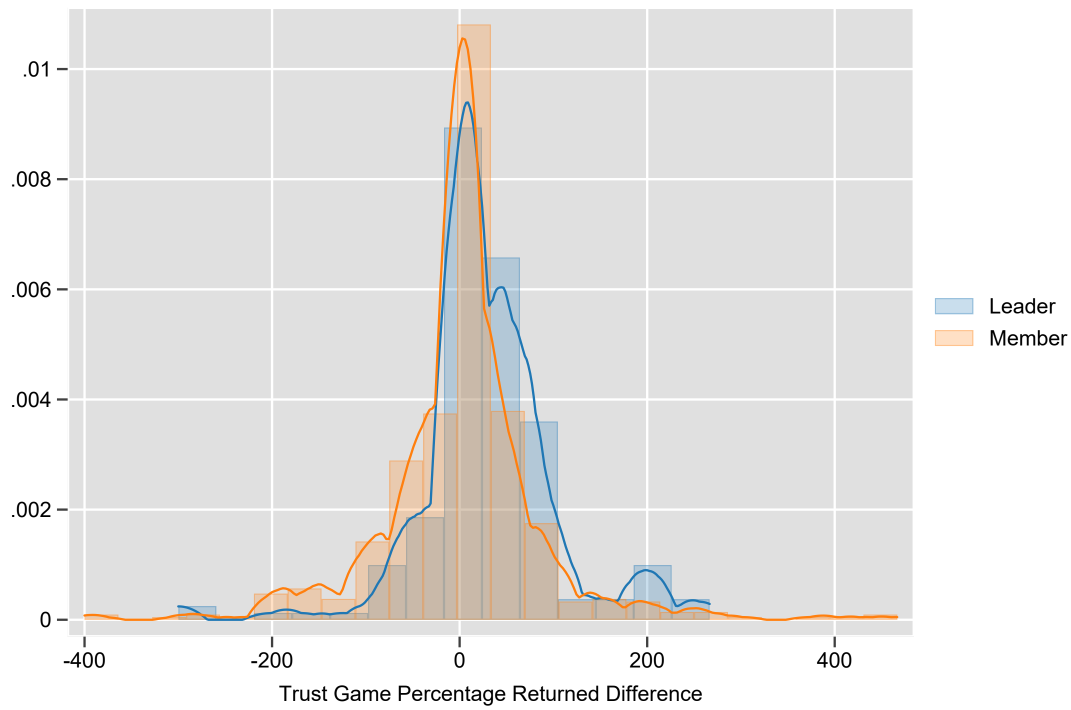
Note: Our model predicts returning double the amount sent is necessary, but not sufficient to be elected.

Table 3.3: Summary of trust game behavior for elected leaders and group members

	Elected Leader	Group Member (not elected)	Difference (p-value)
Average return amount	13.1	10.5	0.00
Average return %	172	150	0.00
Returned > 200%	0.155	0.125	0.27
Returned 0	0.030	0.047	0.30

One possible reason voters do not value observed honesty as much as competence is that trust game behavior is a noisy signal of trustworthiness; they cannot know whether giving is genuine or performative. Figure 3.5 shows a histogram of the difference between candidates' trust game return percent in the election rounds (rounds 2-6) and the non-election round (round 1). Many successful candidates are engaging in "performative giving" in election rounds; they are increasing their giving only when they need to be elected leader.

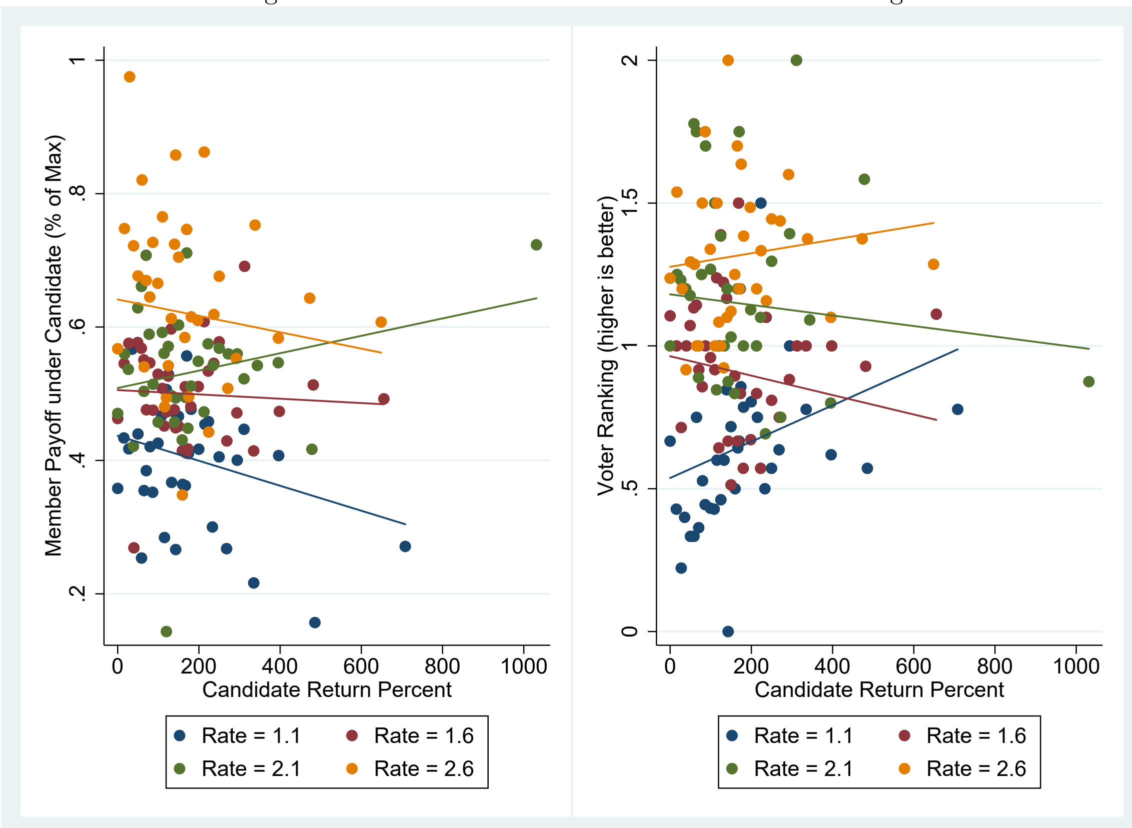
Figure 3.5: Within-subject change in trust game behavior: Elected vs Random leader selection



Note: Elected candidates return more in the election rounds than in their baseline trust game.

Are voters correctly weighing competence and trustworthiness? Figure 3.6 compares a candidate's voter ranking and the payout for group members if that candidate were elected. For the most competent candidates, higher amounts returned in the trust game result in lower payouts for group members, yet voters tend to rank them higher if they return more. The opposite occurs for the second-best candidates: returns in the trust game are positively correlated with group payouts, yet voters do not respond to this. This suggests that voters over-value trust game behavior for the highest competence candidates and under-value trust game behavior for the second most competent candidates.

Figure 3.6: Candidate Potential Performance vs Ranking

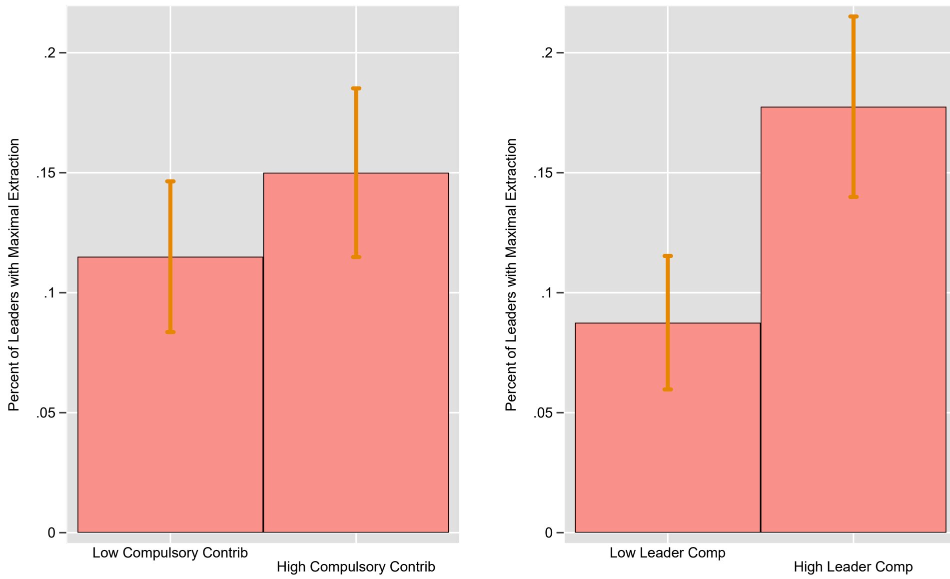


3.6.2 Testable predictions across treatments

3.6.2.1 Crooked behavior

Figure 3.7 gives the percent of subjects who chose to embezzle everything ("crooks") over our treatments. Consistent with Prediction 3.1 of our model, there is no significant difference between the percentage of crooks in high and low compulsory member contribution sessions. However, there was a significantly higher percentage of crooks when leader compensation was high than when it was low. Contrary to Prediction 3.1, higher leader salaries resulted in worse leader behavior.

