Bidding, Playing, or Competing?
Rational and Irrational Determinants in Internet Auctioning

by

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Submitted to the Center for Transportation Studies
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Master of Science in Transportation

at the

Massachusetts Institute of Technology

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ABSTRACT

Auctions, especially Internet auctions, are claimed to be efficient pricing mechanisms, assuming rational behavior and recognition of individual fundamental values. This assumption and its implication are at the heart of the thesis work. The research includes both survey studies which utilize one of the most popular sites for Internet auctions, and experiments developed in the laboratory. Both field studies and laboratory experiments paid specific attention to the psychology of bidders with main focuses on starting prices, price comparison, competition, and auction formats.

Two surveys and two field studies were conducted to collect statistics in real auctions and subjective opinions from real auction participants. One field experiment was performed on a real web site to test price sensitivity. A simulation bidding system was built in the laboratory to examine auction formats and the effect of competition.

Four primary results are shown. First, game-playing attitude towards auctions generally exists among bidders. Second, bidders hold strong winning aspects and suffer either “winner’s curse” or regret losing. Third, bidders are price sensitive when price comparison is available and their price preferences are affected by the original starting prices. Fourth, auction formats convey different information to bidders and influence the way bidders behave.

(Auctions, Internet auctioning, Individual fundamental values, Bidders’ behavior)

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Chapter 1  Introduction

One of the most interesting aspects of the Internet, as well as one of the most popular rapidly growing types of e-commerce, is Internet auctioning. Since the earliest web-based auction sites Onsale (www.onsale.com) and eBay (www.ebay.com) opened in 1995, Internet auctioning has been growing so fast that, at present count, over three hundred auction sites are running their businesses on the World Wide Web (Snyder 1999) with new ones appearing almost every day. Internet auctioning has not only captured the attention of the public and the media but it also provides new challenges and opportunities in terms of generating great interests in understanding its trading mechanisms, market efficiencies, and implications.

One should note that Internet auctioning is not a conceptually new auction method. Long distance auctions by mail have existed for more than a hundred years. Back in the 1870s, there were stamp dealers in the United States offering "mail-bidding" services for individuals who wished to bid on stamps without having to travel to the auction site in person. Bidders submitted bids through mail and the stamps were sold to the highest bidder at the price of one increment over the second highest bid. This practice is common in many auction houses today, not just in stamp auctions, but also in auctions for wine, art, and other collectibles. (Lucking-Reiley, 1999a).

Even electronic auctions already have a substantial history. Before the first web browser for personal computers was released at the end of 1993, there already were a number of auctions taking place on text-based Internet newsgroups and email discussion lists. Hundreds of different sellers ran auctions on newsgroups. Bidders would submit their bids via email, and sellers would post daily updates of their high bids. (Lucking-Reiley, 1999b).

1.1  Auctions as pricing mechanisms

Sellers often find it difficult to pick a price to offer for their goods. What would be the best price that can attract the most buyers while at the same time maximize sellers’ profits? Usually there is one systematic way by which one can determine the
Market research has been adopted as a major practice for making pricing policies. In market research, sellers usually collect price information by evaluating costs, estimating supply and demand, and conducting surveys on consumer preferences and needs. It is a time-consuming and expensive process since sellers have to go into the market and get all the information by themselves. The results of market research are therefore subject to biases due to limitations of time, cost and geographical locations -- it is unrealistic for sellers to look at the whole market as opposed to a small part of it as a sample for the market research. Moreover, the results from market research are usually based on certain assumptions about the validity of the measures. For example, participants (potential buyers) are asked how much they were willing to pay if they would buy the good. Without any purchase obligation, answers to such questions do not necessarily reflect the true value of the good but introduce errors into the price estimates.

An alternative method to reach a price is auctioning. Auctioning shifts the pricing effort from sellers to buyers by allowing the market force, mostly supply and demand, to determine the prices. Instead of researching prices by themselves, sellers only need to open their goods to the public and wait for buyers to come and bid. Compared to market research, auctioning is much simpler and provides more benefits to both sellers and buyers.

To illustrate some of these benefits, let us look at the Figure 1. Figure 1 presents two identical demand curves for a specific good. In market research (Figure 1a), when sellers pick a fixed price $P$ to offer their goods, buyers will be willing to buy up to the quantity $Q$ (Figure 1a). In this case, we see that the total amount consumers pay is $OP \times OQ = OPBQ$, with a consumers’ surplus of $PP'B$. We can also see from Figure 1a that, in this case, even though some of the buyers would have been willing to pay more than $P$ to get the goods, they actually pay only the price $P$. At the same time, potential buyers who do not want to pay more than $P$ are lost.

In auctions (Figure 1b), there is not a fixed price, and the price $(PB)$ is free to vary between 0 (or a very low baseline) and $P'$. In other words, buyers are free to pick a price which they are willing to pay, and goods are sold to buyers according to price priority. For sellers, there are several additional benefits from such pricing methods. First, sellers
now have chances to sell their goods to buyers who are willing to pay more than \( P \) at the prices those buyers are willing to pay. Second, sellers are able to attract more buyers, not just those who would be willing to pay more than \( P \). Buyers also benefit from such auctions. Buyers who are willing to pay more get priority over buyers who are willing to pay less (this is important when the demand exceeds the supply). In addition, buyers who don’t mind waiting can get the goods once the price drops.

1.2 Internet auctioning

Auctioning is then a superior pricing method. Internet auctioning as a new type of auctioning has even more advantages beyond traditional advantages of auctioning.

Internet technology can provide advantages in space, time, and cost to conduct auctions. First, it breaks down the spatial restriction traditional auctions have and allows people from all over the world to participate in auctions at remote sites through the World Wide Web. Second, in terms of duration, Internet auctions can last for several days and allow asynchronous bidding, which gives both sellers and bidders more flexibility. Third, auction sites can manage to run auctions at substantially lower operational costs by connecting their servers to the Internet so that they can charge lower commission fees and attract more customers. Finally, because of these reasons, anybody who has access to the Internet can become sellers and buyers. Together, these advantages allow deep market penetration that was once reserved only for expensive and unique goods.

However, there are greater risks associated with Internet auctioning. For example, with the elimination of spatial restrictions, buyers are not able to inspect the goods before bidding. It also takes much longer for the transaction of Internet auctions to be completed while traditional auctions provide instant exchanges of payments and goods. Moreover, as a trust-based trading system, Internet auctioning presents an ethical challenge to both bidders and sellers.
Figure 1  Pricing Mechanism: Market Research vs. Auctions
1.3 Economic and psychological views on auctions

Economists are interested in auctions because auctioning is considered a quick and efficient mechanism for pricing and resource allocation. The efficient market hypothesis of economic theory assumes a "frictionless, competitive market" in which prices efficiently incorporate all public information and are regarded as optimal estimates of true value of the goods at all times. However, one should be aware that the efficient market hypothesis in turn is based on primitive notions that people behave rationally, that they can value the items offered, that they can accurately maximize expected utilities, and that they are able to process all available information. To the extent that these assumptions do not hold (or do not hold perfectly) auctions may score lower as efficient market mechanisms. The current work aims to explore some of the psychological aspects of Internet auctions in order to provide a more complete understanding of these mechanisms.

The most important assumption one has to make when considering auctions as an efficient mechanism is that individuals can pick prices that reflect their true underlying utility. The idea here is that individuals have internal values (fundamental values) for different goods based on their own value systems. Theoretically, an individual’s value for a specific good can be interpreted as an exact value. For example, if individual A’s value for an apple is \( x \) cents, it means A would be willing to exchange up to \( x \) cents for an apple. If the price of an apple is higher than the individual’s value \( x \), a “not-buy” decision will be made; but if the price of an apple is lower than the individual’s value \( x \), a “buy” decision will be made. Note that the claim here is not that individuals can set prices in an error free way, rather that they do not have any systematic bias in their price assessments.

There is a large body of literature that questions whether individuals have accurate representations of their values (Ariely 2000). In the same spirit, the main question we will ask in the current work is whether individuals have accurate internal values for goods. To the extent that they don’t, we will try to understand what are some of the mechanisms by which individuals arrive at their price estimates and what are some of the factors that influence them.
One may ask whether the psychological effects will have higher or lower influence on consumers' decision making in fixed price environments or in auction environments. In the next section we would like to propose why we think that the effects of psychological factors can be much higher in auction environments.

1.4 The role of error in fixed prices and in auction mechanisms

In a regular market where prices are fixed, only individuals with values above the fixed price will make "buy" decisions (individuals A, B in Figure 2a). In auctions, individuals pick prices by themselves and the prices they pick will be the maximal prices they are willing to pay. Goods are first sold to the highest bidder A, second to B, third to C, etc. (See Figure 2b). The pricing decisions depicted in Figures 2a and 2b assume that consumers have precise values with no errors. Under this assumption, the likelihood of consumers to make mistakes (in either buying something and paying too much, or not buying something they should have) are the same across both pricing mechanisms, and they don't make mistakes.

