Public vs. Private Signals in Information Acquisition

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Abstract

We study a persuasion model as in Kamenica and Gentzkow (2011) where two agents collect and reveal information to each other. After collection, the players choose an action that influences a payoff-relevant outcome. Each player can collect information that is relevant both to themselves and to the other player. The players face a tradeoff in collecting information between informing themselves and inducing the other player to take a desired action. We analyze this model under two different settings of observability: private signals and public signals. We also compare the outcomes of both majority rule and unanimity. We find that, in the setting of private signals, there is no benefit to joint collection over that of a single player. The only beneficial equilibria involve freeriding where one player collects a perfectly informative signal and the other player collects no information. In the setting of public signals, we show that joint collection can improve upon the expected payoff from single-player acquisition. We also find the the equilibria in the majority rule and unanimous settings are analogous.

1 Introduction

One goal of organizations is to aggregate decentralized information in order to implement sound policies. Yet, different members of the organization my have different preferences and may feel hesitant to disclose information if it may lead to actions that do not achieve their goals. In addition, certain relevant information may be unknown and can only acquired by some members in the organization. If once acquired, the information becomes public, these members may be hesitant to acquire it.

Consider the following example (adapted from Roesler 2014): a is committee hiring a new faculty candidate. This committee is composed of two members: a theorist and an empirical economist. The candidate conducts both empirical research and theoretical research. While both committee members would hire a candidate who conducts strong empirical and theoretical research, their hiring preferences differ over specialized candidates. One member is willing to hire candidates who conduct strong research in pure economic theory (but none in empirical work). The other member prefers to hire candidates who conduct strong empirical economic research (but none in theoretical economics). Each member is tasked with collecting information about the candidate's research in the different fields.

The empiricist collects information regarding the strength of the candidate's empirical research, while the theorists collect information regarding the candidate's theoretical research. They then share the information that they collected. After sharing this information, the committee then votes on whether to hire the candidate or not. One may ask the following questions: what type of information is collected given the voting rule? Who benefits from the decision making process? Do different voting rules yield different equilibrium outcomes?

One criticism with the model is that the commitment assumption (which leads to symmetric information) may fail hold. While commitment may be difficult to achieve in situations where the cost of acquiring information is cheap, it may be easier to form when the cost of acquiring information is large. Thus, the information may be purchased through the institution and may, therefore, become available to all members once acquired. In addition, there may be legal barriers to the acquisition of certain private information without the consent of the other parties of the committee.

In this paper we compare the expected payoff of the players under both public and private information acquisition to that where only one player can collect information and decide the outcome. We find that private information acquisition does not improve upon single-player collection. In contrast, we find that public information may improve the expected payoff of both parties from the single-player outcome. We also find that the decision rule (majority rule or unanimity) does not effect the types of equilibria under each observability structure.

This paper differs from the Condorcet Jury Theorem literature (such as Austen-Smith and Banks, 1996, Feddersen and Pesendorfer, 1998) in that players acquire signals relevant to the outcome. This paper differs from the deliberation literature (such as Austen-Smith and Feddersen, 2006, Dorszelski et. al. 2003, and Gerardi and Yariv, 2007). In that players choose the precision of the information. Thus, the control of precision distinguishes the paper from others on information acquisition in committees (Persico, 2004, Gerardi and Yariv, 2008, and Mathis, 2011). In addition, this paper differs from these committee papers in that preferences are heterogenous. This paper borrows asepects from the literature on persuasion (Brocas and Carrillo, 2007, Kamenica and Gentzkow, 2011, and Milgrom and Roberts, 1986) but differs in that each agent both receives and acquires information.

2 The Model

In this model there are 2 players and four states: $\Omega = \{G_1G_2, G_1B_2, B_1G_2, B_1B_2\}$ There is a common prior μ_0. The set of possible outcomes is $\mathcal{O} = \{Y, N\}$. The payoffs to each player are given by the following function:

$$u^i(\omega, o) = \begin{cases} 1 & \text{if } \omega_i = G \text{ and } O = Y \text{ or } \omega_i = B \text{ and } O = N, \\ 0 & \text{otherwise} \end{cases}$$

Notice there is conflict in states, G_1B_2 and B_1G_2. For example, in state G_1B_2, player 1 would prefer Y to N, while player 2 prefers the opposite. Each player votes $v_i \in V = \{y, n\}$. Outcomes are determined by a voting rule $\delta : V^2 \to O$ maps votes to outcomes. This talk considers two rules: unanimity $\delta^u(v_1, v_2) = Y \iff v_1 = v_2 = y$ (both y are needed for Y) and majority $\delta^m(v_1, v_2) = N \iff v_1 = v_2 = n$ (one y is needed for Y).

