Social Buying: The Effects of Group Size and Communication on Buyer Performance

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ABSTRACT: Viewing social communication on group-buying platforms as a new form of IT-enabled coordination mechanisms, we examine the impact of group size and communication capacity on buyer performance on group-buying platforms. Using an economic experiment, we found that although larger groups were able to extract moderately higher surplus on average than smaller groups, there was also a negative impact of group size on group coordination for time to task completion. Interestingly, when a private communication channel was introduced for buyers, it actually lowered group surplus. We explain this unexpected finding as caused by the increased task complexity that arises from the additional needs for information processing of the exchanged messages. In general, adding communication capacity slowed down task completion, and this effect was stronger for larger groups than smaller ones. Our study suggests that business managers of group buying sites should be concerned about both the level and the kind of communication tools they want to offer and they need to be mindful that larger buyer groups may need different kinds of communication support from those needed by smaller groups.

KEY WORDS AND PHRASES: Buying platforms, coordination, electronic market design, experimental economics, group buying, information overload, social buying, task complexity.

Social buying, or group buying, presents a particular form of social commerce [31] that has attracted a fair amount of attention from business worldwide since the early 2000s. Industry examples of group buying businesses include early ventures like Mercata, which ceased operation by 2004, as well as more recent ones like Living Social and Groupon in the United States and Meituan and Lashou in China. The nascent market of online group buying is still evolving, and companies continue to innovate both new group buying technology platforms and business models.[1] Exploring new revenue streams and experimenting with new technology features are the two principle drivers for business change in this dynamic industry. In this study, we focus on the latter of the two and examine, mainly from the buyers' perspective, the potential value of introducing a new social technology feature on a group buying platform.

From a theoretical perspective, our study is motivated by research on information technology (IT)-enabled coordination. We view social communication on group buying platforms as a new form of an IT-enabled coordination

An earlier version of this paper was presented at the 2012 International Conference on Electronic Commerce, held in Singapore in August 2012. We appreciate comments from the session chair, Ting Li, and the participants in the session. We thank Rob Kauffman for sharing his insights on our research, which helped us greatly in developing the paper. We also thank Raquel Benbunan-Fich for her help in using the laboratory facilities at Baruch College, where we conducted our experiments.

International Journal of Electronic Commerce / Winter 2013–14, Vol. 18, No. 2, pp. 127–157.

ISSN 1086–4415 (print) / ISSN 1557–9301 (online)
DOI: 10.2753/JEC1086-4415180205

mechanism. Historically, various IT-enabled coordination innovations have had a profound impact on market structure and seller-buyer relations in different industries. For example, Malone et al. [35] advanced the idea that electronically coordinated business-to-business markets tend to increase market transparency and reduce the role of intermediaries, and Brynjolfsson and Smith [3] showed empirically that electronically coordinated business-to-consumer markets reduce transaction costs and lead to lower consumer prices. Clemons et al. [8] argued that IT-enabled coordination reduces monitoring cost in supply chains and likely leads to more outsourcing and to the development of strategic partnerships with key suppliers. Porter [40] theorized that the adoption of the Internet as a coordination platform would tend to shift bargaining power from sellers to buyers. Clemons [7] posited that social commerce technologies like online communities, recommendation systems, and consumer ratings and reviews increase consumer informedness, that is, consumer knowledge about products, availability, and prices. This leads to consumers' demanding steeper compromise discounts and to decreasing consumer willingness to pay for products that are useful to them but do not perfectly meet their individual preference and taste. Finally, Zwass [56] concluded that Web 2.0–based coordination platforms foster collective effort by users in order to co-create consumer value.

The literature on IT-enabled coordination has looked specifically at the impact of an IT innovation on a specific market and found that new IT-enabled coordination tools and mechanisms lead to significant changes in market structure (e.g., level of vertical integration, role of intermediaries, bargaining relationships) and market performance measures (e.g., economic efficiency, price and surplus levels, transaction costs, transparency levels). Our aim with the present study is to add to this body of research by examining the impact of incorporating a novel IT-enabled coordination mechanism in the design of an electronic group buying platform, initially from a buyers' perspective.

There have been theoretical arguments among economists about the bargaining power of buyer groups and group coordination since at least the 1920s, predominantly saying that larger buyer groups should be able to obtain better prices from sellers but that coordination costs among buyers may offset price advantages when buyers do not already have established relationships [15]. Yet, in the absence of modern information and communication technology, Galbraith at the time also argued that advantages of group buying in practice were essentially limited to corporate buyers in large-scale procurement and supply chains, and they were largely unavailable to consumers because of the difficulty in coordinating consumers' buying decisions, especially given their differences in product attribute preferences and product valuations. Recent advances in digital technology, however, have enabled the development of online platforms that do in fact support coordination of consumers on a large scale.

Commercial group buying platforms support various forms of social buying. They differ in how groups form, what kinds of deals are offered, what group size thresholds are required to make deals, how group buyers can communicate with each other and what social features are supported, and how prices are determined. *Group size* and *communication capacity* are hence two salient features for the design of group buying models from a theoretical as well as a practical perspective.

Based on analytical results using economic modeling, researchers have suggested that improving the coordination and cooperation process among group buyers should result in higher welfare for both buyers and sellers [5, 24, 30]. Empiricists are also showing interest in group buying–related issues [26, 28, 29], but none of the currently available studies has specifically investigated how communication capacity among buyers affects group buying performance. Adding communication capacity can affect both individual users' attitudes and group performance. The presence of reciprocal communication can positively influence cognitive and affective involvement of individual users [23], and increasing media synchronicity among group members can improve group coordination [10, 19].

Thus, in the present research, we explore specifically the impact of group size (larger vs. smaller) and communication capacity level (high vs. low) on group performance in terms of economic welfare (buyer surplus) and group coordination (task completion time).

We conducted experiments in the laboratory using an adaptation of the buyer-initiated intra-auction group buying model [5] in our design. We found that group size had positive effects on buyer surplus. Larger groups were able to extract more surplus on average than smaller groups. We also found a negative impact of group size on group coordination in terms of time to task completion. Interestingly, and contrary to our prediction, introducing a private communication channel for buyers did show a negative effect on group surplus. We explain this unexpected finding as due to the cognitive load that arises from the additional need for message processing. In general, adding communication capacity slowed down task completion, and this effect was stronger for the larger groups than the smaller ones.

The key finding of our study is the interesting trade-off between the benefits from IT-enabled coordination capabilities and their associated costs due to increased task complexity, which raises the practical question of how to best manage consumer interactions on social buying platforms. We discuss implications of these results and offer some possible explanations later in the paper.

Theoretical Perspective and Hypothesis Development

Social commerce generally refers to e-commerce activities that are supported by social technology platforms or social media tools [19, 31, 32]. Online group buying represents a social commerce example that uses a market mechanism in which customers with similar interests but diverse demand regimes participate in generating collective orders with volume price discounts [27].

