On the value of Persuasion by Experts

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Motivation

A little bit of ancient history:

- Spring 2014 — First presentations of "Persuading Voters"
  - Big question during every single presentation: "what if the sender has private information?"
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- Intriguing question: What if the sender does not have access to a fully informative signal?

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How should we think about this question?

That is, what is an interesting and relevant setup to model and study this question?

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Our Setup: the sender only has access to a finite set set of experiments

Examples of limited experimentation:
prosecutor, central bank, tenure letters

Example 1

- A retailer sells two types of cars, A and B. She receives payoff 1 if she sells either car, and zero otherwise.
- A consumer can choose to buy a car A, B, or choose not to buy a car.
- Players are uncertain regarding how much the consumer values each car.

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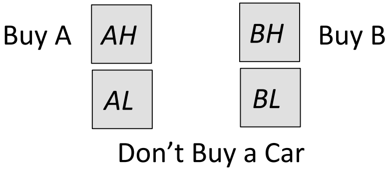
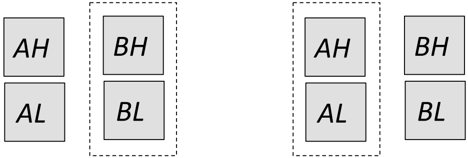
- A consumer can choose to buy a car A, B, or choose not to buy a car.
- Players are uncertain regarding how much the consumer values each car.
- This uncertainty is captured by the unknown state $\theta \in \{AH, AL, BH, BL\}$, uniform prior belief.



Example 1

- To persuade the consumer (receiver), the seller (sender) can design a public signal (test of the product or marketing campaign) that allows the consumer to learn about his true valuation of the product.
- Suppose the retailer has to choose one of two experiments:



(a) Exp. π_A (b) Exp. π_B

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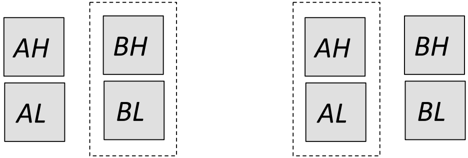

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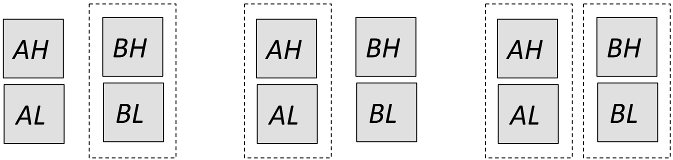
- Without private information, the seller picks either experiment and sells the car with probability 25%

Example 1



(a) Exp. π_A (b) Exp. π_B (c) Signal π_e

- Now suppose that the seller is an expert, and privately observes signal π_e.
- Note that π_e is *strongly redundant*: $\{\pi_e, \pi_A\} \preceq_B \pi_A$ and $\{\pi_e, \pi_B\} \preceq_B \pi_B$.

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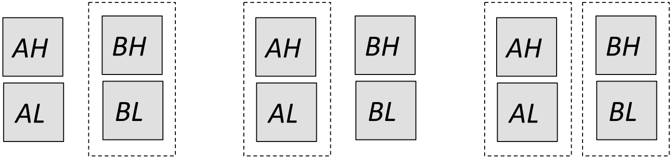

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- Note that π_e is *strongly redundant*: $\{\pi_e, \pi_A\} \preceq_B \pi_A$ and $\{\pi_e, \pi_B\} \preceq_B \pi_B$.
- Nevertheless, the expert seller can sell a car with probability 50%!
- What makes π_e valuable? There is no fully informative experiment, and here expertise helps in the choice of an experiment

In a Nutshell

Our Question

Does the sender benefit from becoming an expert (observing a private signal prior to selecting an experiment)?

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Our Key Result

We define a condition (sequential redundancy) to formalize our intuition that "the informativeness of public experiments can substitute for the sender's expertise"

Other Results

Sufficient conditions for the sender to strictly benefit/lose from becoming an expert

Related Literature

Everybody in this conference!

