Strategic communication: theory and experiment

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Chapter 1

Introduction

Acquiring and communicating information is an important part of most economic activity. In many economic interactions, communication has a strong 'strategic' element. If two people have different interests, then there may be pieces of information they would want to withhold from each other, or one would like to persuade the other of things that are not necessarily true. A job applicant might want to appear more qualified than he or she actually is. A salesman might want to overstate the value of a product in order to sell it. An expert advisor might want to advise in favor of a certain policy, partly because it is 'the right policy' but also partly because of his own interests. Examples of 'strategic communication' having an essential role are abundant in economics.

The game theoretic literature on strategic communication was started by Spence in his 1973 article on job market signaling. Here, Spence argued that individuals of different types could separate themselves by sending different levels of a costly signal. If different types have different marginal benefits given a marginal cost for changing the signal (or have different costs for sending the same signal), then credible signaling is possible. The main example used by Spence was attaining a certain level of education to signal a worker's quality on the job market. If the cost of acquiring a high level education is lower for qualified workers or the benefits of having high qualified job are higher for high quality workers, education can serve as a credible signal of quality.

The work of Spence showed that many costly actions could be interpreted as strategic communication of one's type or knowledge. Later, other economists, notably Crawford and Sobel (1982), showed that costless messages, or 'cheap talk', can also have an impact on economic outcomes, in the case of partial alignment of interests. If a sender who has knowledge about the 'state of the world' can advise a receiver, who has to make a decision whose outcome depends on the state and will have consequences for both the sender and the receiver, the sender probably wants to communicate relevant information about the state to the receiver. If both players have exactly the same interests, perfect

communication can take place. However, if interests slightly differ, full transfer of information of the state is impossible if both parties act strategically. Information transmission is still possible in equilibrium, but it will only be partially revealing, or 'vague'. In fact, Crawford and Sobel show that given an ordering of the states of the world, an imprecise language emerges via a partitioning of the state space. So by only defining the interests of parties and assuming strategic behavior, they can say something about what kind of language will emerge.

Building on these two results, a large literature on strategic communication has emerged, ranging from topics on initial public offerings in finance (e.g. Leland and Pyle, 1977) to for example committee decision making (Visser and Swank, 2007). The theories on signaling and cheap talk do face a few difficulties, though. One theoretical difficulty is the fact that most communication games have more than one outcome that has the characteristics of a Perfect Bayesian Equilibrium, the usual tool used to make predictions in sequential games of imperfect information. Sometimes a whole list of equilibria exists. This sparked a literature on equilibrium refinements, with notable signaling game refinements being the intuitive criterion (Cho and Kreps, 1987) and the strategic stability criterion of Kohlberg and Mertens (1986). These refinements, designed for costly signaling games, put restrictions on 'off equilibrium path' beliefs. In the standard costly signaling setup these refinements select the equilibrium in which types reveal themselves. Also for cheap talk games, refinements have been proposed, notably the 'neologism proofness' criterion of Farrell (1993). The refinements from the costly signaling literature have no selection power for cheap talk games, and many well-known refinements for cheap talk games often reject all Perfect Bayesian Equilibria. The quest to find a good theoretical model that makes clear predictions for communication games is still going on (see e.g. Chen, Kartik and Sobel, 2008).

Thanks to the arrival of Experimental Economics, theoretical exercises can be guided by findings from people actually playing strategic communication games in the lab. Here, in a controlled environment, using real incentives, the effects of changes in the structure of a communication game on the choices that participants make can be studied. Researchers can observe what outcomes, possibly equilibrium outcomes, players coordinate on, and find out more about the way participants reason in a game by looking at how their behavior alters when game parameters are changed. Next to providing help on which equilibria to select in different communication games, experimental studies on communication have also introduced new insights that were originally not predicted by theory. Whereas communication in standard theory can only be credible in case of costly signaling or aligned interests, experimental studies on pre-play communication (e.g. Dawes et al. 1977 or Ellingsen and Östling 2010; see for an overview Ledyard 1995 and Camerer 2003), have

shown that communication can help build up trust, and that participants tend to use and interpret communication more truthfully than would be possible in case of fully strategic behavior of all parties. Also in the first tests of the cheap talk communication model (see Dickhaut et al, 1995 and Cai and Wang, 2006), systematic over-communication has been observed, which again points to participants being more trustworthy and slightly less strategically best responding than standard theory predicts.