Our group buying study looks at two important dimensions of group performance—economic performance and group task performance—from the buyer perspective. Group surplus indicates monetary payoffs for the group buyers, and task performance measures indicate how well the buyers in a group coordinate to accomplish the group tasks of agreeing on a joint offer and making a deal with the seller. To examine to what extent group size and communication capacity affect group performance, we draw on two principal streams of research to theoretically ground our study and develop specific hypotheses.[2] For one, we look at the economics literature to theorize the relationship between buyer group size and buyer surplus generated in the market. Second, we borrow from the media synchronicity theory in the information systems literature and the task complexity theory in the organizational management literature to theorize about the effect of communication capacity and information availability on group coordination.

Group Buyer Surplus

Countervailing power theory provides us with the theoretical basis to understand how group size and communication capacity can affect the arguably most important aspect of group buying performance—group surplus (i.e., the buyer surplus that obtains by aggregating the individual surpluses that are generated by the members of the group). Galbraith [15] presented a countervailing power theory, stating that unbalanced economic power can be "held in check by the countervailing power of those who are subject to it" and that the existence of coordinated buyers would evolve as a response to aggregation of power by sellers. Researchers have found that buyer concentration is a source for countervailing power, which can lower seller margins and accrue more surplus at the buyers' side [45]. Galbraith originally focused on the buying consortiums of his time and noted that large buying groups were able to resist actions by monopolistic sellers. Galbraith recognized that it was theoretically possible for consumers to exercise some form of direct countervailing power, too, but pointed out that it would be unrealistic to expect it to occur in practice at any significant level because of the difficulty for the consumers to coordinate effectively. Nonetheless, consumers could realize some of these benefits indirectly, through intermediaries [15]. Rha and Widdows [42] extended this view to electronic commerce settings.

Economists have confirmed this kind of benefit to consumers when large retailers exercise countervailing power [34, 46] and pass some of the achieved cost savings on to their customers. By providing quantity discounts, group buying sites attempt to aggregate disparate and asynchronous buyers, with buyers benefiting from lower prices (and thus higher buyer surplus) and sellers benefiting from increased economies of scale [1]. However, retail intermediaries can be replaced with electronic group buying sites, for some purchases, since online consumers can interact more easily [35]. Similarly, Porter [40] has argued that the Internet has the potential to increase the bargaining power of buyers. Moreover, Parameswaran and Whinston [38] and Rezabakhsh et al. [41] have suggested that the shift of bargaining power to consumers will be stronger in social commerce environments based on Web 2.0 architectures, such as social buying settings, than in standard Internet commerce environments. Recent economic experiments on countervailing power have shown that even a small number of buyers can influence monopolist pricing, concluding that group size matters. Ruffle [43], for example, showed that markets with two buyers (smaller groups) attained lower prices than those with four buyers (larger groups). Thus, we hypothesize:

> ***Hypothesis 1 (Group Size and Buyer Surplus Hypothesis):*** *Increasing the group size of buyers in a group-buyer model will tend to increase buyer surplus.*

Rha and Widdows [42] studied how consumers actually organize to exercise countervailing power, especially on the Internet. Forming successful coalitions of consumers requires better organization and simplified communication. The Internet provides the means by which communication and organization can occur more efficiently, breaking down demographic, geographic, and temporal barriers [37].

The communication process pertaining to the group buying task represents an example of a typical convergent process and as such needs support for verification, negotiation, and clarification [33]. According to the theory of media synchronicity, a simple synchronous communication channel like an instant messaging tool can provide a good fit for such communication process needs [10]. With the appropriate communication tools, group buyers should collaborate more effectively in order to reach consensus and achieve common goals [55]. Hence, offering additional communication capacity to the buyers should enable them to share more information and thus coordinate better bidding strategies and consequently also obtain better deals than buyer groups without such a communication mechanism. Thus, we hypothesize:

> ***Hypothesis 2 (Communication Capacity and Buyer Surplus Hypothesis):*** *Introducing a communication channel for buyers to exchange private messages will tend to increase buyer surplus.*

Assuming heterogeneous consumer preferences in terms of different willingness-to-pay (WTP) values held by buyers introduces some conflicts of interest. For example, high-WTP buyers (Hi-WTP), that is, buyers who are willing and able to pay a higher price for a product, may want to bid to increase the chances for an offer to get accepted by the seller, and low-WTP buyers (Lo-WTP) may not be able or willing to follow suit and so drop out of a group bid. Evidently, bigger groups encounter more such interest conflicts than smaller groups. Group buyers can coordinate better bidding strategies if they can recognize those conflicts due to diverging WTP values and reach consensus within those constraints in order to not jeopardize possible deals, e.g., Hi-WTP buyers may decide to bid less aggressively in order to allow the more constrained Lo-WTP buyers to stay in the group, and Lo-WTP buyers may bid more aggressively to keep the group intact. Of course, in some cases, a deal that is acceptable to all may still be difficult to negotiate, or simply not be possible at all. Introducing a communication channel among buyers should help buyers recognize WTP-related conflicts and move their group price threshold to a feasible level. The more potential conflicts are present among buyers, the more important the communication channel should be for mitigating them. Moreover, the effect of the communication channel on increasing group surplus should become more salient in bigger groups than in smaller groups. Hence, theoretically, in accordance with Baron and Kenny [2], the communication channel serves not only as a predictor for buyer surplus but also as a moderator between group size and buyer surplus by strengthening the effect of group size. Therefore, we propose the following interaction effect between group size and communication level:

> ***Hypothesis 3 (Communication Capacity and Group Size Interactions on Buyer Surplus Hypothesis):*** *The positive effective of introducing a communication channel for buyers to exchange private messages on buyer surplus will be more salient in bigger groups than in smaller groups.*

Group Task Completion

The second dimension of group performance that we consider in our study concerns task completion, and primarily how fast the members of a group can complete the task of generating their first joint offer to the seller. This involves decisions to join a group bid and to negotiate a jointly agreed-on bidding price. Time to task completion is strongly connected with task complexity. Theory suggests that task complexity is best conceptualized from three interdependent perspectives—psychological experience, task-doer interactions, and objective task characteristics [4]. When task performance is regarded as a psychological experience, the doer's motivation, the level of stimulation, and potential arousals during performance of the task should be taken into account (e.g., [53]).

The task-doer interaction relationship focuses on the doer's cognitive limitation and task-related proficiency [47, 17]. Objective measures for complexity can be constructed from the number of information sources and the degree of information diversity that the people who are involved in performing a task are confronted with [52]. It is important to note that both group size and communication capacity can change the nature of a task and thus change task complexity [4]. Enlarging the group size can substantially increase the information input to the task performance process, and hence increase task complexity. Introducing a private communication channel allows the buyers to acquire more information through exchanging messages instead of merely observing the market movement on the trading platform. Working on more complex tasks, groups should need more time to reach consensus.

Compared with a bigger group, a smaller group deals with fewer divergent WTP values, and thus less information needs to be processed by the group members and fewer WTP-related bidding conflicts need to be resolved. However, coordination becomes more complex as the size of the group increases. For example, Chen et al. [5] showed that technology provides, in principle, effective communication in intra-auction bidding clubs, but coordination becomes increasingly more difficult as the member base grows. This leads to our next hypothesis.