Figure 3.7: Percent of leaders with maximal extraction



Note: Prediction 3.1: Whether a player is crooked (embezzles everything) or honest/fair does not vary with c or b.

3.6.2.2 "Fair" leaders: Theoretical e^* vs Observed Behavior

Our model predicts that a fair leader will embezzle $\min[0, e^*]$, where $e^* = \frac{(r_i-1)c-b}{(r_i+n-1)c}$. However, we observe players embezzling significantly higher rates than e^*. Table 3.4 gives the embezzle rate for each type of fair leader over the different treatments as predicted by the model, and Table 3.5 gives the average embezzle rate of players who did not embezzle the entire public fund (sub-max extractors). We observe that not only are players consistently embezzling more than the "fair" e^*, but also that the average sub-max extraction rate did not vary with representative competence nor treatment. This result is inconsistent with Predictions 3.2 and 3.3.

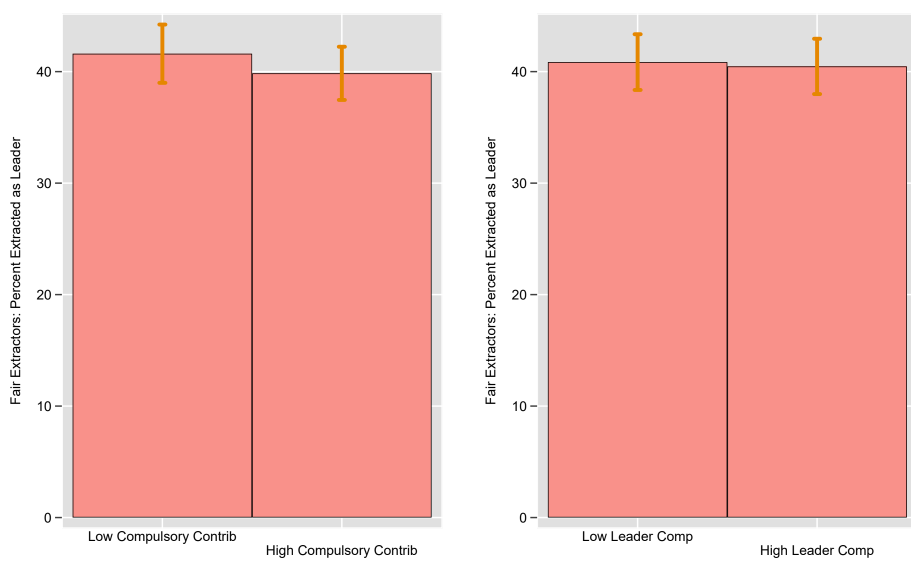
Table 3.4: Value of e^* for players across treatments

r-value	High c, Low B	High c, High b	Low c, Low b	Low c, High b
1.1	0.00	0.00	0.00	0.00
1.6	0.01	0.00	0.00	0.00
2.1	0.11	0.04	0.00	0.00
2.6	0.19	0.13	0.06	0.00

Table 3.5: Average embezzle rate for fair players across treatments

r-value	High c, Low B	High c, High b	Low c, Low b	Low c, High b
1.1	0.3753	0.3564	0.3476	0.3720
	(0.23)	(0.22)	(0.22)	(0.20)
1.6	0.4329	0.3111	0.4059	0.4550
	(0.19)	(0.23)	(0.23)	(0.19)
2.1	0.4386	0.4321	0.4643	0.4697
	(0.19)	(0.22)	(0.19)	(0.19)
2.6	0.4092	0.4213	0.3874	0.4101
	(0.25)	(0.13)	(0.27)	(0.25)

Figure 3.8: Fair extractors: Percent embezzled as leader

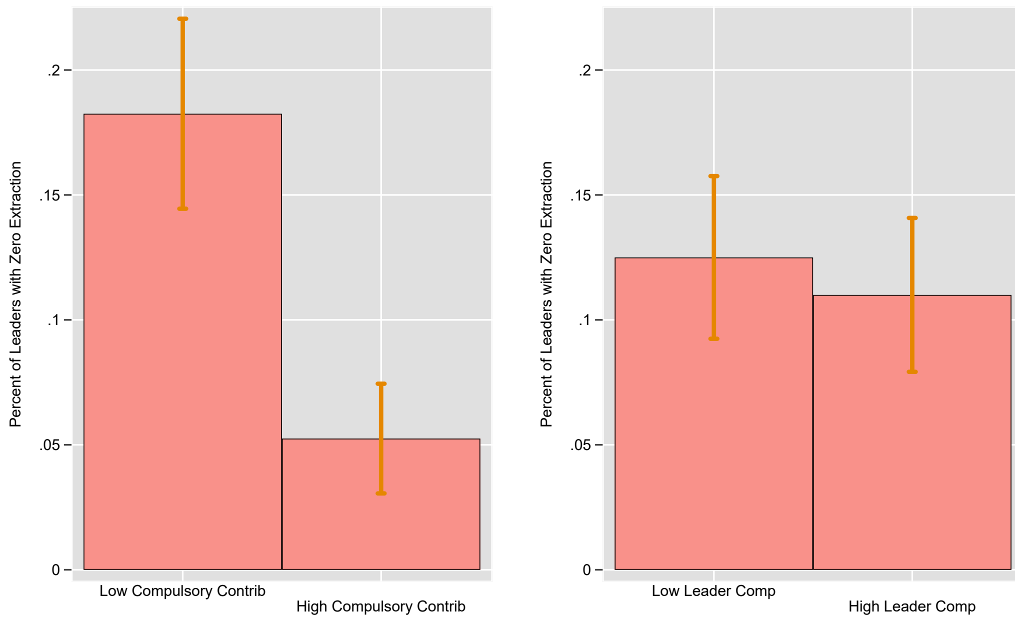


Note: Prediction 3.2: Fraction embezzled by a fair representative is increasing with c. **Prediction 3.3:** Fraction embezzled by a fair representative is decreasing with b.

3.6.2.3 Honesty over treatments

Figure 3.9 gives the percentage of subjects who chose to embezzle nothing over treatments. Consistent with Prediction 3.2a, there are significantly fewer honest leaders when compulsory contribution is large. However, there is no significant difference in the percentage of honest leaders when we vary leader compensation, which is inconsistent with Prediction 3.3a.

Figure 3.9: Percent of leaders with zero extraction



Note: Prediction 3.2a The fraction who embezzle nothing is decreasing in c. **Prediction 3.3a** The fraction who embezzle nothing is increasing in b.

3.6.3 Expectations and Beliefs

Our model does not make any assumptions on subjects' prior expectations of potential candidates. We asked subjects two questions regarding their beliefs about their fellow group members. When ranking their group members, we asked subjects "How much do you think the player will take from the group account?" and "What is the probability that the player will take everything in the group account?" Figure 3.10 shows how expected embezzlement and actual embezzlement changed over the multiple rounds for our treatments. While subjects begin to embezzle more in later rounds, subjects' expectations do not vary significantly over rounds.

Table 3.6 reports results from an OLS regression expected embezzle percent on characteristics of the individual and the candidate. We find that the percent a subject chooses to embezzle is significantly, positively related to her expectations of others. This is also shown in Figure 3.11.

