Testing social theories in computer-mediated communication through gaming and simulation

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Testing social theories in computer-mediated communication through gaming and simulation

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Information is a critical component of commercial transactions. Our games, the LEMONADE STAND and HULIA, and simulation, AUCTION SIMULATION, represent a variety of computerized commercial situations where information may be actively shared or traded or passively available as part of the transaction. These games and simulation served as research tools for testing a variety of social theories aiming to offer some explanations for information behavior in online spaces and its subsequent effect on the commercial transactions taking place. We demonstrate, using the analytical sciences approach, how computerized games and simulations are used to study and validate theoretical constructs in networked environments. Validating a variety of theories using three different artifacts, while acknowledging their strengths and limitations, shows promise for the continued development of games and simulations as important instruments for the analytical sciences approach.

KEYWORDS: *business games; computer-mediated communication; information sharing; information trading*

Research on usability and user preferences in various areas of information systems is often based on surveys and questionnaires that reveal managers' attitudes toward the issues at hand (Glass, Ramehs, & Vessey, 2004). Another prevalent research method is the case study method whereby in-depth research focuses on a specific activity of a single company. An emerging tool in recent years is the unobtrusive measurement of information system usage patterns such as access logs analysis and data mining techniques, which shed light on usability and user preferences. For the study of causal relations between information behavior and its antecedents in the context of business research, computer-based games and simulations offer an excellent environment. They combine lifelike experiences in a theory-based environment with control of the independent variables and measurability. The purpose of this article is to demonstrate, using the analytical sciences approach, how games and simulations—related to computer-mediated communication (CMC)—are used to study and validate theoretical constructs.

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Games and simulations are frequently used for professional training or academic education and knowledge building (Klabbers, 2001; Rafaeli, Raban, Ravid, & Noy, 2003). In such interactive learning environments, subjective experiences and objective outcomes become intertwined. They serve to deliver a message or to learn a lesson by getting the participants involved in a dynamic problem-solving or decision-making process. In addition, the analytical sciences use games and simulations as a laboratory method for developing and testing theories by researching the relationships between variables. Whereas theories are usually developed within a specific knowledge domain (Klabbers, 2001), games and simulations enable testing known theories in new domains where they may be elaborated and extended. This article describes how two games and one simulation, all from the business domain, are used to test hypotheses based on various social theories. Experiments using these artifacts are based on the design-in-the-small (DIS) approach (Klabbers, 2003, 2006 [this issue]). For each artifact, we will describe the theoretical basis and how the game or simulation was operated on three levels suggested by Klabbers (2003, 2006), namely the *agents*, shaping a social organization; *assertions*, representing a particular worldview; and *media of representation*. Our findings enlighten social influences on behavior in business environments.

The first part of the article will provide pertinent literature on the theories explored. Because the domain of the article is analytical sciences, the article will identify key variables and the causal relationships between them. Next, we shall focus on the process and methodology of moving from theory to experimental design, using games and a simulation as research tools. We shall describe how these games and simulation were selected and how they were used to test the theories. Finally, without shifting the discussion to the design sciences, we shall briefly compare common themes embedded in all three experimental tools: level of cognition, level of interaction, and the type of participant, agent, or actor. The main difference between an actor and an agent is that an agent is a computer program, a mechanic set of rules without self-awareness, whereas an actor is a human being, group, department, or institution that is self-aware (Klabbers, 2004a).

Games and simulations as research tools

Simulations and, even more so, games are entertaining, captivating, provide immediate feedback, and generate motivation among players. They provide active, experiential, student-centered learning environments. When delivered via a computer or over a network, data collection can be automated so there is less chance of errors and omissions as compared with a noncomputerized measurement. Such attributes make games and simulations attractive as research tools. On the other hand, they can be very elaborate, involving many decision junctures and long and interconnected series of actions (moves). The complexity of these artifacts may draw criticism from fellow researchers, especially with regard to their internal and external validity. Nevertheless, the engaging and controllable behavior laboratories offered by games and

simulations, coupled with unobtrusive data collection facilities, provide golden research opportunities. Reliability and validity checks help address potential caveats and impart authority to these research tools. Specifically, previous research has shown that business games have external validity pertaining to the learning deliverables (Hemmasi & Graf, 1992; Norris, 1986; Wolfe & Bruton, 1994). Our own early pilot studies have demonstrated the reliability of the games and simulation described below (Rafaeli & Raban, 2003; Rafaeli & Ravid, 2001). As we use games and simulations for theory development rather than for learning purposes, we will focus attention on games as research tools rather than on the learning process per se.