> ***Hypothesis 4 (Group Size and Task Completion Hypothesis)****: Increasing the group size of buyers tends to delay group task completion.*

Similarly, making a buyer communication channel available on the group buying platform introduces a new information source to the buyers, in addition to the publicly posted bidding prices, and one which can make WTP-related conflicts more transparent. On the one hand, the new information can help buyers coordinate more effective bidding strategies by better recognizing the different pricing constraints. But, on the other hand, some of the shared information may be irrelevant to the task or even incorrect. Processing the additional information also presents a higher cognitive load for each buyer and consequently may lead to a longer completion time for performing the group task. The information exchange among the buyers increases their mutual interdependency, which tends to help them work out better coordinated outcomes [44] but also increases task complexity and may make the buyers more cautious in announcing their individual offer prices [4, 52]. Therefore, we hypothesize the following:

> ***Hypothesis 5 (Communication Capacity and Task Completion Hypothesis)****: Introducing a communication channel for buyers to exchange private messages tends to delay group task completion.*

Furthermore, because buyers in bigger groups face more potential conflicts when they deal with more diverse WTP values than those in smaller groups, they are likely to exchange more information through the communication channel than those in smaller groups in order to manage conflicts and reach agreements. The information exchanges in larger groups, dealing with increased levels of potential interest conflicts, are also likely to create more emotional pressure than in smaller groups and stimulate arousal among buyers, thus increasing the cognitive challenges they face [4, 53] and decelerating the group decision-making process. The relationship conflicts, pertaining to feelings, tension, and friction, will further slow down the task completion process, especially for more complex tasks [9, 21]. Therefore, we propose that there is an interaction effect between communication and group size with regard to task completion:

> ***Hypothesis 6 (Communication and Group Size Interactions on Task Completion Hypothesis)****: Introducing a communication channel for buyers to exchange private messages will delay the group task completion in bigger groups more than in smaller groups.*

Methodology

Experimental Design

Using a specific variant of the buyer-initiated intra-auction group buying model proposed by Chen et al. [5], we designed a laboratory economic experiment that created an electronic social buying market in which participants were asked to coordinate group purchases of a single product from a monopolistic seller. Each individual buyer was given a demand of one unit with a preassigned unique willingness-to-pay value. These valuations varied across buyers, thus modeling heterogeneous consumer demand preferences. Buyers were preassigned to groups. The experimental environment was developed using the z-Tree software [12] and was implemented in a Windows client-server network environment.[3] The participants were recruited from an undergraduate student pool and were compensated with course credit in an introductory-level information systems class.

We used a 2 × 2 factorial design in which we manipulated two variables, group size and communication capacity, at two levels. First, we manipulated group size and compared smaller groups with larger groups, and based on prior experimental research [43], we operationalized smaller groups as two-buyer groups and larger ones as four-buyer groups.[4] The second manipulation compared low with high communication capacity among buyers. At the high level, we operationalized communication capacity by including a communication channel as a social technology feature on the buyer screen, whereas no such communication channel was offered at the low level. The used communication mechanism resembled a standard chat box.

As depicted in the flow chart (see Appendix A), which shows the basic logical sequence of the events and decisions in the experiment, buyer subjects could either place an opening bid (the first proposed purchasing price to be offered to the seller) or join an already-existing bid within the group. However, a group offer was not routed to the seller until the required number of buyers (minimum buyer threshold) had joined the offer at the proposed bid price. Hence, group bidding occurred in two stages, requiring the completion of two group tasks.

The first task involved proposing in-group bids, among themselves, to determine an agreed-on joint offer bid. The bargaining process with the seller began only after the first task had been completed and a joint offer had been submitted to the seller. Successfully negotiating with the seller and making the deal was the second group task in our study. If the seller rejected an offer, the buyers needed to renegotiate a new, improved bid. This process continued until the seller either accepted an offer and closed the deal (the group successfully completed the task) or the experimental round terminated when time expired, without a deal (the group failed to successfully complete the task).

Procedure

Each session consisted of groups with one seller (monopolist) and either two or four buyers. Upon entering the laboratory, the participants were randomly assigned to computer terminals with a seller screen for the seller and a buyer screen for the buyers. Once the participants were seated, they were asked to review a set of instructions[5] that explained the electronic group buying mechanism and the user interface for their specific role as either a buyer or a seller. Each session consisted of one extended practice period and ten experimental periods, in which buyers worked to coordinate group offers to the seller. The data from the practice round were discarded and not used in our analysis. Each regular round lasted 150 seconds.

The seller received only finalized group bids, once a group had agreed on a joint offer. The seller screen showed the group bid as the number of people who joined in the bid, the offer price per unit, and the total amount of the offer (see Appendix B for an illustrative seller screenshot). The seller then had the opportunity to accept the bid and thus terminate the current round, or not. Buyers could work on a new, improved joint offer if their bid was not accepted.

Both buyer user interfaces, with or without a communication box, were simple, convenient, and very easy to use, but the design of the buyer screen was a bit more complex, as illustrated in Appendix C). It showed them their assigned willingness-to-pay value for the product they were asked to buy. With the beginning of each round, a buyer could initiate a bid or wait and join an existing bid price. When all the buyers in the group joined a bid, a group offer was generated and immediately forwarded to the seller for review. In any case, a new bid price could be proposed at any time. Buyers could observe the market by looking at the current bids, pending offers, and also by learning from declined offers. In the treatment with a private communication channel, buyers could exchange text messages via an instant message type of communication box. No such communication channel was made available to sellers.

When a transaction occurred, that is, a seller accepted an offer from the buyer group (completing group task 2), both the seller's surplus and buyers' surplus were calculated and shown to the participants. Individual buyer surplus values were computed for each buyer as transaction price less WTP value. Summing individual buyer surplus over the members of a group yielded group surplus. No surplus accrued when a round ended with no bids accepted. The participant rewards were not linked to task completion time.

In each period of the ten repeated rounds of the experiment, the buyers were given different WTP values. The values were generated randomly and rotated to buyers sequentially in each period, as detailed in Appendix D. First, we generated ten random integer numbers between 25 and 100 from a uniform distribution. These ten numbers were then recorded and reused for all of the ten repeated rounds for all the experimental groups in order to experimentally control for WTP effects. In the first round of the experiment, the first two (or four) numbers were assigned to the two (or four) group buyers sequentially, and in the second round, the next two (or four) values, starting from the second number, were assigned to the buyers sequentially, and so on. This WTP rotation method ensured that every buyer got to use all of the ten generated values over the course of the ten repeated rounds and that for any given round, all the buyers also had different values.

Measures

The two experimental treatment variables, presence of the communication channel and group size, represented the two independent variables in our study. We also investigated two dependent variables—group-level surplus, measured as average buyer surplus within groups, and group performance in terms of time for group task completion. More specifically, the latter was

Table 1. Measures Used in the Experiment.