Subjects were also significantly more pessimistic in high leader compensation treatment sessions, while the member contribution treatment did not significantly affect expectations. Low-competence subjects ($r = 1.1$) were significantly more optimistic than more competent subjects.

Figure 3.10: Embezzlement behavior and expectations over rounds

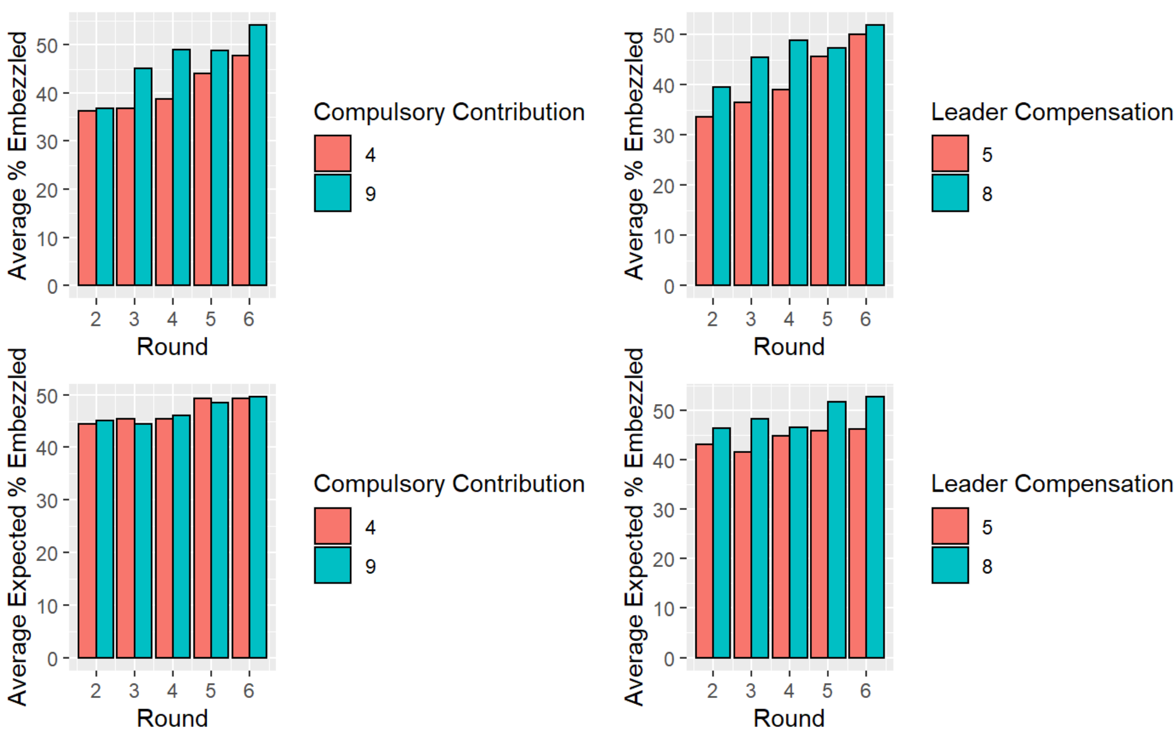
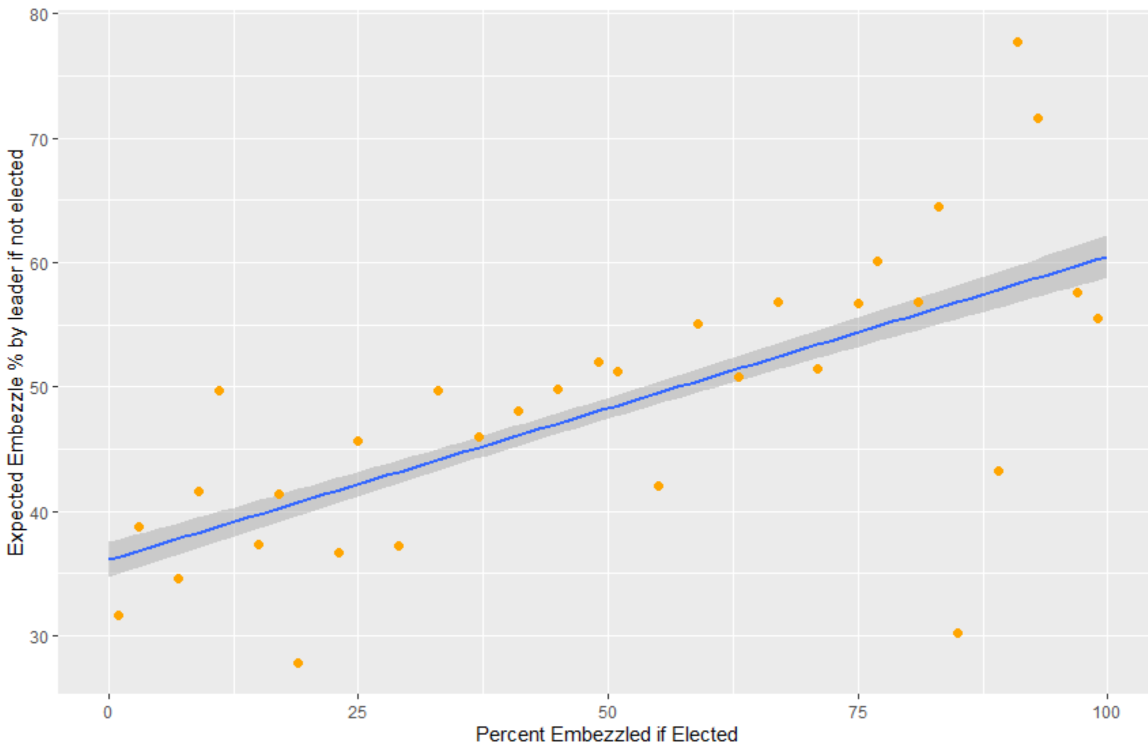


Table 3.6: Regression results (OLS)

	Dependent variable:
	Expected Embezzle Percent
Individual percent embezzled	0.226***
	(0.017)
High compulsory contribution	−1.441
	(1.044)
High leader compensation	3.520***
	(1.044)
Candidate rate = 1.6	−1.311
	(1.559)
Candidate rate = 2.1	−2.712*
	(1.559)
Candidate rate = 2.6	−2.303
	(1.559)
Individual rate = 1.6	6.853***
	(1.559)
Individual rate = 2.1	7.954***
	(1.571)
Individual rate = 2.6	6.662***
	(1.565)
Constant	31.697***
	(2.122)
Observations	2,400
R^2	0.108
Adjusted R^2	0.103
Residual Std. Error	25.454 (df = 2386)
F Statistic	22.137*** (df = 13; 2386)
Note:	*p<0.1; **p<0.05; ***p<0.01

Figure 3.11: Candidates' embezzlement decisions and expectations of others



3.7 Discussion and Conclusion

We develop a simple two-stage election model in which heterogeneous voters elect candidates according to their known ability and observed virtuosity. We tested our model in a one-to-one recreation in a laboratory experiment. When ranking candidates, voters consistently valued competence more than trust game behavior across all rounds and treatments. The potential for selfish candidates to engage in performative giving to win the election limits the salience of giving as a signal of trustworthiness. This leads to voters employing a voting strategy in which they rank candidates based on their competence subject to them meeting a minimum, necessary level of trust game giving. Costly signaling above the "fair" amount is not effective at proving honesty; virtuous candidates cannot separate themselves from bad actors in the eyes of the voters.

Our model's predictions regarding compulsory member contribution are supported by the laboratory results. While increasing the size of the resource pool available to steal from does not significantly change the fraction of leaders whole stole everything, there is a dramatic decrease in leaders who take nothing. Our results on leader compensation do not align with the model's predictions. Raising leader pay increased the prevalence of crooked leaders embezzling the entire group fund did not affect the fraction of honest leaders or the embezzle decisions of fair leaders.

