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Journal of Economic Theory 177 (2018) 594–615

JOURNAL OF Economic Theory

www.elsevier.com/locate/jet

Strategic gradual learning and information transmission

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Received 23 September 2016; final version received 28 June 2018; accepted 19 July 2018
Available online 23 July 2018

Abstract

Prior to advising a decision maker, the expert needs to gather some relevant information. This often takes time, and therefore, even if the expert's learning process is unobservable, the timing of advice can be informative in itself. If, in addition, the expert can choose which experiments to perform, the timing of her advice may reveal not only the amount but also the type of information at her disposal. This paper studies a dynamic information transmission problem where a biased expert acquires information by performing a sequence of experiments, which cannot be observed by the decision maker. It is shown that, even in the absence of an objective reason to expedite information transmission, artificial time pressure can increase the amount of information transmitted and be beneficial to both players.

JEL classification: D82; D83

Keywords: Gradual learning; Strategic scheduling of experiments; Dynamic information transmission; Cheap talk

1. Introduction

Strategic interactions with asymmetric information have been a main interest of economics during the past few decades. In many cases, the asymmetry in information is not exogenously fixed but changes over time in an endogenous manner. When it takes time to acquire information, the timing of actions becomes informative in itself. Furthermore, if the actual learning process is

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[1] I thank Yair Antler, Elchanan Ben-Porath, Daniel Bird, Eddie Dekel, Ran Eilat, Ariel Rubinstein, and Ran Spiegler for useful comments and suggestions. I am especially grateful to my advisors Ady Pauzner and Kfir Eliaz. This work has been supported by the Spanish Ministry of Economy and Competitiveness (projects ECO2014-56154-P and SEV-2011-0075).

https://doi.org/10.1016/j.jet.2018.07.006
0022-0531/

determined strategically, the timing of actions can reveal not only the amount but also the type of information acquired. This friction of gradualness in learning brings in new strategic considerations and can significantly affect predicted outcomes. However, ongoing strategic information acquisition has not yet received enough attention in the literature.

In this paper, I study a dynamic interaction between a biased sender (expert) and a receiver (decision-maker). At the start, both players are uninformed, but the expert has the ability to explore the state of the world. The expert's learning is gradual as it is carried out under some technological limitations; it is impossible to perform many experiments at the same time, and only certain experiments can be performed (for example, the "perfect experiment" that instantaneously reveals all the relevant information does not exist). Learning is strategic in that the selection of a particular collection of experiments to be performed and the ordering of these experiments are left to the expert's discretion. The actual learning process cannot be observed by the decision maker. To emphasize the particular effect of gradualness in the expert's learning I assume that learning is costless and that the time available for learning places no restrictions on the expert's ability to become fully informed.

To present the basic forces at play in the most transparent way, I consider a convenient discrete version of Crawford and Sobel (1982) model and add to the traditional state space a special state, denoted by 0, where the players' interests are aligned. Even though this is done mostly for technical and expositional purposes, such a state space can actually fit better some real-life situations. One possible interpretation of this special state is that of a "categorically different" state, where it is commonly agreed that no active actions should be taken. For example, it may be agreed that if a defendant is innocent he should not be punished, while if guilty, different parties may consider distinct punishments as more appropriate. Similarly, a doctor, who is usually biased towards certain treatments, can be unbiased if the patient's problem is outside the area of her expertise and, like the patient, prefer not to pursue any active treatment.

The initially uninformed expert acquires information by performing a sequence of experiments. In this paper, I assume that the set of available experiments is given by a collection of "perfect tests," each of which examines a specific element of the state space. In particular, for each possible state $\theta \neq 0$, there is an experiment that reveals whether the true state of the world is θ. Performing each experiment takes one unit of time, and parallel experimentation is not allowed.

The main result of this paper identifies the sufficient conditions under which a fully informative equilibrium exists. One condition involves the sender's preferences in the special state 0: It is assumed that inducing an "active" action, $a > 0$, in this state is sufficiently costly for the sender. The other is a monotonicity condition that relates the sender's preferences at states $\theta \neq 0$ with her prior beliefs. This condition replaces the standard supermodularity condition that is often assumed in models of asymmetric information where one party is fully informed. For example, the suggested condition is satisfied in the leading uniform-quadratic specification that has been the focus of many theoretical and applied papers. However, it is also satisfied in many other cases, including situations where, unlike in the uniform quadratic case, the players do not rank identically the set of possible equilibria ex-ante.

It is also shown that there exists a unique inspection sequence that can be consistent with a fully informative equilibrium. In any such an equilibrium, the states are inspected in the direction opposite to the expert's bias. When the true state of the world is identified, the expert reports to the decision maker without delay.

After proving these results for a state space that contains the special state 0, I discuss the role of this state and show that the results are not an artifact of the assumed environment. In