

Revealing Negative Information in Monopoly and Duopoly Settings: Experimental Analysis*

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We provide an experimental analysis of the setting where a seller, either a monopolist or a duopolist, sells a product with quality that is unobservable to buyers. The seller can send either an honest or dishonest cheap-talk message to buyers about the product quality. We show that low-quality sellers have a positive propensity to communicate their low-quality to buyers. Communicating low-quality results in buyers' higher-propensity to purchase the product and introduces product differentiation in a duopoly. We do not find strong evidence that communicating low-quality information negatively affects sellers' profit: the effect is often insignificant, and in some treatments it becomes significantly positive. Finally, revealing negative information has a strong positive welfare effect in a monopoly, where it raises the likelihood of product purchase; but a weak or negative effect in a duopoly, where it boosts the likelihood of purchasing a socially inefficient low-quality product.

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I. Introduction

The setting where the product quality is seller's private information has been extensively studied in the literature with the main focus placed on the tension between the consumers who want more quality information and the low-quality sellers who would like to hide it (Dranove and Jin, 2010). However, there are many examples of sellers voluntarily sharing negative aspects of their products. For example, two-sided advertising where an advertisement includes negative information—in conjunction with positive claims—about the product is a well-known practice among sellers (Crowley and Hoyer, 1994; Eisend, 2006, 2007). Furthermore, disclosure of negative information does not necessarily have a negative effect on profits or customers' perception of the product. Two-sided advertising has been shown to “*enhance source credibility, positive cognitive responses, perceived novelty, attitude toward the brand, and purchase intention*” (Eisend, 2006, p. 191)."

Voluntary disclosure of negative information regarding experience or credence attributes can be also found in many consumer-to-consumer online marketplaces. For example, eBay and Craigslist where sellers voluntarily describe weaknesses of their listed products, both via cheap-talk messages, such as “*the product is in fair condition,*” and via verifiable information, such as pictures of specific damages or scratches that are otherwise indiscernible. Jin and Kato (2006) find that many eBay sellers of collectible baseball cards are honest about their claims, even though most buyers cannot correctly evaluate the quality prior to or after their purchase.

Theoretical literature suggests at least two factors that can incentivize sellers to *reveal* rather than *hide* negative information: product differentiation and buyers' uncertainty. Board (2009) and Guo and Zhao (2009) have shown that in the framework with risk-neutral buyers where information disclosure is credible and verifiable, low-quality sellers may disclose their types in order to achieve product differentiation and soften competition. In the setting where credible and verifiable information disclosure is impossible, Kim (2012) and Gardete (2013) have shown that low-quality sellers may choose to disclose their quality via cheap-talk messages because it can either reduce the search costs of risk-neutral buyers or reduce the competition intensity among sellers, thereby increasing sellers' profit.

Finally, Shapiro and Huh (2021) (hereafter SH), which is the closest paper to this study, show that in the setting with no search and matching costs and where quality can be communicated via cheap-talk messages only, there can exist equilibria with partial separation of low-quality sellers. Differently from earlier work they consider the setting with loss-averse buyers and show that equilibria with partial separation can exist not only in the duopoly but also in the monopoly setting.

In this paper, we use the SH-framework to experimentally investigate the impact of negative information's disclosure. We are specifically interested in the following

questions: how does revealing negative information affect buyers' behavior and their willingness to pay? How does it affect sellers' profit? In the duopoly setting, does revealing negative information introduce product differentiation and soften competition intensity? How does revealing negative information affect welfare?

We design and conduct five treatments: a monopoly treatment with robot sellers (MR), a monopoly treatment with human sellers (MH), a duopoly treatment with robot sellers (DR), a duopoly treatment with human sellers where sellers do not have information about the competitor's quality (DH), and a duopoly treatment with human sellers where sellers have information about the competitor's quality (DHi). Buyers are always played by human participants. All treatments have the same timing. First, sellers send one of the two public messages: "*I sell a high-quality product*" or "*I sell a low-quality product*." Second, sellers set prices. In the duopoly treatments, this implies that sellers choose their prices after observing the competitor's message. Finally, buyers observe all the public information, message(s) and price(s), but not the actual quality. Buyers then decide whether to purchase a product or not, and in the duopoly treatments, from which seller to purchase.

Our results are as follows. First, in the human treatments the propensity of low-quality sellers to reveal negative information was positive across all treatments and for most parameter values.¹ Second, despite the expectations that revealing negative information should always hurt sellers' profit we do not observe it. While, depending on parameters, in some treatments revealing negative information had a significantly negative effect on the seller's profit, in other treatments negative information had a significantly positive effect on profit and, most of the time, it had an insignificant effect. The significantly positive effect on profit was typically observed in the robot treatments, especially, in (DR). In the human treatments, both the monopoly and the duopoly, the effect of revealing negative information was usually negative but insignificant.

Following theoretical insights from the literature we then analyze how a low-quality message affects buyers' willingness to purchase and, in the duopoly setting, competition intensity. Looking at buyers' willingness to purchase, we observe that buyers exhibit very strong preferences towards purchasing the product with negative information. This holds in the monopoly and the duopoly treatments and regardless of whether purchasing the product with negative information led to a lower or a higher buyer's surplus. Looking at the competition intensity, we find that if the two sellers sent different messages, i.e., one seller claimed to have a low-quality product and the other claimed to have a high-quality one, then buyers' demand was less price-sensitive than in the case where the two sellers sent the same messages. This indicates that revealing negative information, as compared to pretending to be of

¹ In the robot treatments, low-quality sellers also had a positive propensity to reveal negative information but it was pre-programmed.

high-quality with probability one, can be beneficial as it results in product differentiation and, therefore, can have a positive effect on profits.

Finally, we look at how revealing negative information affects welfare. The effect differed between the monopoly and the duopoly treatments. In the monopoly treatments, the welfare effect of revealing negative information was mostly positive. In the monopoly case, the welfare is determined by whether buyers purchase the product or not. Sending a low-quality message increased buyers' willingness to purchase the product and, therefore, had a positive effect on welfare. In the duopoly, on the other hand, the welfare effect was less pronounced and often negative. In the duopoly case, the welfare is determined by whether buyers purchase the product or not, *and* by whether they purchase the high-quality or low-quality product. Revealing negative information in the duopoly steered buyers towards purchasing low-quality—and socially inefficient—products. This had a negative effect on welfare as socially efficient high-quality products were purchased less often.

II. Literature Review

There are many experimental papers in which, as in our work, quality information is communicated via cheap-talk messages. Forsythe et al. (1999) consider a setting where a seller of a financial asset can send a cheap-talk message about the quality of his asset. The message is a subset of qualities, rather than the exact quality, and depending on the parameters it can be either anything (cheap-talk treatment) or it has to include the true quality (anti-fraud treatment). They show that buyers tend to believe cheap-talk messages and overpay for products. Thus, the cheap-talk treatment produces a different outcome than the no-communication treatment. Furthermore, just like in our experiment, in the cheap-talk treatment not all sellers exaggerate their quality.

Siegenthaler (2017) uses a theoretical framework of Kim (2012) to experimentally show that cheap-talk communication can reduce market inefficiency in the lemon-market setting and alleviate adverse selection. He considers the setting with search and matching frictions and confirms the theoretical predictions of Kim (2012). Our setting is different from his in several aspects: first, in our study transaction prices are set by sellers who sell via posted price, while in Siegenthaler (2017) buyers make take-it-or-leave-it offers which are then accepted or rejected by sellers. Second, we do not introduce market frictions to our experimental design. Finally, we study the case of one and two sellers per market while Siegenthaler (2017) studies the case of six sellers per market.

The setup in our monopoly treatments is related to the ultimatum game where the pie's size is unknown to the respondent and the proposer can send the cheap-talk about the pie's size prior to making an offer. For example, Croson et al. (2003)

consider such a design and show that the proposer misrepresents the size of the pie and that the lies of the proposer are accompanied by significantly lower offers but with no change in the probability of acceptance. That is, cheap-talk affects the behavior of responders. Anbarcı et al. (2015) investigate ultimatum games with proposers' cheap-talk in which responders observe cheap-talk messages with certainty but the offer with a given probability. They find that responders accept the offer more often after truthful cheap-talk messages. Rankin (2003) and Ong et al. (2012) experimentally investigate non-binding communication in ultimatum game where responders send a request of a certain amount to proposers. They find that responders' requests reduce proposers' offers in spite of their positive relation and responders value the impact of cheap talk. Lusk and Hudson (2004) show that cheap talk in ultimatum games makes subjects' behaviors more resemble Nash equilibrium predictions.

Finally, there are experimental papers that study disclosure and asymmetric quality information in a duopoly setting. Ackert et al. (2000) and Jansen and Pollak (2015) look at the information disclosure of industry-wide conditions in duopoly and oligopoly settings. They show that subjects are strategic when choosing to disclose information. Pigors and Rockenbach (2016) look at firms' honesty towards the third party (workers) that is not present in the experiment but can reduce sellers' cost. They show that in a duopoly setting being honest is profitable. Dulleck et al. (2011) look at the markets with credence goods where a seller can over- or undertreat consumers without consumers realizing it. They show that the competition drives the prices down but does not yield higher efficiency.

III. Experimental Design and Procedures

3.1. Experimental Design

In our experiment, participants were assigned to one of the two roles: a seller or a buyer. A seller sells a product with exogenously given quality, which can be either v_L or v_H with $v_L < v_H$. The prior probability of a product being of high quality is q and all the three parameters are common knowledge. The product quality is unobservable to buyers. The seller's payoff is price, p , times quantity sold, s : $\pi^S(p, s) = p \cdot s$. A buyer has unit demand and a buyer's payoff is product value minus price if the buyer purchases a product and zero otherwise: $\pi^B(p, s) = (v - p) \cdot s$ where $s \in \{0, 1\}$.

In this study, we designed five treatments. The four treatments among them are as described below:

- (MR), or monopoly-robot treatment: one seller per group played by a computer;

- (MH), or monopoly-human treatment: one seller per group played by a participant;
- (DR), or duopoly-robot treatment: two sellers per group played by a computer;
- (DH), or duopoly-human treatment: two sellers per group played by participants.

In the robot treatments, computerized sellers were programmed to play according to equilibrium strategies of the SH-framework, as described in the next subsection. However, neither in the robot treatments nor, naturally, in the human treatments were buyers aware of sellers' strategies.

In treatments (DR) and (DH), as in the SH-framework, the seller's product quality is pure private information, that is, not only buyers but also the competitor do not observe it. In addition, we also conducted one more treatment for the duopoly setting in which two sellers were played by human participants and the product quality was common knowledge between sellers:

- (DHi), or duopoly-human treatment with quality information observable to a competitor.

