

# Aggregative Approach to Cheap Talk Credibility: A Survey

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## Abstract

Credibility of cheap talk have been studied in various ways. It stands as, for example, a result of a common interest among party, an outcome of an appeal using a common language, and yield from finely tuned terms of trade. Further, communication among multiple agents also contributes to strategic information extraction. However, there are rather little research that focuses on interaction among many senders in a dynamic setting.

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## 1 . Signaling and Cheap Talk

Cheap Talk model is a natural extension of signaling models; the signaling models themselves are pioneered by Spence (1973). Signals, including cheap talks, work as transmitters of hidden information in a situation of asymmetric information. Suppose that a person is considering over some economic decision making of his own. That decision has a substantial effect to multiple other persons. The problem is that the decision maker does not have a sufficient amount of information on the problem and those other persons have it. Then, other persons, say advisers, have an incentive to make a signal (talk, advise, evidence, suggestion, etc.) for the decision maker in order to affect the final decision. The decision maker, on the other hand, has to consider how he should process those signals into his belief because the advisers can and may lie about the hidden information.

In the signaling model in particular, making a signal incurs a cost. The decision maker screens the signals utilizing the mechanism of such a cost. In Spence (1973), for example, hidden information is each worker's ability and thus making a signal of higher ability costs more for the workers with lower abilities. Therefore, if the difference in signaling costs between a high-ability worker and a low-ability worker is large, the decision maker screens for higher-ability by believing only those signals with sufficiently high level.

Cheap talk, on the other hand, does not incur any direct cost. Each adviser may offer a cheap talk for free. In almost all cases, it is assumed that no one can verify the relevancy of such a talk. Then, a natural question arises: how can the decision maker gain any information from such a groundless

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speech? In other words, in what situation the decision maker can *believe* what an adviser says? It is a problem of *credibility*.

## 2 . Sender-Receiver Game

Crawford and Sobel (1982) were pioneers who answered to that question. They constructed a simple sender-receiver model, wherein one sender makes a cheap talk message to one receiver who has control over some decision. A type, say  $t \in [0, 1]$ , which is randomly determined, is hidden and known only by the sender. The receiver wishes to take an action  $a(t)$  if she could know exactly what the type is. However, the sender wants an action for somewhat higher type than truth, say  $a(t + b)$  ( $b \geq 0$ ). Thus, simply telling the truth by the sender is not likely to occur.

Crawford and Sobel, by studying Bayesian Nash equilibria of this game, have shown that a partial information extraction is achievable if the sender's preference is sufficiently close to the receiver's (that is, if  $b$  is sufficiently small). On each equilibrium path, the sender reveals which part of the possible range the true type belongs to, in order to induce the receivers to move in a better direction for him than he would without this information. The receiver, based on that talk, updates her belief on probabilistic distribution of the type and modifies her decision. The key point is some correlation of their interests; if what they want is close to each other, their payoff improves through sharing information.

Simultaneously, however, Crawford and Sobel showed two interesting and/or problematic features. First, there always exists a babbling equilibrium, in which the receivers ignore all the messages, the sender sends his message in a purely random way, and thus no relevant communication occurs. This outright inefficiency cannot be avoided, since the only source of meaning of the message is their belief. Second, there are multiple equilibria that cannot be Pareto-ranked ex-post. With some maximum number  $N^*$ , there exists an equilibrium that divides the range of types into  $N$  parts as long as  $1 \leq N \leq N^*$ . And depending on the realized value of type, equilibrium that the sender prefers varies. Crawford and Sobel tried to rationalize that they tended to realize an equilibrium with  $N^*$  segments based on the fact that its ex-ante welfare performance is the best, though that approach has not performed very well.

## 3 . Equilibrium Notion Refinement

If you have some strange equilibria when studying a model and cannot ignore it even after you have improved the model itself, then, here comes a chance for equilibrium (notion) refinement. Indeed, the refinement techniques on (perfect) Bayesian equilibria have been already studied in 80s for both incomplete information games in general (McLennan 1985, Kohlberg and Mertens 1986) and signaling games (Banks and Sobel 1987, Cho and Kreps 1987). However, refining cheap talk equilibria is a fundamentally different task from refining signaling equilibria. Simply speaking, since cheap talk does not directly affect payoff, payoff-matrix based refinement does not work for cheap-talk games. Therefore, we had to wait for the development of a technique that is designed exclusively for cheap talk games.

