17.8: Signaling Theory

We all want to live in a world in which every buyer and seller is always completely honest, dependable, and trustworthy. In such a world, no one would lie, cheat, or steal. No one would misrepresent a product or hide a defect to make a sale, and the buyer would always alert the cashier when receiving too much change. Even politicians and children would always tell the truth.

Plainly, we do not live in such a world. Cigarette manufacturers swear under oath that their products are safe and that there is no proof that tobacco causes lung cancer. Management lies to labor about the true profitability of the firm and the size of the wage increase that the firm can really afford. It seems that we live in the midst of lies and deceit. Few can be trusted and few trust us.

This then is the problem: How can we make our world—the one full of distrust and scams—more like the world we all agree is better—the one in which individuals are sincere and open? How can we get people to tell the truth?

Three Ways to Handle Dishonesty

We review utopian and authoritarian solutions to fighting dishonesty, and then focus on a third way that most people rarely consider.

If somehow it were possible to create a perfectly honest person, we could attain our goal of living in an honest world. People could be counted on, with no doubt or reservation whatsoever, to be completely clear and forthright. This is the utopian solution.

Karl Marx believed private property, money, and the capitalist system created an all-encompassing greed that generated fraud, deception, and a variety of other reprehensible individual behaviors. For Marx, the solution to the problem was
quite simple: Replace vicious capitalism with its superior evolutionary offspring, communism, and replace the money-hungry *homo economicus* with the noble *new socialist man*.

Although seemingly hopelessly idealistic, in certain cases, reliance on people’s good qualities is, in fact, possible. We all have close friends and family whom we can trust to be sincere and truthful. In our daily lives, however, we deal with countless strangers, and we cannot rely on personal relationships to ensure honest behavior. In a modern society that incorporates the actions and decisions of millions of individuals, it is simply impractical to expect trustworthiness from everyone.

To protect against dishonesty, many people think immediately of monitoring. This second approach can be called the *authoritarian solution*.

If a store owner thinks customers are going to steal, valuable merchandise can be put under a glass counter, security cameras installed, and guards can watch the customers. If the government knows that citizens will cheat on their taxes, a sample of tax returns will be audited carefully to check for full compliance and severe penalties will be imposed on those caught cheating.

In general, the authoritarian approach to solving the problem of dishonesty requires a powerful judge who can check the truthfulness of statements and punish those who are caught violating the rules. Monitoring and punishment can work well when it is clear what constitutes a lie, and it is easy to observe the dishonest behavior.

Unfortunately, in many cases, it is quite difficult to determine dishonest behavior because there are shades of deceitfulness, ambiguities in truthfulness, and inherent uncertainty in the world. For example, if I sell you an expensive product, promising that it is of high quality, and then it breaks, am I a liar? It may very well be a high-quality good that just happened to break. Of course, I may have known that it was really shoddy merchandise and I just tricked you. How can you know which case is true?

In addition to that rather large subset of cases in which detecting dishonesty is nearly impossible, every application of the authoritarian approach suffers from a much larger drawback. To be effective, the powerful judge must be able to monitor individuals, including investigating alleged wrongdoing, determining guilt, and meting out punishment accordingly. This raises a serious concern: Who watches the watcher?

The inescapable paradox is that the stronger the authority, the more it will be able to control the individual, but also the more dangerous it becomes to the individual. Secret police, neighbors spying on friends, and severe control of individual behavior via strict rules and regulations seem the destiny of authoritarian schemes to coerce honesty from unwilling individuals.

There is little doubt that the authoritarian approach to the problem of dishonesty is the most common solution contemplated and applied. Faced with severe cheating, our first instinct is to call the referee and demand that force be applied to ensure truthfulness. There is, however, another alternative—one that does not suffer from the dangers inherent in the authoritarian solution.

Transforming humans to remove the driving force of self-interest or imposing authoritarian control to repress behavior driven by greed is like swimming against a powerful tide. The third approach is completely different. It is based on accepting self-interest and greed as immutable forces, but using them to get desired behavior. We can harness the
power of self-interest in favor of our desired end. Individuals are free to decide to lie or not, but lying leaves them worse off. If honesty is the best choice from a self-interested point of view, then honesty is what we will get. This is the key idea underlying signaling theory.