Variables	Measures
Independent variables	*Communication capacity (with vs. without a communication channel)*
	Group size (bigger vs. smaller)
Dependent variables	*Group performance*
	Buyer surplus (average surplus per buyer in a group)
	Time for task completion (generating the first offer)
Control variables	*Experimental periods (Period1, Period2, ..., Period9 = 0 or 1; Period10 fixed)*
Other variables	*Bidding outcome (success rate of deal closings)*
	Bidding activities (number of group bids submitted per buyer)
	Communication activities (number of messages per buyer)

measured as the time a group needed to generate their first joint offer for the seller, which we previously defined as the first group task. Because the groups controlled this performance task, it was chosen as the primary task performance indicator in our study. We also measured the performance of the second group task—making a deal with the seller—by calculating the success rate of task completion over the repeated rounds of the experiment as a secondary group performance variable in the study. To control for round effects, we modeled the periods as control variables. In addition, we also collected data on some bidding and communication activities of the group buyers by observing the number of bids submitted and the number of messages posted per buyer and group. The measures are summarized in Table 1. Finally, the group surplus was normalized by group size as well as by average WTP within experimental sessions to adjust for potential differences.

Data Analysis

Descriptive Analysis

The experiment was carried out with a total of 45 groups. Each group had one seller and either two or four buyers. Data from each group was collected in one session over 10 rounds of bidding. The design represents a typical 2×2 experiment with repeated measures. The descriptive analysis of the experimental data is summarized in Table 2. Out of the 450 rounds of potential deal making by the 45 groups, 296 final bids from 44 groups were successful and accepted by sellers, and 154 rounds were unsuccessful and failed to produce a winning bid. Due to inconsistent show-up rates of the recruited subjects at the laboratory for the scheduled experiments, some planned sessions had to be canceled, resulting in an unbalanced experimental design. One of the groups in the treatment with four buyers without the communication channel exhibited total group performance failure and did not generate any successful bids. In the rounds that did not generate a sales transaction, groups failed for two reasons: either the buyers could not agree on a common bid to form a group offer (failure to complete the first group task) or the submitted bids were too low and rejected by the seller (failure to complete the second group task). Periods with unsuc-

Table 2. Descriptive Statistics of Successful Rounds of Bidding.

	Without communication					With communication				
	Number of bids (groups)	Buyer surplus		Completion time		Number of bids (groups)	Buyer surplus		Completion time	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
Group size 2	85 (11)	40.7	10.3	16.7	12.5	94 (13)	37.0	10.4	20.0	20.2
Group size 4	75 (12)	41.8	7.8	24.5	21.0	42 (8)	40.2	7.1	41.5	34.9

Table 3. Spearman's Rho Correlations.

	Surplus	Time	Comm-Capacity	GroupSize	Period
Time	-0.395**				
CommCapacity	-0.191**	0.117*			
GroupSize	0.088†	0.254**	-0.163**		
Period	0.132*	-0.119*	0.039	0.064	
Number of bids submitted	-0.198**	0.069	-0.111	-0.187**	-0.057

† Regression is significant at the 0.10 level (two-tailed). * Correlation is significant at the 0.05 level (two-tailed). ** Correlation is significant at the 0.01 level (two-tailed).

cessful bids were removed from the main analysis. On average, buyers in the larger groups outperformed their counterparts in the smaller groups in both treatments, with and without the communication channel. The descriptive analysis result is consistent with our Group Size and Buyer Surplus Hypothesis (H1), and formal testing is discussed in the following section.

A nonparametric Spearman's rho correlation analysis was conducted to check the correlations between the major measures of the study (Table 3). The correlation between the two dependent variables, group surplus and time for group formation, is significantly negative, which implies that more time spent on the preparation for the first bid does not necessarily mean higher surplus. The correlation analysis shows that communication capacity is negatively correlated with buyer surplus ($p < 0.01$) and positively correlated with time for group task completion ($p < 0.05$). Group size is positively correlated with both surplus ($p < 0.1$) and the time for group task completion ($p < 0.01$).

Number of group bids submitted, used as a proxy for degree of buyer initiative, is negatively correlated with surplus ($p < 0.01$). This indicates how tactically buyers act in submitting group bids but also reflects how tough the seller is in terms of rejecting group bids. A high number of group bids submitted shows a lot of activity but could also mean that the buyer group does not develop an effective bidding strategy over the course of the experiment.

The rank of the bidding period (1 to 10) is positively correlated with surplus ($p < 0.05$) and negatively with time for group task completion ($p < 0.05$). The correlation results indicate that buyers in later rounds tend to generate higher surplus in less time than in earlier rounds of the experimental session. The trend lines of surplus and time over the bidding periods are consistent with the correlation analysis (see Figures 1 and 2). These results point to the possible presence of learning effects, prompting us to incorporate the periods as control variables in the following section on hypothesis testing.

Hypothesis Testing

Because we regarded rounds with unsuccessful deal-making attempts as missing values, we obtained an unequal sample size for our 2×2 design. To control

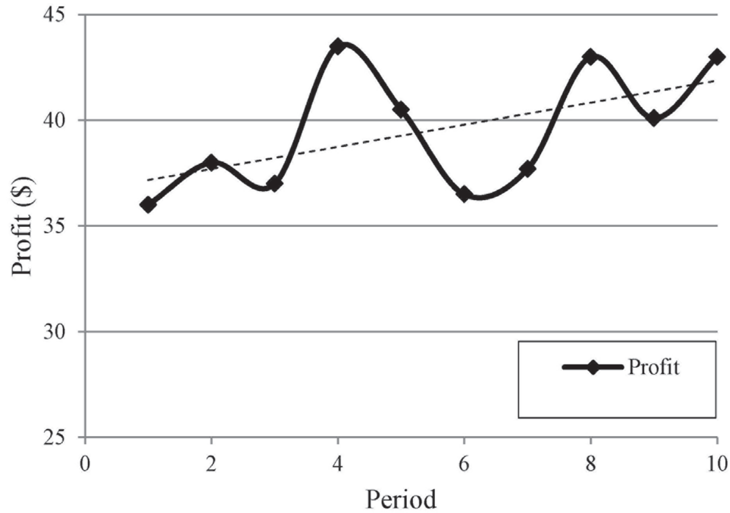

Figure 1. Buyer Surplus

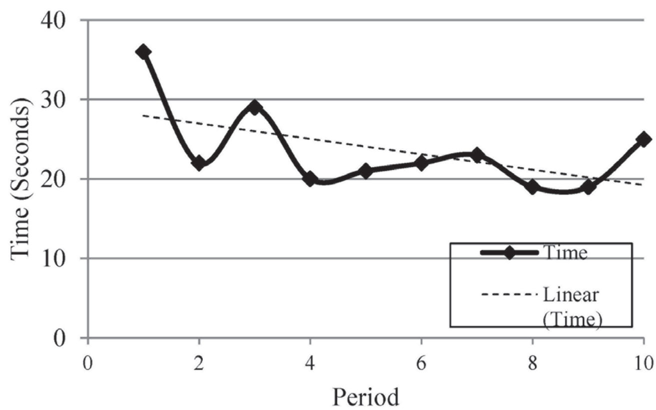

Figure 2. Time to Task Completion

for the effect of repeated measures with unequal sample size, we applied two sets of statistical examinations. First, we employed multiple linear regression analysis for the main test. Second, we followed up with a robustness test using a mixed model analysis with maximum likelihood estimation to verify the results. We developed the following regression model for our analysis:

$$Surplus = \alpha_0 + \Sigma_{i=1}^{9}\alpha_i Period_i + \alpha_{10} GroupSize + \alpha_{11} CommCapacity + \alpha_{12}(GroupSize \times CommCapacity) + \varepsilon \quad (1)$$

$$Time = \beta_0 + \Sigma_{i=1}^{9}\alpha_i Period_i + \beta_{10} GroupSize + \beta_{11} CommCapacity + \beta_{12}(GroupSize \times CommCapacity) + \mu, \quad (2)$$

where *Surplus* is buyer surplus; *Time* is time to generate the first bid; α_i, β_i are regression coefficients ($i = 0, 1, ..., 12$); $Period_i$ is experiment period ($i = 1, 2, ..., 9$); *GroupSize* is group size (bigger vs. smaller); *CommCapacity* is communication capacity (with vs. without a communication box); *GroupSize* × *CommCapacity* is an interaction term of group size and communication capacity; and ε, μ are error terms.

Main Test

We introduced dummy variables to model group size *(GroupSize)* and communication capacity *(CommCapacity).* Specifically, for the treatment with the smaller group size (two-buyer model) *GroupSize* was coded 0, and for the larger group size, *GroupSize* = 1. Likewise, for the treatment without a communication channel, *CommCapacity* was coded 0, and for the treatment with a communication channel, *CommCapacity* = 1. An additional nine dummy variables *(Period1, ..., Period9*) were generated to represent the experimental periods 1 to 9, with "period" 10 was fixed to serve as the reference measure for our analysis. Two separate regression tests were conducted to analyze the main effects of group size and communication capacity on the two dependent variables, (buyer) *Surplus* and *Time* (for generating the first group bid), respectively.

We combine the results of the two separate linear tests in Table 4. It shows buyer surplus at the group level, expressed as average surplus of the buyers within a group, across the ten repeated rounds (*Surplus*) and the time for task completion (*Time*). To examine the contribution of each of the four treatments, we did a hierarchical multiple linear regression in four stages, Model 0, Model 1, Model 2, and Model 3, in which we added the variables *Period, CommCapacity, GroupSize,* and the interaction effect (*CommCapacity* × *GroupSize*). The nine dummy variables, $Period_1$ through $Period_9$, are included in the test to control for the effect of repeated measurement, especially learning effects.[6]

According to Model 1, buyers in bigger groups generated $2.4 more surplus than in smaller groups ($p < 0.05$) shown in Table 4. It contributes 1.5 percent explanatory power. After adding presence of a communication channel as an independent variable in the regression, we did find that the effect of group size on buyer surplus was still positive, but it was only moderately significant ($p < 0.1$; Model 2). Thus, H1 is weakly supported. Presence of a communication channel has a significant negative effect on buyer surplus, which interestingly not only rejects H2 but also shows an effect that is actually opposite to our prediction. Based on the testing results in Model 3, we cannot identify any significant interaction effect between communication and group size on buyer surplus.

With respect to group task performance, in terms of task completion time, both the main effects and the interaction effect are significant. Based on Model 2, the groups with a communication channel spent 8.8 seconds longer than the groups without one to generate the first agreed-on bidding price ($p < 0.01$). The larger groups (with four buyers) spent 13.8 seconds longer than the smaller groups (with two buyers) to generate the first bidding price ($p < 0.01$). That is,

Table 4. Multiple Linear Regression Coefficients.

	M0		M1		M2		M3	
	Surplus	Time	Surplus	Time	Surplus	Time	Surplus	Time
Intercept	42.7**	24.6**	41.5**	21.4**	43.2**	13.2**	43.7**	15.8**
Period1	-6.2*	11.4†	-6.0*	11.8*	-6.2*	13.5*	-6.2*	13.6*
Period2	-4.3†	-2.1	-3.8	-1.9	-4.0	1.0	-4.0	0.9
Period3	-4.7†	4.0	-4.3†	4.4	-4.6†	6.9	-4.6†	6.8
Period4	0.6	-4.7	1.0	-4.7	0.9	-2.5	0.9	-2.2
Period5	-1.9	-3.7	-1.6	-2.7	-2.1	-0.8	-2.1	-0.8
Period6	-5.6*	-2.8	-5.5*	-2.9	-5.4*	-1.9	-5.4*	-1.9
Period7	-4.2†	-1.8	-3.9	-2.0	-3.9	.0	-3.9†	-0.4
Period8	0.0	-6.3	0.2	-6.4	0.3	-5.3	0.3	-4.8
Period9	-2.5	-6.6	-2.1	-6.5	-2.3	-4.4	-2.2	-4.1
GroupSize			2.4*	12.3**	1.8†	13.8**	0.8	8.2*
CommCapacity					-3.0**	8.8**	-3.9**	3.8
CommCapacity × GroupSize							2.5	13.4**
ΔR^2 Surplus	0.061		0.015		0.024		0.004	
Standard error surplus	9.352		9.296		9.191		9.187	
ΔR^2 Time		0.052		0.069		0.036		0.020
Standard error time		22.480		21.679		21.269		21.057

Notes: Unstandardized coefficients are displayed. † Regression is significant at the 0.10 level (two-tailed). * Regression is significant at the 0.05 level (two-tailed). ** Regression is significant at the 0.01 level (two-tailed).

Table 5. Robustness Test on Surplus.

Source	Numerator df	Denominator df	*F*	Sig.
Intercept	1	258.6	5,722.1	0.000
GroupSize	1	258.6	2.1	0.149
CommCapacity	1	258.6	4.7	0.031
CommCapacity × GroupSize	1	258.6	1.0	0.328

enlarging groups and introducing a communication channel both delay group task completion in terms of generating an initial group bid.

Based on Model 3, the groups of four buyers with a communication channel spent 13.4 seconds longer than the groups in the other treatments to generate the first bid offer, that is, the larger the group, the stronger the effect of communication. The *R*-squared changes indicate that a communication channel, group size, and the interaction effect contributed 6.9 percent, 3.6 percent, and 2 percent explanatory power, respectively.

Robustness Tests

Using linear regression, we can easily interpret the effects of each predictor through the significance level of the coefficients. But employing a mixed model analysis has been recommended as the better alternative in cases with missing observations in repeated measures data than the conventional regression method [51, 36]. To check the robustness of the main tests, we therefore conducted a mixed model analysis on the two dependent variables. In the new model, we set group as the test subject instead of experimental round of a group, and, likewise, we set the period as within-subject effects instead of as control variables. The type III tests of fixed effects for the two dependent variables are shown in Tables 5 and 6, and they suggest that *CommCapacity* is a significant predictor for *Surplus,* and *CommCapacity, GroupSize,* and the interaction *CommCapacity* × *GroupSize* is a significant predictor of *Time.* These results are highly consistent with the results of the main tests, except for the effect of group size on buyer surplus. Our robustness analysis could not identify a significant effect of group size on buyer surplus, which, however, was only weakly significant at the 0.1 level in the main test to begin with. But this inconsistency could perhaps be attributed to the unequal sample size of the testing groups. Our hypothesis testing results are summarized in Table 7.