While this divergence from the model's predictions could potentially be due to idiosyncratic differences in the subjects in the high compensation rounds or some component of utility being absent from our assumed utility function, a more interesting plausible explanation for this result is that leader pay elicits a behavioral response to voters and leaders that is exogenous from the present model. Our model does not make any assumptions about prior beliefs of players, but the results of our experiment suggest that leader compensation significantly increases voter pessimism about candidates. If people's own behavior is influenced by their beliefs of others and they think high salaries attract the wrong kind of representatives, paying representatives more can create a "self-fulfilling prophecy" of crooked leaders.

Appendices

Appendix A Chapter 1 Appendix

A.1 Proof of Proposition 1.1

The expected value of the MSNE for player 2 can be written as $-\frac{\delta^2}{U_2+2\delta}$, which is always negative since $U_2 \in [-1, 1]$ and $\delta > 1$. When $U_2 \geq 0$, the worst outcome from delegating is player 1 choosing A, which gives 2 a payoff of 0. Therefore, even if player 1 chooses A with certainty, the expected payoff of delegation is greater than the MSNE. If $U_2 < 0$, the worst outcome from delegating is player 1 choosing B, and it is clear that $-\frac{\delta^2}{U_2+2\delta} < U_2$ for all possible values of U_2. Thus, even if player 1 chooses B with certainty, the expected payoff of delegation is greater than the MSNE. ■

A.2 Proof of Proposition 1.2

Consider player 2's decision following revelation from player 1. If $b_1 > -\frac{\alpha_1}{1-\alpha_1}b_2$ and $b_2 > -\frac{\alpha_2}{1-\alpha_2}b_1$, players will coordinate and play the Pareto-dominant PSNE {B, B} if player 2 reveals b_2 by Assumption 1. Player 2 prefers option B when $b_2 > -\frac{\alpha_2}{1-\alpha_2}b_1$ and therefore optimally reveals his type. Similarly, if $b_1 < -\frac{\alpha_1}{1-\alpha_1}b_2$ and $b_2 < -\frac{\alpha_2}{1-\alpha_2}b_1$, player 2 optimally reveals and the players coordinate on the Pareto-dominant PSNE {A, A}. If neither of the above are true, then revelation from player 2 results in the MSNE and player 2 delegates according to Proposition 1.

Therefore, if player 2 reveals after player 1 reveals, player 1 receives her preferred outcome. If player 2 delegates after player 1 reveals $b_1 > 0$ and $\alpha_1 < 1-\alpha_2$, then it must be that $b_2 < -\frac{\alpha_2}{1-\alpha_2}b_1$ and $b_1 > -\frac{\alpha_1}{1-\alpha_1}b_2$. Player 1 therefore knows with certainty that she prefers option B. Similarly if player 2 delegates after player 1 reveals $b_1 < 0$ and $\alpha_1 < 1 - \alpha_2$, player 1 knows with certainty she prefers option A. A symmetric argument follows for $\alpha_1 > 1 - \alpha_2$. Revelation guarantees player 1 her preferred outcome and therefore dominates delegation as an action for player 1. The sequential rationality requirement for a PBE therefore requires player 1 to reveal for all b_1. ■

A.3 Proof of Proposition 1.3

Lemma 1: In equilibrium, given message m_k^1 from player 1, player 2 must delegate if $b_2 \in [\min[-\frac{\alpha_2}{1-\alpha_2}R_k^1, -\frac{1-\alpha_1}{\alpha_1}R_k^1], \max[-\frac{\alpha_2}{1-\alpha_2}R_{k-1}^1, -\frac{1-\alpha_1}{\alpha_1}R_{k-1}^1]]$.

Proof If any message includes a b_2 in the above region, it is clear that it must be of type

m_X^2 by Assumption 1. Then by Proposition 1, that message is dominated by delegation. ■

Lemma 2: Neither m_A^2 nor m_B^2 can exist in equilibrium.

Proof: Consider a message m_k^1 with R_{k-1}^1, R_k^1. From L1, we know that in equilibrium 2 must delegate if $b_2 \in [\min[-\frac{\alpha_2}{1-\alpha_2}R_k^1, -\frac{1-\alpha_1}{\alpha_1}R_k^1], \max[-\frac{\alpha_2}{1-\alpha_2}R_{k-1}^1, -\frac{1-\alpha_1}{\alpha_1}R_{k-1}^1]]$. For b_2 above this necessary delegation region, Player 2 knows B is Pareto-dominant, so if he can credibly send m_B^2, he will do so. Similarly, for b_2 below the necessary delegation region, he will want to send m_A^2 if possible. Define θ_A^2 as the expected value of b_2 given 2 sends message m_A^2, θ_B^2 as the expected value of b_2 given 2 sends message m_B^2, and θ_D^2 as the expected value of b_2 given 2 delegates. It is clear that $\theta_A^2 < \theta_D^2 < \theta_B^2$.

Consider the case when $-\frac{\alpha_2}{1-\alpha_2}R_k^1 < -\frac{1-\alpha_1}{\alpha_1}R_k^1$, or when $R_k^1 > 0$. Further consider a $b_2 = -\frac{\alpha_2}{1-\alpha_2}R_k^1 + \epsilon$ in the delegation region. The expected utility for player 2 is then

$$Pr(b_1 > -\frac{\alpha_1}{1-\alpha_1}\theta_D^2|m_k^1)[(1-\alpha_2)(-\frac{\alpha_2}{1-\alpha_2}R_k^1 + \epsilon) + \alpha_2 E[b_1| - \frac{\alpha_1}{1-\alpha_1}\theta_D^2 < b_1 < R_k^1]].$$

If 2 deviates and sends m_A^2, they coordinate on A, and 2's utility is 0. As $\epsilon \to 0$, delegation is only better if $E[b_1] > R_k^1$. But, for continuous f_1, $E[b_1] < R_k^1$. Thus, there is some b_2 in the delegation region who would profitably deviate by sending false message m_A^2. Therefore, any m_A^2 is not credible to player 1, leading to the MSNE.

If $-\frac{\alpha_2}{1-\alpha_2}R_k^1 > -\frac{1-\alpha_1}{\alpha_1}R_k^1$, or $R_k^1 < 0$, consider any b_2 such that $-\frac{1-\alpha_1}{\alpha_1}R_k^1 < b_2 < -\frac{\alpha_2}{1-\alpha_2}R_k^1$. Player 2 then prefers option A for sure (even if b_1 is R_{k-1}^1, A is preferable to B for 2). So if there is a m_A^2 in equilibrium, 2 can profitably deviate by falsely signalling it when it is the delegation region. Therefore, m_A^2 cannot be credible to player 1, forcing any potential m_A^2 into a m_X^2 type.

Similar arguments rule out m_B^2 in equilibrium. This leaves delegation as player 2's only possible equilibrium strategy. ■

A.4 Derivation of a general R^k in an $n-$partition equilibrium

The homogeneous difference equation is

$$R^{k+1} = \frac{1}{\gamma}R^k - R^{k-1}, \tag{11}$$

where $k = 0, ..., n$, with $R^0 = -1$ and $R^n = 1$. Guess $R^k = \lambda^k$, then rewrite

$$\lambda^{k+1} = \frac{1}{\gamma}\lambda^k - \lambda^{k-1}. \tag{12}$$

Divide by λ^{k-1} to get characteristic equation

$$\lambda^2 - \frac{1}{\gamma}\lambda + 1 = 0, \tag{13}$$

which has 2 roots $\lambda = \frac{1 \pm \sqrt{1-4\gamma^2}}{2\gamma}$. Therefore we can write

$$R^k = C(\frac{1+\sqrt{1-4\gamma^2}}{2\gamma})^k + D(\frac{1-\sqrt{1-4\gamma^2}}{2\gamma})^k \tag{14}$$

and solve for constants C and D using the initial conditions from above. We have

$$-1 = C + D, \tag{15}$$

and

$$1 = C(\frac{1+\sqrt{1-4\gamma^2}}{2\gamma})^n + D(\frac{1-\sqrt{1-4\gamma^2}}{2\gamma})^n. \tag{16}$$

Substituting $C = -(1 + D)$ and solving for D yields

$$D = \frac{(2\gamma)^n + (1+\sqrt{1-4\gamma^2})^n}{(1-\sqrt{1-4\gamma^2})^n - (1+\sqrt{1-4\gamma^2})^n}. \tag{17}$$

Similarly we can solve for C, then we have R^k as a function of α_1, α_2, k and n. ■

Appendix B Chapter 2 Appendix

B.1 Proof of lemma 2.1

It is clear that $\frac{\partial E[V_{d,\text{ delegate}}]}{\partial u_d} = \gamma$. As long as E chooses to enact with some positive probability, the expected value of delegating is increasing in u_d. Thus, for any $u_d < u_{LB}$, $E[V_{d,\text{ delegate}}] < 0$ and D will choose to not enact.