An Economic Model of Used Cars

Suppose that there are only two kinds of used cars: high-quality A cars and low-quality B cars (called lemons in the United States). To keep things simple, suppose that there are equal numbers of each and that the high-quality A car is worth $10,000 while the low-quality B car is worth only $5,000.

The seller knows whether his or her car is of low or high quality, but the buyer does not. This is called asymmetric information because one party has knowledge and the other does not. The general problem of honesty, in this case, is reduced to figuring out a way to get sellers to tell the truth about the quality of the cars they are selling.

It is important to emphasize that, as illustrated in Figure 17.33, the buyer has no easy way to tell the cars apart. The underlying distribution of cars is on the left, and is known to the seller, but what the buyer actually sees is on the right.

![Figure 17.33: The problem of asymmetric information.](image)

In a world where buyers cannot tell the difference between low- and high-quality cars and there are equal numbers of each type, buyers would expect to get a car worth $7,500 on average. Half of the time they would get a $10,000 car and the other half a $5,000 car. Thus, on average, a used car would be worth $7,500 and this is the amount buyers would be willing to pay for a used car.

Whereas sellers of low-quality cars would be quite happy getting $7,500 for their low-quality cars, sellers of high-quality cars would be upset. After all, owners of A cars have a product worth $10,000. They might try to convince buyers to pay $10,000 by making claims about the high quality of the car. Declarations about high quality, however, are likely to be ignored because the buyer has no way of knowing if the seller is telling the truth. After all, the seller might actually have a low-quality car worth $5,000 and is lying to make more money. The buyer would worry that the seller's self-interest would dominate any desire to be honest.

The frustrated sellers of high-quality used cars simply leave the market. This phenomenon is an example of Gresham’s Law, “bad money drives out good.” It was first stated in the 16th century, when monarchs would debase coinage (by adding filler) to get more coins out of a given amount of gold. People would exchange the less valuable coins (bad...
money) and hoard the pure gold ones (good money). With more bad money in circulation, prices would rise.

Applied to the used car market, the low-quality used cars can be seen as driving out the high-quality cars. Left alone, we would not expect to see high-quality used cars for sale. In fact, that is not what happens—high-quality used cars are sold. How?

Instead of fixing the problem of dishonesty (lying about the quality of the car) by attempting to correct the unethical behavior of the sellers of low-quality used cars (whose dishonesty is causing the trouble here) or imposing authoritarian control over the used car sellers, an alternative scheme has evolved that has certain appealing properties—not the least of which is that car sellers truthfully reveal the qualities of their cars without any central, controlling authority.

Before explaining signaling theory, it is worth pointing out that what is happening here is actually an externality problem. The low-quality sellers fail to take into account the full cost of their lying and, therefore, they lie too much. No individual seller is aware, or would care, that his or her lying is contributing to the elimination of high-quality goods.

Another point that merits attention is that no one designed the system you are about to see. It emerged out of the interaction of buyers and sellers. Probably, some seller of a high-quality car got the idea and, when it worked, it was imitated, but you are about to meet another example, like supply and demand, of a decentralized system.

**Signaling Theory**

Developed by Spence (1973), the idea behind signaling theory is simple: when we cannot directly observe quality, we use a substitute that is observable (a signal) to enable the market to function. The signal is like a stoplight, green means go and red means stop. The signal will sort the combined low- and high-quality cars into separate markets.

Buyers cannot directly observe the quality of the car, but there are other observable characteristics bundled with the car and seller. *Indices* are attributes that cannot be changed, such as the age of the seller. *Signals*, on the other hand, are observable markers that can be acquired.

The signal, however, must have some special properties to be effective. The signal must be correlated with the underlying, unobservable characteristic. It must be something the A car owner is willing to do, but the B car owner is not, so that it is not immediately copied by unscrupulous sellers of low-quality cars.

In the case of used cars, a common signal is a warranty. Suppose that high-quality cars will have low warranty costs to the seller because they are unlikely to break, but the sellers of low-quality cars would face high warranty costs for their cars that will probably require many repairs.