First appeared Farrell (1985, 1993). He invented a notion of 'neologism,' which is a player's counter argument against any equilibrium. Assuming the existence of common preexisting rich language, neologism transfers what the sender wants to say, without being ignored by the receiver. Then, if a neologism is credible for the receiver, it can break the equilibrium. According to this logic, Farrell as-

served the criterion of ‘neologism-proofness’. That is, an equilibria is relevant if it has no credible neologism against itself. Simultaneously, Matthews, Okuno-Fujiwara and Postlewaite (1991) have developed three extensional refinement criteria that are essentially based on the neologism-proofness criterion.

While the neologism-proofness and related notions provide ample interesting implications for game theorists and applied researchers,<sup>1</sup> they have a substantial limitation. When they are applied to the Crawford-Sobel model, they fail to select out the  $N^*$ -partition equilibrium. In particular, Farrell (1993) has shown that none of the equilibria is neologism-proof in the model with quadratic utility and uniform distribution of the types, which is typical for applied research of cheap talk.

Recently, Chen, Kartik and Sobel (2008) have provided us with a novel refinement criterion, NITS (No Incentive To Separate). It supports those Crawford-Sobel equilibria that have more divisions with higher likelihood. The NITS notion is simple and essentially rooted to the notion of neologism-proofness. It simply asks whether a sender with the lowest type has an incentive to verify his type, if he could, rather than accept the payoff from putative equilibrium. If he has, then the equilibrium shall be broken due to the counter-argument by the sender. The NITS requires the sender’s answer to be negative. Though the NITS criterion cannot be applied to the games without the lowest type, it sheds light on the power of counter argument to sort out relevant style of communication.

#### 4 . Multiple Senders and Multiple Dimensions

Beside the refinement studies, model-based approaches to strategic information extraction have also continued. Remarkable is, among others, Battaglini (2002). Studying a model with multiple (at least two) senders and multiple dimensions, he showed that the receiver may gain full information combining multiple messages from the senders. Its story is somewhat technical. If a message space (and action space) is multidimensional such as  $R^n$ , each sender and the receiver hold a hyperplane such that they have common interest on it. The sender shall send a message that tells the type on that hyperplane. If there are multiple senders who have different preferences, then the receiver observes that the type indicated by putative messages falls into the intersection of those hyperplanes. On equilibrium path, the receiver states that each sender should report the truth or otherwise she shall believe the putative intersection, which induces much lower payoff than the truth-telling for one of the senders.

The dream of full information, however has a fragility. Ambrus and Takahashi (2008) pointed out that Battaglini’s result depends on the assumption that the action space is without restriction, i.e.  $R^n$ . If the space is restricted into substantially smaller area, then the full information becomes difficult to achieve. Here the point is in a sense simple. The key way to full information is a situation when the receiver can make at least one of the senders regret his lying. If her action is restricted, that will be difficult.

There are other researches that focus on situations with multiple senders. Those dealing with competition among the senders (Bharracharya and Mukhejee 2012) and laboratory experiment (Battaglini and Makarov 2012) seem promising. Multidimensionality, on the other hand, is studied by, for example, Chakraborty and Harbaugh (2007, 2010).<sup>2</sup>

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<sup>1</sup> See Farrell and Rabin (1996)

## 5 . Applications to Political Economy

Through such a long history of studies on cheap talk, a vast amount of applied research has been accumulated.<sup>3</sup> Here, the author wishes to introduce some distinguished researches on political issues.

Generically speaking, a political process can be deemed as a bargaining process over usage of some rare resources. And as far as we have to bargain, i.e. dispute over an appropriate way of using resource, communication occurs. Thereby, it is natural that some game theorists have considered applying the cheap talk framework to those contexts of bargaining and political debate.