The strategic communication literature is rich but still faces some major challenges, especially in keeping a balance between a neat strategic description of a situation and a good account of the actual considerations of people. In this thesis, I will contribute to the literature on strategic communication using the methods of economic theory and laboratory experiments.

This manuscript contains five chapters. Chapter 2 investigates what happens in a standard costly signaling setup, if noise is added to the signal sent. Schooling outcomes can be regarded as a costly signal, but how well someone performs at an exam depends also on whether someone was ill or healthy during the day of an exam. Noise seems to be a natural component of actual signaling situations. When adding a noise term we obtain the following theoretical results. First, each information set is reached with a positive probability in a noisy signaling game. There are no Perfect Bayesian Equilibria that are driven by 'off equilibrium path' beliefs. Therefore none of the above mentioned signaling refinement criteria will have any selection power in this model. Second, we find in general that if the variance of the noise term increases, then the equilibrium in which types separate will be one with increasing spending on signal cost. This might explain high cost signals even in cases where 'low' types are only willing to spend a very little amount on the costly signal. Usually a credible signal would also be low cost here, but not necessarily in a model with noise. For very high levels of noise, the separating equilibrium disappears. Third, for medium levels of noise the separating outcome is an equilibrium. However, for low values of noise the separating outcome is not an equilibrium. In Chapter 2, the intuition for this finding is explained. The finding is striking because apparently the addition of a tiny amount of noise gets rid of exactly the equilibrium that would be favored by practically all the refinement criteria in the case of no noise. Experimentally there are the following findings. First, subjects coordinate on the separating equilibrium for no, low and medium levels of noise and start coordinating in the no-information pooling equilibrium for high noise. Subjects coordinate on a separating outcome in the case for low noise, even when it is not an equilibrium. Second, when subjects coordinate on a separating equilibrium, a higher noise variance leads, as the theory predicts, to higher levels of signal cost chosen. Chapter 2 shows that a simple attraction learning model can reproduce the main patterns in the data, notably, coordinating on the non-equilibrium

separating outcome in the case of a low noise level. Participants show a high level of strategic understanding of the game, but as they do not best respond in a precise manner some unraveling that one might expect to take place, actually does not take place.

In Chapter 3, the results of an experiment are reported where participants play a communication game where they can both communicate with costless and costly messages. Whereas in Chapter 2, the natural feature added was noise in the communication, here the addition comes from the fact that in the real world, people can always combine costless and costly messages. The main research question here is what channel will sender and receiver coordinate on to use for communication. The model implemented in this experiment comes from Austen Smith and Banks (2000), who study a special case of the Crawford and Sobel (1982) cheap talk model and add the possibility for the sender to send both a costless and a costly message, where the costly message will equal the amount it cost the sender to send it. As with most models of communication, the setup allows for a large collection of equilibrium outcomes, some of them using only the costless or costly channel, some of them using both channels. Most refinement criteria have been developed for either a costly signaling setup or a cheap talk setup and therefore provide little guidance concerning what outcomes to focus on. In the experiment the variable that was varied over treatments was the magnitude of the disalignment of interest between the sender and the receiver. Our hypothesis was that the higher the disalignment, the more difficult communication via the costless channel would be and the more participants would rely on the costly signal channel. The main result of this experiment is that participants indeed mainly use the costless communication channel in case of low interest disalignment but start to cautiously use the costly channel in the case of high disalignment between sender and receiver. What drives this result is that senders are, in accordance with their interests, 'overstating' the state which they have to inform the receiver about. When disalignment gets too large, this 'inflating' of the language will make communication impossible and this is when some of the participants started to use the costly channel. The outcomes found are not in line with any of the standard equilibria. In line with previous findings of for example Cai and Wang (2006) we find more information transmission than predicted in any of the equilibrium outcomes. As also observed in Chapter 2, subjects behave relatively strategic, but still do not play close enough to 'best response' so that play can unravel to one of the equilibria. A behavioral equilibrium concept developed by Kartik (2009) where senders experience a cost from lying and therefore only overstate the state to a certain degree, describes many features of the data and also fits the data relatively well when compared to the other equilibrium models.