However, a much more realistic assumption is that individuals have some errors in their judgments (Lawrence, 1986) and that these errors are higher when the price is closer to their stated values.

Such uncertainty can be thought of in terms of a signal-detection-theory decision space (Macmillan & Creelman, 1990). Such a formulation can be seen in Figure 3, which shows probability density functions that an individual will or will not buy a specific good. In Figure 3a, every point on the curve corresponds to the probability density that this good is a "bad deal" at a specific price. Similarly, in Figure 3b, every point on the curve corresponds to the probability density that this good is a "good deal" at a specific price. The shaded areas in Figure 3a and 3b denote the probability that this good is a "bad deal" and "good deal" for this individual at price $P$ respectively. Ultimately, the decision to buy or not to buy this good at price $P$ would be a function of these two shaded areas (which will be influence by the horizontal distance, the variance of the
a) In a regular market

b) In an auction

Figure 2
curves and the specific value of $P$). Note that this formulation represents a probability density function and therefore, consumers will sometimes consider price $P$ as "good deal" while at other times, they consider it as "bad deal".

We can also use signal detection theory to explain this phenomenon if we think of $P$ as a price cut-off (the fundamental value) that the individual sets up for this good. Supposed the good is a "good deal". If the individual can purchase the good for no more than $P$, we consider it a "hit"; otherwise a "miss." The hit rate is the proportion marked [2] in Figure 3, which is equal to the probability of getting a "good deal" when the cut-off price is set up at $P$. The area to the left of the criterion, marked as [1], is the proportion of "misses", which represents the outcome of a "not-buy" when the decision should have been to buy (because it is indeed a good deal). The area marked [3] is the "correct-rejection" which is equal to the probability of correctly not buying a "bad deal" when the cut-off price is set up at $P$. Finally, "false alarms" are marked as [4] which is the area of wrongly making buying decisions when the deal is bad.

False alarms and misses are errors caused when people buy things they shouldn’t have bought or do not buy things they should have bought. At every point along the price axis, decisions are subject to these two types of errors. In auctions, individuals with different error preferences will behave differently. Consumers who care more about "misses" (i.e. they would rather pay more to avoid missing anything), would set higher prices, while consumers who care more about "false alarms" (i.e. they rather miss things than overpay for anything) will choose lower prices. Consumers who care about both types of errors and want to balance both types of errors will choose a price that will have a high overlap between the two curves.
Figure 3  Probability Density Function of making a deal
The effect of these two types of errors in setting prices is that we should expect a higher probability of consumer erroneous decisions in auctions as opposed to fixed price markets. The idea is that errors exist in fixed price markets but that they occur only to a small fraction of people whose distribution coincides with the fixed price \((P)\). For consumers whose values are high above or below \(P\), the probability of error is very low. For a graphical illustration of this effect see Figure 4a which is a replication of Figure 2a with the added assumptions about errors. As can be seen from Figure 4a, for the majority of the consumers in fixed price markets \((A, B, D, \text{ and } E \text{ in this case})\), there is no overlap between the probability density function and \(P\), and hence no mistakes. Because their distribution curves either fall far below the fixed price line and "not-buy" decisions are called for \((A \text{ and } B)\); or their distribution curves stand far beyond the fixed price line and "buy" decisions are concluded \((D \text{ and } E)\). \(A \text{ and } B\) will correctly buy the product at price \(P\) (hit) while consumers \(D \text{ and } E\) will correctly not buy the product at price \(P\) (correct rejection). Consumer \(C\) in this case is the only one that is susceptible to make mistakes. In auctions, on the other hand, the picture is very different and the potential for errors is substantially increased. Assuming consumers try to balance both types of errors, they will pick prices within their decision spaces, which will expose them to a high degree of error. For a graphical illustration of this effect see Figure 4b which is a replication of Figure 2b with the added assumptions about errors. As can be seen in Figure 4b, every single consumer in this case picks a price that balances the two types of error and therefore also causes their decision to be susceptible to errors.
Figure 4

a) In a regular market

b) In an auction
In this paper, particular attention is paid to the psychological factors involved in Internet auctions. Several questions are to be answered: Is Internet auctioning an efficient mechanism? Do psychological factors and human behavior impact bidding patterns in Internet auctions? If yes, what are the rules that govern the psychology of bidding? The paper presents some experimental work that has been conducted to examine sellers' and bidders' behavior and provides some insights into whether the auctioning mechanism actually works as a competitive market and how human behavior is engaged in this trading system. The evidence presented came from four different sources. First we present survey data regarding Internet auctions. Second, we present analysis of existing data from different auctions. Third, we present a field experiment we conducted on one of the largest Internet auction sites, and finally we report a lab experiment in which we implemented our own auction web sites. The paper concludes with an overall discussion of the findings, summary, and suggestions for future research.
Chapter 2  Survey Studies

Two surveys of Internet auction users were conducted to study the characteristics of auctions, users, and their behaviors. Participants for both studies were recruited from eBay and responded by filling out one of two web surveys presented on our personal site. There are several reasons of recruiting subjects from eBay. First, eBay is the largest international web-based person-to-person auction site in terms of number of users, number of listed items, and item variety. Second, eBay is one of the earliest web-based person-to-person auction sites and therefore eBay users on average have more experiences in Internet auctioning than those of other auction sites. Moreover, users in eBay have formed several online communities that have made it easier to promote the surveys to anonymous users and get feedback from them. Surveys were put on the community bulletin board of eBay inviting volunteer participation in an academic study of online auctions.

2.1  Survey 1

The first survey was a descriptive survey of Internet auction users. The goal of this survey was to find out whom the auction users are, how often they visit auction sites for buying and selling, their trading interests, their concerns for Internet auctioning, and their expectations to the future of Internet auctioning.

This study collected feedback from 197 subjects, 67% of who were female and 88% speak English as their first language. The age of the participants ranges from 18 (the minimal legal age to register for online auctions) to 69, with a mean of 39. Their level of education ranges from 1 year to 26 years with a mean of 14 years. A large majority of the participants (85%) indicated that they visit eBay most frequently, followed by Amazon (6%).

Table 1 shows the frequencies of auction sites visiting and usage. First, it is interesting to note that almost 92% of the participants indicated that they visit auction sites at least 3 times a week. The frequencies of buying and selling on these auction sites are obviously lower then the frequency of visiting these sites but they are also
substantial. 50% of the participants indicated that they sell things at auction sites once a week or more, and 30% of the participants indicated that they buy things at auction sites once a week or more. These numbers demonstrated that Internet auctions have become an important source for retailing and shopping.

Table 1: Usage frequency of action sites for different purposes

<table>
<thead>
<tr>
<th>Questions</th>
<th>At least 3 times a week</th>
<th>About once a week</th>
<th>About once every 2 weeks</th>
<th>About once a month</th>
<th>Less than once a month</th>
<th>Total number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often do you visit auction sites?</td>
<td>91.9%</td>
<td>5.6%</td>
<td>0.0%</td>
<td>0.5%</td>
<td>2.0%</td>
<td>197</td>
</tr>
<tr>
<td>How often do you sell at auction sites?</td>
<td>35.6%</td>
<td>14.4%</td>
<td>10.8%</td>
<td>11.3%</td>
<td>27.8%</td>
<td>194</td>
</tr>
<tr>
<td>How often do you buy at auction sites?</td>
<td>11.7%</td>
<td>18.3%</td>
<td>25.9%</td>
<td>22.3%</td>
<td>21.8%</td>
<td>197</td>
</tr>
</tbody>
</table>

Participants were also asked to rate their level of interests in different auction categories (based on eBay’s categories) on a scale from 0 “not interested at all” to 10 “extremely interested in”. As Table 2 shows, Collectibles seems to be the most attractive categories to auction fans, while those big tickets such as automobiles are the least popular. Analyzing the interest level in a regression analysis revealed a gender difference on some categories and concerns. The data show that males are more interested in automobiles, electronics, coins and stamps, and sport memorabilia while females favor more in collectibles, dolls, jewelry and pottery. In addition, the results also showed that participants with higher education were less interested in toys.

Table 2: Average preference for different product categories on eBay.

