Abstract
We study effects of social processes’ representation in Internet auctions using laboratory experiments. The inability of participating parties to learn about each others’ bidding behaviour and to extend their comprehension beyond what is presented in auction sites today decreases the social influence compared to traditional face-to-face auctions. This reality is about to change since new interaction and collaboration technologies are emerging. A conceptual model used here associates social factors influencing bidders and the resulting bidding behaviour. We utilized an online auction simulation framework that facilitates transmission of social cues during an auction and conducted empirical study of behaviour in both English and Dutch auctions. We found that social presence, expressed by virtual presence and interpersonal information, significantly affects both bidding behaviour and market outcomes.

Keywords: auctions, bidding behavior, computer mediated communication, internet auctions, social presence, social cognition online

INTRODUCTION
Internet auctions are software-based implementations of a traditional auction format. Online auctions may have some inherent advantages. They allow access to a larger pool of potential buyers; remove some time and space constraints; decrease transaction costs and increase information availability. At the same time, in a computer-mediated environment, as opposed to face-to-face interactions, buyers cannot manually touch or handle the item that is on sale, and both sellers and buyers have more difficulties sizing up the other. This limitation raises issues of perceived risk and imposes behavioural limitations. Since direct and indirect interaction among auction bidders is limited, the influence of one on the others is ostensibly precluded.

Many scholars have noted the influence of technology on the social context in shaping the ways in which the medium is used. There is even a popular slogan about the medium being the message. In this study the focus is on the reverse influence – from social context and layout to technology. Social factors that affect bidding strategies in brick and mortar auctions may have different effects when using computerized interaction mechanisms that enable transmission of social cues.

The Internet is perceived to be ‘cold’ and impersonal. Many e-commerce websites enhance usability and sociability by providing visual display of sales representatives, sales agents and virtual 3D environments. Social presence in traditional face-to-face commerce is replicated in online environments. However, though online auctioning is tremendously popular and social interaction is an essential part of traditional auctions, Internet auction sites were not affected by this trend.

This study tests how social presence of bidders in online auctions affects bidding behaviour. The conceptual model emphasizes the relationship between social factors affecting the individual bidder, the influence that is generated by others, and the resulting bidding behaviour. We utilize an innovative auction framework that embodies communication technology to extend and express social context during the auction. We report on the results of a study conducted with this framework.

Two auctions models: English and Dutch auctions were used in this study. An English auction is an ascending price auction and is the most popular auction mechanism in traditional and online environments. A Dutch auction differs from the English auction mechanism in its descending price mechanism. This

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type of auction became famous as the mechanism used in flowers market in Netherlands.

The rest of this paper is organized as follows. First we review previous literature on auctions, social processes in groups and emerging Internet communication and presentation technologies. Next we present our research questions and describe the conceptual and research models. Hypotheses regarding the variables in the model are presented and the research method is described. Following a report of the results of our online simulations we conclude by identifying the experiments’ limitations. Finally, we present the contribution and propose future research directions.

THEORETICAL BACKGROUND

Research on auctions

Auctions are of research interest in the fields of economics, marketing and consumer behaviour. Various laboratory experiments and empirical field studies have been conducted in traditional markets (see Kagel 1995; Kagel and Levin 2002 for a thorough review). Internet auctions have been studied following the increase in trade values. Many empirical field studies collect data available in auction sites to analyse bidding behaviour. In what auctions do bidders participate? How do various auction rules affect the bidding? (for example: Bapna 2003; Bapna et al. 2001, 2004; Dholakia and Soltysinski 2001; Dholakia et al. 2002; Lucking-Reiley et al. 2000; Wilcox 2000). Most of these data were collected at eBay, the largest Internet auction site. These studies relate to various aspects of online auctioning. The following paragraph relates to studies of various factors affecting the individual bidder.

Determinants of bidding behaviour

A range of studies identify the determinants of bidding in Internet auctions: price, time of bidding and number of bids. These determinants can be classified into three groups according to their source:

1. **Personal factors** – these factors include perceived risk (Ha 2002; Resnick et al. 2003), internal independent estimates (Chakravarti et al. 2002; Dholakia and Soltysinski 2001), pre-purchase information search (Ha 2002; Hoyer and Brown 1990), level of experience in previous auctions (Dholakia et al. 2002; Hayes et al. 1995; Shogren et al. 2000; Wilcox 2000), information and learning (Hoffman et al. 1995; Jeitschko 1998) and enjoyment and thrill derived from the participation (Herschlag and Zwick 2000). These factors affect the price a bidder is willing to pay.

2. **Environmental factors** – these include the auction mechanism and rules (Pinker et al. 2003) such as: initial price, reserved price, bid increment and auction ending rule. These factors affect the price, time of bidding and the number of bids.

3. **Social factors** – these factors include people who are physically or virtually present. These factors also affect the price, the time of bidding and the number of bids. Social factors are composed of three subgroups:

   - **Other bidders** – the history of other bidders’ behaviour may provide valuable information. The behaviour may also be perceived as having greater credibility than seller-originating content. For example: it was found that herding bias is negatively related to the bid price (Dholakia and Soltysinski 2001). The number of bidders at the auction may also affect bidding behaviour and have a negative effect. The ‘winner’s curse’, a term which was coined while analysing loss of profits of winners at auctions, is explained by the rules of an auction – the prize goes to whoever has the most optimistic view of the value of the object being bid upon. In some cases, this implies that the winner is the person who has overestimated the most. A larger number of bidders implies higher winner’s curse (Andreoni and Miller 1995; Kagel and Levin 1986).