Additional Analysis

Based on our results, we found an effect of adding a communication channel on buyer surplus that is in the opposite direction from that we theoretically predicted. Because the group buying process is very dynamic and highly interactive, it is difficult to discern the underlying reasons for the negative role

Table 6. Robustness Test on Time for Task Completion.

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	212.52	461.2	0.000
GroupSize	1	212.52	37.9	0.000
CommCapacity	1	212.52	22.9	0.000
CommCapacity × GroupSize	1	212.52	11.2	0.001

Table 7. Summary of Hypothesis Testing.

No.	Hypothesis	Dependent variable	Result
	Buyer Surplus		
H1	Group Size and Buyer Surplus Hypothesis: Increasing the group size of buyers in a group buyer model tends to increase buyer surplus.	Buyer surplus	Weakly supported
H2	Communication Capacity and Buyer Surplus Hypothesis: Introducing a communication channel for buyers to exchange private messages tends to increase buyer surplus.	Buyer surplus	Not supported
H3	Communication Capacity and Group Size Interactions on Buyer Surplus Hypothesis: Introducing a communication channel in group-buying will increase buyer surplus in bigger groups more than in smaller group.	Buyer surplus	Not supported
	Time for Group Task Completion		
H4	Group Size and Task Completion Hypothesis: Increasing the group size of buyers tends to delay group task performance.	Task completion time	Supported
H5	Communication Capacity and Task Completion Hypothesis: Introducing a communication channel for buyers to exchange private messages tends to delay group task performance.	Task completion time	Supported
H6	Communication and Group Size Interactions on Task Completion Hypothesis: Introducing a communication channel in group-buying will delay the group task performance in bigger groups more than in smaller groups.	Task completion time	Supported

of the communication channel. Therefore, we conducted a post hoc analysis to explore some possible explanations for this unexpected but interesting finding.

In Tables 8 and 9, which summarize the descriptive statistics on bidding and communication activities (i.e., number of bids submitted and number of messages posted), our analysis shows that bigger groups submitted more bids and exchanged more messages than smaller groups. This implies that bigger groups have to process more information within the same time window in the process of reaching consensus on a joint offer than smaller groups. We followed up on this insight and ran a logistic regression[7] for *GroupSize* and *CommCapacity* on success rate, using rounds (early vs. late) as a control variable, and found that bigger groups were less successful in making deals, that

Table 8. Bids per Group.

	Without communication					With communication				
		Failed rounds		Successful rounds			Failed rounds		Successful rounds	
	Success rate	*N*	Number of bids	*N*	Number of bids	Success rate	*N*	Number of bids	*N*	Number of bids
Small groups	77.3%	25	12.4	85	5.6	72.3%	36	6	94	2.6
Large groups	57.7%	55	14.4	75	6.1	52.5%	38	11.1	42	5.9

Table 9. Messages Posted per Buyer (Group).

	Failed rounds	Successful rounds
Small group	1.3 (2.7)	0.9 (1.8)
Big group	2.9 (11.6)	1.8 (7.2)

is, in getting a bid accepted by the seller, than smaller groups ($p < 0.01$). While groups with communication channels showed a lower success rate than the groups without a communication channel (Table 8), this difference was statistically not significant. However, we also found that all groups were generally more successful in making deals in later rounds than in earlier ones ($p < 0.01$), confirming learning effects in terms of deal-making success rates similar to those we found for surplus levels.

The number of bids submitted per group depends not just on group coordination but also on mutual interdependencies between buyer and seller bidding tactics, like how hard a seller negotiates or how efficiently the buyers respond to an offer rejection. The average number of bids per buyer per group submitted almost doubles in failed rounds compared to successful rounds (Table 8). In the rounds that ended successfully with accepted bids, groups with a communication channel submitted fewer bids than the groups without a communication channel, which implies that with communication, buyers tend to submit their bids more tactically than the buyers without a communication channel. In other words, the availability of a communication channel helped groups with coordination, resulting in more efficient bidding and fewer exploratory bids. However, we did not observe the surplus increases that we expected from these improved group coordination patterns.

For messages exchanged, we found that in rounds that ended unsuccessfully, with failed last bids and no deals, buyers posted more messages than they did in the successful rounds. Given the time constraints for a round, this means that if buyers were not able to use the communication channel effectively, for example, if they posted irrelevant or redundant information, information overload could occur. The literature in task complexity and decision making suggests that for performing more complex decision tasks, decision makers tend to simplify the process by limiting information search to accelerate their evaluation [39]. Ineffective communication burdens the decision-making process for the buyers, which can result in information overload and failed bidding outcomes. This applies especially to the larger groups, which not only generate more messages per group member but also need to read and process messages from a larger number of group mates. In other words, the amount of information shared grows exponentially with group size.

With regard to message content, we also noticed that, perhaps because of the time constraints and task complexity, a considerable number of emotional expressions were shared through the communication channel. In Table 10, we show a few selected sample messages illustrating how the participants

Table 10. Sample Messages Shared Through a Communication Channel.

Nonemotional examples	Emotional examples
"i joined 14"	"this is getting boring"
"price might be too low"	"i hate this game."
"i like 22"	"*no PRESSURE!"
"worth a try"	"damn"
"i think 20 is fair"	"?!!!!!!!?!??!?!?!?!?!?!?!?!?!?"
"what's your values?"	"hopeless"
"mine is 83"	"you definitely did not read the instructions!"
"how about 23 first then bit up?"	"u bettah watch yoself b4 u reck urself playa"

expressed emotion. The emotional messages imply stress as well as conflicts, and they may stimulate even more arousal among the other group members when they receive them, and thus further increase task complexity.

Our analysis of buyer activity suggests that introducing a communication channel can help group buyers coordinate better bidding tactics, but also that if buyers use the communication channel inappropriately, information overload may occur. Given the ambiguity between improved bidding tactics but unchanged buyer surplus, we can draw the conclusion that increasing communication capacity will not by itself improve buyer surplus in a group buying auction setting. This outcome is also consistent with the efficient market hypothesis that publicly posted price signals (bids) contain all the information needed to discover efficient transaction prices in transparent markets [16, 50].

Discussion

Our study finds some partial support for Galbraith's original skepticism regarding the potential for countervailing power from consumers [15]. While adding a communication channel improved the groups' ability to form, it did not prove sufficient to help them negotiate better prices. In other words, the communication channel provided groups the necessary capacity to accomplish the coordination task of group formation but was insufficient to successfully accomplish the more complex task of price negotiation. As a possible explanation for this finding, we suggest that a simple messaging box may be sufficient to support the former but not the latter task and that more advanced communication tools, such as social media tools with better information filtering features, may be necessary to provide consumers with the communication capacity to more effectively negotiate better prices in group buying settings.