Model

- Sender (Information Designer) and Receiver (Decision Maker)
- Finite state space, $\theta \in \Theta$, Finite action set, $a \in A$.
- Utilities: $u_S(a, \theta)$, $u_R(a, \theta)$.
- Experiment π: Z_π-valued random variable.
- Finite set Π of feasible experiments
- The sender can costlessly garble any experiment $\pi \in \Pi$.

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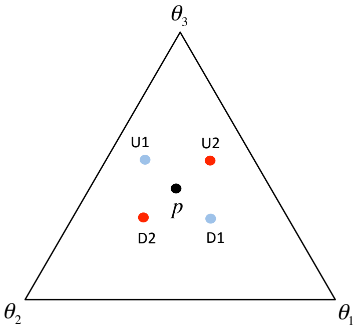
- The sender can costlessly garble any experiment $\pi \in \Pi$.
- A mixture assigns probabilities of selecting different experiments (possibly garbled experiments)
- The sender supplies the receiver an experiment $\pi \in \Gamma(\Pi)$, where $\Gamma(\Pi)$ is the set of all possible mixtures of garblings of experiments in Π

Model



Model

Privately informed sender:

- Sender privately observes the outcome z_e of experiment π_e; then she selects an experiment $\pi(z_e) \in \Gamma(\Pi)$.
- Receiver chooses action $a(\pi, z_\pi)$.
- Perfect Bayesian Equilibrium.

Value to the Sender:

- V_U maximum expected utility of uninformed sender.
- V_I maximum ex-ante expected utility of informed sender.

When is V_I smaller/larger than V_U?

Result: Sequential Redundancy

- Definition: Experiment π_e is *sequentially redundant* given $\Gamma(\Pi)$ if for every z_{π_e}–contingent selection of experiments $\pi(z_{\pi_e}) \in \Gamma(\Pi)$, where $\pi(z_{\pi_e})$ is selected whenever z_{π_e} occurs, there exists $\pi' \in \Gamma(\Pi)$ such that $\{\pi_e, \pi(z_{\pi_e})\} \preceq_B \pi'$.

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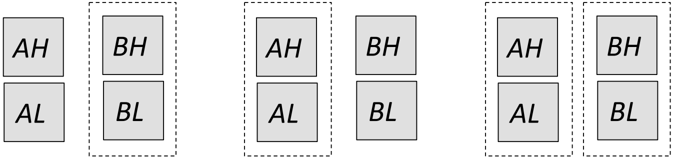
Proposition

We have that $V_U \geqslant V_I$ *for all persuasion games — all* $u_S(a, \theta)$ *and* $u_R(a, \theta)$ *— if and only if* π_e *is sequentially redundant given* $\Gamma(\Pi)$.

- Intuition: replication argument.
- Sequential redundancy: adapting experiment to sender's signal cannot generate more information.

Going Back to our Initial Example



(a) Exp. π_A (b) Exp. π_B (c) Signal π_e

General Rule : Consider partitional experiments π_A and π_B, and a partitional π_e. Then

- π_e is strongly redundant if and only if π_e is coarser than both π_A and π_B.
- For π_e to be sequentially redundant, it must be that there exists at most one realization z_{π_e} such that the restriction of experiments π_i to z_{π_e} are distinct.

Strict Benefit from Expertise

- If expertise is sequentially redundant, then it has no value for the sender
- If expertise is not redundant, then private information can be beneficial if player's preferences are sufficiently aligned
- Our focus: when can the sender strictly benefit from redundant, but not sequentially redundant, information?

Strict Benefit from Expertise

- Recall that V_I is the sender's payoff from privately observing π_e before choosing an experiment, while V_U is the payoff of an uninformed sender.
- V_I is typically hard to compute.

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- V_I is typically hard to compute.
- It is easier to compute the payoff V_{Pub} from an alternative game, in which all players first publicly observe π_e, and then the sender chooses an experiment.
- Useful insight: we provide conditions such that if the sender benefits from publicly observing π_e, $V_{Pub} > V_U$, then the sender also benefits from privately observing π_e, $V_I > V_U$.