In all treatments the number of buyers per group was two, and buyers were always played by human participants. Participants were informed about the number of sellers, and whether sellers were played by computer or human participants. That is, in the robot treatments, all participants were informed that they would play buyers and sellers would be played by computer. In the human treatments, participants were informed that, at the beginning of a session, they would be randomly assigned to be either sellers or buyers and would play the assigned role throughout the session.² While the role of either a buyer or a seller was fixed for each subject throughout the session, all participants were randomly re-matched into a group to form a market in each period. So there should be no concern for reputation building between buyers and sellers in our experiment.

Once a period started, sellers observed their own quality, $v \in \{v_L, v_H\}$, as well as the value of q . In (MH), each seller was informed that he/she was the only seller in the market. In (DH) and (DHi), each seller was informed that there was another seller in the market, and in (DHi), each seller also observed the product quality of the other seller. Sellers had a binary choice of sending a message of either "*I sell a high-quality product*" or "*I sell a low-quality product*". We label the former message as m_H , and the latter message as m_L . In what follows, we use term m_H -seller to refer to a seller who sent message m_H and m_L -seller to a seller who sent the message m_L . An m_H -seller does not mean that the seller sells a high-quality

² Additional instructions to the robot and human treatments can be found in the appendix C.

product but only that the seller claims to have one. For example, a low-quality m_H -seller refers to a low-quality seller who sent message m_H .

After choosing a message, the pricing stage began as sellers observed both messages of their own and their competitors in the duopoly treatments. Sellers had to set a price for their product. The upper limit of a price was v_H , i.e., sellers could set a price above v_L but not above v_H . Then the buyers' stage started.³ At the buyers' stage, buyers would observe all the publicly available information, such as q , v_H and v_L , as well as messages and the prices sent by the sellers in the market. In the monopoly treatments, they decided whether to purchase the product or not. In the duopoly treatments, they decided whether to buy from seller 1 or seller 2, or not buy anything at all. Once buyers made their decisions, the profits of both buyers and sellers were calculated and shown in the screen. Sellers learned how many units they sold, how many units their competitors sold, and their own profit. Buyers learned the quality of the purchased product, their monetary payoff, and in the case of duopoly, the quality of the other seller's product. Then, the period ended and another followed until it repeated 24 times.

3.2. Equilibrium and Robot Treatments

Sellers in the robot treatments were programmed to play equilibrium strategies from the SH framework which we outlined in the Appendix. Equilibria characterized in SH have the following partial separation structure. A high-quality seller sends message m_H with probability one and a low-quality seller randomizes between m_L and m_H with probabilities λ and $1-\lambda$. Message m_L is a separating message as buyers know that seller's quality is v_L with probability 1. Message m_H is a pooling message as buyers believe that seller's quality is v_L with probability $q_{LH} = \Pr\{v = v_L \mid m = m_H\} = \frac{(1-\lambda)(1-q)}{(1-\lambda)(1-q)+q} < 1$.

In the case of monopoly, the low-quality monopolist sending message m_L charges price $p_L = v_L$ and sells with probability 100%. A seller sending message m_H charges a higher price $p_H > v_L$ but buyers with the high degree of loss aversion do not purchase the product. In equilibrium, λ is such that the low-quality seller is indifferent between the two messages. Table 1 provides the exact values of equilibrium strategy that we used for robot sellers in (MR). Note that equilibrium depends on q and v_H/v_L so that, given v_H/v_L , individual values of v_L and v_H do not matter. The equilibrium is calculated under the assumption that buyers' loss aversion is uniformly distributed on $[0, 2.8]$ to match the theoretical median degree of loss aversion, 1.4, to the median loss aversion in South Korea (Wang et al., 2017, Table 1).

³ In (MR) and (DR) the seller's stage was pre-programmed so human participants participated in the buyers' stage only.

[Table 1] Normalized Equilibrium Values

	$v_H / v_L = 2.75$				$v_H / v_L = 4.25$			
(MR)	0.15	0.3	0.5	0.7	0.15	0.3	0.5	0.7
p_L	1	1	1	1	1	1	1	1
p_H	1.06	1.06	1.06	1.20	1.48	1.48	1.48	1.64
λ	0.90	0.76	0.44	0.00	0.88	0.72	0.34	0.00
q_{LH}	0.36	0.36	0.36	0.30	0.40	0.40	0.40	0.30
(DR)								
$(m_L, m_H) : p_L$	0.51	0.53	0.39	0.19	0.94	0.99	0.72	0.35
$(m_L, m_H) : p_H$	0.51	0.69	0.75	0.75	0.95	1.28	1.39	1.38
λ	0.58	0.54	0.42	0.20	0.58	0.54	0.42	0.20
q_{LH}	0.70	0.52	0.37	0.26	0.70	0.52	0.37	0.26

Notes: All prices are normalized with respect to v_L : for example, entry $p_H = 1.06$ means $p_H = 1.06 \cdot v_L$. For (MR) row p_L shows an equilibrium price after m_L , row p_H shows an equilibrium price after m_H , row λ shows the probability of low-quality sellers to reveal negative information, row q_{LH} shows equilibrium values of $\Pr(v = v_L | m = m_H)$. For (DR) row p_L shows an equilibrium price of the m_L -seller when the two messages are (m_L, m_H) . Row p_H shows an equilibrium price of the m_H -seller when the two messages are (m_L, m_H) . In the duopoly setting, theoretical prices are non-monotone functions of q . When the sellers' messages are (m_L, m_L) or (m_H, m_H) equilibrium prices are zero and are not shown. Values in rows λ and q_{LH} have the same meaning as in (MR).

In the case of duopoly, sellers play Bertrand competition after (m_L, m_L) and (m_H, m_H) . The reason is that buyers have identical beliefs about both sellers and purchase the cheapest product. Thus, both sellers charge price 0 and earn zero profits. In contrast, after (m_L, m_H) the two products are differentiated from buyers' point of view. The m_L -product has low but certain quality v_L , while the m_H -product has a higher but uncertain quality. Other things being equal, buyers with a high (low) degree of loss aversion prefer the m_L -product (m_H -product). Buyers' demand is less price-sensitive and, therefore, sellers charge positive prices and earn positive profits: the m_L -seller charges price p_L , where $0 < p_L < v_L$, and the m_H -seller charges price p_H , where $p_L < p_H < v_H$.

In equilibrium, parameter λ is such that the low-quality seller is indifferent between the two message. Message m_L leads to a lower profit in the (m_L, m_H) -case but to a higher probability of the (m_L, m_H) -case. Message m_H leads to a higher profit in the (m_L, m_H) -case but to a lower probability of the (m_L, m_H) -case. Table 1 provides the exact values of equilibrium strategy that we used for robot sellers in (DR). As in the (MR)-case the equilibrium is calculated under the assumption that buyers' loss aversion is uniformly distributed on $[0, 2.8]$.

The reason for conducting the robot treatments was two-fold. First, it allowed us to disentangle the effect of cheap-talk messages and prices. All robot sellers were

pre-programmed to follow the same messaging and pricing strategies. Given exogenous parameters $(q, v_H / v_L)$ and message(s) m there was no variation in sellers' prices across groups. For example, in the case of (MR, $q = 0.15, v_H / v_L = 2.75, m = m_L$) all buyers faced exactly the same price p_L and in the case of (MR, $q = 0.15, v_H / v_L = 2.75, m = m_H$) all buyers faced exactly the same price p_H . Second, given our focus on the effect of negative information disclosure it was essential to have observations where low-quality sellers reveal negative information. Having computerized sellers guaranteed that we had treatments where low-quality sellers revealed negative information.

3.3. Procedures

We conducted 8 experimental sessions at Seoul National University in Seoul, Korea. 120 university students were recruited for the 8 sessions of 5 treatments,⁴ which lasted about an hour. The subjects were recruited through online and offline advertisements.⁵ Each treatment had eight markets (groups) in every period. Each market consisted of two buyers, computer sellers in (MR) and (DR), one human seller in (MH), and two human sellers in (DH) and (DHi). Thus, 16 subjects participated in (MR) and (DR), 24 subjects in (MH), and 32 subjects in (DH) and (DHi).

In each treatment, the values of q were taken from the set of $\{0.15, 0.3, 0.5, 0.7\}$ and the values of v_L and v_H were such that v_H / v_L was either 2.75 or 4.25. The numerical values for q and v_H / v_L were chosen so that there would be a sufficient variation in q and so that a theoretical equilibrium with negative information would exist for as many parameter values as possible.⁶ Every treatment had 24 periods with each of eight pairs of $(q, v_H / v_L)$ being applied three times. From theoretical point of view, an equilibrium is fully determined by q and v_H / v_L while the actual values of v_L and v_H do not matter. In our experiment, the values of v_L were drawn from a uniform distribution and v_H was calculated from v_L and the quality ratio v_H / v_L . The boundaries of the uniform distribution differed across the treatments and were set in such a way that cash payouts would be roughly similar across the treatments.⁷

For each session, subjects were seated in the laboratory according to the order of

⁴ We conducted two sessions for the (MH), (DH), and (DHi) treatments, and one session for the (MR) and (DR) treatments.

⁵ The online advertisement was made via *snulife.com* and the posters were posted around the campus for the offline advertisement.

⁶ In other words, parameters are such that in a theoretical equilibrium, message m_L is sent with positive probability. The only instance when the equilibrium with negative information does not exist is the (MR) treatment with $q = 0.7$.

⁷ For (MR), v_L was generated using $U [4850, 5350]$, for (MH), using $U [5000, 5500]$, for (DR), using $U [1400, 1900]$, for (DH), using $U [3300, 3800]$, and for (DHi), using $U [2000, 2500]$.

arrival to the session. All sessions started with subjects signing a consent form and reading written instructions, written in Korean. In the instructions, subject were also provided Korean translation of English terms that would be used in the experiment. Then, participants had a chance to ask questions. The experiment was programmed in the software zTree (Fischbacher, 2007). After the instructions, participants played three practice periods. The values for v_L in the practice periods were set in $[0, 10]$ so that they were irrelevant to the values in the actual periods. The practice periods were programmed in such a way that in the human treatments, each subject had a chance to play both roles – of a seller and a buyer – at least once. In the robot treatments, all subjects only played buyers during the practice periods. Then, the actual periods started by assigning the role of either a buyer or a seller to each subject. Subjects were randomly re-matched with other subjects to form a market at the beginning of each period. They played their role according to the stages of the treatment until the periods repeated 24 times.

Among the 24 actual periods, 4 periods were randomly drawn for the final payment at the end of the session.⁸ Subjects were paid either in cash at the end of the session or via bank transfer after the session. The average payoff per subject was about 13,500 KRW (approximately 11 USD) for an one-hour session.

IV. Results

As mentioned earlier, we use term m_H -seller to refer to a seller who sent message m_H and m_L -seller to a seller who sent the message m_L . An m_H -seller does not mean that the seller sells a high-quality product, but only that the seller claims to have one. The same convention applies to the term “ m_H -product.”