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean (level of interests)</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collectibles</td>
<td>7.221</td>
<td>.236</td>
</tr>
<tr>
<td>Books, Movies, Music</td>
<td>5.704</td>
<td>.241</td>
</tr>
<tr>
<td>Antiques</td>
<td>4.831</td>
<td>.279</td>
</tr>
<tr>
<td>Computers</td>
<td>3.852</td>
<td>.247</td>
</tr>
<tr>
<td>Pottery &amp; Glass</td>
<td>3.785</td>
<td>.276</td>
</tr>
<tr>
<td>Dolls and Figures</td>
<td>3.392</td>
<td>.262</td>
</tr>
<tr>
<td>Toys</td>
<td>3.082</td>
<td>.264</td>
</tr>
<tr>
<td>Electronics</td>
<td>3.082</td>
<td>.228</td>
</tr>
<tr>
<td>Jewelry &amp; Gemstones</td>
<td>2.958</td>
<td>.239</td>
</tr>
<tr>
<td>Coins &amp; Stamps</td>
<td>2.318</td>
<td>.220</td>
</tr>
<tr>
<td>Sport Memorabilia</td>
<td>2.166</td>
<td>.217</td>
</tr>
<tr>
<td>Automobiles</td>
<td>1.150</td>
<td>.167</td>
</tr>
</tbody>
</table>

*The data is sorted from most attractive to least attractive.
Participants were also asked to rate their levels of concerns for different factors that would impact their usage of online auction sites and decisions on whether or not to bid. Ratings were ranged from 0 the “not concerned with” to 10 “very concerned with”. Data in Table 3 show that auction site server reliability, product quality, and bidder/seller reputation were of highest concern. Reserve price, starting price, auction duration, and number of other bidders were among the least concerns (we will later test some of their self-reports against behavioral data later). In addition to the ratings of the different factors, we also ran a regression model between the different concerns and genders. The results also showed that females are more concerned with starting price ($t = 2.48, p = 0.014$), reputation ($t = 2.03, p = 0.044$), and marginally more concerned with product quality ($t = 1.77, p = 0.078$), and with its description ($t = 1.87, p = 0.063$).

Table 3: Level of concerns for using Internet auctioning in descending order

<table>
<thead>
<tr>
<th>Concerns</th>
<th>Mean (Level of concerns)</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server Reliability</td>
<td>9.163</td>
<td>.114</td>
</tr>
<tr>
<td>Product Quality</td>
<td>9.151</td>
<td>.070</td>
</tr>
<tr>
<td>Reputation</td>
<td>9.149</td>
<td>.117</td>
</tr>
<tr>
<td>Description/Photo</td>
<td>9.097</td>
<td>.115</td>
</tr>
<tr>
<td>After auction Service</td>
<td>8.888</td>
<td>.130</td>
</tr>
<tr>
<td>Procedure and Expense</td>
<td>8.760</td>
<td>.147</td>
</tr>
<tr>
<td>Privacy Policy</td>
<td>8.597</td>
<td>.173</td>
</tr>
<tr>
<td>Auction Rules</td>
<td>8.563</td>
<td>.161</td>
</tr>
<tr>
<td>Searching Options</td>
<td>8.543</td>
<td>.170</td>
</tr>
<tr>
<td>Web Security</td>
<td>8.533</td>
<td>.184</td>
</tr>
<tr>
<td>Shipping and Handling</td>
<td>7.851</td>
<td>.186</td>
</tr>
<tr>
<td>Reserve Price</td>
<td>6.959</td>
<td>.218</td>
</tr>
<tr>
<td>Starting Price</td>
<td>6.802</td>
<td>.212</td>
</tr>
<tr>
<td>Payment methods</td>
<td>6.434</td>
<td>.250</td>
</tr>
<tr>
<td>Auction Duration</td>
<td>5.908</td>
<td>.236</td>
</tr>
<tr>
<td>Number of other bidders</td>
<td>4.617</td>
<td>.258</td>
</tr>
</tbody>
</table>

- Responses are on 10-point scale with 0 the least concerned to 10 the most concerned.
- Items marked with a (*) will be tested later.

Subjects were also asked to describe in text their pleasant and unpleasant experiences and make comments regarding Internet auctioning. In general, many Internet auction users are positive with auctioning online as a way to sell and buy. The pleasant experiences are often described as selling or buying things at decent prices or finding things that are hard to be found elsewhere. Many subjects also mentioned that they enjoyed the friendly relationship built up with other auction users through smooth
transactions and they considered appreciation from other auction users very important to them. One of the subjects wrote:

"Actually collecting the money would have to be (the) best thing but it's also very satisfying helping someone else locate that one special collectible!"

For the unpleasant experiences, most comments were related to transaction problems such as delay or denial of payment or shipment, overcharges of shipping fees, damaged shipment, etc. Subjects also expressed strong concerns of honesty in auctions. Another frequently mentioned issue was the stability and reliability of the auction sites. Because online auctions are time sensitive and all bids are submitted through remote access to the servers, the reliability and the stability of the servers become crucial to the performance of auction sites. Some subjects mentioned bids not going through at a time close to the end of the auction due to heavy traffic and delays in the system.

2.2 Survey 2

In this second survey, subjects were asked to provide answers for eight questions in an online survey form. These questions are specifically related to individuals' in-auction and after-auction feelings. Subjects were asked to rate their feelings in a scale from 0 "the least" to 10 "the strongest". 199 subjects responded to the survey and the results are shown in Table 4. In addition to the responses of the participants, Table 4 also includes a column that gives the expected result that would have been given if participants are treating auctions by examining whether they want the good, comparing prices and using this information to set their bidding prices. We name this column Rational Expectations. Note that these are rational expectation only to the extent that people use such auction channels as purchasing instances without deriving any utility from the experience itself.
Table 4: Responses to on-line behavior in auctions.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Rational Expectation</th>
<th>t-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.025</td>
<td>.258</td>
<td>0</td>
<td>19.462</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>2</td>
<td>5.337</td>
<td>.188</td>
<td>0</td>
<td>28.429</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>3</td>
<td>2.548</td>
<td>.162</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2.157</td>
<td>.137</td>
<td>0</td>
<td>15.983</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>5</td>
<td>1.646</td>
<td>.141</td>
<td>0</td>
<td>11.679</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>6</td>
<td>4.843</td>
<td>.212</td>
<td>0</td>
<td>22.825</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>7</td>
<td>4.726</td>
<td>.269</td>
<td>10</td>
<td>-19.602</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>8</td>
<td>1.077</td>
<td>.137</td>
<td>0</td>
<td>7.873</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

*Responses are on 10-point scale with 0 the least of the feeling to 10 the strongest of the feeling. When there is a rational answer it is indicated in the rational expectation column and the results are compared to it in a t test.

As can be seen from Table 4, people often feel bidding is like a game, they want to win this game (Question 1, Question 2), and they admit that sometimes they get carried away and over bid or regret it later (Question 3, Question 4, Question 5). It is also interesting to see that people have a much higher regret for not setting their prices sufficiently high (Question 6) and loosing an auction compared with winning at a price that is set too high (Question 4, Question 5). This last comparison of regret and disappointment correspond to “false alarms” and “misses” respectively. Regret usually occurs when people realize later that they bought the good at a price that is too high, while misses are often due to under-bidding (see Figure 3). Since there is always a chance of at least one type of errors within the decision space, it is reasonable to assume that the rational behavior of an individual who has no bias (preference) on either type of errors would be to balance between these two types of errors. That is, to pick a price where the false alarm rate is equal to the miss rate. However, we see that in Table 4, the mean for questions 4 and 5, which represents the rate of false alarms, is about less than half of the reported misses (Question 6). This comparison indicates that people think
that in many cases their bids are too low and that they commit too many misses compared with false alarms.

Our participants also indicated that they compare prices only about half of the times but that they rarely buy things which are more expensive at auction sites compared with other internet stores. We will test some of these self reports in the later sections.

2.3 Discussion

Survey 1 and 2 have shown the overall information about Internet auction players and their auction perspectives. We see that participants in our survey are very involved with Internet auction sites, visit them often and participate in many transactions. Survey 2 showed that the behavior of auction users, does not always follow what is predicted by a simple minded economic theory, and seem to involve other factors such as treating the experience as a game with a win/lose outcome, and also differentially treating winning auctions and loosing auctions. These aspects which relate to the psychology of Internet auctions will be tested in the next sections by using field data, a field experiment, and a lab experiment.
Chapter 3  Field Studies

We conducted two field studies by tracking auctions in a large auction site and trying to relate the final bids to different characteristics of the auction itself. Field Study 1 tracked auctions for the Rose Bowl game and Field Study 2 tracked prices for commodities such as books, CDs, DVDs etc.

3.1  Field Study 1

Field Study 1 started one month before the day of 2000 Rose Bowl Game, which was on January 1, 2000. During this month (December 1999), more than two hundred auctions selling Rose Bowl Game tickets were put on eBay and tracked.

We kept tracking of all auctions selling Rose Bowl Game tickets and recorded details of each auction. From December 2nd 1999 to December 31st 1999, there were 275 valid\(^1\) auctions selling Rose Bowl Game tickets on eBay. We have taken out some auctions that sold not only tickets but also other services such as parking, flight, accommodation, etc. For each auction we recorded starting price per ticket, final price per ticket, total number of bids, total number of bidders, date started, auction duration, seller reputation, and the number of tickets offered at each auction.