We have gone as far we can in abstract terms and we are ready to see an Excel implementation of the signaling model.

**STEP** Open the Excel workbook *SignalingTheory.xls*, read the *Intro* sheet, then go to the *Optimizing* sheet.

The cost of the warranty to the sellers of A and B cars is depicted in Figure 17.34. With no warranty at all (the car is sold "as is"), at a warranty level of zero, a seller has no warranty costs if something breaks after the car is sold, it is the buyer’s problem.
As the amount of warranty coverage offered by the seller increases, however, costs rise. The seller of the B car’s costs rise faster so the gap between the two seller’s warranty costs expands.

At a warranty level of 40 (this might be repairs covered by the seller for the first 12 months or 12,000 miles), in Figure 17.34, sellers of high-quality cars expect to incur costs of about $3,000, whereas the sellers of low-quality cars will pay around $8,000 for repairs.

The warranty cost functions are determined by the slopes in cells C6 and C7. It is easy to see that a seller’s warranty cost is simply the slope parameter times the warranty level.

Now, suppose there was a warranty level, which is set at 40, initially. Buyers are willing to believe anyone who claims that their cars are high quality and pay the $10,000 price if and only if the car comes with a warranty level of 40.

So the warranty is the signal and any seller who acquires it will sell a car for $10,000. It seems like everyone will offer the warranty, right? Not so fast.

**STEP** Click the

Show Price

button.

Excel adds a price function to the chart. It is simply two horizontal lines with a break at a warranty level of 40. The hollow and solid dots mark the discontinuity. The solid dot means the endpoint is included and the hollow dot indicates it is not. Thus, any warranty level from zero up to the signal level (the hollow dot) means the car sells for $5,000. As soon as the signal level is reached, the price jumps to $10,000.

Anyone buying a car with a warranty level below 40 will be willing to pay, at most, $5,000 because it is assumed that the car is of low quality. Even if the car is actually a high-quality car, if it fails to come with the warranty level for high-quality cars, no buyer will pay $10,000 for it because the claim that the car is of high quality is unbelievable without the
warranty. On the other hand, a buyer would be willing to pay $10,000 for any car with a warranty level of 40, even if it is actually a low-quality car.

It is now up to the sellers of used cars to make a decision of whether or not to lie. Sellers of low-quality used cars can claim that their cars are high quality and thereby receive the $10,000 high-quality price.

They will not misrepresent the quality of the car, however, because they would end up worse off. Their individual self-interest will drive them to tell the truth.

**STEP** Click the

Show Net Gain button to see why low-quality sellers will not lie.

Figure 17.35 shows what is on your computer screen. We use data from the graph to create a table below that explains how the two sellers will behave.

Figure 17.35: Understanding why sellers will not lie.

*Source: SignalingTheory.xls!Optimizing.*

All sellers seek to maximize the net gain, or profit, from the sale of their goods and services. Sellers of used cars would not look simply at the fact that they can make $10,000 by offering a warranty level of 40. This decision-making strategy completely ignores the cost of the warranty. Instead, sellers must compare the net gain, price minus cost of the warranty, to arrive at an optimal decision concerning the warranty level.

The table below the graph contains each type of seller’s net gain from selling a car with no warranty versus selling the same car with warranty level of 40. Read the table horizontally for each type of seller, compare the net gain without and
with the warranty, and choose the higher number.

It is clear that sellers of high-quality used cars will offer the warranty level and make $7,000 in profit because that beats the $5,000 net gain if no warranty is chosen. The sellers of low-quality used cars will choose to forgo the warranty and walk away with $5,000 because that is superior to the $2,000 net gain from choosing to lie and offering the warranty.

This is a rather remarkable result. To restate the outcome, the sellers of low-quality used cars will voluntarily and honestly admit that their used cars are of low quality and only worth $5,000. The sellers of low-quality used cars will not lie to the buyers. Is this because they suddenly were overcome by their conscience? No. They are the same fallible, less than perfectly honest people before and after the warranty scheme. Are they telling the truth because an authority figure is watching them, ready to punish liars? No. No one is watching them.

