Informing to Divert Attention

Margarita Kirneva

CREST - Ecole Polytechnique

August 28, 2023
EEA-ESEM congress
Introduction

– Consider an interaction between a policy-maker and an informational lobbyist over 2 policy issues

– The lobbyist and the policy-maker may have aligned interests on both, on one of them or misaligned on both

– The lobbyist provides policy-relevant information to the policy-maker

– The policy-maker may access some additional information afterwards prior to making the decisions

– The lobbyist is strategic and chooses the type of information and its quality to make her preferred policies more likely
Introduction

In such framework lobbyist’s information has two effects:

– **Informing** policy-maker to assure better decision

– **Directing policy-maker’s own search** for information (to influence which issues are under PM’s attention)

Questions:

– Can the lobbyist influence Receiver’s information acquisition to her benefit in the presence of a conflict of interests?

– Can more information be harmful for the policy-maker?
Introduction

In such framework lobbyist’s information has two effects:

– **Informing** policy-maker to assure better decision

– **Directing policy-maker’s own search** for information (to influence which issues are under PM’s attention)

Questions:

– Can the lobbyist influence Receiver’s information acquisition to her benefit in the presence of a conflict of interests?

– Can more information be harmful for the policy-maker?
This paper

- 2-dimensional Sender-Receiver framework with private information acquisition
- Receiver needs to take 2 actions, one for each of the dimensions of the state of the world
- Prior to making a decision Receiver acquires information in 2 stages:
  - Sender strategically provides some information (commitment)
  - Receiver may obtain some additional information afterwards
- Receiver’s (and Sender’s) access to information is restricted
Preview of the results

- We uncover the new role for the information provision in the presence of a conflict of interests

  ▶ To provide information on the dimension where interests are aligned if such exists
  ▶ To prevent Receiver from discovering excessively the dimension of (greater) misalignment

- In the latter case Sender provides information in order to divert Receiver's attention

Information provision is possible under fully misaligned interests!
Preview of the results

- We uncover the new role for the information provision in the presence of a conflict of interests

- When the interests of Sender and Receiver are partially aligned or fully misaligned, Sender is facing a trade-off:
  - To provide information on the dimension where interests are aligned if such exists
  - To prevent Receiver from discovering excessively the dimension of (greater) misalignment

- In the latter case, Sender provides information in order to divert Receiver’s attention
Preview of the results

- We uncover the new role for the information provision in the presence of a conflict of interests

- When the interests of Sender and Receiver are partially aligned or fully misaligned Sender is facing a trade-off:
  
  - To provide information on the dimension where interests are aligned if such exists
  
  - To prevent Receiver from discovering excessively the dimension of (greater) misalignment

- In the latter case Sender provides information in order to divert Receiver’s attention

- Information provision is possible under fully misaligned interests!
Key intuition

- Receiver looks for information which reduces uncertainty the most ⇒ **Receiver learns the most uncertain dimension**
Key intuition

- Receiver looks for information which reduces uncertainty the most ⇒ Receiver learns the most uncertain dimension

- To divert attention from the dimension of misalignment
  Sender:
  ▶ partially reveals this dimension to make it less uncertain
  ▶ which forces Receiver to look for information on the other dimension
Key intuition

– Receiver looks for information which reduces uncertainty the most ⇒ **Receiver learns the most uncertain dimension**

– To divert attention from the dimension of misalignment Sender:

  ▶ partially reveals this dimension to make it less uncertain
  ▶ which forces Receiver to look for information on the other dimension

**Other applications:** privacy concerns, hiring process, expert advice ...
Contribution (theory)

1. Bayesian persuasion
   - Multidimensional environment: 
     Tamura (2018); Khantadze, Kremer & Skrzypacz (2022)
   - Persuasion with private information acquisition 
     Bizotto, Rudiger & Vigier (2020); Matyskova & Montes (2023)

This paper: combines the 2 strands as the only possibility to capture diverting attention motives
2. Lobbying

Cotton & Dellis (2016); Ellis & Groll (2020); Cotton & Li (2018)

This paper: provides new insights on the lobbyist’s motives and optimal PM’s information

3. Other applications

Duggan & Martinelli (2011); Yuksel & Perego (2021); Yuksel (2021); Biglaiser et al. (2023)
Baseline framework

- 2 agents: Sender (S) and Receiver (R)
Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$
Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$
- R needs to take 2 actions: $a \in \mathbb{R}^2$
Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$
- R needs to take 2 actions: $a \in \mathbb{R}^2$
- R’s payoff:

\[
u_R(a, \theta) = -(a_1 - \theta_1)^2 - (a_2 - \theta_2)^2\]