Among the 275 auctions monitored, average starting price per ticket is $117.64 while average final price per ticket is $148.17, presenting an average increase of 26%. We ran a regression model with final price per ticket as the dependent measure and starting price per ticket, total number of bids, total number of bidders, date started, auction duration, seller reputation, number of tickets available per auction as independent measures. The full model was highly significant [R= .919, F (8,264) = 179.146, p < .0001].

Examination of the coefficients in Table 5 show that final price was positively related to starting price, total number of bids, and total number of bidders. The latter two effects are easily reconciled with our understanding of auctions. If there are more bidders or more bids, the price by definition has to increase. However, the large effect of starting price is not easily apparent. Why would bidders pay more when the starting

\(^1\) Valid auctions only included auctions that were not cancelled before the official ending time.
price is higher? One could suggest that the starting price acted as a reference price but this would have to be a specific reference price to that particular ticket since there were many tickets for sale at that time and participants could easily obtain a general reference price for the category. The results also showed that final price was negatively related to the date the auction started and its duration. This starting date result could be interpreted by segmentation of bidders by their priority in purchasing. It is highly likely that bidders who were more interested in going to the Rose Bowl were bidding earlier to be sure that they can go to this game and that they were also willing to pay higher prices for this experience. The auction duration time is not as easily explained since the shorted auctions ended up with higher prices. A prior one would expect that longer auctions would allow more people to place more bids. The fact that shorted auctions seems to bring higher prices could suggest that such shorter auctions increase competition among bidders. Finally, it is interesting to note that despite the high concern participants in Survey 1 showed for sellers’ reputation, this factor did not seem to have any influence on the final price. In fact it was the factor with the lowest effect from all the factors we examined in this study.

Table 5: Regression results for Rose Bowl Game Ticket Sale.

<table>
<thead>
<tr>
<th></th>
<th>Std. Coeff</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting price</td>
<td>.809</td>
<td>28.265</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Total number of bids</td>
<td>.404</td>
<td>7.106</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Date Started</td>
<td>-.273</td>
<td>-6.844</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Auction duration</td>
<td>-.128</td>
<td>-3.772</td>
<td>.0002</td>
</tr>
<tr>
<td>Total number of bidders</td>
<td>.176</td>
<td>2.844</td>
<td>.0048</td>
</tr>
<tr>
<td>Number of Tickets</td>
<td>-.015</td>
<td>-.587</td>
<td>.5577</td>
</tr>
<tr>
<td>Seller reputation</td>
<td>-.008</td>
<td>-.307</td>
<td>.7590</td>
</tr>
</tbody>
</table>

3.2 Field Study 2

Field Study 2 was designed to examine the issue of price comparison and efficiency of auctions as selling mechanisms. Recall that participants in Survey 2 indicated that they price compare about half of the time and that they rarely buy things in auctions which would have been more expensive elsewhere (see Table 4). In Field Study 2, we tracked auctions on a large Internet auction site for music CDs, books, and
movies (VHS and DVDs). For each of the items that was offered at the auction, we spend between 2 and 20 minutes searching (mean search time 7.23 min) for the same item at other sites and receded the prices in other sites for the same item. In all cases, we searched common popular sites and the search time we recorded was the time it took us to find the price of the item in all sites.

The results showed that the prices on the auction site were lower than the best site we found in only 1.2% of the times (for more results see Table 6). This difference caused consumers to pay an average 15.3% more for goods on the auction site compared with other Internet retailers. Combining this increased price together with the facts that transactions on the auction site take longer (the buyer usually has to send a check or money order, which has to be cleared and only then the order is shipped), that the reputation of individuals most likely is lower than that of commercial sites, and that it is harder to return merchandise to individuals compared with commercial sites, suggest that electronic auctions might be less than efficient.

Table 6: Results for Price Comparison

<table>
<thead>
<tr>
<th>Lowest site</th>
<th>% of times when prices were lower in Auction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest site</td>
<td>1.2%</td>
</tr>
<tr>
<td>2nd Lowest site</td>
<td>21.1%</td>
</tr>
<tr>
<td>3rd Lowest site</td>
<td>55.3%</td>
</tr>
<tr>
<td>4th Lowest site</td>
<td>69.5%</td>
</tr>
<tr>
<td>5th Lowest site</td>
<td>72.4%</td>
</tr>
</tbody>
</table>

3.3 Discussion

Field Studies 1 and 2 indicated a few interesting deviations from rational expectations about auction behavior and from the self-reports of participants in our surveys. First, despite of the self-reported concern with reputation of sellers, bidders for the Rose Bowl tickets did not seem to be influenced by the reputation. This is despite the fact that these are unique items that cannot be accurately described (what is a good seat?) and despite the fact that there is no way to return them after discovering that the tickets are not good or not as good as promised. Moreover, the second field study
indicated that prices bidders pay for commodities are not as low as they indicated in Survey 2 and in fact are almost always higher than prices of regular Internet retailers. How to explain this discrepancy and the drivers of people's behavior in electronic auction will be addressed in the next field experiment and lab experiment.
Chapter 4 Field Experiment

4.1 Method

This field experiment was conducted on a real public-accessible Internet auction site. Each week we placed four items on auction for a week. These goods were purchased in advance from other retail stores and put on auctions for resale. The goods we auctioned off were movie DVDs and tapes, web cameras, computer keyboards, and trackballs. We had three different starting price conditions. In the low starting price condition, items started at a low price ($1). In the high starting price condition, items started at a high price (either $5 or $30 depending on the item). In the “High & Low” starting price condition, 2 items were offered, one starting at the low price ($1) and one at the high price (either $5 or $30 depending on the item). In all cases we used four fictional sellers to sell each of the four items that were offered each week (for more info see Table 7)

Table 7: Starting Price Experiment Schedule.

<table>
<thead>
<tr>
<th>Week</th>
<th>Movie DVD</th>
<th>Web Camera</th>
<th>Computer Keyboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>H ($5)</td>
<td>H ($30)</td>
<td>L ($)</td>
</tr>
<tr>
<td></td>
<td>L ($)</td>
<td></td>
<td>H ($)</td>
</tr>
<tr>
<td>B</td>
<td>H ($5)</td>
<td>L ($)</td>
<td>H ($) ($30)</td>
</tr>
<tr>
<td></td>
<td>L ($)</td>
<td></td>
<td>L ($) ($1)</td>
</tr>
<tr>
<td>C</td>
<td>H ($5)</td>
<td>L ($)</td>
<td>H ($) ($30)</td>
</tr>
<tr>
<td></td>
<td>L ($)</td>
<td></td>
<td>L ($) ($1)</td>
</tr>
</tbody>
</table>

| Week | Movie Videotape | Web Camera | Computer Trackball |
|------|----------------|
| D    | H ($5)         | L ($)      | H ($) ($30)        |
|      | L ($)          | H ($)      | L ($) ($1)         |
| E    | H ($5)         | L ($)      | H ($) ($30)        |
|      | L ($)          | H ($)      | L ($) ($1)         |
| F    | H ($5)         | L ($)      | H ($) ($30)        |
|      | L ($)          | H ($)      | L ($) ($1)         |

*H is indicating a high price and L a low price

As can be seen in Table 7, in week A one seller was selling a movie DVD at a high starting price, another seller was selling a computer keyboard at a low starting price, and two other sellers were selling web cameras one with a high and one with a
low staring price. Other weeks were similar in the auction formats but counterbalanced the products at each of the starting price conditions.

To eliminate possible disturbance, all sellers were newly registered fictitious sellers at that time and had zero rating of reputation. All auctions started on the same day at the same time of each week and all lasted for exactly seven days. The advertisement and description for the same type of goods over different weeks were exactly the same and only differed in starting prices and sellers’ IDs. Rules and conditions remained unchanged across all auctions.

4.2 Results

The purpose of this experiment was to see whether identical goods with different starting prices will be treated differently by bidders and also to see whether bidders compare between identical goods with different starting prices.

In order to examine the results we first ran an overall ANOVA test on the 2 (starting price) by 2 (availability of comparison) on the entire sets of bids that were submitted. The results showed a main effect for starting price \( [F (1, 168) = 8.79, p = 0.0035] \) and a significant interaction between starting price and availability of comparison \( [F (1, 168) = 4.45, p = 0.036] \). As can be seen in Figure 5a, higher starting prices caused participants to pay higher prices for the goods but only when there were no immediate comparisons. When participants could compare the prices of two items, there was no effect for the starting price. An analysis of the overall profits/losses we had during this experiment revealed two interesting aspects (see Figure 5b). First, while we lost an average of $7 for each item sold when comparison was made easy, we did not lose any money in the conditions where subjects were not able to do a direct comparison. Second, it is interesting to note that we made a profit for items we sold in the separate high price condition. Finally, it is also interesting to note that low starting prices attracted more bids \( [F (1,20) = 9.775, p < .01] \) and more bidders \( [F (1,20) = 9.538, p < .01] \).
Figure 5: Results of Starting Price experiment
4.3 Discussion

When starting this experiment we had two opposing hypotheses about the effect of starting price. On one hand, we expected that if prices started low, participants would be drawn to the auction (and we see from the results that indeed lower starting prices drew more bidders and more bids) and if their bidding pattern would escalate, they would end up paying higher prices in the low starting price condition. On the other hand, given the results of the Rose Bowl study, we expected that higher starting prices would cause higher ending prices. We also expected that the availability of direct comparison (when two items are sold simultaneously at two different starting prices) would reduce the effect of starting price.