Before voting they collect information and observe signals, s_1, s_2, where $s_i \in S_i = \{g_i, b_i\}$. Each player chooses $\theta_i = \pi(g_j|G_j) = \pi(b_j|B_j)$. Notice that player i determines the precision of signal j (which is relevant to ω_j). Signals are conditionally independent. Notice that while each player collects information that is relevant to the other party, but they can make inferences about their relevant state from the prior $\mu_0(\cdot)$, $\mu_0 \in \Delta(\Omega)$. We consider two different observability structures. Signals can be either private or public. Under private signals, each player chooses a voting strategy σ_i such that $\sigma_i : S_j \to V$. Under public signals, each player chooses a voting strategy σ_i such that $\sigma_i : S_i \times S_j \to V$. Under private signals the timing is as follows:

1. Nature chooses $\omega = (\omega_1, \omega_2)$ according to distribution μ_0.
2. Each player chooses $\theta_i = \pi(g_j|G_j) = \pi(b_j|B_j)$.
3. Player i observes s_j (not s_i).
4. Players take action $v_i \in \{y, n\}$.
5. Payoffs are determined.

Under public signals, the timing is as follows:

1. Nature selects ω.
2. Players first choose θ_i and each observes other's choice.
3. Players each observe s_i, s_j after they are realized.
4. Players take actions in $V = \{y, n\}$.

5. Outcomes are determined and payoffs are realized.

6. Remember that $\sigma_i : S_i \times S_j \to V$.

The equilibrium concept is perfect Bayesian equilibria, though refinements will be employed as needed. An equilibrium has *full acquisition* if $\theta_1^* = \theta_2^* = 1$. An equilibrium is *beneficial* if no player earns lower expected payoff and some player earns strictly more than a payoff with one player. An equilibrium is *mutually beneficial* if both players earn strictly more than both one player games.

3 Results

The results can be summed up in the following chart:

Info Structure Voting Rule	Private Signals	Public Signals
Majority	Freeriding at best	Mutually Beneficial, Full Acquisition
Unanimity	Freeriding at best	Mutually Beneficial, Full Acquisition

We characterize the pure-strategy equilibria of the private setting (for majority rule and unanimity) and find that:

Result 3.1. *The pure-strategy equilibria under the private observability structure must be one of the following:*

1. *Freeriding Equilibrium: Under majority rule, there is an i such that $\theta_i^* = 1$, $\sigma_i^*(\cdot)$ is strictly increasing, $\sigma_j^*(\cdot)$ is constant (n) (it is a constant y under unanimity),and θ_j^* can be any number in $[0.5, 1]$. Payoffs are equal to the single-player case.*

2. *Pathological A: Both players vote y in the case of majority (and vote n in the case of unanimity).*

3. *Pathological B: Under majority, one player votes y after each signal and the other player votes in contrast to his information (y under a signal b_j and n under signal g_j). Under unanimity this equilibria takes the form where one player always votes n and the other player votes in contrast to his information.*

Thus, the payoff to both players is, at best, equal to that when a single player acquires full information and votes based on the signals obtained. In addition, under the pathological equilibria, players obtain worse payoffs than if a single-player collects information and chooses the outcome.

In contrast, for the public setting, we may improve upon the single decision-maker payoffs:

Result 3.2. *While freeriding equilibria exist under the public information structure, equilibria with full acquisition also exist under public observability. In addition, there exist other mutually beneficial equilibrium.*

Thus, under the public setting, newer and mutually beneficial equilibria arise that may improve expected payoffs of both players from those under the private observability setting.

4 Conclusion

In this paper, we extend the persuasion model to committee decision-making. In addition, we study a setting with conflict of preferences. We examine the acquisition of information in a two-person committee. We characterize equilibria in a private observability setting and show that better equilibria exist in a setting of public observability than in a setting of private observability.

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