4.1. Sellers' Behavior and Profit

4.1.1. Propensity to Reveal Negative Information

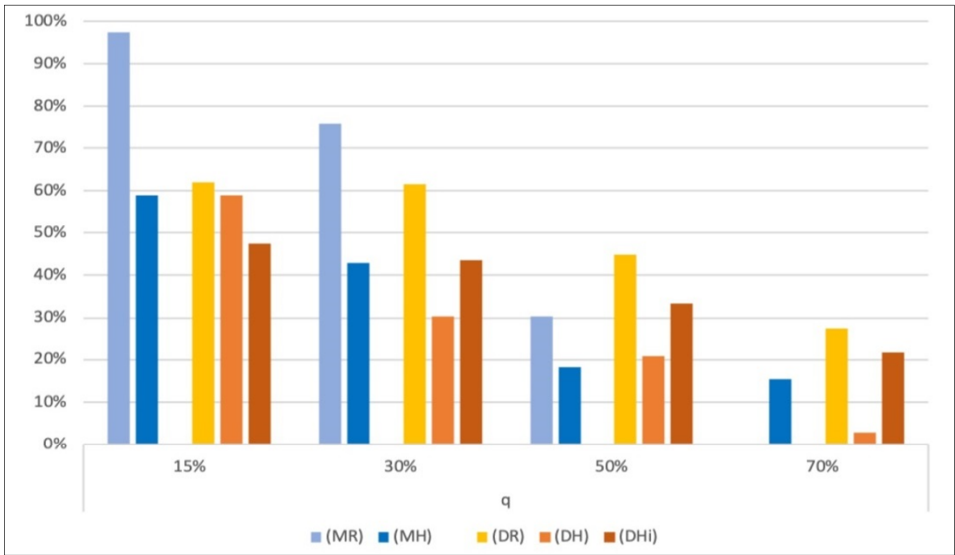
First, we study the propensity of low-quality human sellers to make low-quality claims, λ .⁹ Table 2 and Figure 1 show that revealing negative information was common across all treatments and for most parameter values. Within a treatment, the propensity to reveal negative information varied with values of exogenous parameters q and v_H/v_L . In all five treatments, lower q led to higher

⁸ We asked 4 subject volunteers to draw 4 random numbers which determined 4 paying periods out of 24 periods.

⁹ Computerized low-quality sellers were pre-programmed to reveal negative information with a positive probability according to Table 1. For the sake of completeness, we report results from *all* five treatments including treatments with computerized sellers.

propensity to reveal negative information; lower v_H / v_L led to a higher propensity to reveal negative information in the monopoly treatments and (DH). Results of a fixed-effect logit regression, where the binary dependent variable is whether the low-quality seller made a low-quality claim, are reported in Table 3. The results are similar to the univariate results in Table 2. Variable q is negative and statistically significant in every treatment. Variable v_H / v_L is negative and significant in the monopoly treatments and in (DH).

[Figure 1] Revealing negative information depending on q



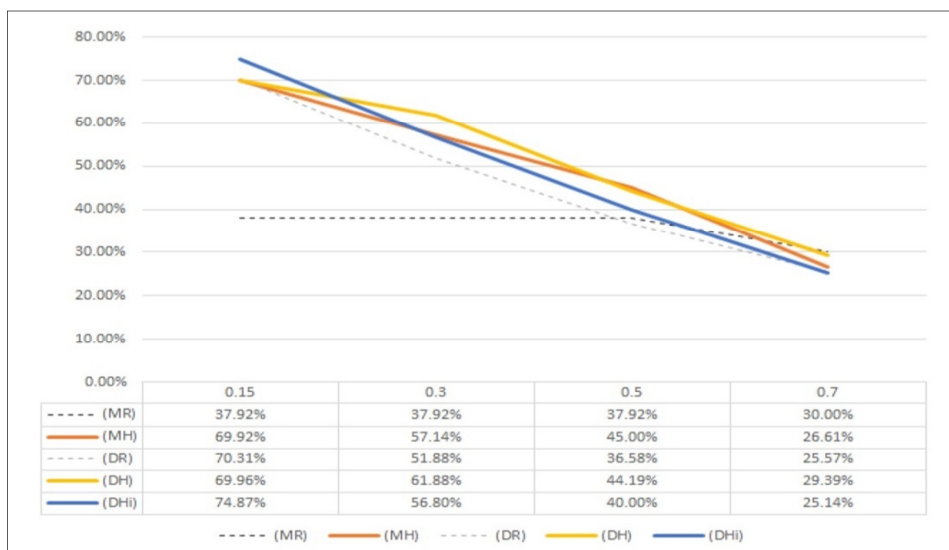
Notes: Figure shows the percentage of revealing negative information in each treatment for each q values of 0.15, 0.30, 0.50, and 0.70.

In the case of the monopoly, the intuition is straightforward because the sellers' profit depends on buyers' willingness to pay. Higher q or higher v_H / v_L mean that benefits of pooling with high-quality sellers are higher. Consequently, both in (MR), where computerized sellers were programmed to play equilibrium strategy, and in (MH) the propensity to disclose negative information is lower with higher q and higher v_H / v_L . In the case of duopoly, the equilibrium probability to disclose negative information is a decreasing function of q and does not depend on v_H / v_L (see Table 1). Unlike the monopoly case, however, there is no straightforward intuition regarding the relative profitability of m_L and m_H messages since it depends not only on buyers' willingness to pay but also on the strategy played by the competitor and the intensity of competition between the two sellers in subgames that follow their messages. Generally speaking, the effect of q and v_H / v_L on λ is not even necessarily monotone.

We conjecture that it is unlikely that human sellers in the duopoly treatments

took the complex equilibrium considerations into account when deciding on their strategy. Instead, duopoly sellers followed the “naive” monopoly reasoning wherein their propensity to disclose negative information was driven by its effect of negative information on buyers’ willingness to pay. To test this conjecture we check whether there was a significant difference in the propensity to reveal negative information between (MH) and (DH) and between (MH) and (DHi). As reported in Table 2, the difference was insignificant in both cases and for all parameter values. To visualize the similarity in human sellers’ behavior across treatments, we plot the posterior probabilities of the m_H -product to have low quality, $q_{LH} = \Pr(v = v_L | m = m_H)$. Results are reported in Figure 2.¹⁰ One can see that in the robot treatments, there is a clear difference in q_{LH} -values between (MR) and (DR). In contrast, in all three human treatments values of q_{LH} are close to each other. This is despite the fact that strategically (MH), (DH) and (DHi) are quite different: in (MH) sellers are monopolists; in (DH) sellers are duopolists and their quality is unknown to competitors; in (DHi) sellers are duopolists and know each others’ qualities.

[Figure 2] Implied q_{LH}



Notes: Figure shows $q_{LH} = \Pr(v = v_L | m = m_H)$ for different values of q . For (MR) and (DR), we use the theoretical values of q_{LH} whereas for (MH), (DH), and (DHi), we calculate q_{LH} based on subjects’ behavior.

¹⁰ In (MR) and (DR) treatments Figure 2 is based on values of q_{LH} that are calculated given the theoretical values of λ rather than the observed values of λ , i.e., those reported in Table 2. It does not affect our result which is about the treatments with human sellers. Nonetheless, for the sake of completeness, we report here the values of q_{LH} that are calculated given the observed λ ’s. In (MR), it is 13.28%, 36.12%, 41.03% and 30% when q is 0.15, 0.3, 0.5 and 0.7, respectively. In (DR), it is 68.34%, 47.30%, 35.53% and 23.68%. Out of the 8 cases, the only time that there is a substantial difference between q_{LH} ’s implied by theoretical λ versus observed λ is in (MR, $q = 0.15$).

[Table 2] Propensity to reveal negative information conditional on being low-quality type

	Mean	q				v_H / v_L		Diff
		0.15	0.3	0.5	0.7	2.75	4.25	
(MR)	0.62	0.97	0.76	0.30	0.00	0.71	0.56	-
(MH)	0.40	0.59	0.43	0.18	0.15	0.52	0.30	**
(MR)-(MH)	***	***	***	-	-	*	***	
(MH)-(DH)	-	-	-	-	-	-	-	
(MH)-(DHi)	-	-	-	-	-	-	-	
(DR)	0.54	0.62	0.62	0.45	0.28	0.52	0.56	-
(DH)	0.33	0.59	0.30	0.21	0.03	0.43	0.24	***
(DHi)	0.39	0.47	0.44	0.33	0.22	0.42	0.39	-
(DR)-(DH)	***	-	***	**	***	-	***	
(DR)-(DHi)	***	*	**	-	-	*	***	
(DH)-(DHi)	-	-	-	-	**	-	**	

Notes: Column “Mean” uses the entire data from a given treatment. Columns with q use data from a given treatment for given values of q . Columns with v_H / v_L use data from a given treatment for given values of v_H / v_L . Column “Diff” shows whether the difference in the propensity to reveal negative information for $v_H / v_L = 2.75$ and $v_H / v_L = 4.25$ within a given treatment is statistically significant. Rows with (treatment1)-(treatment2) show whether the difference between treatment 1 and treatment 2 is statistically significant. The significance is estimated using the proportion test. ***/**/* means significance at the 1%/5%/10% level. ‘-’ means the difference is insignificant.

[Table 3] Fixed-effect logit regressions of whether a low-quality seller sends m_L

	Send m_L				
	(MR)	(MH)	(DR)	(DH)	(DHi)
q	-12.67*** (-5.23)	-4.175** (-1.99)	-2.232*** (-2.82)	-7.641*** (-5.06)	-3.925*** (-3.54)
v_H / v_L	-1.146** (-2.44)	-0.881** (-2.26)	0.0689 (0.38)	-0.434* (-1.66)	-0.0936 (-0.39)
IsCLow			-0.113 (-0.36)	0.210 (0.45)	0.163 (0.40)
pseudo R^2	0.590	0.245	0.043	0.329	0.111
N	109	64	227	172	177

Notes: The t-statistics are reported in parentheses. The dependent variable is whether a low-quality seller sends message m_L . Variable *IsCLow* is a dummy variable equal to 1 if the competitor’s quality is low. ***/**/* means significance at 1%/5%/10% level.

Our last result is that low-quality human sellers are less likely to reveal negative information than low-quality robot sellers and, as reported in Table 2, the difference is often statistically significant. Experimental literature has documented subjects’ aversion to lying even if being honest reduces one’s monetary payoff (see e.g., Gneezy, 2005). Based on results from the lying-aversion literature, one would expect human subject to exhibit more honest behavior than that of profit-

maximizing robots. While our results are the opposite, they are *not* inconsistent with lying-aversion findings. In lying-aversion experiments, subjects are more likely to be dishonest when the monetary cost of being honest is higher. As we show below, in the human treatments, the relative profitability of m_H , as compared to m_L , was higher than in the robot treatments. That is, in the human treatments the monetary cost of disclosing negative information was, on average, higher and, therefore, it is not inconsistent with lying aversion to observe a lower propensity to be honest in the human treatments.