Strict Benefit from Expertise

Assumption (A1) (Monotone Preferences)
Let $A \subset \mathbb{R}$ and $u_S(a', \theta) \geqslant u_S(a, \theta)$ for $a' > a$ and $\theta \in \Theta$.

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Proposition

Suppose ***(A1)*** *holds. If* π_e *and all signals in* Π *are partitional, with* π_e *coarser than each* $\pi \in \Pi$*, then* $V_I \geqslant V_{Pub}$.

As in our Example 1.

Strict Benefit from Expertise

Proposition

*Suppose **(A1)** holds. If there exists a selection of public optimal signals* $\pi^*(z_{\pi_e})$, $z_{\pi_e} \in Z_{\pi_e}$, *such that* π_e *is strongly redundant given* $\Pi^*_{\text{Pub}} \equiv \{\pi^*(z_{\pi_e})\}_{z_{\pi_e} \in Z_{\pi_e}}$, *then* $V_I \geqslant V_{\text{Pub}}$.

By offering experiments that make her private information strongly redundant, the sender is "letting the evidence speak for itself" — the receiver's interim belief after observing the choice of signal $\pi^* \in \Pi^*_{\text{Pub}}$ does not affect his posterior belief after observing the realization z_{π^*} of π^*.

- For instance, the conditions of the Proposition hold if π_e can be replicated by each $\pi \in \Pi$.

Strict Loss from Expertise

When does redundant expertise strictly hurt the sender, $V_U > V_I$?

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Assumption (A2) $\Pi = \{\hat{\pi}\}$ *and* π_e *can be replicated with* $\hat{\pi}$.

- **(A2)** implies that π_e is sequentially redundant and $V_U \geqslant V_I$.
- **(A2)** implies that one can without loss restrict attention to pooling equilibria.
- One important case that satisfies **(A2)** is the case of partitional experiments with $\hat{\pi}$ a finer partition than π_e.

Strict Loss from Expertise

Proposition

*Suppose that **(A1)** and **(A2)** hold.*

The informed sender is hurt by her expertise if and only, for every optimal uninformed sender experiment π^*_U, some informed sender type would prefer to offer an experiment that both "certifies" her type and is an optimal experiment when her type is public.

That is, $V_U > V_I$ if and only if

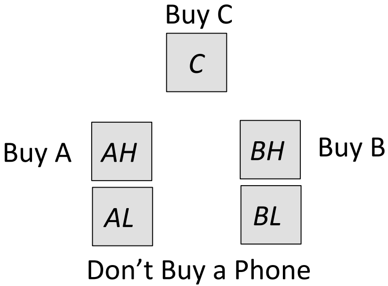
$$\min_{\pi^*_U \in \Pi^*_U} \max_{t \in T} \left[V_{z_{\pi_e}(t)} - v^*_{\pi^*_U}(t) \right] > 0.$$

Application: Persuading Consumers

- The consumer must choose which smartphone to buy: brand A, B or C, or the consumer can choose not to buy a phone.
- Brand C is a more expensive and advanced phone, while brands A and B are cheaper but have very distinctive features.
- The retailer's payoff from selling a C phone is 12, while her payoff from selling an A or B phone is 10. The retailer receives zero if she does not sell.

Application: Persuading Consumers

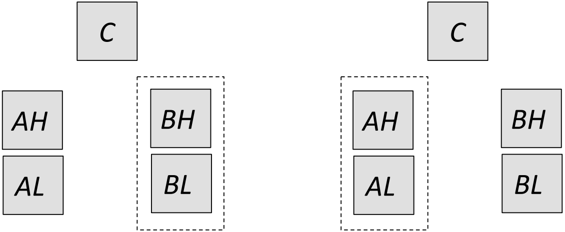
- The consumer is uncertain about which phone is the best match for his needs. This uncertainty is captured by the unknown state $\theta \in \{AH, AL, BH, BL, C\}$.