B.2 Proof of lemma 2.2

It can be shown that $\frac{\partial E[V_{d,\text{ delegate}}]-E[V_{d,\text{ enact}}}{\partial u_d} = \gamma - 1 < 0$. Then, for any $u_d > u_{UB}$, $E[V_{d,\text{ delegate}}] < E[V_{d,\text{ enact}}]$ and D will choose to enact.

B.3 Proof of Proposition 2.1

We must show that u_{LB} decreases and that u_{UB} increases as either $F_e(0)$ decreases or $(1 - F_e(0))$ decreases.

Lemma: $\frac{\partial u_{LB}}{\partial F_e(-h_e)} > 0$.

Proof: Assume not. Then

$$\frac{\partial u_{LB}}{\partial F_e(-h_e)} = -h_d[\frac{1 - F_e(-h_e)}{[(1 - F_e(-h_e)) + (1 - F_e(0))]^2} - \frac{1}{[(1 - F_e(-h_e)) + (1 - F_e(0))]}] < 0,$$

$$\frac{1 - F_e(-h_e)}{[(1 - F_e(-h_e)) + (1 - F_e(0))]^2} > \frac{1}{[(1 - F_e(-h_e)) + (1 - F_e(0))]}],$$

$$1 - F_e(-h_e) > (1 - F_e(-h_e)) + (1 - F_e(0)),$$

$$0 > 1 - F_e(0).$$

But $1 - F_e(0) > 0$. This is a contradiction.

Lemma: $\frac{\partial u_{LB}}{\partial(1-F_e(0))} > 0$.

Proof:

$$\frac{\partial u_{LB}}{\partial(1 - F_e(0))} = h_d[\frac{1 - F_e(-h_e)}{[(1 - F_e(-h_e)) + (1 - F_e(0))]^2}] > 0.$$

The above two lemmas prove u_{LB} behaves as we claimed.

Lemma: $\frac{\partial u_{UB}}{\partial(1-F_e(-h_e))} < 0$.

Proof: Assume not. Then

$$\frac{\partial u_{UB}}{\partial F_e(-h_e)} = -h_d[\frac{1}{[1+F_e(-h_e)+F_e(0)]} - \frac{F_e(-h_e)}{[1+F_e(-h_e)+F_e(0)]]^2}] > 0,$$

$$\frac{1}{[1+F_e(-h_e)+F_e(0)]} < \frac{F_e(-h_e)}{[1+F_e(-h_e)+F_e(0)]]^2},$$

$$1+F_e(-h_e)+F_e(0) < F_e(-h_e),$$

$$1+F_e(0) < 0.$$

But $1+F_e(0) > 0$. This is a contradiction.

Lemma: $\frac{\partial u_{UB}}{\partial F_e(0)} > 0$.

Proof:

$$\frac{\partial u_{UB}}{\partial F_e(0)} = h_d[\frac{F_e(-h_d)}{[1+F_e(-h_d)+F_e(0)]} > 0.$$

If u_{UB} is increasing in $F_e(0)$, then it must be decreasing in $(1-F_e(0)$. Thus the above two lemmas prove u_{UB} behaves as we claimed.

Appendix C Chapter 3 Appendix

C.1 Proof of Lemma 3.1

Lemma 3.1: *In an isolated trust game where a sender sends t_s, a receiver will return $t_r = 2t_s$ if $\lambda_r \geq \frac{1}{2}$, and returns $t_r = 0$ if $\lambda_r < \frac{1}{2}$.*

Proof: If $\pi_s < \pi_r$, then

$$U_r = (1 - \lambda_r)\pi_r + \lambda_r \pi_s. \tag{18}$$

Differentiating with respect to t_r yields

$$\frac{\partial U_r}{\partial t_r} = 2\lambda_r - 1, \tag{19}$$

which is negative if $\lambda_r > \frac{1}{2}$. If $\pi_s \geq \pi_r$, then $U_r = \pi_r$, and the marginal utility of t_r is positive for all λ_r. ■

C.2 Proof of Lemma 3.2

Lemma 3.2: *A representative will embezzle everything ($e = 1$) if $\lambda_{rep} < \frac{n-1}{r_{rep}+n-1}$. If $\lambda_{rep} > \frac{n-1}{r_{rep}+n-1}$, the representative will embezzle $e = \max[0, e^*]$, where $e^* = \frac{(r-1)c-b}{(r+n-1)c}$.*

Proof: It can be shown that $\pi_{rep} = \pi_{member}$ when $e = e^*$. If $\pi_{rep} < \pi_{member}$, then $U_{rep} = \pi_{rep}$ and $\frac{\partial \pi_{rep}}{\partial e} > 0$. The representative always wants to embezzle more until $\pi_{rep} = \pi_{member}$. If $\pi_{rep} > \pi_{member}$, then $\frac{\partial U_{rep}}{\partial e} = (1 - \lambda_{rep})(n-1)c - \lambda_{rep} rc.$, which is positive when $\lambda_{rep} < \frac{n-1}{n-1+r}$.

C.3 Proof of Proposition 3.1

Proposition 3.1: *If candidates are perfectly homogeneous in their beliefs about others, regardless of their optimism or pessimism, then no amount of t_r is sufficient to signal trustworthiness.*

Proof: If $f_i = f$ for all i, then both crooked and fair/honest candidates have the same expected utility of being a group member. Therefore, we can simply compare their utilities of being the representative to determine who has more to gain from being the representative. Since $U_{rep}(e = e^*)$ does not vary with λ, then it is clear that for any $\lambda < z$ (ie, crooks), that $U_{rep}(e = 1)$ is greater. Therefore, for a given r, a crook will always have more to gain from being the representative than an honest/fair candidate. ■

C.4 Experiment Instructions

Consent Form: Investment and Representative Behavior in Groups

You are invited to participate in a research study about economic decision making in groups. This study is designed to help us to better understand how investment and group behavior relate to the decisions individuals make. The primary investigator is Dr. Wafa Hakim Orman, from the University of Alabama in Huntsville.

PROCEDURE TO BE FOLLOWED IN THE STUDY: Participation in this study is completely voluntary. Once written consent is given, you will receive instructions that explain in detail how you and the other participants in the study, who have been randomly selected, will make certain decisions that will influence how much money you can earn in the experiment. Your earnings will be determined by your decisions, as well by as the decisions of the other participants. Your actions and responses will be kept completely confidential. This session will take approximately 80 minutes.

DISCOMFORTS AND RISKS FROM PARTICIPATING IN THIS STUDY: There are no expected risks associated with your participation. There is no cost to you except for a few minutes of your time

EXPECTED BENEFITS: Results from this study can benefit society by helping us better understand human decision-making and how groups function. Please see the section below for incentives and compensation for participation in this study.

INCENTIVES AND COMPENSATION FOR PARTICIPATION: In addition to your participation fee, compensation will be paid commensurate with the payoffs to decisions made at each step of the experiment, based on your decisions and the decisions of other participants. The showup fee is $5, and the additional earnings will range from $20-$50 for the single session.

CONFIDENTIALITY OF RESULTS: Participant numbers will be used to record your data, and these numbers will be made available only to those researchers directly involved with this study, thereby ensuring strict confidentiality. This consent form will be destroyed after 3 years. The data from your session will only be released to those individuals who are directly involved in the research and only using your participant number.

FREEDOM TO WITHDRAW: You may withdraw from the study at any time, and you will still receive your participation fee. You are free to withdraw from the study at any time. You will not be penalized because of withdrawal in any form. Investigators reserve the right to remove any participant from the session without regard to the participant's consent.