Result 1: *Revealing negative information is common across all treatments. Low-quality human sellers reveal negative information less frequently than robot sellers.*

Result 2: *In all five treatments, the propensity to reveal negative information was higher when the prior probability of high-quality product, q , was lower. In the monopoly treatments and (DH) the propensity to reveal negative information was high when v_H / v_L is low.*

Result 3: *Human sellers' strategies are similar in all human-seller treatments—(MH), (DH) and (DHi)—despite strategic differences among the three treatments.*

4.1.2. Effect of Negative Information on Profit

A priori, in our experiment it is unclear what is going to be the effect of negative information on profit. The most plausible and intuitive hypothesis is that the impact should be negative. First, negative information decreases buyers' willingness to pay for the product which is likely to hurt sellers' profit in both monopoly and duopoly settings. Second, even though we observe that sellers had a positive propensity to send m_L in all treatments, it does not mean that making a low-quality claim does not have a negative effect on profits. Because of aforementioned lying aversion, or other pro-social considerations, sellers might be willing to honestly communicate their quality despite monetary loss. At the same time, at least theoretically, there exist equilibria with partial separation where sellers are indifferent between the two messages so it is possible that m_L is not going to be less profitable than m_H . Finally, it is possible that subjects simply do not play equilibrium strategies if, for example, buyers have incorrect beliefs about sellers' strategies or sellers have incorrect beliefs about buyers' risk preferences. Then, m_L can be either more or less profitable than m_H .

Table 4 reports the profits of low-quality sellers who sent message m_L (rows Reveal) and who sent message m_H (rows Not reveal). In (MR) revealing negative information lead to higher profits for low values of q , $q=0.15$ and $q=0.3$, and the difference is statistically significant when $q=0.15$.¹¹ Intuitively, when q is

¹¹ Our discussion in this subsection includes robot treatments because even though sellers' behavior

low then revealing negative information does not have strong negative effect on buyers’ willingness to pay. Therefore, when q is low any positive effect of removing quality uncertainty is more likely to outweigh a negative effect on buyers’ willingness to pay than when q is high. In the case of (MH), revealing negative information resulted mostly in a negative but insignificant effect on profits. As we show in the next subsection, in (MH) buyers were more likely to purchase the m_L -product than the m_H -product which cushioned the negative effect of the m_L -message so that it was statistically insignificant for most parameter values.

[Table 4] Normalized profit of low-quality sellers conditional on their message

		Mean	q				v_H / v_L	
			0.15	0.3	0.5	0.7	2.75	4.25
NR	Reveal	1.70	1.75**	1.68	1.57	no obs.	1.58	1.82
	Not reveal	2.24***	0.00	1.51	2.24**	2.73	2.05***	2.33*
MH	Reveal	1.56	1.56	1.32	1.94	2.49	1.54	1.59
	Not reveal	1.72	1.58	1.75*	1.71	1.90	1.66	1.76
DR	Reveal	0.41***	0.29	0.59**	0.45**	0.15***	0.27**	0.53***
	Not reveal	0.20	0.22	0.24	0.26	0.04	0.16	0.23
DH	Reveal	0.73	10.63	0.73	1.13	0.72	0.71	0.75
	Not reveal	1.19**	0.97	0.93	1.45	1.45	1.02*	1.30
DHi	Reveal	0.64	0.69	0.52	0.72	0.71	0.54	0.74
	Not reveal	0.88	0.80	0.99**	0.87	0.83	0.90**	0.85

Notes: All profits are normalized with respect to v_L . Column “Mean” uses the entire data from a given treatment. Columns with q use data from a given treatment for given values of q . Columns with v_H / v_L use data from a given treatment for given values of v_H / v_L . Rows labeled “Reveal” show average normalized profits given message m_L and rows labeled “Not reveal” show average normalized profits given m_H . For each treatment and each column the two numbers in rows *Reveal* and *Not reveal* are compared and the larger one is in bold. Wilcoxon rank-sum test is used to see if the difference is significant: ***/**/* means significance at the 1%/5%/10% level. Entry ‘no obs.’ means that no low-quality seller revealed negative information.

Looking at the duopoly treatments, we see that in (DR) revealing negative information was always more profitable and in all but one case (DR, $q = 0.15$) the difference was statistically significant. In equilibrium, messages m_L and m_H should be equally profitable. The reason in (DR) the m_L -message was more profitable is buyers’ behavior. Theoretically, in the (m_L, m_H) -case the majority of buyers should purchase from the m_H -seller. As we show in the next subsection, however, in the (m_L, m_H) -case of (DR) the majority of buyers purchased from the m_L -sellers thereby boosting the relative profitability of the m_L -message.

In (DH) and (DHi) revealing negative information was less profitable for all

in the robot treatments was pre-programmed, sellers’ profit was determined by (human) buyers’ decisions.

parameter values though, similar to the monopoly human treatment, the effect was typically insignificant. The difference between the robot and the human treatments is because in (DH) and (DHi) human sellers did not play equilibrium pricing strategies in (m_L, m_L) - and (m_H, m_H) -cases, which increased relative profitability of m_H in the human treatments. To be specific, in (DR) sellers were programmed to play the Bertrand equilibrium in both (m_L, m_L) - and (m_H, m_H) -cases: they charged zero prices and earned zero profit. In contrast, in (DH) and (DHi) human sellers did not play Bertrand equilibrium in either case. Human sellers never charged zero prices and earned, on average, positive profits. Moreover, sellers' profits in the (m_H, m_H) -case was more than twice as high as in the (m_L, m_L) -case: $1.26 v_L$ vs $0.57 v_L$ in (DH) and $0.92 v_L$ vs $0.41 v_L$ in (DHi). This increased relative profitability of m_H in (DH) and (DHi) as compared to (DR).

Result 4: *In the robots treatments, revealing negative information has a significantly positive effect on profit in (MR) when $q = 0.15$ and in (DR) in all instances but $q = 0.15$.*

Result 5: *In the human treatments, revealing negative information has a negative but usually an insignificant effect on profit.*

4.2. Buyers' Response to Negative Information

In the previous subsection we established that revealing negative information does not necessarily have a negative effect on sellers' profit. Theoretical literature has identified two factors that make negative information disclosure possible in equilibrium: in a monopoly, sellers who disclose negative information sell more; in a duopoly, it introduces product differentiation softening the competition and increasing profit. In this subsection we test whether the two factors were present in our experiment.

4.2.1. Purchasing Decision

In the SH framework with the monopolistic seller, if the seller sends m_L then buyers' willingness to pay is v_L regardless of their loss aversion. The seller charges $p_L = v_L$, all buyers purchase and the seller's market share is 100%. If the seller sends m_H then buyers' willingness to pay depends on their loss aversion. The profit-maximizing price, $p_H > v_L$, is such that buyers with high loss aversion do not purchase the product and the seller's market share is less than 100%. Thus, in the monopoly case m_L -sellers sell more than m_H -sellers but at a lower price. In equilibrium with partial separation the expected profit of both messages is the same. In the SH framework with duopolistic sellers, in the (m_L, m_L) - and (m_H, m_H) -cases sellers charge zero price and earn zero profit. In the (m_L, m_H) -case, the m_H -

seller charges a higher price than the m_L -seller and has the market share above 50%. The m_H -seller earns a higher profit than m_L -sellers in the (m_L, m_H) -case but the probability of the (m_L, m_H) -case is lower for the m_H -seller than for the m_L -seller. In equilibrium with partial separation the expected profits of both messages are the same.

Table 5 reports buyers' propensity to purchase given the message(s) sent by the seller(s). It follows from Table 5 that both in the monopoly and the (m_L, m_H) -case of duopoly treatments buyers were more likely to purchase the m_L -product than the m_H -product. The result holds for all five treatments and for most parameters values though the difference is not always statically significant.

[Table 5] Buyers' propensity to purchase by message

	Mean	q				v_H / v_L	
		0.15	0.3	0.5	0.7	2.75	4.25
(MR) m_L	0.853	0.875***	0.840***	0.786	no obs	0.794	0.912**
m_H	0.810	0.417	0.565	0.902	0.948	0.855	0.766
(MH) m_L	0.754***	0.820***	0.694	0.722	0.700	0.786**	0.705*
m_H	0.570	0.565	0.617	0.564	0.547	0.607	0.541
(DR) (m_L, m_L)	0.911	0.933	0.889	0.875	no obs	0.875	0.938
$(m_L, m_H): m_L$	0.553**	0.500	0.659**	0.607	0.313	0.500	0.609**
$(m_L, m_H): m_H$	0.386	0.409	0.295	0.357	0.625	0.456	0.313
(m_H, m_H)	0.959	0.818	1.000	0.983	0.963	0.970	0.948
(DH) (m_L, m_L)	0.875	0.875	0.833	1.000	no obs	0.885	0.833
$(m_L, m_H): m_L$	0.519	0.480	0.472	0.722*	0.500	0.580	0.466
$(m_L, m_H): m_H$	0.389	0.440	0.389	0.278	0.250	0.380	0.397
(m_H, m_H)	0.857	0.909	0.778	0.816	0.924	0.862	0.852
(DHi) (m_L, m_L)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
$(m_L, m_H): m_L$	0.561**	0.591**	0.500	0.575	0.611	0.500	0.618***
$(m_L, m_H): m_H$	0.365	0.273	0.413	0.425	0.333	0.486	0.250
(m_H, m_H)	0.871	0.824	0.947	0.852	0.868	0.941	0.800

Notes: The buyers' propensity to purchase a product. The maximum value is 1.
In the monopoly treatments, we compare propensity to purchase given message m_L and given message m_H . The larger numbers are in bold. ***/**/* indicate that the difference in the propensity to purchase m_H and m_L -products is statistically significant at the 1%/5%/ 10% level.
In the duopoly treatments, we report the propensity to purchase a product in symmetric (m_L, m_L) -and (m_H, m_H) -cases. In the asymmetric (m_L, m_H) -case, we compare the buyers' propensity to purchase from the m_L -seller (row $(m_L, m_H): m_L$) versus the buyers' propensity to purchase from the m_H -seller (row $(m_L, m_H): m_H$). The larger numbers are in bold. ***/**/* indicates that the difference between the two is statistically significant at the 1%/5%/10% level.

Table 5 does not control for prices and, therefore, it is not clear whether buyers' preference for the m_L -product is because they dislike the quality uncertainty of the m_H -product, or because the m_H -product was relatively more expensive so the m_L -product gave buyers a higher surplus. To see whether buyers' reluctance to purchase the m_H -product was due to it being more expensive or due to it being more uncertain, Table 6 compares buyers' actual profits that they earned by deciding to buy (or not to buy) the m_H -product and hypothetical profits that they could have earned had they made a different choice. In the monopoly setting, the alternative to buying from the m_H -seller was not buying and vice versa. In the (m_L, m_H) -case of the duopoly setting, the alternative to buying from the m_H -seller was buying from the m_L -seller and vice versa.¹² For example, assume the m_L -seller has low quality and sets a price $p_L = 0.9v_L$, while the m_H -seller has low quality and sets a price $p_H = 1.2v_L$. Buyer's decision was to purchase the m_H -product. Then buyer's actual profit is $-0.2v_L$, and buyer's hypothetical profit, had he purchased the m_L -product, is $0.1v_L$.