Since the bargaining games had been already a popular topic at the age of 80s (Nash 1950, 1953, Rubinstein 1982, Rubinstein and Wolinsky 1985, Binmore, Rubinstein and Wolinsky 1986), the researchers' responses were quick. Matthews (1989) and Farrell and Gibbons (1989) were pioneers in this direction. Matthews (1989) analyzed an extended sender-receiver model wherein the sender has a right of vetoing the receiver's decision. The sender, similarly as in Crawford-Sobel model, just states a region to which his type belongs. On the path, those decisions that make a compromise get vetoed with positive probability. Farrell and Gibbons (1989) introduced a talk process before the agents play a sealed-bid auction and found that the talk indeed expands the set of possible outcome from the auction. Trade-off between the reservation price and possibility of the auction to be held plays a central role for the result.<sup>4</sup>

With respect to political debate, on the other hand, researches started rather later and are still on their way. First, Austen-Smith (1990, 1993) did studies on rhetoric in political debates, using cheap talk framework as a tool. His work not only formalizes legislative process along with the sender-receiver protocol but also introduced an environment with multiple referrals as a natural one for political dispute (see, in particular, Austen-Smith 1993). He found that a sequential referral system is superior to a joint referral system in a sense that it enables more information to be extracted. Recently, clearly inheriting such an interest of Austen-Smith (1993), Gerardi, MacLean and Postlewaite (2009) have shown that the receiver can extract more information from sufficiently many senders by distorting her decision making rule. Chen and Eraslan (2011) introduced multiple receivers and multiple dimensions into the veto model by Matthews (1989) and showed that legislators' competition through a majority rule may harm the sender's payoff by disturbing information extraction. Further, from somewhat different point of interest, Morris (2001) has shown that the sender's concern over his own lifetime payoff tends to make his speech more conservative in a politically correct way. However, this is rather related to the topics of reputation, which are in the next section.

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<sup>2</sup> Although being out of the range of the current survey, there are also studies which introduce multiple chances of talk (Aumann and Hart 2003) and combination with signaling (Austen-Smith and Banks 2000, Kartik, Ottaviani and Squintani (2007)).

<sup>3</sup> See Sobel (2013, forthcoming) for a comprehensive review.

<sup>4</sup> Recently, Croson, Boles and Murnighan (2003) have shown through an experimental study that cheaptalk actually matters to a bargaining process.

## 6 . Reputation Based Approach

Reputation-based studies on cheap talk have their own characteristic development. First of all, it sounds fairly natural that the senders' concern over their reputation shall make them more often honest. In such a context, the collapse of reputation works as a punishment against lying, similarly as in the models of folk theorem (see Kim 1996). Further, in the context of one-shot trust game, which theoretically holds no room for improvement of payoff, preceding cheap-talk has actually provoked cooperation among the agents (Bracht and Feltovich 2009). Thus, combination of reputation and cheap talk matter to many situations in both rational and behavioral ways.<sup>5</sup>

Furthermore, surprisingly, the concern over reputation may deter the information extraction. Ottaviani and Sørensen (2006) studied a dynamic model with reputation-concerning senders and found out their concern makes themselves reluctant to tell the truth. Its implication becomes clear when we consider, in particular, a situation wherein senders' degrees of accuracy are different among them. If you know that you are rather inaccurate in expecting future types, telling the signal you truthfully have shall verify your inaccuracy and therefore deteriorates your reputation. Thereby, you have an incentive to randomize your report in order to protect your reputation.<sup>6</sup>

The reputation-based research suggests that dynamic interaction among agents may well have unknown power to enforce or harm the credibility of cheap talk message. This insight leads to an agenda in the next section.

## 7 . Possibility of Aggregative Approach

Given the literature, those models with multiple senders in dynamic time seem promising. Typically, introducing cheap-talk process into an aggregative model, such as market model, seems to be fruitful. There exists at least one research in such a direction; Kim and Kircher (2012). They have introduced a foregoing cheap talk process into a model of directed search in labor market. They showed that the cheap talk process substitutes for commitment devices for firms to determine their wage ex-ante and eventually enables the economy to achieve the constrained efficient outcome that appears in the economy with the commitment device. Although their interest is not directly on the credibility issue but rather on the performance of labor market, still their results suggest that we have more topics left to be investigated in the field of dynamic games with communication.

## 8 . Conclusion

Cheap talk has been a hot topic of research since 1980's. Watching through a history of research with respect to information extraction through cheap talk, studying a dynamic model with many agents seems currently promising. In particular, applying the cheap talk framework to aggregative model shall, in the author's opinion, be fruitful.

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<sup>5</sup> To consider the reputation effect, of course, we have to formalize a dynamic setting. See, for example, Golosov, Skreta, Tsyvinski and Wilson (2012).

<sup>6</sup> See also Morris (2001).

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