   - **The seller** – a large body of empirical studies on effects of seller’s reputation have been undertaken in the last few years (for overviews see: Dellarocas 2003; Resnick et al. 2003). It was found that seller’s past history and feedback rating affect the probability of the sale as well as the price paid. History and feedback ratings have a measurable effect on the auction price (Lucking-Reiley et al. 2000).

   - **Other people** – these are people who are not involved directly in the auction but may be the cause for participating in the auction, such as family members and other consumers.

While this classification identifies the influencing factors, a range of variables measures bidding behaviour:

1. The decision to participate in a specific auction (Dholakia and Soltysinski 2001; Dholakia et al. 2002; Lucking-Reiley et al. 2000) and the number of bidders in a specific auction (Wilcox 2000).

2. Times of entry and exit (Bapna 2003; Bapna et al. 2004; Dholakia et al. 2002).

Social influence in traditional and CMC groups

To classify the type of influence imposed by other bidders we need to explore the context in which this influence arises and examine the conditions favouring each type. We begin with a discussion of social influence theory in traditional groups followed by social influence in CMC groups. Then, we examine relevant studies of social influence in traditional and online auctions.

Groups are of interest in the fields of marketing, consumer studies and other applied research because an individual consumer belongs to several groups and is influenced by others. Behaviour in groups is often more readily predictable than that of individuals (Foxall et al. 1998). The interdependence of group members is made enduring by the evolution of group identity that integrates beliefs, values and norms of the group. A reference group, in its social context, is any individual or collection of people whom an individual uses as a source of attitudes, beliefs, values or behaviour (Wilkie 1994). The group is used by the individual as a source of comparison for behaviour, personal attitudes and performance. There are extensive implications of reference groups for consumer behaviour since a reference group may influence the individual. One example is of purchases that are subject to group pressure.

Membership in a group involves accepting a degree of conformity. Conformity also occurs through the referent power of groups. An individual who conforms to a group gives the group the power to influence her actions. The group acts as a standard of social comparison or as a point of reference. The individual compares her behaviour to that of the group and adjusts to match what is observed.

Sources and process of social influence are explained by two general theories: normative and informational influence (Bearden and Etzel 1982; Kaplan 1987; Latane 1981). Normative and informational influence models differ in the underlying mechanism of persuasion that they propose and in assumptions made about human nature. Normative influence presupposes an emphasis on the group and on individual's position in it. The motivation for normative influence is based on social rewards and is centred on interpersonal relations. Informational influence emphasizes the task concerns and is driven by an individual's desire to arrive at accurate or correct decisions. If a change or a shift in the decision occurs, it is caused by the incorporation of new data that was provided to the individual. When both models are introduced, studies show that informational influence is more common than normative influence and causes stronger shifts (Kaplan and Miller 1983).

Social Impact Theory (Latane 1981) proposes that social influence is a function of the strength (S), the immediacy (I), and number (N) of the people (or sources) present. Despite the lack of direct physical contact or immediacy, even mediated groups can be very real to their members (Postmes et al. 1998, 1999; Sudweeks et al. 1998). Social influence in CMC groups is at the focus of many studies. These investigate how limitations of social interaction, when using CMC, affects group communication and decisions (Kiesler and Sproull 1992; Rafaeli 1988; Spears and Lea 1992; Sproull and Kiesler 1991). It was found that content and form of communication within a CMC group is normative and that conformity to group norms increases over time (Postmes et al. 2000). While early theories suggested that face-to-face interaction strengthen the interpersonal bonds that transmit social influence, whereas isolation and anonymity weaken them, more recent theories including the Social Identity model of Deindividuation Effects (SIDE) (Reicher et al. 1995) predicts that relative anonymity in CMC group can enhance the influence of group norms.

Bidders aggregated or congregated with other bidders present at an auction share some characteristics of a group, though of course this group is not a community. A collection of individuals who congregate at an auction has a limited life span. The individuals are present at the same place, have a similar goal, and are influenced by one another. Earliest research insights in the literature about auctions claimed that a bidder should study the past behaviour of competitors (Friedman 1956). Other auction literature emphasized the importance of learning and being aware of the influence of other bidders (Kagel 1995; McAfee and McMillan 1987; Milgrom 1989; Smith 1989; Wilson 1992). The influencing process in auctions is strengthened as the vast majority of auctions contain a CV (Common Value) component. Items sold in CV auctions do not have a definite market value. It is a situation where the individual may need to refer to other
bidders’ estimations. The individual may also change valuation due to the influencing power of others.

Research on auctions in the digital market reported similar observations. Despite the anonymity, and only weak sense of a group, bidders are influenced by one another (Chakravarti et al. 2002; Herschlag and Zwick 1999; Dholakia and Soltyensiski 2001; Dholakia et al. 2002; Jeitschko 1998; Senecal and Nantel 2001; Varian 2000; Wilcox 2000). This influence occurs despite the limited ability to receive social cues in online auctions.

Social cues, which consist of verbal and non-verbal signs, provide signals to behaviour in face-to-face environments and are replicated in some online environments (as will be discussed later).

Though online auctioning is tremendously popular and both direct and indirect social interactions are part of traditional auctions, Internet auction sites do not provide virtual presence and real-time interaction capabilities. One reason for limiting communication and interaction among bidders during the auction is a concern about an increase in fraud.

Absence of social cues in online auctions may limit bidders’ ability to analyse behaviour of other bidders and make improved decisions. In the next paragraph we discuss theories about social cues in different media and describe several online mechanisms used today to enhance social cues in a CMC environment. Later we examine effects of incorporating similar mechanisms in an online auction framework.

Enhancing social cues in CMC

Social cues can be enigmatic in CMC, especially in the absence of supporting technologies that facilitate interaction. Two theories should be addressed in this context: (1) Social Presence theory and (2) Media Richness theory.