First, we look at the robot treatments where, given the exogenous parameters and message(s), there was no price variation across groups and all buyers faced the exact same prices. Both in (MR) and (DR) buying the m_H -product was more profitable than the alternative—not buying in (MR) and buying the m_L -product in (DR)—while *not* buying the m_H -product was less profitable than the alternative. Thus, buyers' lower propensity to purchase an m_H -product in the robot treatments cannot be due to m_H -products yielding lower monetary surplus.

In the human treatments the profit difference between purchasing the m_H -product and the alternatives is less pronounced. In (MH), buying an m_H -product results in positive profits as in the (MR) treatment. Differently from the (MR) treatment, *not* buying an m_H -product and earning zero profit was not necessarily suboptimal. We observe two negative entries for hypothetical m_H -profits and, but with one exception, the hypothetical profit is not significantly different from zero. In the duopoly treatments with human sellers, we also observe that monetary surplus from an m_H -product is not necessarily higher than that from an m_L -product. There are several instances where the monetary surplus from an m_L -product, whether it is actual or hypothetical, is higher, including two instances when it is significantly higher. The difference from the robot treatments, where an m_H -product always yielded higher profits, is due to the fact that human sellers were charging higher prices after m_H and were less honest, meaning that the average quality of m_H -products was lower in the human treatments.

As Table 6 shows, purchasing the m_H -product, depending on the treatment, could lead to similar, higher or lower profits than the alternative. Yet, as Table 5

¹² In the duopoly, buyers had a choice of not purchasing anything and earning zero profit. However, we have excluded it from our analysis since, as follows from Table 5, it was rare.

[Table 6] Buyers’ normalized profit: actual and hypothetical

Mean		q				v_H / v_L	
		0.15	0.3	0.5	0.7	2.75	4.25
(MR) m_H : purchased	1.25***	1.79***	1.19***	1.22***	1.23***	1.21***	1.29***
If not purchased	0.00	0.00	0.00	0.00	0.00	0.00	0.00

m_H : not purchased	0.00	0.00	0.00	0.00	0.00	0.00	0.00
If purchased	1.33***	1.61***	1.48***	0.33	1.53***	1.38***	1.29***
(MH) m_H : purchased	0.71***	0.26	0.20	0.89***	1.20***	0.69***	0.74***
If not purchased	0.00	0.00	0.00	0.00	0.00	0.00	0.00

m_H : not purchased	0.00	0.00	0.00	0.00	0.00	0.00	0.00
If purchased	0.10	0.09	-0.02	0.20	0.08	0.32*	-0.06
(DR) (m_L, m_L) : purchased m_L	0.31	0.31	0.18	0.42	0.75	0.54	0.12
If purchased m_H	1.45***	1.06***	1.32***	1.90***	2.34***	1.28***	1.59***

(m_L, m_H) : purchased m_H	1.35***	1.40***	1.10**	0.95	2.00***	1.31	1.43
If purchased m_L	0.42	0.29	0.35	0.37	0.78	0.57***	0.18***
(DH) (m_L, m_L) : purchased m_L	0.49	0.42	0.42	0.59	1.28*	0.31	0.68
If purchased m_H	0.46	0.53	0.34	0.67	-0.61	-0.05*	1.02

(m_L, m_H) : purchased m_H	0.65	0.84	0.11	1.81**	-1.83	0.44	0.82
If purchased m_L	0.37	0.34	0.58	-0.10	0.27	0.13	0.57
(DHi) (m_L, m_L) : purchased m_L	0.59	0.39	0.54	0.76	0.77	0.61	0.57
If purchased m_H	0.62	0.26	0.71	0.88	0.78	0.59	0.65

(m_L, m_H) : purchased m_H	0.63	0.15	0.55	1.26	0.10	0.66	0.59
If purchased m_L	0.50	0.23	0.58	0.42	1.00*	0.40	0.68

Notes: For each pair of rows, the top row is the average of *actual* normalized profits that buyers earned and the bottom row is the average of *hypothetical* normalized profits that buyers would have earned had they made a different decision. A larger number is in bold. ***/**/* indicates that the difference between actual and hypothetical profits is statistically significant at the 1%/5%/10% level.

For the monopoly treatments, the first two rows compare average profits of those who purchased the m_H -product versus the hypothetical scenario of them not purchasing it (rows “ m_H : purchased” versus “If not purchased”). The second two rows compare average profits of who did not purchase the m_H -product versus the hypothetical scenario of them purchasing the m_H -product (rows “ m_H : not purchased” and “If purchased”).

For the duopoly treatments, we only report profits in the (m_L, m_H)-case. The first two rows compare average profits of those who purchased an m_L -product versus the hypothetical scenario of them purchasing an m_H -product (rows “(m_L, m_H) : purchased m_L ” and “If purchased m_H ”). The second two rows compare average profits of those who purchased an m_H -product versus the hypothetical scenario of them purchasing an m_L -product (rows “(m_L, m_H) : purchased m_H ” and “If purchased m_L ”).

shows, buyers’ propensity to buy an m_H -product was consistently lower across all treatments. Therefore, we conclude that buyers’ lower propensity to purchase the

m_H -product was driven by buyers' preferences for certainty rather than maximizing their monetary payoff.

Result 6: *In the monopoly treatments and the (m_L, m_H) -case of duopoly treatments buyers are more likely to purchase an m_L -product.*

Result 7: *Buyers have a higher propensity to purchase an m_L -product regardless of whether it yields a higher or lower monetary payoff.*

4.2.2. Product Differentiation

A common theme in theoretical literature is that in the duopoly setting disclosure of negative information introduces product differentiation, thereby softening price competition and increasing the profit (Board, 2009; Guo and Zhao, 2009; Kim, 2012; Shapiro and Huh, 2021).

To test whether in our experiment revealing negative information introduces product differentiation, we study whether buyers' demand in the (m_L, m_H) -case was less price-sensitive than in the symmetric (m_L, m_L) -and (m_H, m_H) -cases. Specifically, we compare buyers' willingness to purchase a product from a more expensive seller which is defined as a seller who offers a lower expected consumer surplus. In symmetric (m_L, m_L) -and (m_H, m_H) -cases, the more expensive seller is simply the one who charges a higher price. In the (m_L, m_H) -case, we assume that buyer's expected consumer surplus from the m_L -product is $CS(m_L) = v_L - p_L$. Buyer's expected consumer surplus from the m_H -product is $CS(m_H) = q_{LH}v_L + (1 - q_{LH})v_H - p_H$, where $q_{LH} = \Pr(v = v_L | m = m_H)$ and it is calculated based on the actual experimental values of q_{LH} . We say that an m_L -seller is a more (less) expensive seller if $CS(m_L)$ is less than (greater than) $CS(m_H)$.

Table 7 shows the average sales made by a more expensive seller for each of three message profiles: (m_H, m_H) , (m_L, m_H) , and (m_L, m_L) . Since the propensity to purchase a more expensive product depends on the difference in expected consumer surpluses, we separately report the average sales for the case when the absolute value of the difference in normalized consumer surpluses, $\Delta CS = \left| \frac{E_{m_1} v - p_1}{v_L} - \frac{E_{m_2} v - p_2}{v_L} \right|$, is between 0 and 1, 1 and 2, 2 and 3, and above 3. In the (m_L, m_H) -case, which is the only asymmetric case, we separately report the sales made by a more expensive m_L -seller and a more expensive m_H -seller. The maximum number of sales that a seller can make is 2.

Comparing m_L -sale and m_H -sale rows in the (m_L, m_H) -case, we see that more expensive sellers were able to sell their product and that m_L -sellers were more successful in making sales than more expensive m_H -sellers.¹³ Looking at

¹³ In the case of (DR), m_L -sellers were always more expensive than m_H -sellers so the " m_H -sale" row is empty.

[Table 7] Average sales made by the more expensive seller

$ \Delta CS /v_L$	(DR)				(DH)				(DHi)			
	(0,1]	(1,2]	(2,3]	> 3	(0,1]	(1,2]	(2,3]	> 3	(0,1]	(1,2]	(2,3]	> 3
(m_H, m_H)	-	-	-	-	0.25	0.18	0.00	0.00	0.37	0.00	0.17	0.00
(m_L, m_H)	0.98	1.36	-	-	0.89	0.27	0.00	-	0.81	0.44	0.00	-
m_L -sale	0.98	1.36	-	-	1.23	0.29	0.00	-	1.08	0.53	0.00	-
m_H -sale	-	-	-	-	0.40	0.00	0.00	-	0.19	0.00	0.00	-
(m_L, m_L)	-	-	-	-	0.31	0.00	-	-	0.07	0.00	-	0.00

Notes: Columns correspond to the treatments and the range of values of the difference in normalized consumer surpluses, $|(E_{m_1} v - p_1) - (F_{m_2} v - p_2)|/v_L$. Thus, column (0, 1] is the average sales made by a more expensive seller when a difference in CS between two sellers is less than v_L , column (1, 2] is when it is between v_L and $2v_L$, and so on. Rows (m_H, m_H) , (m_L, m_H) , and (m_L, m_L) correspond to sellers' messages. In the (m_L, m_H) -case, row m_L -sale (m_H -sale) shows the average sales by a more expensive seller when the more expensive seller is the one who sent message m_L (m_H). '-' means no observation for a given cell. The maximum number of sales a seller can make is 2.

symmetric (m_L, m_L) -and (m_H, m_H) -cases in the human treatments, we see that sending the same messages did not lead to a Bertrand's type of demand in which more expensive sellers made zero sales. Nonetheless, the average sales made by more expensive sellers in both (m_L, m_L) -and (m_H, m_H) -cases tend to be much lower than in the asymmetric (m_L, m_H) -case. Thus, price is a less important factor in the asymmetric (m_L, m_H) -case than in the symmetric case of the identical messages.

To formally substantiate this finding, we conduct fixed-effect logit regressions in which the dependent variable is equal to 1 if a buyer purchases the product from a more expensive seller. Variable ΔCS is the normalized difference in expected consumer surpluses as defined earlier. Variable $\Delta CS * IsSame$ is the interaction term of ΔCS and the dummy variable $IsSame$ that is equal to 1 if the two messages are the same.¹⁴ Table 8 shows the estimation results. As one can immediately see, the interaction term $\Delta CS * IsSame$ is negative and significant at 1% level in the (DH) and (DHi) treatments. It means that buyers are more sensitive to the differences in expected consumer surplus when both sellers send the same message. In other words, demand is less price-sensitive after (m_L, m_H) messages than after (m_H, m_H) or (m_L, m_L) messages.