The sellers of low-quality used cars can lie if they so wish. They will not lie, however, because it is not in their self-interest. They end up worse off if they lie in this situation. The warranty scheme has managed to successfully separate or sort the two qualities of cars into their respective groups. This result is called a separating equilibrium.

Figure 17.36 shows that the warranty acts as a screen, separating the true car qualities into two distinct groups, Xs and Ys, from which it easy to tell which cars are high quality and which are not.

In essence, two markets for cars are created, one for low- and the other for high-quality cars, each with their own prices. Sellers of low-quality cars, although they are able to do so, will not lie and enter the high-quality car market because the price of admission is too high. Lying is not profit maximizing; therefore, sellers will not lie.

Let’s repeat a key idea: no individual or organization runs this scheme. No one sets the warranty level and no one sets the price of the cars. The whole system bubbles up from the interaction of the two kinds of sellers and the buyers. Adam Smith would have called it an example of the invisible hand of the market; Friedrich Hayek would have described it as a spontaneous order; and modern day mathematicians would speak of self-organizing systems. It is all the same thing: individual interaction generating a quite agreeable systemwide result. To see how the equilibrating forces operate in this model, we examine how the signaling scheme can break down.

### Signaling Failures and Equilibrium

One way that a signal can fail is if it is set too high.

**STEP** Use the scroll bar to set a high warranty level like 80 or so.
In this case, as shown in Figure 17.37 and your computer screen, not even the sellers of high-quality cars find it in their self-interest to offer the warranty level that brings the $10,000 price. The signal has failed to separate the two qualities of cars.

![Figure 17.37: Signaling failure from a warranty level set too high.](https://socialsci.libretexts.org/Bookshelves/Economics/Book%3A_Intermediate_Microeconomics_with_Excel_(Barreto)/17%3A...)

On the other hand, if the signal is set too low, sellers of B cars will find it in their self-interest to lie and claim their cars are actually high quality. They will choose the warranty level that brings the $10,000 price.

**STEP** To see this, use the scroll bar to set a low warranty level, 20 or less.

Your screen should show that both sellers opt to acquire the signal. The low-quality seller will lie and claim that the car is of high quality because the net gain from lying (cell H27) is greater than the net gain from telling the truth (cell G27). Once again, this signal has failed.

When the signal is too high, the holes in the screen are too small and no one can get through. If the signal is too low, the holes are too large and everybody passes through. In a separating equilibrium, the level of the signal is such that the two types are sorted and grouped together so they are easily identifiable.

The fact that signals can be observed as failing provides the key to understanding how the system can settle down to a result that effectively solves the problem without central control. If the signal is too low, self-interested sellers of high-quality cars will offer higher warranty levels in order to block their lying brethren from diluting their market. The sellers of high-quality cars want to distance themselves from low-quality sellers.

If the signal is too high, no one will take it and buyers will lose the means by which to identify the two qualities of cars. The market will collapse so pressure will push the level down.

*Source: SignalingTheory.xls!Optimizing.*
The forces inherent in the system, self-interested behavior by the interacting agents, will conspire to generate an equilibrium signal level that effectively sorts the two qualities of cars. The process works just like supply and demand pressure in disequilibrium pushes the signal in one direction or another until it equilibrates.

**STEP** Play around with the warranty level to reveal the range for which it effectively separates the two qualities of cars.

You already know 80 is too high and 20 is too low. Look at the chart to help you see what must be true for the signal to succeed. When you are ready to check your answer, click the

**Range**

button.

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**Other Applications of Signaling Theory**

We have barely scratched the surface of signaling theory. There are many situations in which one party to a transaction has available information that the other party lacks and this asymmetric information puts honesty in peril.

Consider the job market (which was Spence’s original example). Faced with many job applicants, all claiming to be high-productivity A workers, the firm might insist on a signal, a college degree, to back the claims made by job applicants.

Suppose that low-productivity workers are also likely to be weaker students, and that it is more costly for them to acquire the educational signal. As in the used car case, the successful screen will separate the two worker groups into their respective low- and high-productivity categories. The signal will elicit honest responses from low-productivity workers because lying requires a college degree to be believed and this is not in their best interest.