Social presence is a variable in mediated communication (Short et al. 1976). It is defined as the sense of intimacy and immediacy, leading to increased satisfaction, involvement, task performance and social interaction (Lombard and Ditton 1997). It affects the way individuals perceive a medium and people whom they receive messages and communication from. The amount of social presence varies among each type of medium. While face-to-face yields a high level of social presence, computers have been found to have less social presence than other mediums due to an absence of nonverbal cues (Papacharissi and Rubin 2000). Social presence has two dimensions related to intimacy (interpersonal versus mediated) and immediacy (asynchronous versus synchronous). Social presence theory predicts that several types of CMC can create in users a sense of intimacy and immediacy.

A medium’s richness is measured by its capacity for immediate feedback, multiple cues, language variety and personalization (Daft and Lengel 1986). A medium affects the process of communication and collaboration between people in different ways due to which modalities it supports. It has been argued that media differ in their capacity to carry data that are rich in information (Daft and Lengel 1986; Rice 1993; Short et al. 1976). Social presence ranking depends on an interaction between the medium and the task at hand, and is based on the subjective judgment of the user (Lombard and Ditton 1997).

In the years since the formulation of the medium richness approach, technology’s evolution has contended with the challenge of limited social cues of computers. In contrast, recent times were marked by the emergence of numerous communication and visualization technologies that enhance person-to-person interaction. These new arrangements include but are not limited to Instant Messaging (IM), interpersonal interfaces, peer-to-peer, streaming audio, Voice over IP, video and much more.

With the incorporation of human or ‘human-like’ faces into mediated environments the participants gain a stronger sense of their community (Donath 2001). People react differently to a ‘human-like’ interface. They are more aroused and present themselves in a more positive light (Sproull et al. 1996). Mediated entities, as social actors, have been introduced in computers just after television (Lombard and Ditton 1997). Microsoft, for example, presented ‘Bob’ which featured several characters and other products, tools and components with social interfaces and human like appearance such as ‘Office Assistant’ and ‘Microsoft Agent’. However, we should not overlook the distinction between human-like impersonations of real people, and those of imaginary entities.

Numerous social and personalizing technologies were adopted by educational and e-commerce sites. To name a few: BuddySpace provides enhanced presence management in IM and other contexts by presenting location maps and visual representations of the parties in conversation. MSN messenger, a popular IM tool enables users to add their picture and even conduct video chats. LivePerson offers online salesperson assistant tools each with intuitive ability to chat with a customer. OddCast creates broadband interfaces. Included are realistic, computer-generated ‘spokespeople’ who guide users through a variety of tasks (Berman 2003). OddCast found that talking characters enhance users’ experience to positively improve most key business metrics, such as: ‘click through rate’, ‘visitors converted into registrants’, ‘conversions’ and ‘traffic’. Streaming animation of a face and other characters is also used in mobile technologies.

Although high bandwidth connections have eliminated many technical barriers to making CMC features real world appearance, a large body of research (including several research groups) has focused on the
presentation of participants and social interaction in a minimalist way. Interaction maps (Baker 2002), visualization of crowds (Erickson et al. 2002; Minar and Donath 1999), conversations (Donath et al. 1999; Erickson et al. 1999) and other online activities (Donath 1995; Erickson et al. 2002) are a few examples.

RESEARCH QUESTIONS, MODELS AND HYPOTHESES

Earlier, we described evidence of social influence in traditional and in Internet auctions. Of course, traditional and Internet auctions are very different. In Internet auctions, due to the lack of interaction among bidders, a participant is limited to relevant information that is transmitted by the explicit behaviour of other bidders. While interaction technologies have been adopted in various e-commerce domains, online auctions have been left out. Our research turns attention to the following question: How does social presence of bidders in online auctions affects strategic bidding behaviour? The term ‘strategic bidding behaviour’ refers to decisions and activities made during an auction, such as the decision to participate in a specific auction, time of entry and time of exit from the auction, the highest bid and number of bids a bidder submits.

Studying this question will provide better understanding of the impact of social influence in CMC environment and will test the SIDE model in a competitive environment as online auctioning. Additionally, by analysing the influence of the underlying components of social presence and by utilizing the ‘Media Richness theory’ and ‘Social Presence theory’, it will provide recommendation to constructing richer online environments.

The conceptual model presented in Figure 1 correlates between three groups of influencing factors that were identified earlier: (1) Personal factors that characterize the individual bidder as: perceived risk, internal independent estimate and level of enjoyment from the auction; (2) Environmental factors which include auction’s mechanism and rules; and (3) Social factors: relating to other people who are physically or virtually present during the auction such as other bidders, the seller and other influencing people. These factors, and especially social factors, generate social influence on the individual bidder, which may have both normative and informational constructs and some other types of influence. As a result of the influence, strategic behaviour of the bidder, which is demonstrated by: selection of the auction site and the specific auction, time of entry and exit from the auction, her bids and number of bids, may change.

Social cues can be generated by multiple sources. In this study we focus on Virtual Presence because of its role in the ‘Social Presence theory’, the ‘Media Richness theory’ and the SIDE model. A second source of social signals is Interpersonal Information which may be generated by consumer’s WOM.

In this study we use these two sources as independent variables that may generate normative and informational influence. We are interested in finding the effects on three dependent variables that comprise the ‘strategic bidding behaviour’ construct: (1) Purchasing decision – the purchasing decision variable gauges bidders’ eagerness to succeed in the auction; (2) High bid – the price a bidder is willing to pay for the item; (3) Number of bids – submitted by a bidder throughout the auction. This variable reflects the level of involvement in the auction (Bapna et al. 2004).