Result 8: *In all duopoly treatments, buyers are more likely to sacrifice their expected consumer surplus in exchange of buying a product of certain quality.*

¹⁴ As a robustness check, we also ran regressions with the interaction term of ΔCS and the dummy variable for (m_H, m_H) . We found similar results.

Result 9: The (m_L, m_H) -messaging profile results in a less price-sensitive demand than (m_L, m_L) and (m_H, m_H) .

[Table 8] Fixed-effect logit regressions of buyers' willingness to buy from the more expensive seller

	(DR)		(DH)		(DHi)	
q	-4.311** (-2.05)	-4.311** (-2.05)	-1.262* (-1.78)	-0.556 (-0.71)	-0.313 (-0.49)	0.0640 (0.09)
v_H / v_L	-1.840* (-1.81)	-1.840* (-1.81)	0.331* (1.65)	0.339* (1.68)	0.0477 (0.27)	0.0408 (0.22)
ΔCS	5.429** (2.11)	5.429** (2.11)	-0.694** (-2.50)	-0.217 (-0.67)	-0.818*** (-2.85)	-0.292 (-0.93)
$\Delta CS * \text{IsSame}$		0 (.)		-0.989** (-2.34)		-1.680*** (-3.64)
N	106	106	339	339	330	330

Notes: The dependent variable is equal to 1 if a given buyer purchased from a more expensive seller and 0, otherwise. Variable ΔCS is the difference in consumers' expected surpluses as defined in Table 7. Variable $\Delta CS * \text{IsSame}$ is the interaction term of ΔCS and a dummy variable that is equal to 1 if both sellers send the same message. In the (DR) treatment, variable $\Delta CS * \text{IsSame}$ was omitted due to collinearity.

4.3. Welfare

In this section, we examine the effect of revealing negative information on welfare. We calculate the welfare from the ex-post perspective. For a given group (one/two sellers and two buyers) in a given period of a given treatment, we calculate the group's welfare as the average of seller(s)' and buyers' profits. To control for differences in the actual product's quality we separately analyze the following three cases. The first case is the monopoly treatments when a seller's quality is v_L ; the second case is the duopoly treatments when both sellers have low quality, (v_L, v_L) ; the third case is the duopoly treatments when exactly one seller has low quality, (v_L, v_H) . In the first and second cases the first-best welfare is $2v_L$ and in the third case it is $2v_H$. Table 9 shows the difference in social welfare per group when negative information is revealed and when it is not. A positive entry means that social welfare is higher if a low-quality seller reveals negative information.

In the monopoly treatments, the disclosure of negative information had a positive effect. In the monopoly, the only factor that determined social welfare was how many units of the product were purchased. As established earlier, in the monopoly treatments buyers were more likely to purchase if the seller's message was m_L than if it was m_H .

In the duopoly, when sellers' quality is (v_L, v_L) , the effect of revealing negative information was weaker. While most entries in Panel B were also positive, most of

the time the difference was insignificant. When both duopolists had the same quality, then, just as in the monopoly case, the only factor affecting welfare was how many units were sold. In the duopoly treatments the buyers’ propensity to purchase was high regardless of whether the negative information was revealed or not (see Table 5). That is, revealing negative information did not have a strong effect on the buyers’ willingness to purchase, which was already high, and therefore, did not have a strong effect on welfare.

[Table 9] Difference in welfare when negative information is revealed and when it is not

Panel A: Welfare (Reveal)- Welfare (Not Reveal); v_L							
Mean		q				v_H / v_L	
		0.15	0.3	0.5	0.7	2.75	4.25
(MR)	0.032**	0.583**	0.185**	-0.01	no obs.	-0.06	0.101**
(MH)	0.097	0.140*	0.005	0.092	0.272	0.063	0.098
Panel B: Welfare (Reveal)- Welfare (Not Reveal); (v_L, v_L)							
Mean		q				v_H / v_L	
		0.15	0.3	0.5	0.7	2.75	4.25
(DR)	0.001	0.028	-0.02	-0.05	-0.18	-0.04	0.043
(DH)	0.017	-0.04	0.058	0.035	0.05	0.054	-0.02
(DHi)	0.051**	0.008	-0.00	0.15	0.15*	0.031	0.067**
Panel C: Welfare (Reveal)- Welfare (Not Reveal); (v_L, v_H)							
Mean		q				v_H / v_L	
		0.15	0.3	0.5	0.7	2.75	4.25
(DR)	-0.19*	0.281	-0.16	-0.54**	0.133	0.004	-0.44**
(DH)	0.025	0.409	-0.26	-0.00	no obs.	0.170	-0.13
(DHi)	-0.14	-0.18	-0.21	0.024	-0.49	-0.03	-0.25

Notes: Difference in normalized welfare when a low-quality seller reveals negative information minus normalized welfare when a low-quality seller does not. The entry is *positive* if revealing negative information lead to *higher* welfare.

Panel A only includes groups in the monopoly treatments with low-quality sellers. Panel B only includes groups in the duopoly treatment where both sellers had low quality. In this case we say that negative information was revealed if at least one seller sent message m_L . Panel C only includes groups in the duopoly treatments where exactly one seller had low quality, (v_L, v_H) . ***/**/* means that the difference is significant at the 1%/5%/10% level; ‘no obs.’ means that there was no sellers who revealed negative information.

Finally, in the duopoly treatments where sellers’ quality is (v_L, v_H) , revealing negative information had mostly a negative effect on welfare. Most entries in Panel C are negative and some are significant. The difference in Panel C from Panels A and B is that now there are two factors that can affect welfare. One is whether buyers purchased a product or not. The other is whether the purchased product had low quality or high quality. Just as in the case of (v_L, v_L) , the effect of the first

factor was weak: buyers were willing to purchase regardless of the message profile. The effect of the second factor, on the other hand, was strong and it was negative.

Consider, for example, the (DR, $q = 0.5$) treatment where revealing negative information resulted in significantly lower social welfare. Comparing the (m_L, m_H) and (m_H, m_H) cases, we observe that most buyers purchased a product in both cases: 96.4% of the buyers who received (m_L, m_H) and 98.3% of the buyers who received (m_H, m_H) purchased a product (see Table 5). Thus, the propensity to purchase was very high regardless of whether the low-quality message was sent or not. However, in the former case, 67% of buyers purchased a socially inefficient low-quality product, while in the latter case only 25% of buyers purchased a low-quality product. The second effect dominated and revealing negative information resulted in a significantly lower welfare.

Result 10: *In the monopoly treatments, revealing negative information is welfare-improving in terms of both monetary payoffs and utilities.*

Result 11: *In the duopoly treatments, the effect of revealing negative information is weak. A positive welfare effect of removing quality uncertainty is weakened by buyers' increased propensity to purchase a (inefficient) low-quality product.*

V. Conclusion

In this paper, we provide an experimental study of a setting where sellers can reveal negative information via cheap-talk messages. We study the effect of revealing negative information on sellers' profit, market outcomes, buyers' behavior and social welfare. Our findings suggest that revealing negative information occurs in all treatments and for virtually all parameter values. However, we do not find strong evidence that revealing negative information negatively affects sellers' profits. In particular, buyers are more likely to purchase a product with revealed negative information and, in the duopoly settings, we find evidence that revealing negative information leads to product differentiation. Finally, the effect of revealing negative information on welfare is significant, although its sign varies with a market structure. In the monopoly, the effect on welfare is mostly positive. Revealing negative information increases buyers' willingness to purchase the product, thereby increasing welfare. In the duopoly, however, the welfare effect of revealing negative information is often negative. The reason is that in the duopoly negative information has a little effect on buyers' willingness to purchase. At the same time, when negative information is revealed, buyers are more likely to purchase a socially inefficient low-quality product.

Overall, our paper contributes to the literature on asymmetric quality information by studying the effect of truthful revealing negative information on

sellers' profit, buyers' behavior, the intensity of competition and welfare. Earlier theoretical work has shown that revealing negative information can be, under certain conditions, beneficial for sellers via reducing buyers' quality uncertainty or introducing product differentiation. We use this experimental study to show that these effects are indeed present and in some cases can be strong enough to mitigate the negative effects of revealing negative information on profit.

Appendix

A Theoretical Analysis. Monopoly

This section closely follows Shapiro and Huh (2021). Consider first a model with a monopolistic seller who sells a product with exogenously given quality $v \in \{v_L, v_H\}$, where $v_H > v_L$. The marginal cost of both qualities is zero. The quality is unobserved by buyers and q is the prior probability of the product having *high* quality. The seller is risk neutral. If the seller of type v serves share s_v of buyers at price p_v , his profit is $\pi_v(p, s) = (p_v - c_v)s_v$. Sellers can communicate their product's quality to buyers using a cheap-talk message, $m \in \{m_L, m_H\}$, where we label message m_i as "*my product's quality is v_i* ."

There is a mass one of buyers with unit demand. Buyers are loss averse, with the reference point being endogenously determined by their expectations of the product quality. Let q_{Lm} denote buyers' beliefs about the product quality being low conditional on the message, m . The expected quality, $E_m v = q_{Lm} v_L + (1 - q_{Lm}) v_H$, is the buyer's reference point and determines whether the purchase is viewed as a gain or a loss. If the purchased product has high quality, then the buyer does not experience loss, and his utility is simply $v_H - p$. If the purchased product has low quality, then the buyer does experience loss of the size $v_L - E_m v$. Buyers' expected utility is

$$U_b(p, q_{Lm}) = E_m v - p + b \cdot q_{Lm} (v_L - E_m v),$$

where q_{Lm} is the probability of purchasing the low-quality product, and parameter $b \geq 0$ measures the buyer's loss aversion. We assume that $b \sim U[0, B]$.¹⁵

The timing is as follows. First, the seller learns his type, v . Second, the seller sends a publicly observable cheap-talk message $m \in \{m_L, m_H\}$. Third, buyers observe the message and form posterior beliefs about the product's quality, which determines their demand for the seller's product. Fourth, the seller chooses the price, p , and, finally, buyers decide whether or not to purchase the product.

We are interested in equilibria with partial separation, where low-quality sellers separate themselves from high-quality sellers with a positive probability. Consider the messaging strategy $m_\lambda^*(v) = (\lambda, 0)$. According to this strategy, the low-quality type sends message m_L with probability λ , and the high-quality type sends message m_L with probability 0. Message m_H is sent with probabilities $1 - \lambda$ and 1, respectively.

¹⁵ When calculating equilibrium strategies for computerized players, we assumed that $b \sim U[0, 2.8]$. We set $B = 2.8$ to match the median loss-aversion to the median loss aversion in South Korea (Wang et al., 2017).