Additional applications of signaling include insurance, legal bargaining, and firm entry models. In both health and life insurance, asymmetric information is critical. The insurance company does not know the health status of the applicant. If the price of the insurance depends on the applicant’s health, just saying they are healthy is not enough for the insurance company to believe it.

In a lawsuit, where the plaintiff seeks damages from the defendant, asymmetric information means neither party knows the other’s true intentions and beliefs. They can signal the strength of their case by demanding a high pre-trial settlement.

Firm entry models use signaling to convey the degree of confidence and strength of incumbent firms to potential newcomers. Incumbents can signal or make reliable claims about their low costs and ability to compete by charging low pre-entry prices.

In these cases, an incentive mechanism has developed that accepts self-interest among buyers and sellers as a powerful, immutable, driving force. Instead of fighting self-interest by removing or suppressing it, the incentive mechanism uses self-interest to reach the desired end.
The Economics of Honesty

Dishonesty exacts a large cost on society. For lesser developed countries, corruption is a severe obstacle to economic growth. Getting people to be truthful is a serious, critically important goal.

The primary solutions to the problem of dishonesty have centered on utopian and authoritarian approaches. The former seeks to perfect human behavior; the latter to directly control it. A third, somewhat counterintuitive, alternative exists that relies on self-interest to yield an agreeable systemwide result.

This third alternative is marked by individuals following their self-interest. When geese fly in a V-shaped pattern over thousands of miles, they do so not under the guidance of an authoritarian drill sergeant or master goose who tells each bird where to fly, but because they obey a simple rule that says, “If there are no birds around, fly; if a bird is in front, fly just off its wing because it is easier.” This minimizes the effort for each bird and produces a pattern which no bird intended.

Likewise, modern society is composed of millions of individual agents whose interaction establishes a systemwide pattern. Unsatisfactory results can be changed via transmuting the motivating forces of each agent, imposing decisions on each agent, or changing the incentives faced by each agent. The last option is rarely considered, but may be the most effective and best of the three.

Signaling theory says that by making honesty the best policy for the selfish, greedy individual we will get honesty. Sellers reveal the truth because lying leaves them worse off than telling the truth. This is the economics of honesty.

To be sure, signaling requires rules and institutional support. If the seller of low-quality used cars knows that he can renege on warranties or other contracts because the court system is nonexistent or corrupt, then signaling will be useless.

There is, however, a world of difference between an authoritarian approach that relies on a central power to coerce honesty and the system that evolves out of the interaction of the buyers and sellers given appropriately supporting institutions. The decentralized system avoids the question of “Who watches the watcher?” because there is no dominant, central power. And in the end, this may be its most significant advantage.

Exercises

1. Suppose a firm is trying to determine whether an applicant is of low or high ability and it believes people with long fingernails have higher ability. Would fingernail length be an effective signal? Draw a graph to support your answer.

2. Draw a graph that shows how education as a signal could be used to separate low- and high-ability job applicants. Explain how education as a signal works.

3. Draw a graph in which education as a signal fails because the signal level is set too high. Explain why the signal fails.

4. College education as a signal clashes with human capital theory, which says that educated workers earn more because they were made more productive by their education. What does signaling theory say about the value of education? In other words, according to signaling, why are educated workers paid more?
5. Why has it been difficult to determine with data whether human capital or signaling theory is right about college education?

References


In a reply, Eric W. Bond, “Test of the ‘Lemons’ Model: Reply,” The American Economic Review, Vol. 74, No. 4 (September, 1984), pp. 801–804, www.jstor.org/stable/1805152 said that “Pratt and Hoffer find used trucks to be of lower quality not because they have a ‘finer’ test, but because they fail to adjust for observable quality differences and include trucks that are more than 10 years old.” Bond believes there is no lemons effect for used pickups because institutions have arisen to counteract the effects of asymmetric information.

This debate and projects involving new data to test signaling would make an excellent thesis topic.


George Selgin, “Gresham’s Law,” available at eh.net/encyclopedia/greshams-law/, offers a short explanation of the history and application of this concept.