Games and Economic Behavior 96 (2016) 97–114

Contents lists available at ScienceDirect

Games and Economic Behavior

www.elsevier.com/locate/geb

Competition, preference uncertainty, and jamming: A strategic communication experiment

William Minozzi [a,1], Jonathan Woon [b,*,1]

[a] Department of Political Science, 2137 Derby Hall, Ohio State University, Columbus, OH 43210, United States
[b] Department of Political Science, Department of Economics (secondary), and Pittsburgh Experimental Economics Laboratory, 4443 Wesley W. Posvar Hall, University of Pittsburgh, Pittsburgh, PA 15260, United States

ARTICLE INFO

Article history:
Received 10 March 2014
Available online 6 February 2016

JEL classification:
C72
D82
D83

Keywords:
Strategic information transmission
Sender–receiver games
Multiple senders
Laboratory experiment
Bounded rationality
Level-*k*
Behavioral models

ABSTRACT

We conduct a game-theoretic laboratory experiment to investigate the nature of information transmission in a communication environment featuring competition and information asymmetry. Two senders have private information about their preferences and simultaneously send messages to a receiver in a one-dimensional space with a large number of states, actions, and messages. We find that equilibrium predictions fare poorly and that senders overcommunicate by consistently exaggerating their messages. Over time, exaggeration increases and communication unravels. Our analysis suggests that exaggeration and unraveling can only be partially explained by bounded rationality models of iterated reasoning or belief learning. Instead, behavior is consistent with a naive form of exaggeration in which senders know they must exaggerate, but they do so in an understated way that is less responsive to their private information or to opponents' past behavior than would be fully optimal.

1. Introduction

Throughout daily life, people are confronted with conflicting messages from informed sources. In politics, for example, candidates offer competing visions for national policy (Banks, 1990), legislators and lobbyists make conflicting claims for and against legislation (Gilligan and Krehbiel, 1989; Austen-Smith, 1990, 1993), and courts rely on adversarial advocates to inform their judgments (Dewatripont and Tirole, 1999). Each situation features well-informed, interested actors whose preferences remain partially private. Those actors send competing messages to decisionmakers who cannot verify the content of those messages. The set of messages is limited to a single salient dimension, sometimes explicitly by germaneness rules, yet within that dimension of disagreement, the number of possible messages is large. In this paper, we describe a laboratory experiment on information transmission in this context.

Based on existing theory, we have contradictory expectations for information revelation in such settings. Preference differences limit the information that can be conveyed in strategic environments (Crawford and Sobel, 1982), which can be exacerbated if the decisionmaker is uncertain about information-providers' preferences (Sobel, 1985; Lupia and McCubbins, 1998). Yet competition between information providers can also provide mechanisms for the truth

* Corresponding author.
E-mail addresses: minozzi.1@osu.edu (W. Minozzi), woon@pitt.edu (J. Woon).
[1] Associate Professor.

http://dx.doi.org/10.1016/j.geb.2016.01.012

to emerge. Indeed, the "marketplace of ideas" is often invoked to justify the importance of protecting free speech (Mill, 1859). Competition among elites and the news media can yield a more informed public (Page and Shapiro, 1992; Gentzkow and Shapiro, 2008). Yet mixing competition and preference uncertainty may only provide further opportunities for strategic obfuscation (Milgrom and Roberts, 1986; Minozzi, 2011).

To the best of our knowledge, ours is the first experiment to examine an environment that incorporates competition and preference uncertainty in a unidimensional state space with large message and action spaces. Studies in the extant experimental literature on communication tend to focus on simple environments that feature either a single sender, commonly known preferences, a small number of messages and actions, or a combination of only a few of these features (Blume et al., 1998, 2001; Cai and Wang, 2006; Dickhaut et al., 1995; Gneezy, 2005; Hurkens and Kartik, 2009; Peeters et al., 2008; Sánchez-Pagés and Vorsatz, 2007). Studies that investigate environments with two senders are rare. Lai et al. (2015) and Vespa and Wilson (forthcoming) test for Battaglini's (2002) fully-revealing equilibrium, which requires a two-dimensional setting.[2] In contrast, the one-dimensional environment in our experiment makes information-revelation theoretically more difficult. Unlike previous studies, in which there is typically a small set of discrete states and messages, our setting allows for much more varied communication strategies. Our setting is also spatial, meaning that our findings have straightforward applications to many fundamental formal models of politics.