- S’s payoff:

\[
u_S(a, \theta) = -\sum_{i \in \{1,2\}} \left( \beta_i (a_i - \theta_i)^2 + (1 - \beta_i) (a_i - a_i^*)^2 \right)\]

\[
\begin{align*}
\text{correct action} & \quad \text{S’s bias}
\end{align*}
\]
Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$
- R needs to take 2 actions: $a \in \mathbb{R}^2$
- R’s payoff:
  \[
  u_R(a, \theta) = -(a_1 - \theta_1)^2 - (a_2 - \theta_2)^2
  \]
- S’s payoff:
  \[
  u_S(a, \theta) = - \sum_{i \in \{1, 2\}} \left( \beta_i (a_i - \theta_i)^2 + (1 - \beta_i)(a_i - a_i^*)^2 \right)
  \]
  \[
  \text{correct action} \quad \text{S’s bias}
  \]

General: $u_i(a, \theta) = \|Q_i^\theta \theta + Q_i^a a\|^2$
Baseline framework

- S and R share prior beliefs about $\theta$:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} v_1 & 0 \\ 0 & v_2 \end{pmatrix}\right)$$
Baseline framework

– S and R share prior beliefs about $\theta$:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \nu_1 & 0 \\ 0 & \nu_2 \end{pmatrix}\right)$$

Allow for correlation between the dimensions
Baseline framework

- S and R share prior beliefs about $\theta$:

$$\theta \sim \mathcal{N} \left( \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \nu_1 & 0 \\ 0 & \nu_2 \end{pmatrix} \right)$$

Allow for correlation between the dimensions

- S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$

with $\varepsilon_S \sim \mathcal{N}(0, \sigma_S^2)$
Baseline framework

- S and R share prior beliefs about $\theta$:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \nu_1 & 0 \\ 0 & \nu_2 \end{pmatrix} \right)$$

Allow for correlation between the dimensions

- S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$

with $\varepsilon_S \sim \mathcal{N}(0, \sigma^2_S)$

$$S_S = \alpha_{S_1} \theta_1 + \alpha_{S_2} \theta_2 + \varepsilon_S$$

any number of linear signals
Baseline framework

– S and R share prior beliefs about $\theta$:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \nu_1 & 0 \\ 0 & \nu_2 \end{pmatrix}\right)$$

Allow for correlation between the dimensions

– S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$

with $\varepsilon_S \sim \mathcal{N}(0, \sigma^2_S)$

any number of linear signals

– Upon observing realization of $S_S$, R chooses a signal (dimension+noise):

$$S_R = \theta_j + \varepsilon_R$$

with $\varepsilon_R \sim \mathcal{N}(0, \sigma^2_R)$
Baseline framework

– S and R share prior beliefs about $\theta$:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \nu_1 & 0 \\ 0 & \nu_2 \end{pmatrix}\right)$$  
Allow for correlation between the dimensions

– S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$
with $\varepsilon_S \sim \mathcal{N}(0, \sigma_S^2)$

$$S_S = \alpha_{S_1} \theta_1 + \alpha_{S_2} \theta_2 + \varepsilon_S$$  
any number of linear signals

– Upon observing realization of $S_S$, R chooses a signal (dimension+noise):

$$S_R = \theta_j + \varepsilon_R$$
with $\varepsilon_R \sim \mathcal{N}(0, \sigma_R^2)$

$$S_R = \alpha_{R_1} \theta_1 + \alpha_{R_2} \theta_2 + \varepsilon_R$$  
a unique linear signal
Timeline

$t = 0$
$S$ selects $S_S$

$t = 1$
$\theta$ is realized

$t = 2$
$S_S$ is observed
$R$ selects $S_R$

$t = 3$
$S_R$ is observed

$t = 4$
$R$ takes action $a$
Baseline framework

– S is an expert ⇒ signal is costless

– R’s information is costly :

\[ C(\tilde{v}, \check{v}) = \frac{\lambda}{2} \left( \log \frac{\check{v}}{\tilde{v}} \right) \]

where \( \tilde{v} \) and \( \check{v} \) are the interim and posterior beliefs of R on the dimension of \( S_R \) (Mackowiak, Matějka, and Wiederholt (2018))
Baseline framework

– S is an expert $\implies$ signal is **costless**

– R’s information is **costly** :

$$
C(\tilde{v}, \tilde{v}) = \frac{\lambda}{2} \left( \log \frac{\tilde{v}}{\tilde{v}} \right)
$$

where $\tilde{v}$ and $\tilde{v}$ are the interim and posterior beliefs of R on the dimension of $S_R$ (Mackowiak, Matějková, and Wiederholt (2018))