CONTACT INFORMATION: If you have any questions, please ask them now. If you have questions later on, you may contact the Principal Investigator Dr. Wafa Hakim Orman, at (256) 824-5674, or by email at wafa.orman@uah.edu. If you have questions about your rights as a research participant, or concerns or complaints about the research, you may contact the Office of the IRB (IRB) at 256.824.6992 or email the IRB chair Dr. Ann Bianchi at irb.@uah.edu.

This study was approved by the Institutional Review Board at UAH and will expire in one year from <date of IRB approval>.

______________________________ ______________________________

Name (Please Print) Signature Date

Experiment Instructions

Welcome. Thank you for participating in today's experiment. You have earned a $5 show-up fee for participating.

During the experiment you and the other participants will be given tasks that will give you an opportunity to earn significantly more. When you are asked to work with other players or assigned to groups, none of the players know who they are working with or are told their names.

Throughout the experiment you will earn tokens. At the end of the experiment, you will be paid $0.10 for every token earned in the game.

During the experiment, you and the other people participating will be placed into groups, with 4 people in each group. You will not be told the names of those you are partnered or placed in groups with, and they will not be told your name. All participants have identical instructions.

The experiment has three phases and will take approximately 1 hour in total.

Phase one will consist of an individual investment game. You will earn tokens based on your investment performance. Phase two will consist of a partner game and a group game. You will earn tokens based on your decisions and the decisions of the other players in your group. Phase three will consist of multiple rounds, where each round will include a partner game and a group game. You will earn tokens based on your decisions and the decisions of the other players in your group.

Groups and partners will remain anonymous in each round of phases two and three. Groups and partners will be reshuffled in each round.

At the end, there will be a brief survey.

When the experiment concludes, you will be paid in cash. You will be paid 1 US dollar for every 5 tokens you have earned over all phases of the experiment, plus your $5 show-up fee.

Instructions For The Investment Game

Phase 1: The Investment Game

- You will have 10 tokens to invest in any of five available investments: A, B, C, D, or E.
- You may invest some, all, or none of the 10 tokens.
- You may invest all your earnings in one of them or divide them between two, three, four, or all five of the investments in any way you like.
- Remember to enter whole numbers and ensure that the total across all portfolios is less than or equal to 10.
- Enter 0 if you do not wish to invest in a given portfolio.
- Investments may have a positive or zero return.
- Any tokens left uninvested will be held left untouched until the end of the round, without any possibility of gain or risk of loss, and will then be returned to your private account.
- Each investment is defined by two characteristics:
    - The probability of a positive return, p. This is the probability that investments in it will grow.

- Its return factor, r. This is the amount investments in the portfolio will be multiplied by if the portfolio has a positive return.

Example 1:

Suppose Investment A has a 70% probability of a positive return (p = 0.70), and a return factor of 2 (r = 2).

You choose to invest 8 tokens in Investment A, leaving 2 tokens uninvested.

The computer will draw a random number from 0 to 1. If that random number is between 0 and 0.7 (< p), your investment will have a positive return. Your 8 token investment will be multiplied by 2 (r), leaving you with 16 tokens from your investment that will be returned to your private account along with the 2 tokens that you chose not to invest.

If the random number is between 0.7 and 1(> p), your investment will return 0. Your 8 token investment will be multiplied by 0, leaving you with 0 tokens from your investment along with the 2 tokens that you chose not to invest. Your private account will now hold 2 tokens before you start the round.

Example 2:

Investment A has a 60% probability of a positive return, and a return factor of 2.

Investment B has an 80% probability of a positive return, and a return factor of 1.5.

Investment C has a 40% probability of a positive return, and a return factor of 1.1.

You invest 4 tokens in A, 4 tokens in B, and 2 tokens in C.

The random number drawn for A is 0.9, so you earn zero from A.

The random number drawn for B is 0.7, so you earn a positive return from B.

The random number drawn for C is 0.3, so you earn a positive return from C.

The results from your investment this round will add (4 x 0) + (4 x 1.5) + (2 x 1.1) = 8.2 tokens back to your private account.

Determining p and r:

You will not be told the probability, **p**, or the return factor, **r**, for any of the investments.

Instead, you will be presented with five pairs of simultaneous equations with two unknown variables: **p** and **r**.

p represents the probability for the relevant portfolio. **r** represents the return factor.

You will need to solve the pairs of simultaneous equations to obtain the probability p and the return factor r for each investments in order to decide which portfolio would be the best one to choose.

Phase 2: Sender-Receiver Game
This game has two players: a **sender** and a **receiver**. You will play this game twice, once as the sender and once as the receiver. Each time, both the sender and the receiver will begin with 10 tokens in their account. You will be randomly partnered with a different participant each time. Neither you nor your partners will ever learn the identity of the other.
Sender Phase:
As a sender, you must decide how much of their 10 token endowment you want to transfer to the receiver you are matched with. You may transfer between 0 to 10 tokens, **which will be tripled** and placed in the Receiver's account. For example, if you transfer 2 tokens, then 6 tokens will be added to the Receiver's account. You will have 8 tokens in your account, and the Receiver will have 6 tokens in theirs.

Receiver Phase:

The **receiver's** decision depends on how many tokens the sender transferred into their account. You will be shown how much your account has increased, and then make your decision. You can transfer from your account, back to the **sender**, any amount from 0 up to the total number of tokens in your account. For example, if the **sender** transfers 2 tokens, then the **receiver's** account now has 10 + 3 x 2 = 16 tokens. The Receiver can then choose to transfer between 0 and 16 tokens back to the **sender**. The **receiver** will keep whatever remains in their account.

Example 1: In the Sender Phase, you choose to transfer 2 of your 10 tokens to the person you are randomly matched with.
The person you are randomly matched with sees in the **Receiver Phase** that they were sent 3, which is multiplied by 3 so that they have 9 tokens in their account. They choose to transfer 4 back to your account.
At the end of this round, you have 10 – 3 + 4 = 11 tokens. The receiver you were matched with has 10 + 9 – 4 = 15.
Example 2: In the Receiver Phase you find out that the **sender** you are randomly matched with chose to transfer 5 tokens. This 5 is multiplied by 3 so that you have 10 + 15 = 25 tokens in your account. You choose to transfer 6 back to the Sender.
At the end of this round, your private account has 10 + 15 – 6 = 19 tokens. The sender you were matched has 10 – 5 + 6 = 11.

The Group Game

In this round each participant will be endowed with **10** tokens and randomly placed into groups of **4.** Within each group, 3 participants will be group **members** and one will be randomly chosen to be the **representative. 4** tokens will be taken from each of the 3 group members and placed into a **group account**.
Every token in the group account will be multiplied by the representative's growth rate **R** and then divided equally among the 3 group members. Each participant in the experiment has their own **R** value based on how much their investments grew in the **Investment game** in Phase 1 of today's experiment. The **R** value for a group account depends on who is randomly chosen to be the **representative.**
Representatives will not receive any tokens from the group account. Instead, they are paid a flat fee of 5 tokens. The representative may also choose to transfer some tokens from the group account to their own private account. Tokens transferred to the representative's private account **will not be multiplied by R or returned to the group members**.
For the three **members**, their payoff from this round is the 6 tokens remaining in their private account plus their earnings from the group account:

Member payoff from their **private** account = 6

Member payoff from the **group** account = $\frac{(12 - amounttakenbyrepresentative)xR}{3}$

Total Member payoff = payoff from private account + payoff from group account

For the **representative,** their payoff will include a 5 token fee for being the representative in addition to any tokens they transferred from the group account into their private account:

Total Representative payoff = 10 + 5 + the amount they transferred from the group account

Each of you will make this decision in advance ***as if you are the group's representative*.** When entering your decisions, you will not know whether you have been selected as the group's representative. This will not be revealed to you until after you make your decisions. Your decisions have no impact on whether or not you are chosen as the representative.
On the next screen, you will see the amounts sent to and returned by the other members of your group in the sender-receiver game, and their values of **R**. They will be labeled anonymously as Player A, Player B, and Player C. You will be able to enter your best guess about each of the other players' decisions – how much you think they will transfer to their private accounts if they are the representative, and what is the probability that they will transfer all the money in the group account to their private account.
Summary of Group Game:

- You will decide how many tokens you will transfer from the group account to your private account if you are selected to be the representative
- You will guess the decisions made by the other players in the group
- After all players have made their decisions and guesses, the representative will be selected.