Social theories

In this section, we explore social theories that were the underlying constructs of our studies. The common theme of these studies is the usage of simulations/games to test these theories. A large and growing body of research investigates the area of CMC. Many of these studies investigate how limitations of social interaction, when using CMC, affect group decision making and individual behavior in a group (Kiesler, 1992; Postmes, Spears, & Lea, 2000; Spears & Lea, 1992; Sproull & Kiesler, 1991; Straus & McGrath, 1994).

Online spaces are a replication and extension of physical spaces, but at the same time, they offer new technical and social dimensions not available in the physical world. The different social environments in physical and cyberspace bring forward an important new dimension for research. Physically, a player sits alone in front of a computer. However, during the game session, the player can be exposed to varying levels of social interaction and cognition: one-to-one, one-to-many, many-to-one, one-to-machine (game agent), and one-to-network (multiple agents or real players) (Rafaeli, Raban, & Kalman, 2005). Manipulation of the level of social interaction and cognition provides an opportunity to research a variety of social theories to learn whether physical world paradigms apply "as is" in the networked environment and, if not, to investigate the differences. Social theories for such research include, but are not limited to, the endowment effect, the mere ownership effect, group information sharing, social presence theory, media richness theory, and social influence theories. These theories help explain questions in the areas of CMC, online social facilitation, virtual presence, information sharing, and the subjective value of information. Following is a brief description of each of the theories tested using our games and simulation.

The endowment effect

Subjective value has been studied experimentally for many types of market goods (also called private goods) and nonmarket goods (also called public goods). One very interesting finding of experimental research on subjective value is the discovery of a disparity between the highest amount one is willing to pay (WTP) for a good and the lowest amount one is willing to accept (WTA) as compensation for giving up the same

good. This disparity was coined as the Endowment Effect (EE; Thaler, 1980; Thaler, Kahneman, & Knetsch, 1992). Traditional economic assumptions imply that when income effects are eliminated, the difference between WTP and WTA should be negligible (the difference should amount to the decreasing marginal utility). However, experiments with various types of goods have shown that WTA is significantly greater than WTP. By definition, WTA and WTP values are neither normative nor realistic. Instead, they are subjective values because they represent an individual's personal perception of an object's worth. The EE methodology itself is designed with the purpose of eliciting submissions of private values and is described elsewhere (Kahneman, Knetsch, & Thaler, 1990; Rafaeli & Raban, 2003). We apply the WTA/WTP methodology as used for various types of goods to investigate the subjective value of information in an online business game environment, the LEMONADE STAND (information trading version), with a view to determining what characterizes information as a good and how source nature and status affect perceived value.

The mere ownership effect

One of the unique features of information is that it is transmitted both by trading or commerce and by sharing without monetary compensation. Whereas EE helps to explain information trading behavior, a different theory is required for explaining the willingness to share (WTS) information in noncommercial settings. The mere ownership effect theory is suggested as one possible basis for information sharing behavior. Heider's (1958) theory of association suggests that people assign a higher value to owned objects compared with nonowned objects. Research investigating the perception of objects has shown that people perceive objects as an extension of the self (Belk, 1988). A possible explanation for liking what we own could be our desire to reduce cognitive dissonance (see Festinger, 1957). Cognitive dissonance can occur when a person chooses to purchase something and then dislikes what he or she purchased. However, free choice is necessary to trigger cognitive dissonance. Experiments where people had no choice in the objects they received for ownership have ruled out cognitive dissonance as a motive for higher valuations to owned objects. These experiments have shown that even merely owning possessions leads to higher valuations of them and to self-enhancement (Beggan, 1992). Self-enhancement is defined as an individual's tendency to maintain a positive self-concept after a negative experience by compensating on an unrelated dimension (Baumeister, 1982; Brown & Smart, 1991). For example, a helpful attitude may develop following poor performance at an achievement task. This example is particularly interesting because it suggests that social change may be brought about by affecting the self.