The results we got show that high starting prices cause higher ending prices but only when there is no direct comparison. Does this mean that the opposite effect where people could be drawn to auctions and stay in the auction for too long does not exist? It is too early to make a judgment about this issue since we had only a few bidders in each of our auctions (average 6.75) and the items were relatively boring commodities.

Up till now, we have showed that the prices bidders set in auctions are influenced by the starting prices of the auctions. Specifically, we showed that, for the same item, higher starting prices can drive the final bids up and sellers can get higher profits by setting the starting prices higher. These were true in both Rose Bowl ticket sale and the field experiment we conducted on an auction site.

Next, we want to test the effect of competition and auction formats as factors influencing the bidders' bidding behavior.
Chapter 5  Laboratory Experiment

Rational models of behavior would suggest if individual valuations are independent, the bidding behavior should not differ across major auction formats – that is, when individuals know their fundamental values of a given good, the way they place bids is not affected by auction formats (Vickrey, 1961). However, when the assumption of individual fundamental values does not hold perfectly in reality, which has been suggested by our previous studies and a large body of documents (Feldman and Reinhart, 1995a), auction format will affect the way bidders bid on auctions and hence their individual valuations. An experiment was conducted to study whether this is true in Internet auctions.

Before going further to the details of the experiment, let us first give some introduction and discussion of auction formats.

5.1  Concepts in auction formats

5.1.1  Second-price auctions vs. First-price auctions

Auction formats can be categorized by the way how the final prices are set. There are usually two categories, the first-price auctions and the second-price auctions.

In a first-price auction, which has been considered the "standard" format in auction literatures, the highest bidder will pay exactly what he/she has bid for the good. For example, if a total of three bids are received in $10, $20, and $30 respectively, the highest bidder is the one who bid for $30 and he/she has to pay exactly $30 in exchange for the good.

However, in a second-price auction, which is also called a "Vickrey auction", the highest bidder wins the good in return for payment of the second-highest bid amount plus one increment (the size of the increment can be 0). For example, supposed in an auction, one increment is $5.00 and a total of 3 bids are received in $10, $20, and $30 respectively. The good will go to the winner whose bid is $30 but the he/she only needs...
to pay the second-highest bid amount ($20) plus one increment of $5, which is $25 in total, for the good.

From the aspect of individual fundament values, second-price auction format is mathematically proved to be a more precise auction format in that its outcome is more close to the true individual value than that of a first-price auction (Vickrey, 1961). Assuming rational behavior, bidders will always pay less than (or in some cases equal to) their maximal willingness, the outcome of the auction should converge to the true value of the good.

Although mathematically better and being prominent in the stamp business, second-price auctions had been rare in the economy overall. Rothkopf et al. (1990) propose two explanations for the scarcity of Vickrey auctions: (1) bidders may fear truthful revelation of information to third parties with whom they will interact after the auction, and (2) bidders may fear auctioneer cheating. In the course of his research, Lucking-Reiley (1999b) discovered several pieces of direct evidence that the second reason was indeed a real factor: bidders do fear auctioneer cheating in second-price auctions. Once bidders have submitted their maximum willingness to pay, the auctioneer has an incentive to cheat, and pretend that he/she received another bid just under the highest maximum amount.

Despite of the reasons listed above, second-price-like features have been appearing in the rapid growing sector of auction business, online auctions. Led by the largest Internet-based auction sites, eBay and Amazon, more and more online auction sites are adopting second-price formats as standards. First-price auctions are used by many retail auction sites (such as FirstAuction.com, uBid.com, egghead.com, etc) which allow “buy” activities only.

5.1.2 Sealed-bid auctions vs. English auctions

Auction formats can also be classified by the auctioning process. Some of the major formats are Sealed-bid auction, English auction, and Dutch auction. In this thesis, we only look at Sealed-bid auction and English Auction.
Sealed-bid Auctions

Sealed-bid auction is a simple auction mechanism in which each participating bidder can submit only one bid before the official ending time. This type of auction is call “sealed-bid” in the sense that no bids will be revealed until the auction is ended officially. US stamp dealers back in the 1870s used to offer “mail-bidding” services for individuals who wished to bid on stamps without having to travel to the auction site in person. Bidders submitted bids sealed in envelopes through mail and the results were announced in newspaper. There are, but very few, Sealed-bid auctions on the Internet.

English Auctions

English auction is by far the most prevalent format on the Internet. The world’s largest auction sites, eBay and Amazon, are using English auction formats. English auction is also called ascending-price auction in that the auctioneer begins with the lowest acceptable price – the reserve price – and proceeds to solicit successively higher bids from the bidders until no one will increase the bid. The good is sold to the highest bidder.

In English auctions, bidders are able to see their competitors and the bids from the competitors during bidding. Though at anytime the maximum price of the highest bidder will not be revealed, other bidders are able to get feedback by looking at the current winning bid to find out how much the good is at least worth and how much buying power other bidders might have. As bids go up, bidders can get more information on the prevailing value of the good and can adjust their bids constantly.

The way sealed-bid works does not allow feedback among different bidders before the auction is over. Assuming there is no collusion, bidders are given only one opportunity to pick a price that they are willing to pay without knowing how much the second highest bid would possibly be. Hence it is more likely that bidders in sealed-bid auction will submit the maximal prices they are willing to pay, which is equal or very close to their fundamental values. Since there is no learning from other bidders during bidding and no competition among bidders, it is reasonable to expect that the prices bidders offer in a sealed-bid auction reflect the good’s value for each bidder and the winning bid would be relatively higher than that of an English auction.
5.1.3 Laboratory auction formats

Both Sealed-bid auctions and English auctions were examined in our laboratory experiment. For all formats in the laboratory, we applied the second-price rule that the highest bidder paid on the second-highest price plus one increment. While Sealed-bid format is simple in nature and can be easily modeled, English auction format is a little bit complicate. The English formats we examined were developed based on those applied in eBay and Amazon. There is slight difference between the English auction formats applied in these two sites.

In an Amazon auction, the ending time depends on the bidding behavior. An auction will end at a pre-set official time only if nobody bids within the last 10 minutes; otherwise the auction will be automatically extended for another 10 minutes from the time the last bid is entered. The Amazon auction format is more similar to traditional in-house English auctions in which bidders are presented in the same room and the auctioneer closes the auction using the traditional “going... going... gone!” procedure.

On eBay, an auction will end exactly at a pre-set official time without any extension and the highest bidder will get the good. For this reason, it would not be surprising to see that if bidders all rush to place their bids at the last minute, some bids might not be accepted by the server before the auction ends, due to the congestion of the network. However, this will not be the case in the earlier stage of an eBay auction because bids will be able to go through the network anyway as long as time allows. So if the bidding frequency during an eBay auction is a constant, the probability of a bid being accepted is diminishing as it gets closer to the end of the auction.

In order to understand this probabilistic phenomenon, it is reasonable to think of eBay auction format as one of the two slightly different formats under different circumstances. When the network traffic is far below its capacity (small number of bidders), the eBay auction format is an eBay auction format in that bids submitted anytime before the official ending time will be accepted by the server as valid bids. While in the circumstance when the network capacity is limited, the auction is an eBay \( p<1.0 \) auction format in which bids submitted in the last period of an auction is subject to an acceptance rate less than 1. In the experiment, this probability was fixed at \( p=0.5 \).
5.2 Laboratory experiment

Sealed-bid auction and English auction are two very different auction formats not only in the way auctions are conducted but also in the presence of competition. Though both allow multiple participants, competition among fellow bidders is implicit in Sealed-bid auctions but explicit in English auctions. While English auction format seems to be more complicated than Sealed-bid format, the three variations of English formats we mentioned before are in fact only different in the "final period" operation, i.e., the way an auction ends.

In Sealed-bid auctions, bidders can only bid once, so there are no special bidding strategies in general except bidders have to acquire enough information about the good to find out the value before they go for an auction. But there are some common bidding strategies often used by bidders in English auction. For example, bidders might shade their true valuation for the goods at the beginning and start with entering low bids to see how others react, then they gradually increase the bids.