We present evidence for three main findings. First, there is overcommunication relative to equilibrium expectations, consistent with previous research on single-sender games (Blume et al., 1998; Cai and Wang, 2006). Senders select messages best modeled as additive exaggerations in the direction of their hidden biases. In the competitive setting, this sort of overcommunication means that receivers come very close to learning the hidden state information simply by splitting the difference in messages.

Second, we find that there is unraveling. Specifically, we find that senders' exaggerations tend to increase with repeated play. As senders exaggerate more and more, their messages eventually hit the boundaries of the message space. This unraveling suggests the possibility that senders *learn* to exaggerate, in contrast with previous sender–receiver experiments.

Finally, we apply two models of limited strategic sophistication: a level-k model and a belief learning model. Intriguingly, each model explains some of our empirical findings, but neither model dominates the other in terms of predictive accuracy. Moreover, both models over-predict exaggeration. We conclude that senders use a naive strategy consistent with strategic cognition but significantly more limited in sophistication than in typical models of bounded rationality.

2. Theoretical model and equilibrium predictions

Consider a communication environment with two senders and one receiver.[3] Both senders observe a state variable, which we call the *target* T, uniformly distributed over the interval $[-100, 100]$. Each sender i also privately observes his *shift* S_i, which represents his preference divergence from the receiver. The *left sender* has shift S_L distributed uniformly over $[-50, 0]$, and the *right sender* has S_R distributed uniformly over $[0, 50]$. These distributions are common knowledge. The senders simultaneously select messages m_i from the real line to send to the receiver, who chooses action c.[4] The receiver prefers c to be close to T while sender i prefers c to be close to $T + S_i$. Formally, the receiver's payoff is $100 - |c - T|$ and the senders' payoff is $100 - |c - (T + S_i)|$. In terms familiar from the spatial voting model, T is the receiver's ideal point while $T + S_i$ is sender i's ideal point. Thus, the receiver knows that senders are opposed, but she is uncertain whose ideal point is closer to hers. We focus on perfect Bayesian equilibria.

Cheap talk and signaling games typically have many equilibria. The purpose of our equilibrium analysis is therefore not to make unique predictions, but to provide a framework that organizes our experimental analysis and guides our expectations about the kinds of behavior that are consistent with fully rational, strategic play (Schotter, 2006). While previous studies focus on the most informative equilibria (e.g., Cai and Wang, 2006), we focus on equilibria that are simple to implement and heuristically plausible, yet differentiated from each other in structure and informativeness. The three equilibrium classes we consider are babbling, partition, and jamming.[5] Each of these equilibria involves a simplistic message strategy, and straightforward on-the-path and off-the-path beliefs. Moreover, these equilibria feature very different predictions about informativeness and manipulability of outcomes by senders. Generally, babbling involves the least information transmission

[2] Boudreau and McCubbins (2008) conduct an experiment with competition and a version of preference uncertainty, but their experiment involves a decisionmaker who solves SAT math problems with the help of "experts." Their setup departs from standard sender–receiver games because their receivers have heterogeneous (unobserved and uncontrolled) beliefs about the true state.

[3] For a detailed formal analysis of this game, see Minozzi (2011). We use male pronouns to refer to senders and female pronouns to refer to the receiver.

[4] In the experiment, messages are integers in $[-150, 150]$. As is typical in cheap-talk games, equilibrium outcomes, which are mappings from states to actions, do not depend on the literal meanings of messages. For ease of exposition and to be consistent with the experimental design, we nevertheless present our equilibrium predictions assuming that literal messages are used.

[5] In addition to these equilibria, there are other types that we do not focus on. First, hybrids of these three types can also be equilibria. For example, an equilibrium can be constructed in which a central subinterval of the state space is relegated to babbling while the remainder is treated as jamming. We ignore this sort of equilibrium because it relies on intensive coordination to construct and would be difficult to differentiate from the "pure" types we consider here. Second, there are fully revealing equilibria that require punishment strategies based on off-the-path beliefs to induce revelation (Krishna and Morgan, 2001). We ignore these equilibria because such off-the-path beliefs are typically implausible (Battaglini, 2002) and would also require intensive coordination to construct. Third, any relabeling on the message space would yield equivalent equilibrium outcomes with, for example, the signs of the messages flipped. Again we focus on equilibria with literal messages and ignore the relabeled equilibria because the latter are difficult to implement.