These three variables have been identified as measures of bidding behaviour in an earlier section. We intentionally held constant two other (real life) variables: (1) Time of entry; and (2) Time of exit from the auction, as we wanted to control the exposure time to the manipulation of the independent variables.

The research model presented in Figure 2 utilizes Virtual Presence and Interpersonal Information as the independent variables and Purchasing Decision, High Bid and Number of Bids as the dependent variables. Social Influence Theory forms a relationship between the independent and dependent variables, while ‘Social Presence theory’, ‘Media Richness theory’ and the SIDE model are used as part of the explanations for the hypotheses.

We assume that in settings with higher levels of Virtual Presence or Interpersonal Information a bidder may demonstrate:

- A stronger willingness to make a purchase. The desire to win the auction and make a purchase may increase due to the following reasons. First, in setups with higher levels of Virtual Presence or Interpersonal Information additional data becomes available and some uncertainties about the good and its qualities, about the price and the trust of other bidders and the seller, are removed. Second, a higher level of information is related to a lower perceived risk (Ha 2002; Resnick et al. 2003). Third, higher level of Virtual Presence of other bidders may be perceived by the individual as having a bigger crowd at the auction and may drive competition, which sometimes leads to a winner’s curse (Andreoni and Miller 1995; Kagel and Levin 1986). And finally, higher level of Social Presence increases enjoyment, involvement and thrill from the auction, which may increase the willingness to win. Hence we hypothesize:

H1(a): Purchasing Decision is more likely to occur when participating in an auction with a higher level of Virtual Presence of other bidders.

H2(a): Purchasing Decision is more likely to occur when participating in an auction with higher level of Interpersonal Information of and from other bidders.
• Paying lower prices. Two explanations lead to this hypothesis. First, the ability to analyse social cues transmitted by other bidders and the addition of information provided by interpersonal sources can improve decision-making process during the bidding phase. In this situation a bidder may examine other’s strategic behaviour from a different point of view and can arrive at an improved strategic behaviour in order to win the auction but avoid a winner’s curse. A second explanation, which is derived from the SIDE model, is that anonymity may obscure individual inputs and thereby enhance the salience of the group and of its norms. The SIDE model predicts that in CMC settings with a high level of social presence, the social influence will be weaker compared to setups with relatively low level of social presence. When the level of social presence is higher a bidder will feel confidence in her evaluation and be less dependent in others’ valuation. In this situation a bidder will ignore other’s valuation when it is higher then her own valuation. The formal hypotheses are:
Auction theorists identify four basic auction models: First Price Sealed Bid, English, Second Price and Dutch (McAfee and McMillan 1987; Milgrom 1989). Recent Internet auction research has focused on eBay participants. eBay uses a hybrid of the English and Second Price sealed bid formats. Other auction formats are often overlooked in recent studies but are common in traditional auction research. We chose to test our hypotheses in the two contexts of English and Dutch formats.

English and Dutch auctions differ in their underlying bidding rules. An English auction is defined by an ascending price mechanism and an ability to adjust bids during the auction. A Dutch auction has a descending price mechanism with only one bid allowed. However both are characterized by their dynamic format: the ability of participants to react during the auction by posting a bid. We assume that bidding behaviour in these two auction formats will slightly vary due to higher levels of involvement and ability to adjust bids in the English auction. The formal hypotheses are:

- **H1(b): Winning** at lower prices is more likely to occur when participating in an auction with higher level of Virtual Presence of other bidders.
- **H2(b): Winning** at lower prices is more likely to occur when participating in an auction with higher level of Interpersonal Information of and from other bidders.

- A tendency to bid less often. This outcome is explained by two main justifications. First, even if other participants submit a high number of bids, the bidder may ignore it and rely on her own considerations. When the level of social presence is high, the bidder has a lower need to follow other’s strategic behaviour due to a removal of uncertainties and the integration of additional information provided by interpersonal sources. In this situation the bidder will submit fewer bids compared to a situation where she has a higher need to follow other’s behaviour. Second, at setups with a high level of social presence a bidder will try to hide her valuation of the item by submitting less bids, as much as possible, since in this setup she may perceive other bidders more realistically. The hypotheses derived from these arguments are:

  - **H1(c):** When participating in an auction with higher level of Virtual Presence of other bidders a participant will likely post fewer Number of Bids.
  - **H2(c):** When participating in an auction with higher level of Interpersonal Information of and from other bidders a participant will likely post fewer Number of Bids.

During the auction several output variables can be measured. Table 1 correlates between these variables and the dependent variables in each of the two auction models.

**METHOD**

We test the hypotheses by conducting two empirical experiments: one for each format. Each experiment included several sessions where human participants competed with simulated bidders in a simulated online auction. Data pertaining to the hypotheses were collected during a series of eight meetings. To improve reliability of the measures, a pre-test was carried out to detect any necessary changes in the wording of the instruction pages, in the display and in the operation of the auction software.

**Participants**

Participants were undergraduate business and MBA students in Israeli universities. Participation was voluntary, but class credit points were offered as inducement to the best performers in each experiment. Some of the participants performed the experiments online via a home connection, while others performed the experiment in a classroom computing laboratory. No differences were found between location groups. A total of 188 students participated in the English auction experiment and 123 students participated in the Dutch auction experiment.

**Experimental procedure**

A $2 \times 2$ design was used in each experiment. Each independent variable: Virtual Presence and Interpersonal Information, was tested in two levels: high and low. While at the highest level presence or information components were included in the setup, at the low level they were absent. This research design generated four conditions (Condition 1–4) as presented in Table 2.

Figure 3 and Figure 4 present a screen shots of part of the conditions.