Phase 3: The Election Game

In this phase you will play multiple rounds of a two-part game.
The first part of each round will be identical to the **Sender-Receiver game** you played in phase 2 of today's experiment. Players will be given 10 tokens and then assigned to the role of sender or receiver. After all participants have made their decisions, they will be endowed with 10 more tokens and then assigned to play the opposite role.
The second part of each round will be identical to the **Group game,** with one important change: **each group will elect the member that will act as their representative using a ranked choice voting system**.
Each participant will be endowed with **10** tokens and randomly placed into groups of **4.** Same as in the Group game, **4 tokens** will be taken from each of the 3 group members and placed into a **group account**.
Each of you will make the decision regarding the amount transferred to your private account from the group account *as if you are the group's representative* in advance of the representative being elected. When entering your decisions, you will not know whether you have been elected as the group's representative. This will not be revealed to you until after you make your decisions. Your decisions have no impact on whether or not you are elected as the representative.
On the next screen, you will see the amounts sent to and returned by the other members of your group in the sender-receiver game, and their values of **R.** They will be labeled anonymously as Player A, Player B, and Player C. You will rank the other 3 members of their group, assigning **1** to the player you **most** want to be the representative and **3** to the player you **least** want to be the representative. When making their decision, they will be given three pieces of information about each player:

- The amount of **tokens that were sent to them** in the trust game when they were the Receiver
- Of those tokens, **the amount of tokens they returned** in the trust game when they were the Receiver
- The **R** value that was assigned to them based on the Investment game.

On the next screen, you will be able to enter your best guess about each of the other players' decisions – how much you think they will transfer to their private accounts if they are the representative, and what is the probability that they will transfer all the money in the group account to their private account.
Each group member will receive 2 points for each 1st place vote, 1 point for each 2nd place vote, and 0 points for each 3rd place vote. The member with the most points will be the group representative. Ties will be broken randomly.
You will play this game sequence 5 times – the sender-receiver game, followed by the representative election game. After each round you will be informed which member was elected the representative and the results from the round. At the beginning of each round you will be randomly re-matched into a new group of 4 members.

Summary of Election Game:
You will play multiple rounds of the following game sequence:

- First you will play the **Sender-Receiver game twice: Once as Sender, Once as Receiver.**
- You will decide how many tokens you will transfer from the group account into your private account if you are selected to be the representative
- Next, you will vote on who will vote on who will be the representative in the **Group-game.** You will be told each candidate's **R** value and their decision they last made as the **Receiver** in the Sender-Receiver Game. You will be asked to guess how many tokens each candidate would transfer into their private account as the Representative.
- After all players have made their decisions, the representative will be selected.

Reminder of Payoffs:

For the three **members**, their payoff from this round is the 6 tokens remaining in their private account plus their earnings from the group account:

Member payoff from their **private** account = 6

Member payoff from the **group** account = $\frac{(12-amounttakenbyrepresentative)xR}{3}$

Total Member payoff = payoff from private account + payoff from group account

For the **representative,** their payoff will include a 5 token fee for being the representative in addition to any tokens they transferred from the group account into their private account:

Total Representative payoff = 10 + 5 + the amount they transferred from the group account