Application: Persuading Consumers

Case 1: Constrained retailer with no Private Information

The retailer only has access to experiments π_A and π_B:



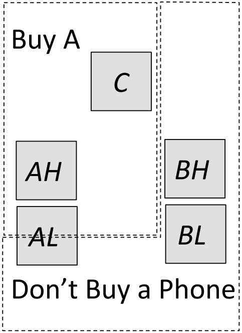
(d) Experiment π_A (e) Experiment π_B

This captures the natural assumption that a more specific experiment is needed to test the consumer's valuation of the distinctive features of each brand.

Application: Persuading Consumers

Case 1: Constrained retailer with no Private Information

Optimal experiment:

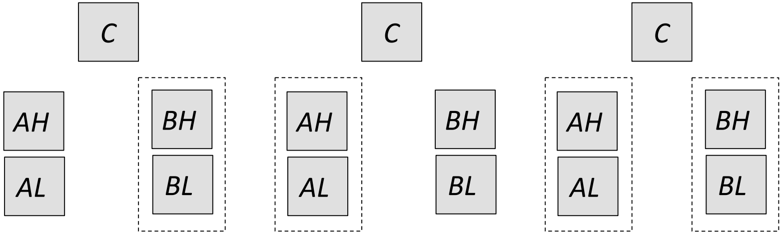


The retailer's expected payoff is 5. Note that this retailer does not find it optimal to sell the more expensive phone C. It is more profitable to bundle type C and type A consumers.

Application: Persuading Consumers

Case 2: Constrained retailer with Private Information

Suppose that the retailer can hire an expert salesperson that is trained to quickly identify the consumer's type.



(a) Experiment π_{A} (b) Experiment π_{B} (c) Private π_e

- π_e is strongly redundant, but not sequentially redundant.

Application: Persuading Consumers

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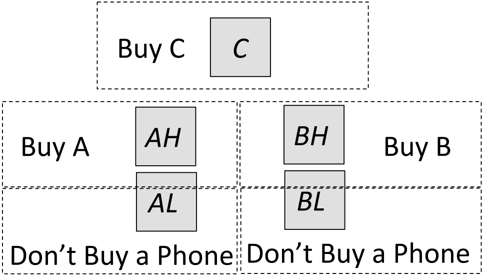


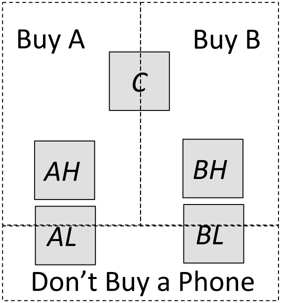
The retailer's expected payoff goes up from 5 to 7.4.
Expertise strictly benefits the constrained seller.

Application: Persuading Consumers

Case 3: Unconstrained retailer with no Private Information

Suppose the retailer has access to a fully informative experiment, but no private information.

Optimal experiment:



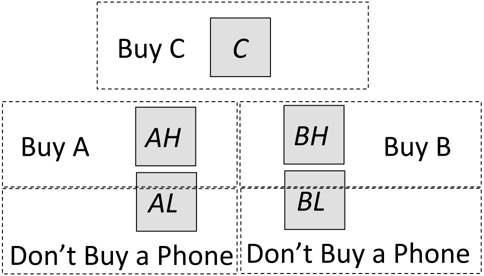
The retailer's expected payoff is 7.5

Application: Persuading Consumers

Case 4: Unconstrained retailer with Private Information

Suppose the retailer has access to a fully informative experiment, and she has access to the same private signal π_e as before.

Optimal experiment:



The retailer's expected payoff goes down from 7.5 to 7.4. The informed retailers cannot pool on the uninformed retailer signal.

Application: Persuading Consumers

Expertise Acquisition versus Strategic Ignorance:

A retailer with access to a fully informative experiment might prefer to hire uninformed salespeople, while a constrained retailer might prefer to hire expert salespeople.

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Thanks!