The two experiments were identical in their design. Participants were randomly assigned to one of four Presence and Information conditions and each trial was composed of four or more phases: (1) Instructions; (2) Trial session; (3) First auction session; (4) Second auction session; and (optional) (5) Additional auction sessions. The total number of auction sessions a
participant would experience was not limited and varied between participants. Every session included participation in an online auction taking 2–3 minutes and followed by a period that allowed viewing results. The only difference between the two experiments was in the underlying auction mechanism.

Experiments were constructed entirely online to reduce experimenter availability or interference. In order to eliminate external distraction participants were instructed to surf only to the auction site and to avoid any other Internet-related activities throughout their participation. During the experiment participants received online feedback about their results after each session. Results included a list of all bids placed during the session in descending order. However participants were not informed about the value of the item and did not know whether the winning bid is relatively high or low. Final results comparing the winning bids to a market value (which was the mean of all winning bids) included names of the best performers. These were presented following the completion of the assignment.

**Auction rules.** No real or artificial money was used, no real payment was made and no real item was awarded to the winner. Winning determination was based on buying at lower prices relative to an unknown market value. In every session a single item (an antique watch) was ‘sold’. This item has a high CV component as its market price was unclear and participants bought it for trading purposes. In the English auction experiment participants joined a seemingly already ongoing auction. The auction ending rule was ‘hard’ (meaning the that the ending time was pre-defined) and a bidder with a highest bid at the end ‘won’ the item and ‘paid’ according to this bid. As the auction progressed, five simulated bidders joined the arena and actively participated in the auction. Each

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<th>Table 1. Relationship between variables</th>
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<td><strong>Variable</strong></td>
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<td>High Bid</td>
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<td>Win Bid</td>
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<td>Num of bids</td>
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<td>Num of bids if won</td>
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<td>Wins</td>
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<td>Bids Zero</td>
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<td>Continue</td>
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(+/-) Was measured (-) Was not measured

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<th>Table 2. Conditions of the experiment</th>
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<td><strong>Independent variable</strong></td>
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<td>Virtual Presence</td>
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<td>Interpersonal Information</td>
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Figure 3. Conditions 1 (left) and 4 of the English auction
of the joining simulated bidders was endowed with an independent predefined bidding strategy and a price limit higher than the initial price. These characteristics of the simulated bidders were interpreted by the simulation software into a sequence of bids (in the English auction) until they reached their price limit.

In each session of the Dutch auction participants joined an auction just before it started and initiated it by pressing a button. Five additional simulated bidders also participated in the auction, each having an independent price limit. Upon reaching this limit, the simulated bidders were programmed to post a bid.

Auction simulation framework. The experiment tool was an auction simulation framework program developed for research and teaching purposes (Rafaeli et al. 2003). This framework is composed of software components operating on both client and server computers and simulating an Internet auction site, auction mechanism and some of the auction bidders. The client side of the framework was implemented in Java, HTML pages and JavaScripts, operating in any Java enabled Internet browser. The server’s components include CGI/Perl scripts and operated on an Apache Web server.

Simulation of other bidders. All simulations are based on a simplified but accurate representation of some aspects of the real world (Maidment and Bronstein 1973). A use of a simulation program in our context enabled us to control the underlying behavioural characteristics of the simulated bidders. Nevertheless, these were not independent variables and were not manipulated.

Developing a social simulation that models behaviour in a social context is harder than a development of a physical simulation. There is no accurate description of the behaviour and behaviour of people and groups can’t be predicted because of the numerous variables with which to contend. For the purpose of this study we simplified the characterizing variables to a minimal set which includes two major groups. The first group of variables controls bidding strategy, while the second group controls the interaction of the simulated bidders via a chat mechanism. The simulated bidders were programmed to have a similar bidding strategy in all experimental conditions; however, their visual appearance and interaction abilities were dissimilar. The bidding strategy was based on a maximal price limit, which was assigned randomly to each of them, and on predefined parameters, which controlled their response time and willingness to react to a previous bid and post a higher bid during different phases of the English auction.

Social and informational cues. Four conditions were created as two levels of Virtual Presence and two levels of Interpersonal Informational. Cues were implemented by inducing different components to the auction site. Virtual Presence components included:

1. Pictures of other bidders’ faces – As other bidders joined the arena, their pictures were shown on the screen.
2. Instant messaging – simulation of an online chat room. Since other bidders were simulated, this chat process was simulated too. Messages ostensibly posted by simulated bidders were displayed and the participant could send messages of their own. A very simple feedback mechanism was implemented to respond to these sentences (Rafaeli and Noy 2002), preserving the illusion of a chat room.
3. Auction proxy – An auction proxy was constructed based on Erickson (2001) who visualized a socially translucent traditional bidding room by minimal graphical representation. A bounding circle represents the bidding room and bidders are represented by colour dots, which changed according to their position in the auction and according to others’ bids.
4. Additional presence cues – displaying the number of the previous interested bidders, displaying names of the bidders near their bids (instead of presenting a general data such as: ‘Bidder No. 4’).

The Interpersonal Information components were:

1. Names of other bidders – these are rarely presented in real auction sites.
2. Bidders’ information – Auction sites provide data about the reputation of the seller and sometimes of the buyer. The simulation framework used here provides additional data about the bidders: (1) Type of participation which was classified into: business or private participation, indicating the intentions and the eagerness to win; (2) Past winning history; (3) Experience level, which was classified to either professional or amateur levels; (4) Bidding interest – level of interest in the current auction, which was classified to: high, medium and low levels.
3. Recommendations – During auction sessions, interpersonal recommendation about the auction and the item on sale were presented to the participants.