The goal of this experiment is to expand our previous field studies and field experiments into the laboratory where we can, by examining all 4 auction formats (Sealed-bid, Amazon, eBay, and eBay p<1), obtain some evidence in the effects of

1. Competition, by comparing Sealed-bid auction format vs. English auction formats; and
2. "Final period", by comparing the 3 formats (Amazon, eBay, eBay p<1) within English auction format.

5.2.1 Method

Subjects: 52 students from Massachusetts Institute of Technology participated in the experiment. Subjects were recruited by advertisements around campus. About half of the subjects were undergraduate students and the other half were graduate students or, in a few cases, staffs at the Institute. Subjects were randomly divided into groups of 4 people each and different experimental conditions were assigned to different groups. There was only one group (4 subjects) participating in the experiment at a time. Each
group spent from 20 minutes to 60 minutes, depending on the experimental conditions and the subjects’ performance (more on this later).

**Experimental Conditions:** There are four types of conditions corresponding to the four auction formats we have discussed before. However, all formats but the sealed-bid have been slightly modified to fit in the experimental environment and purposes.

For all auction formats in the laboratory, time is discrete instead of continuous. Each auction was sliced into multiple rounds of bidding. In each round, members of a given group needed to make bidding decision on an item. There are two types of decisions that bidders can make: they can either raise their bids or keep the bids they entered in the previous round (for the first round, all subjects have to raise their bids). Only when all members in the group have made decisions can the auction move to a next bidding round. The experimental conditions for each of the four formats are listed below:

- **Amazon**  
  In this format, an auction will end *only* if there are two consecutive bidding rounds that nobody raises bids. This is a simulation of the actual Amazon “last-10-minute” rule. All bids (keep or raise) are considered valid bids by the system.

- **eBay p<1 (p=0.5)**  
  In this format, we fixed the probability of bid acceptance to 0.5. An auction will move to a final bidding round immediately after there are two consecutive rounds that nobody raises bids. In the final round, subjects can either raise or keep bids but it will be their last chance to make decision on that given auction. The auction is over after the final bidding round. All bids (raise or keep) submitted in any round but the final round will be considered as valid bids while bids submitted in the final round are subject to a probability of 0.5 of being considered as valid bids.

- **eBay**  
  In this format, an auction will move to a final bidding round immediately after there are two consecutive rounds that nobody raises bids. In the final round, subjects can either raise or keep bids but it will be their last chance to make decision on that given auction. The auction is over after the final bidding round. All bids (raise or keep) submitted in any round will be accepted as valid bids. That is, the probability of any single bid being a valid bid is 1.
• **Sealed-bid** In a sealed-bid auction, all subjects in a given group must submit one and only one bid. All bids are valid.

**Design:** The main experimental manipulation was the auction format, which was manipulated between groups in 4 formats: **Sealed-bid, Amazon, eBay, eBay p<1.** Subjects within the same group shared the same format. All subjects were given both a written and an oral instruction on general bidding. Each subject was provided with a printed catalog with 18 color pictures of 18 different goods each plus brief description (See Appendix 1). Most items were MIT memorabilia and the retail prices range from $5.00 to $30. In addition to the general bidding rules, subjects were informed of the following information before started:

- All 18 items are auctioned for real which means there will be exchange of money and goods at the end of the experiment
- For every given group, even though all 18 items will be auctioned, only 1 out of 18 is available for sale. The available item will be announced only after the experiment is over. This policy is applied to reduce some possible noises in the experiment such as preference bidding (i.e. subjects only bid on things they are interested in) and the worry of one's pocket. All subjects are asked to evaluate each item as if it is the only item that they will be able to get.
- At the end of experiment, the highest bidder of the available item will need to pay for the good he or she wins.
- Subjects are not allowed to talk to each other except the experimenter to avoid any possible collusion.
- Auction rules of the particular auction format that a given group has been assigned to.

After reviewing an item on the catalog, subjects estimated the valuation of the item and entered an initial number for their values. Starting from the second bidding round (**Sealed-bid excluded**), subjects could raise their bids by entering a bigger number which had to be greater than the current highest bid, or they could simply press the "keep bid" button to stay with the original bids they submitted. When they finished
bidding on one item, subjects moved the next item listed on catalog and starting bidding again. Catalogs were prepared in different versions with different listing order of 18 items to counterbalance. Different groups might be presented all items in same listing order, but groups engaged in the same auction format were presented with different listing order. For example, a group bidding on Amazon format might be using the same catalog as another group bidding on Sealed-bid format; but any two groups bidding on Sealed-bid format were presented with different listing order catalog. The experiment was run over all 4 types of formats before it started a new cycle.

Procedures: Before the experiment started, bidding instructions were explained. Subjects were told that they would face real decisions for real money in which they would be asked to indicate the amount they would like to pay for each of the 18 different items listed in the catalog.

Each subject was assigned to a computer from which they can access the Internet. The bidding system was built on one of the server at MIT. Subjects then logged in to the bidding system using a pre-assigned user name. The first web page they saw was the auction for the first item listed in the catalog. The bidding interface was vertically divided into two parts (See Figure 6). The left part showed the public information that all subjects in the group were able to access at the same time. It contained the name of the item currently offered, type of auction format used, the numbering of the current bidding round, highest bidder's user name, current winning bid, and the total number of bidders participated. At the lower part of the public information board, a bidding history of last round's results was presented with the winning bidder’s name on the top and the lowest bidder’s username in the bottom. The right part of the screen showed the private information that only the user who logged in the machine could access. It included the username and the number that user entered last time. On the lower part of the private information board was the box that allowed bidder to enter a higher bid. If a bidder wanted to raise his/her bid, he/she had to press the “raise bid” button after entering a higher bid; or if the bidder wanted to stay with the current bid, he/she could just do it by pressing the “keep bid” button without entering a number. For the first round, subjects could only raise their bids, no matter how much they wanted to raise to. Starting from the second round, subjects could choose from “raise bid” or “keep bid".
However, in any round except the first one, subjects had to enter a number that is greater than the bigger one of the current highest bid and his/her last bid. That is, subjects could not lower their bids. The system automatically moved to a new round when all subjects have finished the current round. During the bidding, subjects were able to look up the public information board on the left part of the screen for the current highest bid. Since all auction formats tested were second-price based, the current highest bid shown on screen was already second-priced, which equals the winning bid. The winning bid was defined as the amount that the highest bidder would actually need to pay. It equals to the second-highest bid plus $1 if the highest bid is more than $1 above the second highest bid or, exactly the highest bid if the difference between the second highest bid and the highest bid is less than $1. Subjects were never able to see the highest bids from the public information board.

After the final round of an auction, subjects can click on the screen and view the results including all final bids of all subjects. Then, they will move to the auction of the next item in the catalog. As mentioned previously, all auctions bid by the same group were in the same auction format. The amount of time spent on each group really depended on the format used and the individual performance. It is obvious that sealed-bid auctions took much less time than the other three formats. While for the other three types of English auction formats, experiments lasted from 30 minutes to 60 minutes. After each auction started, the progress of the whole experiment was under control of the subjects, and an auction could go forever if subjects keep raising their bids.
Dandy.com

Public Information

Item Offered: P1
Offered By: Dan

Seller Reputation Rating
1 2 3 4 5 6 7 8 9 10

Type of Bid: Extended Incremental Bid
Current Round: 4
Highest Bidder: Itamar
Highest Bid: 95
Number of Bidders: 2

Private Information

Itamar
Your Value: ?
Your Last Bid: 55

Bid

New Bid: 99

Raise Bid  Keep Bid

History

Thu. May 4 12:25:32 2000  Itamar
Thu. May 4 12:25:27 2000  Dan
5.2.2 Results and Discussion

We ran 13 groups (52 subjects) in total, which included 3 groups of Sealed-bid, eBay, eBay p<1 each and 4 groups of Amazon auctions. For each group in the experiment, we recorded not only bids of every bidding round of every bidder’s, auction format but also the, max bid² and final bid³ of each bidder, winning bid⁴ of each auction, “Max bid – first bid” and “final bid – second final bid” of each bidder.

In order to exam the effects of competition and “final period”, we calculated the descriptive statistics and ran regression models for each of the measures (winning bid, max bid, final bid, max bid – first bid, final bid – second final bid) as dependant variables of auction format.

Max Bid

“Max bid” is defined as the largest bid amount ever submitted by a bidder in an auction, valid or invalid. It is the maximal amount of money that a bidder is willing to pay in exchange of the goods. Overall descriptive statistics show that Sealed-bid and eBay formats received higher max bids than the other two formats, Amazon and eBay p<1. However, if we looked at the three English auction formats (Amazon, eBay, eBay p<1) as a whole versus Sealed-bid, we see that Sealed-bid receives higher max bid than the average of the other three formats.