– Precision-dependent convex costs $c(1/\sigma_R^2)$, for instance

$$
c(1/\sigma_R^2) = \frac{\kappa}{\sigma_R^2} \quad \text{ or } \quad c(1/\sigma_R^2) = +\infty \cdot 1_{\sigma_R^2 < \tilde{\sigma}^2}
$$
Baseline framework

\[ u_R(a, \theta) = -(a_1 - \theta_1)^2 - (a_2 - \theta_2)^2 \]

It follows:

- \( a_R = \mathbb{E}_{\tilde{F}}[\theta] \)
  where \( \tilde{F} \) - posterior belief of R

- \( \mathbb{E}_F[u_R(a, \theta)] = -\tilde{\nu}_1 - \tilde{\nu}_2 \)
  where \( \tilde{\nu}_1, \tilde{\nu}_2 \) - posterior uncertainty of R
Baseline framework

\[ u_S(a, \theta) = - \sum_{i \in \{1,2\}} \left( \beta_i (a_i - \theta_i)^2 + (1 - \beta_i) (a_i - a_i^*)^2 \right) \]

It follows (given the optimal actions of R!):

\[ \mathbb{E}_F[u_S(a, \theta)] = -(2\beta_1 - 1)\tilde{\nu}_1 - (2\beta_2 - 1)\tilde{\nu}_2 \]

- If \( \beta_1 > 1/2, \beta_2 > 1/2 \) - interests are aligned
- If \( \beta_1 < 1/2, \beta_2 < 1/2 \) - interests are misaligned
- If \( (\beta_1 - 1/2)(\beta_2 - 1/2) < 0 \) - interests are partially aligned
Diverting attention

S’s signal **diverts R’s attention** if:

- It provides information on the dimension where interests are misaligned
- In the absence of S’s signal, R receives information on this dimension

**Intuition:** information is provided not to induce R’s learning but to discourage information acquisition on the unfavorable dimension
Interim beliefs

Figure: Attainable set of interim beliefs
Baseline framework

R is minimizing the remaining uncertainty + entropy costs of information acquisition:

\[ \downarrow \]

R learns the most uncertain dimension \( i \) so that \( \tilde{v}_i = \lambda/2 \)
Baseline framework

R is minimizing the remaining uncertainty + entropy costs of information acquisition:

\[ \downarrow \]

R learns the most uncertain dimension \( i \) so that \( \tilde{v}_i = \lambda/2 \)

Underlying assumption: \( \lambda/2 < v_2 < v_1 \)
Figure: Attainable set of posterior beliefs (given R’s optimal response)
Solution

\[ \mathbb{E}_F[u_S(a, \theta)] = -(2\beta_1 - 1)\tilde{v}_1 - (2\beta_2 - 1)\tilde{v}_2 \]

**Case 1:** \( \beta_1 < 1/2, \beta_2 > 1/2 \) (interests misaligned on the more uncertain dimension)
Solution

\[ \mathbb{E}_F[u_S(a, \theta)] = -(2\beta_1 - 1)\tilde{v}_1 - (2\beta_2 - 1)\tilde{v}_2 \]

**Case 1:** \( \beta_1 < 1/2, \beta_2 > 1/2 \) (interests misaligned on the more uncertain dimension)

\[ \mathbb{E}[u_S(A)] = -(2\beta_1 - 1)\lambda/2 \]
\[ \mathbb{E}[u_S(B)] = -(2\beta_1 - 1)v_2 - (2\beta_2 - 1)\lambda/2 \]
Solution

$$\mathbb{E}_F[u_S(a, \theta)] = -(2\beta_1 - 1)\tilde{v}_1 - (2\beta_2 - 1)\tilde{v}_2$$

**Case 1:** $\beta_1 < 1/2, \beta_2 > 1/2$ (interests misaligned on the more uncertain dimension)

$$\mathbb{E}[u_S(A)] = -(2\beta_1 - 1)\lambda/2$$

$$\mathbb{E}[u_S(B)] = -(2\beta_1 - 1)v_2 - (2\beta_2 - 1)\lambda/2$$

$$\frac{\lambda}{2} < \frac{-(2\beta_1 - 1)}{2(\beta_2 - \beta_1)}v_2 \quad \Rightarrow \quad \mathbb{E}[u_S(B)] > \mathbb{E}[u_S(A)]$$
Solution

\[ \mathbb{E}_F[u_S(a, \theta)] = -(2\beta_1 - 1)\tilde{v}_1 - (2\beta_2 - 1)\tilde{v}_2 \]