RESULTS

Data analysis consisted of classifying auction sessions into groups and comparing the independent results of the first auction session of each participant. The additional auction sessions contained a reduced amount of data and were not independent. Auction sessions were classified into one of the following groups according to the condition:

- LP (Low Presence – low level of Virtual Presence) – Conditions 1 and 3;
- HP (High Presence – high level of Virtual Presence) – Conditions 2 and 4;
- LI (Low Information – low level of Interpersonal Information) – Conditions 1 and 2; and
- HI (High Information – high level of Interpersonal Information) – Conditions 3 and 4.

Hypotheses were tested by comparing results in LP and HP groups, and in LI and HI groups in both English and Dutch setups. To test differences in the ‘High Bid’, ‘Win Bid’, ‘Num of bids’ and ‘Num of bids if won’, four separate one-way analysis of variance (ANOVA) were performed. Difference in the ‘Wins’, ‘Bids Zero’ and ‘Continue’ variables were measured by performing four separate Chi-Square tests.

Hypotheses H1(a) and H2(a) were evaluated through the results of the ‘Wins’, ‘Bids Zero’, ‘Continue’ and ‘High Bid’ variables. The result of each is attributed to a purchasing decision’s component. Participants who offer higher bids and win are more likely to desire the item. In contrast, if a participant is involved in an auction without placing a bid, she may exhibit lower buying intentions. The ‘Continue’ variable provides supplementary indication about a willingness to continue to an additional auction session, and hence, is also attributed to a purchasing decision’s components.

Hypotheses H1(b) and H2(b) were evaluated through the ‘Win Bid’ variable. Hypotheses H1(c) and H2(c) were evaluated through the ‘Num of bids’ and ‘Num of bids if won’ variables.

English auction results

188 different bidders participated in 734 different auction sessions. Four additional sessions were disqualified and dropped from the data set due to extreme outlier, inconsistent and erroneous data. Some of the participants quit after a single session and some played up to 26 auction sessions. Overall there were 3.9 sessions on average per participant. Participants won in 473 sessions (64.44%) and lost in 230 (31.33%). In 31 auctions (4.22%) no bid was submitted. The range of winning bid prices was $290 to $1000 and market value (mean winning bid) was $517.73. Up to 18 bids were posted in each session with a mean number of 3.31 bids. Winning bidders posted up to 16 bids with a mean of 3.22 bids.

In their first auction session 109 (57.97%) participants won and 79 (42.02%) lost. Mean winning bid was $504.30 and mean number of bids of a participant was 4.71 bids per session.

Effects of Virtual Presence and Interpersonal Information. Results strongly support H1(b) and partially support H1(a). Virtual Presence created significant difference in ‘High Bid’ (see Figure 5). HP (High Presence) participants produced a ‘High Bid’ lower by 12.34% than LP (Low Presence) participants (F(1, 186) = 7.35, p<0.01). A significant difference of 20.86% was found in the ‘Win Bid’ variable (F(1,107) = 21.01, p<0.0001).

Results strongly support H2(b) and partially support H2(a). Interpersonal Information did not produce any significant difference in the ‘High Bid’ parameter. However, a significant difference was found in the ‘Win Bid’ parameter. HI (High Information) participants won at 10.19% lower prices than LI (Low Information) participants (F(1,186) = 7.35, p<0.01). These results are presented in Figure 5.

HP participants posted 30.58% fewer bids (‘Num of bids’) than LP participants (F(1,186) = 9.78, p<0.005). Winning participants showed the same tendencies. ‘Num of Bids if won’ in HP was 25.96% lower than in LP (F(1,107) = 3.98, p<0.05). HI participants posted
8.10% fewer bids than LI participants (insignificant). Winning bidders at both HI and LI placed almost the same number of bids (see Figure 6).

HP participants won 26.80% more times than LP participants ($t=5.37$, $p<0.05$). LP participants ‘Continue’ 8.02% more times to the next session than HP participants (insignificant). The number of participants that ‘Bid Zero’ in the two conditions was almost identical (five in HP, four in LP). HI participants won 9.63% more times than LI participant (see Figure 7). LI participants ‘Continue’ to the subsequent auction session 7% more times than HI participants and the number of participants who did not bid at all was almost identical. None of these differences are significant.

Regarding the Virtual Presence effect, results strongly support H1(b) and H1(c), namely that with higher level of Virtual Presence of other bidders, winning is expected at lower prices and with less bids. Results partially support H1(a) (‘High Bid’ and ‘Wins’ percentage were significantly higher in HP but ‘Continue’ and ‘Bid Zero’ results were not), namely that with higher level of Virtual Presence winning may, but will not necessarily be achieved.

Regarding Interpersonal Information effect, results strongly support H2(b), namely that with higher level of Interpersonal Information of and from bidders, winning is expected to occur. On the other hand results provide less support to H2(a), namely that with higher level of
Interpersonal Information winning bids may occur in a lower price. H2(c) was rejected, namely that with higher levels of Interpersonal Information a bidder does not necessarily post fewer bids.

Dutch auction results

123 different bidders participated in 426 auction sessions. Some of the bidders participated in a single session and some continued playing up to 37 sessions for a single participant. The mean number of auction sessions per participant was 3.46. Participants won 268 (62.91%) sessions and lost 158 (37.08%) sessions. In their first auction session 78 (63.41%) participants won and 45 (36.59%) lost. The range of winning bids was $268 to $997 and market value was $509.75.

Effects of Virtual Presence and Interpersonal Information. Results strongly support H1(b) and partially support H1(a). Virtual Presence produced significant difference in the ‘Win Bid’ (see Figure 8). HP participants won at 19.40% lower bids than LP participants ($F(1, 76)=7.1$, $p<0.01$). Interpersonal Information registered an opposite effect. Results partially support H2(a) but did not support H2(b). HI participants won at 4.24% higher prices than LI participants (this difference is not statistically significant).