C.5 Experiment - Subject Interface

Figure C.1: Investment Game - Subject Interface

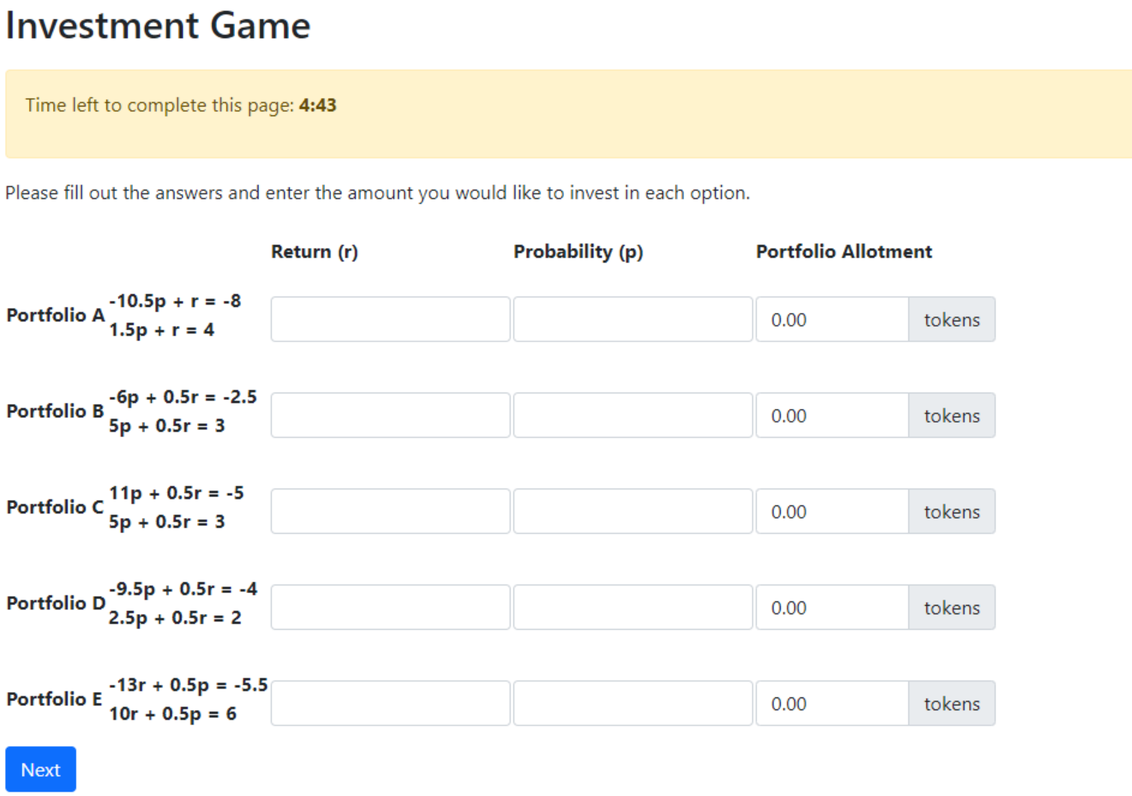


Figure C.2: Trust game subject interface: Sender phase

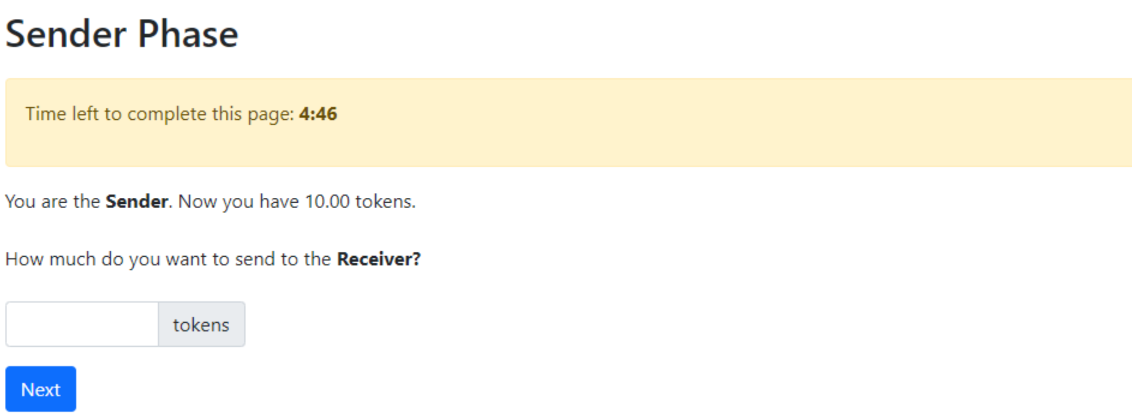


Figure C.3: Trust game subject interface: Receiver phase

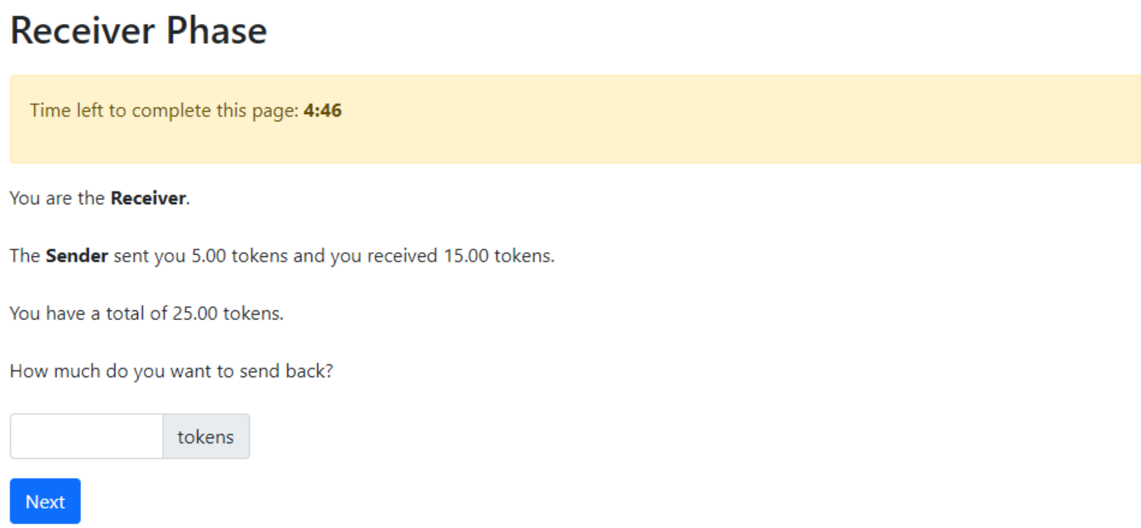


Figure C.4: Candidate - Subject Interface

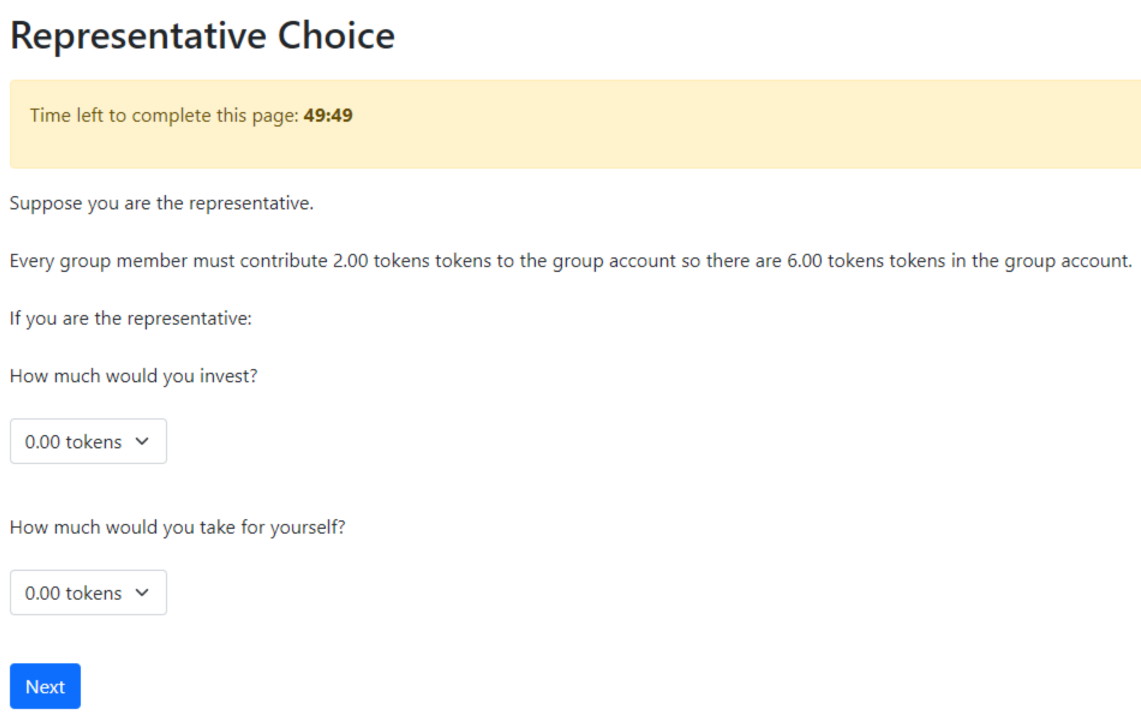


Figure C.5: Voter interface: Candidate ranking

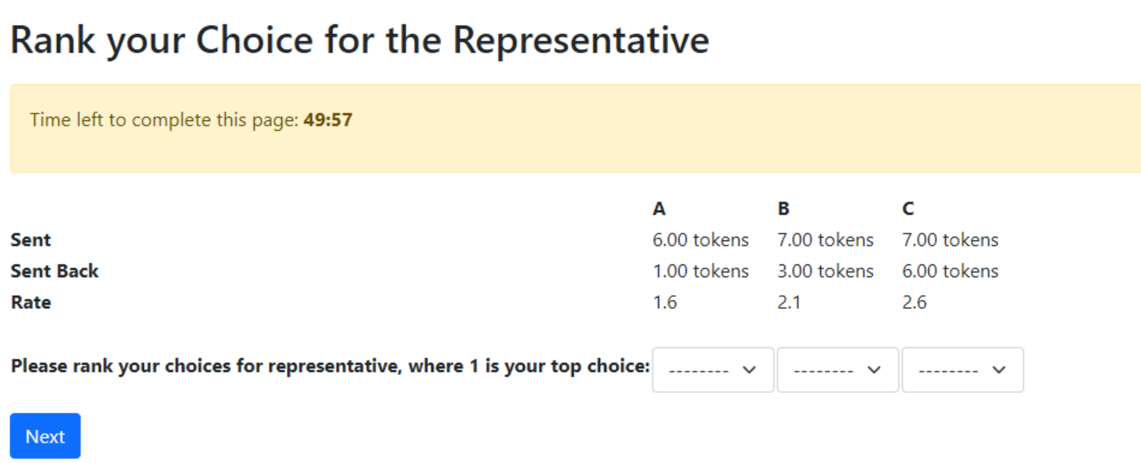
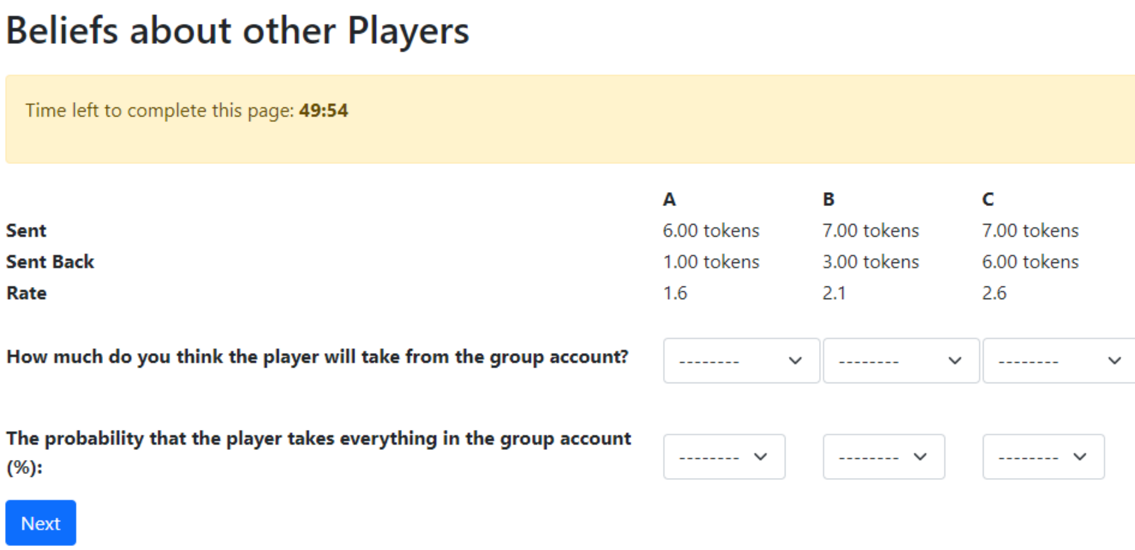


Figure C.6: Voter interface: Belief elicitation



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