**Case 1:** \( \beta_1 < 1/2, \beta_2 > 1/2 \) (interests misaligned on the more uncertain dimension)

\[ \mathbb{E}[u_S(A)] = -(2\beta_1 - 1)\lambda/2 \]
\[ \mathbb{E}[u_S(B)] = -(2\beta_1 - 1)v_2 - (2\beta_2 - 1)\lambda/2 \]

\[ \frac{\lambda}{2} < \frac{-(2\beta_1 - 1)}{2(\beta_2 - \beta_1)}v_2 \quad \implies \quad \mathbb{E}[u_S(B)] > \mathbb{E}[u_S(A)] \]

**BUT!**

R is more informed in A than in B (total uncertainty)
Partially aligned interests

Candidate A: 
\[(\tilde{v}_1, \tilde{v}_2) = (\lambda/2, 0)\]

Candidate B: 
\[(\tilde{v}_1, \tilde{v}_2) = (v_2, \lambda/2)\]

Figure: Attainable set of posterior beliefs
Partially aligned interests

**Candidate A:** \((\tilde{v}_1, \tilde{v}_2) = (\lambda/2, 0)\)

**Candidate B:** \((\tilde{v}_1, \tilde{v}_2) = (v_2, \lambda/2)\)

**Figure:** Attainable set of posterior beliefs

**Candidate A:** S reveals information on dimension 2, R learns dimension 1
Partially aligned interests

Candidate A: \((\tilde{v}_1, \tilde{v}_2) = (\lambda/2, 0)\)

Candidate B: \((\tilde{v}_1, \tilde{v}_2) = (v_2, \lambda/2)\)

**Figure:** Attainable set of posterior beliefs

**Candidate A:** S reveals information on dimension 2, R learns dimension 1

**Candidate B:** S partially reveals information on dimension 1 for R to learn dimension 2
Observation 1

Observation

If

– interests are partially aligned
– misalignment on the more uncertain dimension
– R well-informed (low cost of information acquisition)

then S diverts R’s attention away from the dimension of misalignment
Observation 2

The solution in which S diverts R’s attention might be harmful for R even if the costs of information are low:

Observation

R’s utility is non-monotonic in her costs of information acquisition: \( \exists \) an interval \((\lambda, \bar{\lambda})\) such that \( \mathbb{E}[u_R(\lambda)] < \mathbb{E}[u_R(\bar{\lambda})] \) for all \( \lambda \in (\lambda, \bar{\lambda}) \).

Negative value of information for R!
Misaligned interests

Assume $\beta_1 < 1/2$, $\beta_2 < 1/2$

Candidate A: \((\tilde{v}_1, \tilde{v}_2) = (\lambda/2, v_2)\)

Candidate B: \((\tilde{v}_1, \tilde{v}_2) = (v_2, \lambda/2)\)

– Without S’s signal: A is the solution
Misaligned interests

Assume $\beta_1 < 1/2$, $\beta_2 < 1/2$

Candidate $A$: $(\tilde{v}_1, \tilde{v}_2) = (\lambda/2, v_2)$

Candidate $B$: $(\tilde{v}_1, \tilde{v}_2) = (v_2, \lambda/2)$

- Without S’s signal: $A$ is the solution
- If $\beta_2 > \beta_1$ (conflict of interests stronger on dimension 1) $\Rightarrow$ S partially reveals information on dimension 1 ($B$ is the solution)
Observation 3

Observation

If

- interests are fully misaligned
- misalignment greater on the more uncertain dimension
- R well-informed (low cost of information acquisition)

then S diverts R’s attention away from the dimension of higher misalignment
Extensions

- Single action for R

\[ u_R(a, \theta) = -(a - (\theta_C + \theta_P))^2 \]
\[ u_S(a, \theta) = -(a - \theta_C)^2 \]

where \( \theta_C \) - common component and \( \theta_P \) - private component of R

But! R can observe only \( \theta_C \), or \( \theta_P \), but not a mixture

- Arbitrary number of linear signals for R under a budget constraint
Conclusion

– We uncover a new role for information provision: to divert attention away from unfavorable issues

– We build a multidimensional Sender-Receiver framework with private information acquisition

– In such framework Sender’s signals have two effects: standard information provision + diverting Receiver’s attention

– In the presence of a conflict of interests, Sender diverts Receiver’s attention by providing information on the dimension of (higher) misalignment of interests
Thank you!
Observation 2

Figure: R’s equilibrium utility as a function of cost parameter
Future Research

- Substitutability/complementarity of signals:
  - utility?
  - cost function?

- Beyond normal distributions
R’s and S’s ec-ante expected utilities can be presented as:

\[\mathbb{E}u_R(a, \theta) = -V_R^T\tilde{\Sigma}V_R\]
\[\mathbb{E}u_S(a, \theta) = -V_S^T\tilde{\Sigma}V_S\]

\(V_R\) and \(V_S\) determine the conflict of interests