HP participants won significantly more times ($t=4.15, p<0.05$) than LP participants (32.07%). They ‘Continue’ 9.32% fewer times to the next auction session (insignificant). HI participants won more times (57.42%) than LI participants ($t=10.56, p=0.0012$). They also exhibited a higher tendency (7.49%) to participate in an additional auction session than LI participants (see Figure 9).

Results regarding Virtual Presence effect provides strong support for H1(b) and partial support for H1(a) (the ‘Wins’ percentage was significantly higher in HP, but HP participants ‘Continue’ fewer times than LP participants). Results regarding Interpersonal Information effect provides some support to H2(a) (‘Wins’ was significantly higher at HI and ‘Continue’ was only higher) but H2(b) was rejected.

English and Dutch auction comparison

Hypotheses H3(a) and H3(b) received partial support. The change in the winning percentages (‘Wins’) due to Virtual Presence is higher in the English auction compared to the Dutch auction. The change in ‘Win Bid’ due to Virtual Presence is higher in the Dutch auction compared to the English auction. The change in the winning percentages (‘Wins’) due to Interpersonal Information is higher in the Dutch auction compared to the English auction. The change in ‘Win Bid’ due to Interpersonal Information in the Dutch auction is in a reverse direction compared to the English auction.

Table 3 summarizes the hypotheses and whether they received any support (significant or partial) or were rejected.
DISCUSSION

Though online auctions are popular and have operated successfully without enabling social interaction among bidders, it has been observed that both direct and indirect communication is part of traditional auctions and may influence bidding behaviour.

In this study we found evidence that the introduction of direct and indirect communication among bidders in Internet auctions as expressed in Virtual Presence and

Figure 8. Win Bid in the Dutch auction

Figure 9. Wins and continuation percentages in the Dutch auction
*Interpersonal Information* produced social influence that affected bidding behaviour in both English and Dutch auctions.

Results strongly support hypotheses H1(b) and H1(c) and provide strong support to some of the constructs of H1(a) in the English auction. ‘High bid’ and ‘Num of bids’ of both participants and winners were significantly reduced due to *Virtual Presence* effect.

Participants’ eagerness to succeed (as measured by ‘Wins’, ‘Bids Zero’ and ‘Continue’) was strengthened due to an increase in the winning percentage, but the number of participants who did not place a bid was not reduced, and ‘Continue’ percentage was not increased. Taking into account that only a negligible number of bidders did not place a bid (4–5 participants), and that continuation is not an implicit determinant of purchasing decision, since satisfaction with the current settings may lead to a decision not to leave the state; we can conclude that *Purchasing Decision* was also affected by the *virtual presence*. The results of the Dutch auction experiment provide full support for H1(b) and partial support for H1(a).

When introducing *Interpersonal Information* cues, winning bid was reduced in the English setting, thus H2(b) received strong support. Bidders did not submit fewer bids, thus H2(c) was not supported. H2(a) was partially supported. Percentage of ‘Wins’ was increased and the percentage of ‘Bid Zero’ and ‘Continue’ were decreased. These findings allude to a presence effect, but were not significant. In the Dutch auction settings ‘Wins’ percentage was significantly affected by *Interpersonal Information* providing some support to H2(a), but H2(b) was not supported, namely ‘Win Bid’ was not reduced.

Results provide some support for H3(a) and H3(b). The difference in the percentage of ‘Wins’ due to *Virtual Presence* was higher in the English auction than in the Dutch auction. However, difference in ‘Win Bid’ was higher in the Dutch auction. The difference in the percentage of ‘Wins’ due to *Interpersonal Information*

### Table 3. Summary of results

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>English Auction</th>
<th>Dutch Auction</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1(a) – Stronger purchasing decision as a result of virtual presence</td>
<td>Partial support</td>
<td>Partial support</td>
</tr>
<tr>
<td>% Wins: (t=5.37 p=0.02)</td>
<td>% Wins: (t=4.15 p=0.041)</td>
<td></td>
</tr>
<tr>
<td>% Continue: (t=2.36 p=0.12)</td>
<td>% Continue: (t=3.21 p=0.073)</td>
<td></td>
</tr>
<tr>
<td>% Bid Zero: (t=0.21 p=0.64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1(b) – Lower bids as a result of virtual presence</td>
<td>Strong support</td>
<td>Strong support</td>
</tr>
<tr>
<td>High Bid: (F(1, 186)=7.35 p&lt;0.01)</td>
<td>Win Bid: (F(1,76)=7.1 p=0.0094)</td>
<td></td>
</tr>
<tr>
<td>Win Bid: (F(1,107)=21.01 p&lt;0.0001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1(c) – Fewer bids as a result of virtual presence</td>
<td>Strong support</td>
<td>N.A.</td>
</tr>
<tr>
<td>Num of Bids: (F(1,186)=9.78 p=0.002)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Num of Bids if won (F(1,107)=3.95 p=0.049)</td>
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<td></td>
</tr>
<tr>
<td>H2(a) – Stronger purchasing decision as a result of interpersonal information</td>
<td>Partial support</td>
<td>Partial support</td>
</tr>
<tr>
<td>% Wins: (t=0.63 p=0.43)</td>
<td>% Wins: (t=10.56 p=0.0012)</td>
<td></td>
</tr>
<tr>
<td>% Continue: (t=1.87 p=0.17)</td>
<td>% Continue: (t=1.81 p=0.1781)</td>
<td></td>
</tr>
<tr>
<td>% Bid Zero: (t=0.01 p=0.92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2(b) – Lower bids as a result of interpersonal information</td>
<td>Strong support</td>
<td>Rejected</td>
</tr>
<tr>
<td>High Bid: (F(1,186)=0.7 p=0.40)</td>
<td>Win Bid: (F(1,76)=0.22 p=0.64)</td>
<td></td>
</tr>
<tr>
<td>Win Bid: (F(1,107)=6.41 p&lt;0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2(c) – Fewer bids as a result of interpersonal information</td>
<td>Rejected</td>
<td>N.A.</td>
</tr>
<tr>
<td>Num of Bids: (F(1,186)=0.49 p=0.48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Num of Bids is won: (F(1,107)=0 p=1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H3(a) – Higher effect of virtual presence in an English auction</td>
<td>Partial support</td>
<td></td>
</tr>
<tr>
<td>The change in the winning percentages (% Wins) due to Virtual Presence is higher in the English auction compared to the Dutch auction.</td>
<td>The change in Win Bid due to Virtual Presence is higher in the Dutch auction compared to the English auction.</td>
<td></td>
</tr>
<tr>
<td>H3(b) – Higher effect of interpersonal information in an English auction</td>
<td>Partial support</td>
<td></td>
</tr>
<tr>
<td>The change in the winning percentages (% Wins) due to Interpersonal Information is higher in the Dutch auction compared to the English auction.</td>
<td>The change in Win Bid due to Interpersonal Information is in a reverse direction in the Dutch auction compared to the English auction.</td>
<td></td>
</tr>
</tbody>
</table>
was higher in the Dutch auction but the difference in ‘Win Bid’ was higher in the English auction.