Given $m_\lambda^*(v)$, buyers' beliefs are: $q_{LL} = \Pr(v = v_L \mid m_L) = 1$ and

$$q_{LH} = \Pr(v = v_L \mid m_H) = \frac{(1-\lambda)(1-q)}{(1-\lambda)(1-q) + q}.$$

Conditional on m_L , buyers know for certain that the product quality is low. Therefore, $E_{m_L} v = v_L$ and the expected loss is zero, $ELoss_{m_L} = 0$. Conditional on m_H , buyers expect the product quality to be low with probability q_{LH} . Then $E_{m_H} v = q_{LH}v_L + (1-q_{LH})v_H$ and the expected loss is $ELoss_{m_H} = -q_{LH}(v_L - E_{m_H} v)$.

A buyer will purchase the product if and only if $E_m v - p - b \cdot ELoss_m \geq 0$. In the case of m_L , the buyer will purchase the product if and only if its price is less or equal than v_L . The monopolist will set $p_L = v_L$, all buyers will purchase the product, and the monopolist will earn a profit of v_L . In the case of m_H , the buyer will purchase the product if and only if his loss aversion, b , is such that $b \leq \frac{E_{m_H} v - p}{ELoss_{m_H}}$. Therefore, the demand function conditional on m_H and p is $\Phi(\frac{E_{m_H} v - p}{ELoss_{m_H}})$, where $\Phi(\cdot)$ is a cdf for the uniform distribution on $[0, B]$. Seller's profit from sending message m_H is

$$\pi(m_H) = \max_p \phi\left(\frac{E_{q_{LH}} v - p}{ELoss_{q_{LH}}}\right) p.$$

It doesn't depend on the seller's type since the marginal cost doesn't depend on the quality. In equilibrium it should be the case that $v_L = \pi(m_H)$, where v_L is the expected profit from sending m_L and $\pi(m_H)$ is the expected profit from sending m_H .

Revealing negative information—that is, sending message m_L —leads to low price, $p_L = v_L$ and high market share, $s_L = 1$. Sending message m_H , leads to higher price $p_H > v_L$ and lower market share, $s_H < 1$, as buyers with high loss aversion will choose not to purchase the product. In equilibrium the low-quality seller is indifferent between the two messages.

B Theoretical Analysis. Duopoly

Assume that there are two sellers in the market. The sellers' quality, $v \in \{v_L, v_H\}$, is exogenously given and is pure private information (i.e., it is unobserved by buyers and by the other seller). This corresponds to the (DR) and (DH) treatments. Everything else is the same as in the monopoly setting.

The timing is similar to the one used in the experimental setting. First, both sellers simultaneously send cheap-talk messages (m_i, m_j) that are publicly observed.

Second, given (m_i, m_j) , sellers simultaneously determine prices for their products (p_i, p_j) . Third, buyers observe the messages and prices of both sellers and choose which seller to purchase the product from.¹⁶

As before we are interested in equilibria with partial separation where sellers' messaging strategy is $m_\lambda^*(v) = (\lambda, 0)$. Given $m_\lambda^*(v)$, buyers' beliefs are: $q_{LL} = \Pr(v = v_L | m_L) = 1$ and $q_{LH} = \Pr(v = v_L | m_H) = \frac{(1-\lambda)(1-q)}{(1-\lambda)(1-q)+q}$.

By backward induction, we start with the buyers' decision. If both sellers send the same messages, (m_L, m_L) or (m_H, m_H) , then buyers have identical beliefs about the quality of both sellers and purchase from the seller with the lowest price. If the messages differ, (m_L, m_H) , then let p_L be the price charged by the m_L -seller, and p_H be the price charged by the m_H -seller. Given $m_\lambda^*(v)$, a buyer's utility of purchasing from the m_L -seller is $v_L - p_L$. There is no uncertainty, as the quality of the m_L -seller is known to be low. The buyer's utility from purchasing from the m_H -seller is $E_{m_H} v - p_H - b \cdot E_{Loss_{m_H}}$. The expression for E_{m_H} and $E_{Loss_{m_H}}$ were derived in the monopoly section.

A buyer is indifferent between the two sellers if his b^0 is such that

$$v_L - p_L = E_{m_H} v - p_H - b^0 \cdot E_{Loss_{m_H}}. \quad (B.1)$$

All buyers with low degrees of loss aversion, $b < b^0$, will purchase from the m_H -seller, and all buyers with high degree of loss aversion, $b > b^0$, will purchase from the m_L -seller. The equation above shows the difference between the symmetric case where the two messages are the same and the asymmetric case where the two messages are different. In the symmetric case, buyers have identical beliefs about the quality of both sellers. The products are not differentiated and buyers purchase the product with the lowest price. In the asymmetric case, the two products are differentiated. A small changes in price by one seller is going to have a small impact on sales made by both sellers.

Next, we consider the pricing stage. If the two messages are the same, (m_L, m_L) or (m_H, m_H) , then the buyers purchase a cheaper product. The pricing subgame is equivalent to the Bertrand competition. Both sellers set the price equal to the marginal cost and earn zero profit. In the case of (m_L, m_H) , the two products are differentiated and one can show that, in equilibrium, sellers charge positive prices (p_L, p_H) and earn positive profit. Let $b^0(p_L, p_H)$ denote the solution to (B.1). The optimization problem of the m_L -seller is

¹⁶ In the duopoly equilibrium of SH, it is assumed that the buyers' valuation is high enough so that all buyers purchase a product. In our experiment, buyers had an option of not purchasing the product. In treatments with computerized players, where computerized duopolists played equilibrium strategies, only 5.47% of buyers chose not to purchase any product. Thus, the assumption is appropriate.

$$\max_{p_L} (1 - \Phi(b^0(p_L, p_H))) \cdot p_L, \quad (\text{B.2})$$

and the optimization problem of the m_H -seller is

$$\max_{p_H} \Phi(b^0(p_L, p_H)) \cdot p_H. \quad (\text{B.3})$$

Finally, at the messaging stage the low-quality seller should be indifferent between m_L and m_H when the other seller plays $m_\lambda^*(v)$. The indifference condition is

$$\begin{aligned} & \lambda(1-q)\pi_{(m_L, m_L)} + (1-\lambda(1-q))\pi_{(m_L, m_H)} \\ &= \lambda(1-q)\pi_{(m_H, m_L)} + (1-\lambda(1-q))\pi_{(m_H, m_H)}, \end{aligned} \quad (\text{B.4})$$

where $\pi_{(m_i, m_j)}$ is the profit of seller i when seller i sends message m_i and seller j sends message m_j . Here, the expression on the left is the expected profit from sending m_L , and the expression on the right is the expected profit from sending m_H . Since $\pi_{(m_L, m_L)} = \pi_{(m_H, m_H)} = 0$, it can be simplified as

$$(1 - \lambda(1-q))\pi_{(m_L, m_H)} = \lambda(1-q)\pi_{(m_H, m_L)}. \quad (\text{B.5})$$

In equilibrium a quadruple (λ, b^0, p_L, p_H) is a solution to equations (B.1), (B.2), (B.3) and (B.5). Message m_L leads to a lower profit in the (m_L, m_H) -case but a higher probability of the (m_L, m_H) -case than message m_H . The low-quality seller is indifferent between the two messages.

The duopoly setting differs from the monopoly in that sellers' profit is determined not only by buyers' willingness to pay but also by the intensity of competition. If, for example, the competitor sends m_H with probability 1 then it is suboptimal to imitate the high-quality type and send m_H , as it is guaranteed to result in Bertrand competition and zero profit. Instead, in equilibrium, low-quality sellers send m_L with positive probability so that the asymmetric case happens with positive probability and the sellers of both types earn positive expected profits.

C Experimental Instructions

C.1. General Instructions

Thank you for participating in our experiment. Before we start the session, please put your cell phone on silent and put away all your belongings. The whole session will take about an hour. You will participate in the experiment through the

computer in front of you. Any conversation with other participants will be strictly prohibited from now on.

Please read the experimental instructions carefully and sign the consent form as you agree to participate in this experiment.

(Enough time was given to subjects.)

This experiment will be conducted in English through the computer. Three practice periods will be given before the actual periods start. Your performance in practice periods does not affect your final payoff. The actual periods can determine your final payoff and will be given 24 times. At the end of the experiment, your payoff will be determined according to your performance during the 24 actual periods plus the show-up fee of 5,000KRW. Among the 24 actual periods, 4 periods will be randomly selected and the sum of those 4 periods payoffs will be your payoff besides the show-up fee. The highest of 15,000KRW and the lowest of 10,000KRW in total will be paid as your final payoff.

If you have any questions regarding this experiment, please ask now.

If you agree to participate in this experiment, please hand in the signed consent form to us.

[Practice periods]

The language used in the experiment is English. For you to better understand this session, you will be given three practice periods. Your performance in practice periods does not affect your final payoff. Also, the details of the information such as numbers shown in the screen are irrelevant to what you would see in the actual periods. Please make your decision within the given time shown on the upper right corner of the screen. Let us start the practice periods.

(Three practice periods proceed.)¹⁷

All practice periods have been completed. Before we start the actual periods, do you have any questions?

[Actual periods]

Now, we are about to start the 24 periods that can affect your final payoff. Your decisions and performance in each period can affect your final payoff at the end of the experiment, please make decisions carefully. Please make your decision within

¹⁷ In the practice round, subjects experience both roles of a seller and a buyer with the parameter values irrelevant with the actual periods. Therefore, the screen layouts for the practice periods are the same with those in actual periods, except the parameter values.

the given time shown on the upper right corner of the screen and press Continue button afterwards. Let us start the actual periods.

(Twenty-four actual periods proceed: the details of the instructions shown on the screen can be found in section C.3.)

You completed all the periods of this session. Now, you will answer a set of demographic questions. As you complete the questionnaire, we will determine the 4 paying periods out of 24 actual periods by a lottery. You will be paid on your way out according to your performance in the selected four periods plus the show-up fee.

Thank you for participating in our experiment.

C.2. Additional instructions for each treatment

C.2.1. Robot treatments: MR and DR

In this session, all of you participants are going to play buyers throughout multiple periods. Sellers will be played by computer. There are two buyers in each market while the number of seller played by computer will be one (two). All buyers will be randomly and newly assigned to a market in each period. Periods will be repeated 24 times.

C.2.2. Human treatments: MH, DH, and DHi

In this session, all the participants will be randomly assigned to either a seller or a buyer at the beginning of the session. There will be two sellers and two buyers in each market of each period. Throughout the session, each role will be repeated in multiple periods while two buyers and two sellers in each market will be randomly and newly reassigned in each period. Periods will be repeated 24 times.

C.3 Selected Screenshots

[Figure A.1] Monopoly - instructions

3 out of 24
Remaining time (sec) 2

Subject's ID: 3

Instructions

In this period, you will be asked to make a decision regarding buying or selling a product.

If you are a SELLER, you will be asked 1) which message you will send to a buyer, and 2) the price you offer.

If you are a BUYER, you will be asked to decide whether to buy a product or not.

There are two buyers and one seller in a market. The seller is played by other participants.

In each period, profits of sellers and buyers are determined as follows:

Sellers' profits are 'Price x Number of products sold'.