In our experiments simple message exchange appeared too unstructured and distracting to efficiently aid price finding within the given time restrictions participants had to work with. Smaller groups were the most effective in using communication technology but became bogged down with information overload as group size increased and more messages were posted and needed processing. The larger groups with a communication channel actually performed worse and were ineffective in using communication technology to better support coordination; they performed slower and only got marginally better prices. The complexity from larger groups offset any advantages that adding communication capacity could enable.

This interesting trade-off between the benefits from IT-enabled coordination capabilities and its associated costs due to increased task complexity raises the question of how to best manage consumer interactions on social buying platforms.

Implications

Our findings have implications for both research and business practice. Particularly, they make a contribution to the literature on IT-enabled coordination by showing that introducing a consumer-to-consumer communication tool can create an effective coordination mechanism with significant consumer value that can change the social commerce relations between sellers and buyers.

For business practice, our study suggests that group buying site operators need to be concerned about both the level and the kind of communication tools they want to offer to their buyer customers and should be mindful that larger buyer groups may need different kinds of communication support from those needed by smaller groups.

Possible Future Research Directions

We have investigated the role of communication technology in group buying from a decision-making theoretical perspective that emphasizes task-technology fit and advocates a positivist research approach [20]. To more accurately capture the dynamics among buyer groups, such as leadership, conflict management, or atmosphere, an interpretive research method such as qualitative interviews or protocol analysis should be applied in future research to better understand the decision-making process from the buyer's point of view [11]. In addition, the interdependent role of task complexity, conflicts, and group diversity [22] should be investigated more deeply to develop more efficient market mechanism and provide more personalized technology platform designs.

Another research possibility is to drop the design assumption of fixed, preassigned groups and let buyers decide whether and when to join a group, thereby introducing some level of competition between buyers. More specific seller analysis should be done as well and might include a seller design with more complex seller cost structure with explicit reservation prices.

Another interesting direction concerns the evaluation of other, possibly more sophisticated social technology tools that could be used in online group buying.

Using Internet-based field experiments offers an interesting complementary approach to controlled lab experiments, and they could be used to examine group size effects and impact of communication, allowing researchers to work with very large and dynamic groups and a variety of social tools in a real-world setting.

Finally, we limited our study to a group buying model with an adaptive price threshold, but we suggest examining different types of price thresholds, including fixed and adaptive ones, in future research.

Limitations

This study has a number of limitations. While the experimental design was tested in early pilot tests and subsequently refined and improved several times, a number of potential design limitations became apparent only after data collection had been under way or completed. The following seven appear to be the most critical ones:

1. The number of rounds in which groups failed to successfully form and transact was higher than expected. This may be related to the perhaps too restrictive time restrictions (two and a half minutes per round).
2. The bidding mechanism that was implemented (incremental bid changes only) might have complicated price negotiation among buyers in cases where the valuation spreads were high.
3. Buyers were preassigned to groups and did not have a choice to form alternative groups if the existing one did not match their preference structure well.
4. Participants were compensated with course credit, which might not have been sufficient to fully induce economic behavior in every case.
5. The experiment implemented only one specific type (buyer-initiated) of group buying model, which limits generalization beyond this particular model.
6. It is unclear how robust our results are with respect to changes in the preassigned buyer preferences (i.e., the set of WTP values).
7. Buyers were not made aware of time costs in the experiment and were not given extrinsic rewards for quicker deal completion times.

Another limitation was the exclusion of analyzing the seller data in the present study; however, future studies should closely look at the interaction between the sellers and buyers in this type of setting.

Conclusion

Our paper makes two principal contributions. First, it contributes to the social commerce research literature by showing that the benefits of social technology may diminish when complex group tasks—such as coordinating and negotiating group bids under heterogeneous buyer preferences—need to be performed by large groups. Our study provides empirical evidence that platforms offering users social technology to support group work trade off the benefits from having a better coordination mechanism available with increasing the complexity of the task. As groups grow in size, this effect of trading off better coordination capabilities against higher task complexity becomes stronger and the costs may eventually outweigh the benefits.

Second, our study also contributes to research in design science by presenting a novel approach to evaluating newly developed IT-based systems. We argue that combining design science [18] with experimental economics [49]—designing an IT artifact (e.g., an IT-enabled market mechanism for electronic group buying platforms), implementing it, and then evaluating it using economic performance measures, as demonstrated in this particular study, offers researchers a useful and versatile approach to systematically designing and evaluating new electronic market mechanisms and platform features that is applicable for a large range of research problems. We particularly recommend this approach to researchers who study how incorporating IT-enabled features and mechanisms in electronic market or electronic business platform designs creates economic value.

NOTES

1. The market has grown strongly over the past few years, particularly in the United States and China. For example, Groupon, which was founded in 2008, has had a rapid rise, expanding business globally and generating $1.6 billion in revenue in 2011, but at the same time has also been struggling to find a sustainable business model. According to a report released by the China Investment Consulting group [6], group buying sites generated 14.6 billion renminbi in sales in 2012, an increase of 124 percent over the previous year. The China market is fiercely competitive and highly fragmented. By June 2012, a total of 6,069 group buying businesses were registered, with 3,210 companies (52 percent) still in operation.

2. In addition to theoretical support, innovators have sought and obtained a number of patents that describe the use of IT-enabled coordination features and mechanisms specifically to help buyers on electronic group buying platforms to better coordinate and achieve cost savings (e.g., [14, 25, 54]).

3. The z-Tree software package is widely used in the experimental economics field. z-Tree (Zurich Toolbox for Readymade Economic Experiments) was originally developed in the Economics Department at the University of Zurich. It is distributed under a free user license (www.iew.uzh.ch/ztree/). The software allows researchers to design and run economic experiments in the laboratory. It is a distributed computing application that offers features that support communication between the participants' computer workstations, data collection and management, time management, surplus calculation, and some user interface tools for screen layout. Customizable modules are available to implement a number of standard experiments such as market experiments, auctions, public good experiments, and structured bargaining experiments. Other experiments can be composed and combined from existing modules and additional user-written code.

4. In general, for practical reasons, experimenters will choose the smallest number of human participants that is sufficient to bring out (existing) differences between experimental conditions. We base our specific parameterization on previous experimental research on group task performance showing that two and four are appropriate choices for group size. Using this operationalization, differences in group behavior and performance have been shown in various research areas,

including auction experiments in economics [43] and team performance in group decision support systems research [13]. With group size 2 (dyad), each buyer has equal opportunity to voice opinions and exercise rights. Simmel [48] recommends three as the minimum group size for experiments that require nondyadic, multilateral negotiations. When group size grows from two to four, the complexity with respect to potential conflicts of interest among group members and with respect to communication demanded increases substantially.

5. The seller and buyer instructions are available from the authors upon request.

6. The coefficients for $Period_1$ to $Period_9$ indicate the differences in surplus or time between a specific period and the arbitrarily chosen reference period 10. Mathematically, it does not matter which period is chosen as the reference period. Any of the periods could have been used, and the same results would have been obtained. By statistically controlling for the effects of repeated measures, we can claim more valid results regarding the treatment effects in the experiment.

