# Information design

School of Economics

# FOCUS PAPER

## Information Design by Ina Taneva

**In many economic and social settings one person or institution is in charge of communicating with and disclosing information to multiple agents who are engaged in a strategic interaction. This communication takes the form of information provision about an issue or an object of common interest – the *fundamental* – which impacts the payoffs of the interaction.**

Instances of such situations are ubiquitous in everyday life. For example, in advertising, companies choose how much and what type of information to reveal about their new products in order to optimally target different groups of customers through samples, demo versions, and brochures; in financial markets, a firm's disclosure of information about its profitability is relevant both to shareholders and competitors, albeit in very different ways; in economic policy, a central bank's announcement of its stimulus plan affects the economic outlook and behavior of consumers, as well as those of domestic and foreign investors.

The following excerpt[1] from the Economist provides a good context for the role and importance of information provision in economic policy:

> **It is not what you do but the way you say it:**
>
> The other way to minimize the risks of prolonged bond-buying is to be as clear as possible about the circumstances in which it will end. Vague references to a "substantial" improvement in the job market were not enough. That is why Mr. Bernanke's specificity this week was so important. In a zero-interest-rate environment the central bank can influence monetary conditions more through words than through actions. Its most powerful tool is its ability to influence investors' expectations of future inflation.

All of the above examples share the common feature that an information provider – referred to as the *designer* – with a certain objective of her own, chooses the informativeness and correlation of signals reported truthfully to a group of agents. The agents pay attention to the signals they observe for two reasons. First, the signals convey information about the fundamental, which is relevant for determining the payoffs and incentives in the underlying strategic interaction. Second, since signals are correlated, each agent can infer something about the knowledge and beliefs of his opponents, which in turn affect his strategically optimal choice of action. After observing his own signal, each agent forms these expectations about the fundamental and the knowledge of the other agents, and takes an action. It is through these channels that the provided information determines the resulting *equilibrium* of the strategic interaction – a stable outcome from which no agent wants to unilaterally deviate. Thus, by choosing the structure of signals, the designer can provide incentives for agents to behave in a desired, most beneficial for her objective, way.

[1] The Economist, June 22, 2013, "The Federal Reserve: Clearer, but less cuddly".

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My paper contributed to the literature by extending the Bayesian persuasion framework (Kamenica and Gentzkow 2011), which only allows for a single receiver, to situations where the designer is disclosing information to multiple interacting agents. As the agents care not only about the fundamental, but also about each other's actions, this extension is not trivial since it involves considerations of higher-order informational effects. To circumvent these issues I use a solution concept developed by Bergemann and Morris (2014). I show that in a special case, this solution concept characterizes the set of all possible equilibria of the agents' interaction. The designer can thus optimize her objective over this set and select equilibrium that is most beneficial for her. Then, I show how to infer out the signal structure that induces the desired equilibrium once disclosed to the agents.

Broadly speaking, information design is about the optimal choice of information provision so that the resulting equilibrium played by the agents maximizes the objective of the designer in expectation. It is a powerful tool as it does not require incentivizing behavior through monetary transfers and the related issue of budget balancedness. Instead, the proper incentives are created through the signals released to the agents, which share different degrees of correlation and informativeness about the fundamental.

Of course, the optimal information release depends on the particular objective the designer wants to achieve. The information designer can be, for example, a benevolent policy maker interested in maximizing social welfare. In the context of a bank run or a currency attack framework, the policy maker would like to avoid these socially undesirable equilibria. She can achieve this objective by designing the signals agents observe in a way that minimizes the probability of a coordination failure occurring. Instead of releasing publicly observable signals, it might be optimal in this setting to provide only some individuals with privately observable signals.

Alternatively, rather than having the social good in mind, the information designer can be completely self-interested. For example, consider a prosecutor who would like to convince a jury that a defendant is guilty. In this setting, unanimity is needed for the jury to reach a verdict. The prosecutor conducts an investigation and reports the resulting findings to a jury. While she is required by law to fully and truthfully report the results to the jury, she can choose how to structure her investigation by deciding on which witnesses to subpoena, what questions to ask them, which forensic and other tests to order, how to structure her arguments, etc. If the defendant is guilty, then choosing a more informative investigation will tend to help the prosecutor's case and increase the likelihood of conviction. However, if the defendant is innocent, a more informative investigation will impede the prosecutor's case. The question information design answers is whether and how the prosecutor can gain by choosing the investigation process optimally, in a way that maximizes the overall probability of conviction by a jury consisting of rational agents, who update their beliefs based on the information provided. The specifics of the optimal informativeness of the investigation depend upon the prior beliefs of the jury members regarding the defendant's innocence. Nonetheless, the optimal investigation will perfectly reveal his guilt whenever the defendant is in fact guilty, and will only sometimes reveal his innocence when he is innocent. Moreover, by persuading a jury of multiple people, the designer can play off the complementarities in their actions and lower the extent to which each individual juror needs to be convinced of guilt in order to vote for conviction. This example also suggests that it is important to consider the implications of information design, and, in certain instances, try to mitigate its undesirable consequences through appropriate design of institutions and incentives.

**References**

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Kamenica, E., M. Gentzkow (2011), "Bayesian Persuasion," American Economic Review, 101, 2590-2615.

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