We ran an overall ANOVA test on the 4 auction formats on the entire set of max bids that were submitted, the results showed that the four auction formats were significantly different [F (3, 932) = 2.704, p = 0.044]. Follow-up Fisher’s PLSD test revealed that the differences were mostly contributed by the significantly differences between eBay and eBay p<1 [p = 0.0139] and between eBay p<1 and Sealed-bid [p = 0.0192] at the 0.05 level.

² “Max bid” is defined as the largest bid amount ever submitted by a bidder in an auction, valid or invalid.
³ “Final bid” is defined as the valid bid amount a bidder submitted in the final bidding round. It can be from a “raise bid” action or a “keep bid” action.
⁴ “Winning bid” is defined as the final result of an auction, which equals to the amount that the winner/highest bidder has to pay, on a second-price basis.
Final Bid

"Final bids" can be considered as valid max bids. In fact, the data pattern we obtained for final bid is very similar to that of max bid. In descriptive statistics, final bids in Sealed-bid and eBay were higher than those in Amazon and eBay p<1. Sealed-bid on average received higher final bids than the other auction formats.

The overall ANOVA test on the 4 auction formats on the entire set of final bids showed that the four auction formats were significantly different [F (3, 932) = 3.490, p = 0.015]. Follow-up Fisher’s PLSD test revealed that the differences were mostly contributed by the significantly differences between eBay and eBay p<1 [p = 0.0047] and between eBay p<1 and Sealed-bid [p = 0.0068] at the 0.05 level.

Winning Bid

Unlike max bid or final bid, winning bid is the actual result of an auction and the amount that the winner needs to pay. In a second-price auction, winning bid is determined by the second-highest bid. The winning bid was recorded on a per auction basis. The descriptive statistics on winning bid showed that eBay received the highest average winning bid (mean = 4.761) followed by Sealed-bid, Amazon, eBay p<1, in the order listed.

When analyzing the winning bid in an overall ANOVA test, the four auction formats were significantly different [F (3, 932) = 8.668, p < 0.0001]. Follow-up Fisher’s PLSD test revealed that the differences of most pairs, except the pair of Amazon vs. Sealed-bid and eBay vs. Sealed bid, were significantly different at the level of 0.05.

Figure 7 presents the descriptive statistics for max bid, final bid, and winning bid. Max bid and final bid have almost the same results across different auction formats except for the format of eBay p<1 where some bids in final rounds were lost. In all 3 situations Sealed-bid has shown higher averages than Amazon and eBay p<1, but very close results to eBay. However, if we take the average of Amazon, eBay and eBay p<1, as a representation of English auction; then we see that all three measures (max bid, final bid, winning bid) in Sealed-bid were higher on average than those submitted in English auctions.
Figure 7 Descriptive Statistics of Auction formats

Winning bids on a per auction basis. Others are on a per bidder per auction basis.
The mechanism of English format, as we have introduced, encourages learning among fellow bidders. It was expected that through bidding, bidders are able to obtain additional information on the goods they bid on, hence the final bid would be lower than that of Sealed-bid. However, it is not clear from the three measures (max bid, final bid, winning bid) why eBay resulted in close or even higher averages than Sealed-bid. Further more, given the statistics shown above in max bid, final bid, and winning bid, it is also not clear whether the “final period” operation has any influence in bidders’ behavior. To have a close look at this effect, we constructed another two measures “max bid – first bid” and “final bid – second final bid”, as dependent measures of the three English auction formats we tested. “Max bid – first bid” is defined as the difference between the bid amount a bidder entered in the first bidding round and the bid amount entered in the final bidding round, which will measure the extent that bidders initially announce their true valuations for the goods. The measure “final bid – second final bid” is defined as the bid amount difference between the last two bidding rounds. The higher this measure is, the more likely bidders shaded their bid until the last minute, and the stronger the “final period” effect is.

Max bid – first bid

Descriptive statistics showed that among the three types of English auctions, eBay has the strongest effect (mean = 1.516) followed by Amazon (mean = 1.100) and eBay p<1 (mean = 0.957). In the overall ANOVA test, these three types of English auction formats were significantly different [F (3, 932) = 18.545, p < 0.0001]. Follow-up Fisher’s PLSD test revealed that the differences of all pairs but between Amazon vs. eBay p<1 were significantly different at the level of 0.05.

Final bid – second final bid

eBay had the highest mean [mean = .989, p < .0001] among the three English auction formats followed by eBay p<1 [mean = .254, p<.0001] and Amazon [mean = .012, p = .0327]. All but Amazon have shown strong “final period” effect that bids jumped suddenly in the final rounds. Followed up by an Unpaired t-test for three auction formats, the differences of all pairs were significantly different.

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If bidders knew how much an item was worthy of, why wouldn’t they just place the maximal bids in the first round but bothered to raise the bids gradually or wait to the last minute? In either case the bidder would never overpay for the item since it was a second-price auction. Shading individual valuations are not unusual in English auctions, as it has become a common strategy. It can be explained as a learning process as well as the psychology of second-guessing what other bidders are thinking, which is an especially serious problem in English auctions. The “final period” effect is less significant in Amazon auction format but very significant in eBay and eBay \( p<1 \) formats. In Amazon format, an auction will not finish until nobody raises bids for two consecutive rounds or it will keep going forever, thus bidders will have to disclose their valuations for the goods sooner or later and other bidders will always have chances to challenge the highest bid. While there is always a final chance in either of the eBay auction formats, bidders tend to wait until the final round to disclose their true valuations.

In fact, when the multi-round bidding process in eBay auctions \( (p =1 \) and \( p<1 \)) involves more competition than learning, an eBay format auction will eventually converge to a Sealed-bid auction that bidders will only submit true valuations in the final period. This might explain why eBay \( (p=1) \) auctions has shown very close values as Sealed-bid in all three measures in Figure 7.

Looking at the data we collected in this experiment, we can conclude that different auction formats do have different impacts on bidders’ behavior, especially the “final period effect”. However, we were not able to conclude much on the competition effect. What we can say is only that any knowledge of other bidders’ behavior would influence a given bidder’s valuation of the item to be sold, as well as the extent to which he/she shades, because the auction format itself may convey information about bidders’ valuations. Competition effect, in this experiment, was not considered exclusively hence no judgement can be reached. In the Appendix of this paper, a better experiment design is recommended to examine the competition effect. Due to time limitation, the experiment could not be conducted before this paper was finished.
Chapter 6 Conclusions and Future Research

Now we return from presenting experimental results to summarizing discussions of them with the purpose of drawing general conclusions and implications.

The main focus of this paper has been to document the behavioral phenomenon and to examine some of the potential factors that are responsible for the bidding behavior in Internet auctioning. Both subjective and empirical data have shown evidence that some psychological and behavioral factors are involved in bidding. Here is the summary of the major findings.

First, a noticeable number of subjects admitted that their attitudes towards auctioning were similar to game playing. It is very interesting to see that people treat auctions differently from traditional shopping and that personal emotions, in addition to money, were heavily involved. One may ask how long this tendency will last and whether it is a function of the novelty of Internet auctions or whether this attitude will sustain over time. The proliferation of casinos on one hand and the fact that many of our respondents were very experienced in Internet auctions on the other indicate this might be more than initial enthusiasm.

Second, in a noticeable number of times bidders either suffered “winner’s curse” or they regretted losing in auctions. This has implied strong winning aspects in bidding attitude. While some bidders could win only when they overpaid in auctions, others regretted for losing even though they actually didn’t lose anything in terms of money.

Third, even though bidders said they compared prices elsewhere before they bid on auctions, they actually were not well informed and often ended up with higher prices. Considering the logic behind this, it is very interesting to see what people said were different from what they did.

Fourth, bidders were affected by the initial price information suggested by sellers. Prices suggested by the sellers seemed to have more influence on bidders than the widely available information of market prices. This again implied that many bidders were poorly informed.
Fifth, evidence has shown that bidders were influenced by the way auctions were conducted (auction formats) and the behavior of their fellow bidders. However, it is still too early to make judgment on the effect of competition.

The substantial data collected from real auctions presented supportive results to our expectation that irrational determinants do exist in auctions. These results alone can draw the conclusion that auctions, specifically Internet auctions, are far from an efficient form of trading mechanisms, despite the fact that Internet auctions are often proclaimed as the ideal way to match buyers and sellers. Internet auctions, like any other auctions, are prone to two fundamental flaws: winner’s curse and collusion. The former usually hurts bidders in that the winners are the only ones who overpay. Collusion, which usually hurts sellers, is especially easy when there are few buyers or sellers, as in many business-to-business transactions. While psychological and behavioral factors are related to personal preferences and individual values, it is still possible to minimize their effect through educating bidders and designing clever mechanisms. Educating means enabling bidders to process all available information about the goods for sale hence more accurately maximize their expected utility and estimate their individual fundamental values. Through a better design of auction mechanisms with improved transparency not only in terms of auction rules but also information during bidding, some collusion can be possibly reduced.