The effect of Interpersonal Information was not as pronounced as the effect of Virtual Presence. One possible explanation is that most of the participants were inexperienced bidders. Studies of experience in Internet auctions realized differences between experienced and novice bidders (Andreoni and Miller 1995; Dholakia et al. 2002; Wilcox 2000). The firsts are more likely to appreciate information and informational cues than inexperienced bidders who (in general) are more emotional. This explanation is supported by the observation in the literature that informational influence is more cognitive than normative influence and less emotional (Kaplan and Miller 1983). Another explanation lies in the enthusiasm with facial cues and perception of others’ presence signals. The addition of these may have been deemed more attractive at earliest stages of the experiment (first auction session) than Interpersonal Information which mostly was displayed in a textual manner. To verify this explanation we analysed all auction sessions in each experiment. We found that Virtual Presence effect, which caused lower winning bids and higher tendencies to win, declines as participants became familiar with the setting and results of the effect becomes comparable to results of the effect of Interpersonal Information. However there is another explanation for a change in bidders’ outcome overtime. Because participants experienced the auction in consecutive trials they might have learned the bidding rules of the agents. Once these rules were extracted it becomes easier to play against the agents and exploit the rules.

Internet auction sites today do not provide means for communication among bidders, probably because of concerns about fraud. Bidders and sellers may harness technology and use it to win unethically or unlawfully. Another explanation is that some bidders and sellers may prefer the anonymity enabled by the Internet. However, the inability to interact may damage bidders’ decision processes by limiting information provided by the social environment. Previous research shows that bidders rely on past behaviour of sellers and other bidders. In this study we look one step ahead. We found that, when provided, Virtual Presence and Interpersonal Information, generate social influence which affects bidding behaviour.

LIMITATIONS, CONTRIBUTION AND FURTHER RESEARCH

Research limitations

The implications of our findings are of theoretical interest, and they have importance for the design of online auction systems. These findings are of interest to the understanding of the dynamics of auctions. They might contribute to the broader study of social networks and the influence flows in them. Another field that may benefit from this study is the impact of social influence on economic behaviour.

The study suffers from several limitations. First, we use a simulation as the primary research method. Although participants were not aware of the fact that they competed with simulated bidders, real-life bidders may act slightly different under human or mechanized contexts. The major reason for using a simulation was to control for social presence cues. However, a growth in the use of autonomous bidding agents (e.g., Proxy bidding in eBay) in the past few years (Bapna et al. 2004) may mitigate this problem. We suggest that field studies will supplement our findings when such cues become more prevalent in real implementations of online auctions.

A second limitation is that auctions were not about real money or real items. While winning was encouraged by having credit point incentives, participants had small stakes compared to real-life auctions. Wilson (1992) and Kagel (1995) addressed the absence of economic risk in experimental settings. Despite the differences between field studies and experiments, results are complementary (Wilson 1992) and enhance understanding.

Another limitation of the method is not controlling for the experience level of participants. This limitation was moderated by randomly and evenly assigning participants to each condition and by exposing them to a new auction setting and rules with which no participant had any prior experience.

Research contribution

There are numerous theoretical and practical implications of this study. The key theoretical implication is in demonstrating the social influence determinants in Internet auctions. We found that normative and informational influence affects bidding behaviour. Our findings support conclusions of the SIDE model. Relative anonymity of auction bidders enhances the influence of the group valuation. The study also contributes to ongoing research in marketing, consumer behaviour and social psychology. From a practical perspective the research demonstrates the possibility to construct social influence even with relatively minimal technological cues. It suggests further directions to commercial auction sites and other e-commerce initiatives.

Further research

Social software and the exploitation of communication avenues between anonymous and semi-anonymous
players on the net are growing in popularity and use. This phenomenon is, therefore, of further concern. We propose further research in several directions. The first is to complement the experimental paradigm described here with field studies. Can better data regarding informational and normative influence be collected in real settings? It should also be interesting to extend the scope of this study to other forms of online interaction where a group has a power to influence the individual. Examples are online games and online gambling settings. We believe that in these settings, because of the similar influence conditions, influence results will replicate those found here. A third direction is an extension of the research to other types of e-commerce where the influencing power of the group is lower, such as electronic stores. In this type of setting social presence of the seller may act as a source of influence.

Notes

References