Chapter 4 deals with a costly signaling model in the context of statistical discrimination. Building on the model of Coate and Loury (1993) of statistical discrimination in the

labor market, this chapter describes the crucial role competition between workers is playing in the emergence of statistical discrimination. Economists generally distinguish two types of discrimination. First is the so called 'taste based' discrimination as described by Becker (1971), where an employer has a specific preference for a non-productivity related feature of a worker. This chapter does not address this form of discrimination. The statistical type of discrimination this chapter addresses concerns self-fulfilling stereotypes that employers, in equilibrium, may have about ex-ante equal groups of workers. In the model of this chapter (and in Coate and Loury), there are two ex-ante equal groups of workers. Workers can be of either high or low quality and this quality depends entirely on the decision of the worker to invest in quality. This investment has a certain cost which is drawn from the same distribution for both groups. In the Coate-Loury model, one worker is applying for one vacancy (or promotion within a company). After the investment decision of the worker, the employer observes a noisy signal but not the true quality of the worker and decides whether to hire the worker or not. The employer only wants to hire a qualified worker. Essentially there can be two types of equilibria. In one equilibrium, the employer never hires a worker from a group and in turn the worker never chooses to invest, which justifies the non-hiring of the employer. In the other equilibrium, the employer hires after observing a 'high' signal and the worker invests if the investment cost she has drawn is not too high. Now discrimination occurs if one group is in the 'good' equilibrium and the other group is in the 'bad' equilibrium. A first experimental test by Fryer, Goeree and Holt (2005) showed, however, that in this setting very little discrimination is actually observed. This chapter shows that by adding explicit competition between workers from the two groups, it becomes much more likely that the setup ends up in an equilibrium where discrimination takes place. Competition is modeled by having two workers apply for the same vacancy and the employer hiring at most one of the workers. In the model in which competition between workers is introduced, the equilibrium in which no discrimination takes place becomes unstable. In a laboratory experiment, we replicate the non-discrimination result from Fryer, Goeree and Holt (2005) for the no-competition setup and find substantial discrimination emerging in the setup with competition. Not only is statistical discrimination a possible equilibrium, this chapter shows that when competition between workers is introduced, it can be a likely outcome. A future step will be to use this new setup to test different measures that could counter statistical discrimination.

Chapter 5 deals with a different topic than strategic communication. It investigates whether people who have been confronted with helpful defaults in a difficult choice task, show a larger tendency to follow the default even if the default is no longer helpful compared to people who have not previously been confronted with 'good' defaults. A good default to help steer choosers in the 'right' direction is an example of a so called 'nudge',

a design feature of the choice architecture that influences choices without per se limiting choice freedom. Participants have to perform a difficult multi-attribute choice task. The particular task is chosen for two reasons. First, there is a clear best choice for participants, the one yielding the highest revenue, so it is clear whether in any situation the default is 'good'. Second, as the task is difficult it is precisely the sort of task for which it is often argued (see e.g. Thaler and Sunstein, 2003) that choice makers could benefit from a helpful 'nudge'. Participants in the experiment perform the task for 50 rounds. There are two treatments with only one difference. In the control treatment, the default is purely random for 50 rounds. In the 'nudge' treatment, the default equals the best choice in the first 25 rounds and is again random in the last 25 rounds. There is a significant effect of being nudged in the first half of the experiment on the tendency to choose the default in the second half and on the performance in the second half. Nudged participants follow the default more often and perform worse than participants from the control treatment. This study gives one of the first results on potential 'side-effects' of the use of nudges.