Beggan (1992) has shown experimentally that mere ownership increases individuals' valuations of objects. Surveys have shown that private ownership of information favors sharing (Constant, Kiesler, & Sproull, 1994; Jarvenpaa & Staples, 2000). Expertise is part of a person's most personal endowment, one's intellect. It follows that if personal capacities play an important role in the individual's self, then sharing such capacities without losing them, as is the case of sharing expertise, can serve to

enhance one's self-image. Our research shows experimentally, using the LEMONADE STAND game, that mere ownership of information supports sharing both of expertise and of information products. Causal relations between ownership of information and the tendency to share it were identified.

Group information sharing

The research model, which was tested using the HULIA simulation, proposes theoretical links to antecedents of the main determinants of knowledge sharing and media choice. Specifically, we observe the links (i.e., the causal relations) between elements of knowledge sharing and characteristics of the task at hand, group and individual characteristics, as well as communication variables. We measure information sharing as the amounts of shared information and information searched. We also focus on the efficiency of sharing information. Further detail on the theoretical model can be found in Rafaeli and Ravid (2001).

The learning organization is in high demand in today's rapidly changing environment. We need efficient groups, flexible and able to learn. Members of the group need to understand the group's task and goals (Senge, 1990; Senge et al., 1999; Sproull & Kiesler, 1991). Although organizations learn through their members, the knowledge possessed by the organization is not equal to that owned by each of its members (Lipshitz & Popper, 2000). Rather, organizationally shared knowledge depends on the amount and nature of interaction, the organizational culture, and the technology available to support group sharing.

We aim to achieve such groups so that the organization can survive. Information sharing is one tool used for this purpose (Olson, Olson, Storrosten, & Carter, 1993; Sproull & Kiesler, 1991; Townsend, DeMarie, & Hendrickson, 1998). Our study made use of a variety of theories about the mutual effects of the group or team, the nature of the task and the communication tools, and their effect on information sharing. Among these theories, we identify time interaction and performance theory (TIP) and normative influence theory. The Shannon-Weaver theory, the Social Information Processing Model (Walther, 1994), uncertainty reduction theory (Berger & Calabrese, 1975), channel development theory (Carlson & Zmud, 1999), media richness theory, and the theory of media synchronicity (Dennis & Valacich, 1999) all inform various links in our model (Rafaeli & Ravid, 2001).

Most CMC research tends to focus on the individual as a unit of analysis and has a technological determinism bias (Wellman et al., 1996). The technological determinism approach, as phrased by Marshall McLuhan—who was one of its most famous originators—is a worldview that holds that "we shape our tools and they in turn shape us." This perspective endows technology with livelihood and independence. Technology is portrayed as an extension of humans. This perspective requires and proposes a cause-effect analysis of all that takes place. Our approach attempts to untangle the technological determinism limitation by examining the broad and complex interconnecting effects of various factors on information sharing. We try to take the broadest possible view by incorporating views of the effects of group structure,

and the nature of both the task and communication on information sharing. These effects follow a rich set of causal paths.

Social presence theory

Social presence is one of the most influential theoretical frameworks for analyzing mediated communication. Social presence is a variable in mediated communication (Short, Williams, & Christie, 1976) defined as the sense of intimacy and immediacy leading to increased enjoyment, involvement, task performance persuasion, and socioemotional interaction (Lombard & Ditton, 1997). It affects the way individuals perceive a medium and people with whom they interact. The amount of social presence varies among each type of medium (social presence theory is closely related to the media richness theory discussed below). Face-to-face interaction yields a high level of social presence, whereas computers and some forms of asynchronous communication result in less social presence due to an absence of nonverbal cues (Papacharissi & Rubin, 2000). The theory uses two dimensions related to intimacy (interpersonal versus mediated) and immediacy (asynchronous versus synchronous) and predicts that several types of CMC can create in users a sense of intimacy and immediacy. When people participate in communication, they can assess how much they feel that they are present in a real setting. 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 & Ditton, 1997). In the AUCTION SIMULATION, causality is found between social presence ranking as the independent variable and the level of success in the auction.