7. The larger group/smaller group odds ratio of 2.625 shows that a larger group is much more likely to fail in the bidding task than a smaller group ($p < 0.01$). The later stage/early stage odds ratio of 0.530 shows that in the later stage, groups are much less likely to fail in a bidding task than in the early stage ($p < 0.01$).

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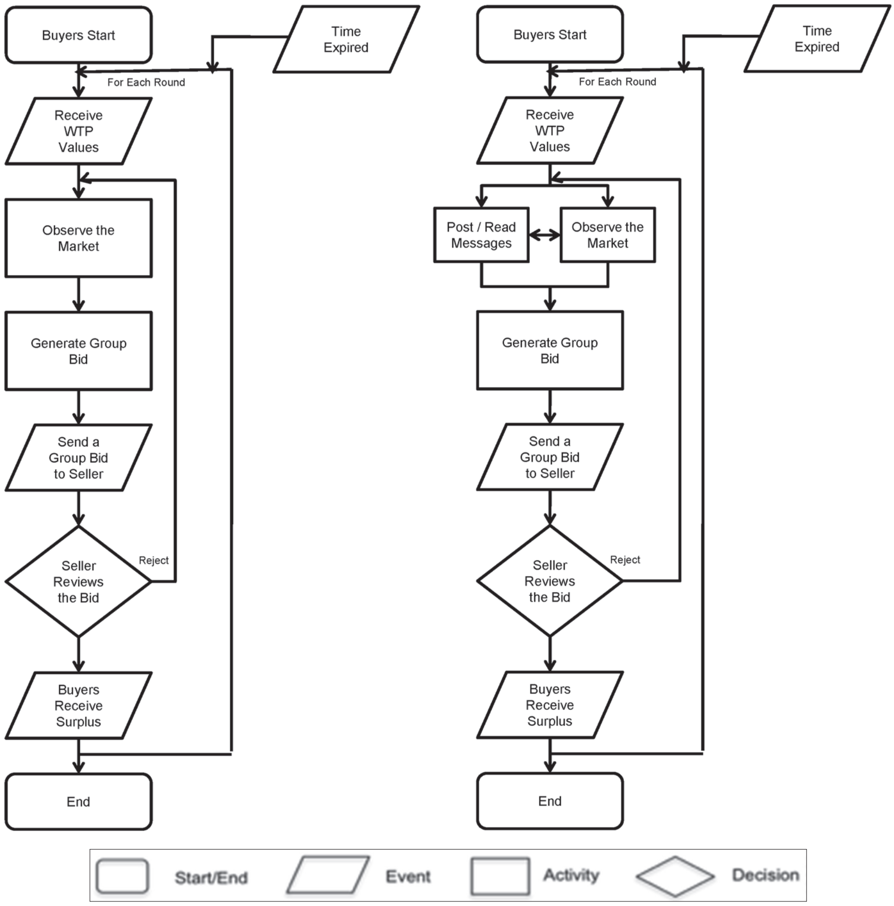
Appendix A: Experimental Flow Chart



Appendix B: Seller Screen Design

Appendix C: Buyer Screen Design

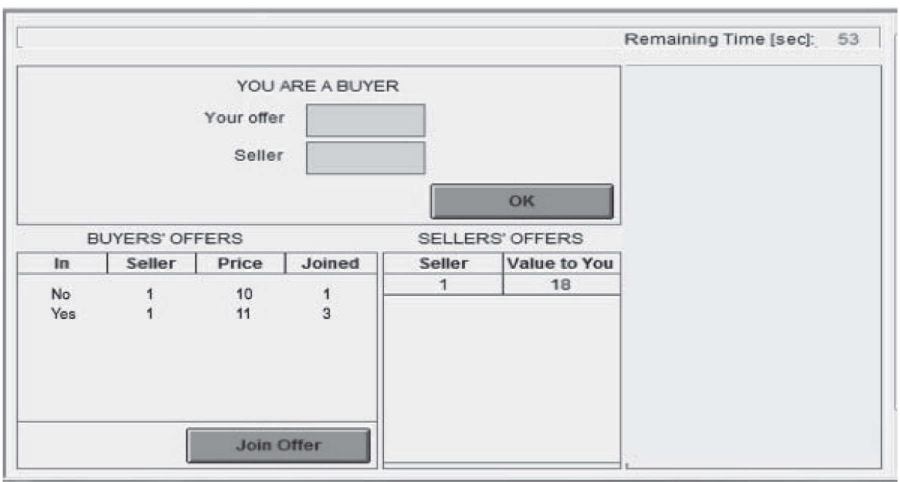


Figure C1. Buyer Screen Without Communication Box

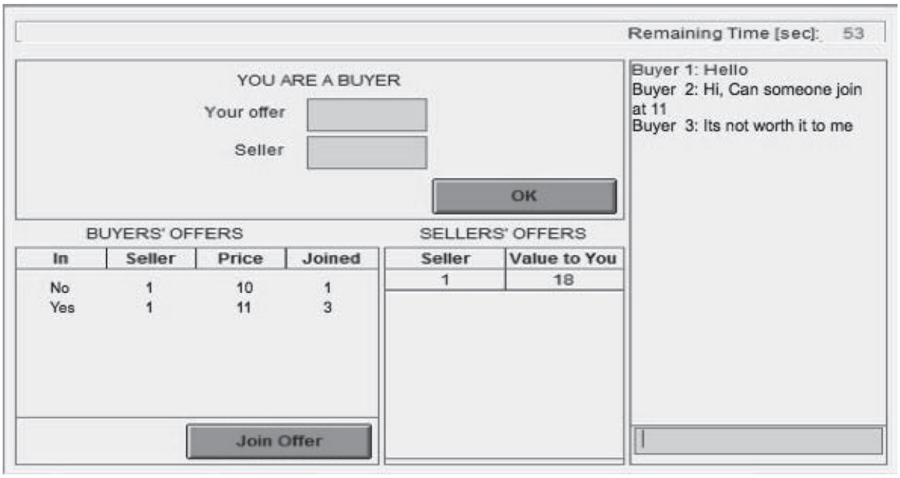


Figure C2. Buyer Screen with Communication Box

Appendix D: WTP Value Assignment Scheme

Table D1. WTP Values: 10 Numbers, Randomly Generated from *U*(25, 100)

V1	V2	V3	V4	V5	V6	V7	V8	V9	V10

Table D2. WTP Rotation Method

	Larger group				Smaller group	
Round	**Buyer 1**	**Buyer 2**	**Buyer 3**	**Buyer 4**	**Buyer 1**	**Buyer 2**
1	V1	V2	V3	V4	V1	V2
2	V2	V3	V4	V5	V2	V3
3	V3	V4	V5	V6	V3	V4
4	V4	V5	V6	V7	V4	V5
5	V5	V6	V7	V8	V5	V6
6	V6	V7	V8	V9	V6	V7
7	V7	V8	V9	V10	V7	V8
8	V8	V9	V10	V1	V8	V9
9	V9	V10	V1	V2	V9	V10
10	V10	V1	V2	V3	V10	V1

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