Buyers' profits are 'Value of the product - Price'.

Please press the Continue button.
Continue

[Figure A.2] Monopoly – seller's sending a message

F8102
3 out of 24
Remaining time (sec) 26

Subject's ID: 3

Sending a Message

You are the only seller in the market.

Your product quality is: **Low**. Buyers do NOT know your product's quality.

There are two types of quality for the product: **High** and **Low**.

Buyers expect the quality of your product to be **High** with probability **0.50**.

Regardless of your product quality, you can decide which message to send to buyers.

The following shows how buyers value the two types of products.

High-quality product	Low-quality product
14849	5327

Now, decide which message you would like to send to the buyers in the market. You can choose either message *regardless* of your product's quality.

☐ I sell a high-quality product
☐ I sell a low-quality product

As you click Continue button, the session will continue.
Continue

[Figure A.3] Monopoly – seller’s setting a price

PERIOD

3 out of 24

Remaining time (sec) 20

Subjects ID: 3

Determining a Price

You are the only seller in the market.
Your product quality is: **Low**. Buyers do NOT know your product's quality.
Buyers expect the quality of your product to be **High** with probability 0.50.
You sent out a message saying that **I sell a high-quality product**.
Buyer's value of your product depends on its quality:

Value of High-quality product	Value of Low-quality product
14849	5327

Set up the price for your product:

As you click **Continue** button, the session will continue.

Continue

[Figure A.4] Monopoly - buyer’s buying decision

PERIOD

6 out of 24

Remaining time (sec) 20

Subjects ID: 2

Buying It or Not

The following is the message sent by the seller: **I sell a high-quality product**.
The message can be TRUE, or it can be FALSE.
The following is the price set by the seller: **10000**
Your value of the product depends on its quality:

Your Value of High-quality product	Your Value of Low-quality product
23273	5476

Given the seller's price, if you purchase the product then your profit will depend on its quality as follows:

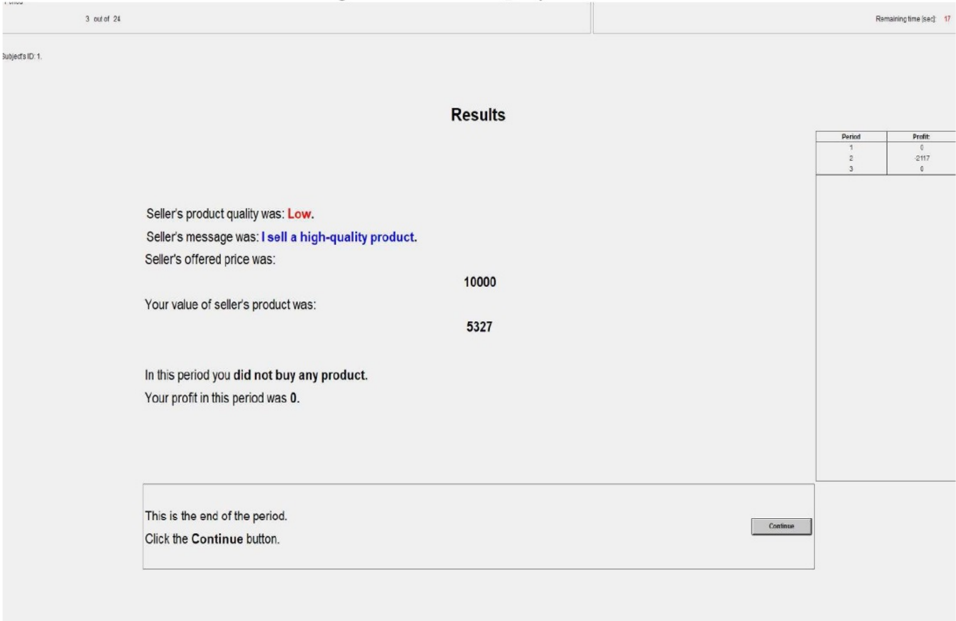
High-quality product	Low-quality product
13273	-4524

With probability of 0.30, the quality of the product sold by the seller is **High**.
Based on the given information, decide whether to buy the product or not:

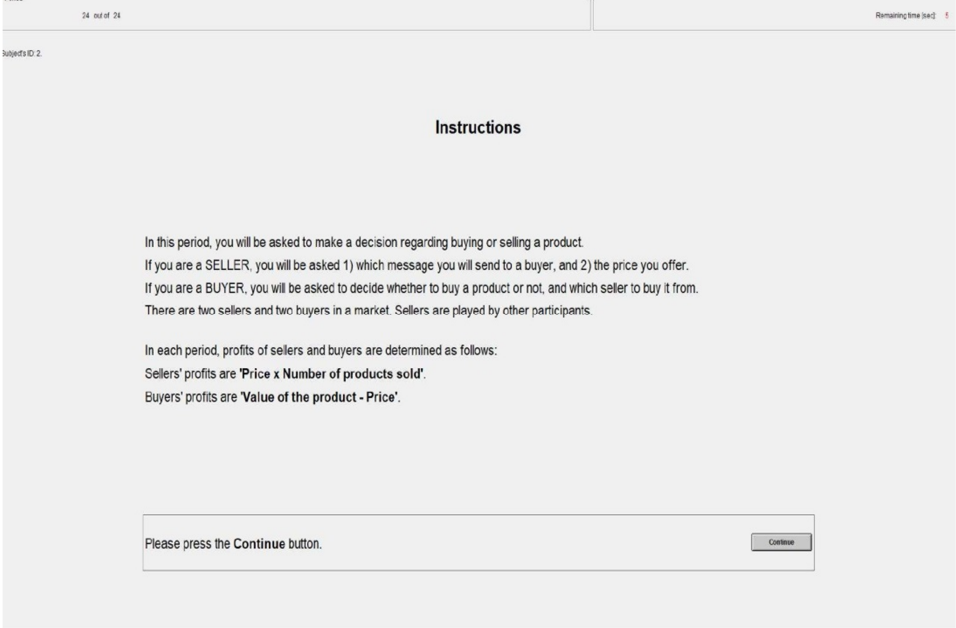
Buy

Do not buy

[Figure A.5] Monopoly - results



[Figure A.6] Duopoly - instructions



[Figure A.7] Duopoly - seller's sending a message

PERIOD24 out of 24

Remaining time (sec)20

Subjects (ID): 3

Sending a Message

There are two sellers in the market and you are **SELLER 2**.
Your product quality is: **Low**. Buyers do NOT know your product's quality.

There are two types of quality for the product: **High** and **Low**.
Buyers do not know the quality of your product or the quality of the other seller's product.
Buyers expect the quality to be **High** with probability **0.30**.

Now, decide which message you would like to send to the buyers in the market. You can choose either message *regardless* of your product's quality.

☐ I sell a HIGH-quality product
☐ I sell a LOW-quality product

Buyer's value of the product depends on its quality:

Value of High-quality product	9501
Value of Low-quality product	3455

As you click **Continue** button, the session will continue.

Continue

[Figure A.8] Duopoly - seller's setting a price

PERIOD24 out of 24

Remaining time (sec)20

Subjects (ID): 3

Determining a Price

You are **SELLER 2**.
Your product quality is: **Low**.
You sent out a message: **I sell a low-quality product**.
The other seller sent out a message: **I sell a high-quality product**.

Buyers do not know the quality of your product or the quality of the other seller's product.
Buyers expect the quality to be **High** with probability **0.30**.
Buyer's value of the product depends on its quality.

Value of High-quality product	9501
Value of Low-quality product	3455

Now, decide how much you would charge for the product:

As you click **Continue** button, the session will continue.

Continue

[Figure A.9] Duopoly - buyer's buying decision

Period: 24 out of 24 Remaining time [sec]: 27

Subjects ID: 2

Buying It or Not

There are two buyers in the market and you're **BUYER 2**.

Your value of the product depends on its quality.

Your Value of High-quality product	9501
Your Value of Low-quality product	3455

The messages and prices sent by two sellers in the market are as follows. Note that messages can be TRUE or FALSE.

	SELLER 1	SELLER 2
MESSAGE	I sell a high-quality product.	I sell a low-quality product.
PRICE	2000	1000

For your reference, the potential profits of buying a product from each seller are given below:

	SELLER 1	SELLER 2
High-quality product	7501	8501
Low-quality product	1455	2455

With probability of 0.30, the quality of the product sold by each seller is assigned to be High.

Based on the given information, decide whether to buy the product or not:

[Figure A.10] Duopoly - results

Period: 24 out of 24 Remaining time [sec]: 19

Subjects ID: 2

Results

The following is the product values and the information about sellers' products:

Value of High-quality product	9501
Value of Low-quality product	3455

	SELLER 1	SELLER 2
MESSAGE	I sell a high-quality product.	I sell a low-quality product.
PRICE	2000	1000
PRODUCT QUALITY	Low	Low

You were **BUYER 2**. In this period you bought one product from Seller 2.

Your profit in this period is 2455.

Period	Profit
1	-5811
2	10000
3	5000
4	0
5	-10511
6	0
7	0
8	-42033
9	2472
10	0
11	21584
12	10000
13	-10511
14	-14895
15	5000
16	0
17	0
18	33328
19	7046
20	-42017
21	0
22	329
23	2998
24	2455

This is the end of the period.

Click the **Continue** button. The session will continue soon.

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독점 및 복점시장 판매자의 부정적 정보 공개에 관한 실험 연구*

Dmitry A. Shapiro** · 이 재 선***

초 록 본 연구는 독점 및 복점시장에서 판매자가 상품에 대한 품질정보를 독점하여 구매자가 알 수 없는 상황에서의 정보공개에 대한 결정을 경제학실험으로 살펴보았다. 본 실험에서 판매자는 상품 정보에 대한 정직한 혹은 부정직한 cheap-talk 메시지를 소비자에게 보냄으로써 품질에 대한 정보공개 여부를 결정한다. 실험 결과, 낮은 품질의 상품 판매자가 품질정보에 대한 기만 없이 정직하게 정보를 공개하는 경향이 존재하며, 판매자가 낮은 품질정보를 기만 없이 제공할 때, 이는 복점시장에서 상품차별화로 귀결되어 소비자가 높은 비율로 상품을 구매하는 결과로 이어졌다. 한편, 이러한 낮은 품질 정보의 제공이 판매자 이익에 부정적인 영향을 주는지는 분명하지 않았다: 대체로 부정적인 영향은 통 계적으로 유의미하지 않았고, 어떤 시장조건들 하에서는 오히려 긍정적인 영향을 보였다. 낮은 품질정보의 공개는 상품 구매율을 향상시킴으로써 독점시장에서 긍정적인 후생 효과로 가져온 반면, 복점시장 하에서는 비효율적인 낮은 품질 상품의 구매율을 높임으로써 전체 후생에 미약하거나 부정적인 영향을 보였다.

핵심 주제어: 부정적인 상품 정보 제공, 레몬시장, cheap-talk, 시장에서의 정보 제공

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