As Internet auctioning has become a widely accepted trading channel for consumers and businesses, it has also become very important to understand the mechanism and the human decision-making process involved. In the future, researches are to be focused on the examination of the competition issue and further analysis in auction formats. In laboratory experiments, a more precise bidding system is needed for better simulation of real auctions.
References


Coy, Peter "Going, going, gone ... sucker!" *BusinessWeek*, March 20, 2000


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## Appendix 1

### Items auctioned in laboratory experiment

<table>
<thead>
<tr>
<th>Item Name</th>
<th>Description</th>
<th>Purchase Price ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIT Baseball</td>
<td>Standard baseball with &quot;MIT&quot; on it</td>
<td></td>
</tr>
<tr>
<td>Beverage Opener Key Ring</td>
<td>Round Key ring functions as opener</td>
<td>5.98</td>
</tr>
<tr>
<td>MIT Leather Folder (Black)</td>
<td>Genuine leather pad holder with black accents embossed with MIT and seal.</td>
<td>29.98</td>
</tr>
<tr>
<td>MIT Logo Mug (Black)</td>
<td>11 oz. black ceramic mug with M.I.T and seal design</td>
<td>12.95</td>
</tr>
<tr>
<td>MIT Logo Glass Shooter</td>
<td>Glass shooter, 6 cm in height with MIT seal on it</td>
<td>5.98</td>
</tr>
<tr>
<td>MIT Metal Logo Mug (Burgundy)</td>
<td>Octagon shape 11 oz mug with metal MIT seal</td>
<td>12.98</td>
</tr>
<tr>
<td>MIT Logo Silver-tone Bookmark</td>
<td>Metal bookmark with MIT seal on it</td>
<td>9.98</td>
</tr>
<tr>
<td>MIT Cap (Stone and Light Olive)</td>
<td>Cotton cap with &quot;MIT&quot; at the front</td>
<td>18.98</td>
</tr>
<tr>
<td>MIT Metal Logo Key Ring (White)</td>
<td>Rectangular King ring with MIT logo on it</td>
<td>0</td>
</tr>
<tr>
<td>MIT Hockey</td>
<td>Hockey Puck and net with &quot;MIT&quot; on the puck</td>
<td>9.98</td>
</tr>
<tr>
<td>MIT Leather Metal Logo Folder</td>
<td>Genuine leather pad holder in Burgundy with metal MIT seal.</td>
<td>21.98</td>
</tr>
<tr>
<td>(Burgundy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIT Cotton T-Shirt (Navy)</td>
<td>Cotton Crew T-shirt with MIT on the front</td>
<td>16.98</td>
</tr>
<tr>
<td>MIT Logo Mug</td>
<td>11 oz. maroon ceramic mug with M.I.T and seal design</td>
<td>6.98</td>
</tr>
<tr>
<td>Godiva Chocolate</td>
<td>Truffle Assortment 4 - p.c. Set, 1 box</td>
<td>6.50</td>
</tr>
<tr>
<td>MIT Antique-finished Round Key Ring</td>
<td>Dimensional brass key tag with MIT seal</td>
<td>6.98</td>
</tr>
<tr>
<td>Boston Screen Saver</td>
<td>Screen Saver CD with lots of pictures of Boston</td>
<td>14.99</td>
</tr>
</tbody>
</table>
Appendix 2

A Proposed Experiment Design for Examination of Competition in auctions

This experiment was designed to examine in a more thorough way the possible effect caused by competition in auctions. By competition, we mean the phenomenon in auctions bidders raise bids as prices go up. It is expected that if more “raising bids” actions take place, the final results of an auction will be higher.

Method

Subjects: Subjects are to be recruited from Massachusetts Institute of Technology. No auctioning experience is required. There will be only one subject participating in the experiment at a time. Each subject will spent from 15 minutes to 40 minutes depends on the experimental conditions and subject’s performance (more on this later). Besides recruiting subjects from real people, 8 different fake personalities will be created by computer and participate in every auction with the human subjects. The actions by fake personalities are programmed by the computer and will be executed automatically. However, human subjects will not be informed that they are to compete with virtual person but similar subjects from other web sites.

Experimental Conditions: There are three types of conditions corresponding to three types of competitions. Auction format will be fixed to the eBay format we have discussed before.

For all auction formats in the laboratory, time is discrete instead of continuous. Each auction will be sliced into multiple rounds of bidding. In each round, members of a given group will need to make bidding decision on an item. There are two types of decisions that subjects can make: they can either raise their bids or keep the bids they entered in the previous round (for the first round, all subjects have to raise their bids). Only when all participants (including fake personalities) in the same auction have made decisions can the auction move to a next bidding round. The three types of competition status are described as:
- **No Competition** In this status, all fake personalities are programmed to submit their bids in a natural way that the bids will go up linearly and converge to a constant. This is the simulation of natural bidding.

- **Early Competition** In this status, all fake personalities are programmed to raise their bids to 75% of the market retail price within the first 2 bidding rounds. Starting from the third round, the bid-raising of fake personalities are programmed to slow down and naturally converge to a constant.

- **Late Competition** In this status, all fake personalities are programmed to submit very low bids naturally for the first 2 bidding rounds. Starting from the third round, bidding will be speed up with a result of reaching 75% of the market retail price by the end of the fourth round. After the fourth round, bid-raising speed will be slowed down again and naturally converge to a constant.

**Design:** The main experimental manipulation is the competition status, which will be manipulated between subjects in 3 status: No competition, early competition, and late competition. All subjects will be given both a written and an oral instruction on general bidding. Each subject is provided with a printed catalog with 18 color pictures of 18 different goods each plus brief description. Most items are MIT memorabilia and the retail prices range from $5.00 to $30.00. In addition to the general bidding rules, subjects were informed of the following information before started:

- All 18 items are auctioned for real which means there will be exchange of money and goods at the end of the experiment

- For every given group, even though all 18 items will be auctioned, only 1 out of 18 is available for sale. The available item will be announced only after the experiment is over. We applied this policy to reduce some possible noises in the experiment such as preference bidding (i.e. subjects only bid on things they are interested in) and the worry of one's pocket. All subjects are asked to evaluate each item as if it is the only item that they will be able to get.

- At the end of experiment, the available item will be randomly generated by computer and if the winner is subject, he/she will pay for the item.
After reviewing an item on the catalog, subject will estimate the valuation of the item and enter an initial number. Starting from the second bidding round (sealed-bid excluded), subject can raise bid by entering a bigger number greater than the current highest bid, or he/she can simply press the "keep bid" button to stay with the original bids they submitted. When subject finishes bidding on one item, he/she will move to the next item listed on catalog and starting bidding again. Catalogs are prepared in different versions with different listing order of 18 items to counterbalance. Also, the competition status assigned to each item will be randomly to avoid awareness from subject. For each listing order, 7 subjects will be tested and the experiment will run over all listing orders before it starts a new cycle.

**Procedures:** Before the experiment starts, bidding instructions will be explained. Subject will be told that he/she will face real decisions for real money in which he/she will be asked to indicate the amount he/she would like to pay for 18 different items listed in the catalog.

Subject is assigned to a computer from which Internet is accessed. The bidding system is built on one of the server at MIT and can be accessed by any browser. Subject then will log in to the bidding system using a pre-assigned user name. The first web page shows the auction for the first item listed in the catalog. The bidding interface is vertically divided into 2 parts. The left part shows the public information that all participants (including fake personalities) in the group are able to access at the same time. It contains the name of the item currently offered, type of auction format used, the numbering of the current bidding round, highest bidder’s user name, current winning bid, and the total number of bidders participated. Also at the lower part of the public information board, a bidding history of last round's results is presented with the winning bidder’s name on the top and the lowest bidder’s username in the bottom. The right part of the screen shows the private information that only the user who logged in the machine can access. It includes the username and the number that user entered last time. On the lower part of the private information board is the box that allows bidder to enter a higher bid. If subject wants to raise his/her bid, he/she has to press the “raise bid” button after entering a higher bid; or if subject wants to stay with the current bid, he/she can just do by pressing the “keep bid” button. For the first round, subject can
only raise his/her bid, no matter how much he or she raises to. Starting from the second round, subject can choose from “raise bid” or “keep bid”. However, in any round except the first one, subject has to enter a number that is greater than the bigger one of the current highest bid and his/her last bid. That is, bids can not be lowered. The system will automatically move to a new round when all participants have finished the current round. During the bidding, subject is able to look up the public information board on the left part of the screen for the current highest bid.

After the final round of an auction, subject can click on the screen and view the results including all final bids of all participants. Then, he/she will move to the auction of the next item in the catalog. The amount of time spent on each experiment really depended on the individual performance.