Media richness theory

A medium affects the process of communication and collaboration between people in different ways due to which modalities it supports. Media richness theory predicts that uncertainty and ambiguity of information communicated will vary with the richness of the media. It has been argued that media differ in their capacity to carry various types of information (Daft & Lengel, 1986; Rice, 1993; Short et al., 1976). A medium's richness is measured by its capacity for immediate feedback, multiple cues, language variety, and personalization (Daft & Lengel, 1986). Rich media convey rich information that can be expected to resolve ambiguity at a high rate. Face-to-face communication is considered a rich medium and is predicted as the best choice to resolve ambiguity. Less rich medium, such as asynchronous CMC, is predicted as the best choice to resolve uncertainty. In the AUCTION SIMULATION, causality is found between the capacity of the media to convey information and the level of success in the auction.

Normative and informational influence

Groups, engaged in discussion, often make decisions and judgments. Group members may enter the discussion with a decision preference and may change it as

a consequence of arguments made by their peers. 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.

Group membership involves accepting some level of conformity to the group. An individual who conforms to a group gives the group the power to influence his or her actions. The group acts as a standard of social comparison or as a point of reference. This social influence is explained by two theories: normative influence and informational influence (Bearden & Etzel, 1982; Kaplan, 1987; Latane, 1981). Normative influence speculates change to enhance one's position in the group and/or one's self-image. Informational influence implies that judgments are based on information about the issue. Normative and informational influence models differ in the underlying mechanism of persuasion that they propose and in assumptions made about human nature. Normative influence implies that people seek approval and belongingness and aim for harmony and communality. Informational influence suggests that centrality of being correct presupposes and emphasizes the task concerns and is driven by an individual's desire to arrive at precise decisions (Kaplan, 1987). In the AUCTION SIMULATION, causality is found between normative and informational influence and the level of success in the auction.

Table 1 presents the social theories that were studied using the three games and summarizes the major variables used.

Games and simulations for testing social theories

LEMONADE STAND

The LEMONADE STAND is a Java-based animated computer simulation of a simple business game. In this game, the player owns a lemonade stand and operates it to maximize his or her profits by managing inventory, quality, and pricing to sell lemonade to virtual passersby. Participants are expected to make rational inventory, pricing, and quality choices in an uncertain demand environment. All transactions and information flows occur online. Participants need to decide about purchasing materials such as ice, lemons, cups, and sugar. They need to set the price for the lemonade and control the quality of the lemonade that is sold, by controlling the amounts of sugar and lemons per cup. Pricing and inventory decisions are based on an attempt to forecast demand. The demand for lemonade is affected by weather permutations. Information about expected weather and assumptions about its effect on demand may affect choices concerning inventory and prices. Participants are offered the chance to trade (buy or sell) this information about the weather, in addition to making decisions about inventory and prices. In the sharing variation of the game, the players respond to predefined requests for information sharing during the game session.

The experiments were launched by a detailed in-class presentation of the game along with handouts that included the instructions and sample screenshots. A prize was offered to the player who achieved the highest profits. In this game, simulated profits could be

TABLE 1: Classification of Theories, Variables, and Tools

Tested Theory	*Independent Variable*	*Dependent Variable*	*Type of Causality*	*Game/Simulation Used*
Endowment effect	(a) source nature (information product, expertise) (b) status of information (original/copy)	(c) willingness to accept payment (WTA)—this is actually willingness to sell, however, in the literature, it is referred to as WTA (d) willingness to pay (WTP)	a, b → c, d	LEMONADE STAND—information trading version
Mere ownership effect	(a) source nature (privately owned information product, organizationally owned information product, expertise)	(b) willingness to share (WTS)	a → b	LEMONADE STAND—information sharing version
Group information sharing (Rafaeli & Ravid, 2001)	(a) levels of information sharing	(b) group net profit	a → b+	HULIA
As above	(a) context (b) the group	(c) social structure	a, b → c	HULIA
As above	(a) context	(b) role taking by the players	a → b	HULIA
Social presence theory Media richness theory Normative and informational influence	(a) virtual presence (b) interpersonal information	(c) winning percentage, (d) bid value, (e) number of bids	a → c+, d–, e– b → c+, d–, e–	AUCTION SIMULATION

NOTE: Variables (a), (b), (c), and (d) are nominal. Plus sign (+) indicates a positive effect; minus sign (–) indicates a negative effect.

earned in two ways: (a) by trying to optimize the inventory, lemonade quality, and price per cup depending on the weather data (if available); and (b) by trading information (selling generates direct income, whereas buying information can generate indirect payoffs if played wisely). Following the introductory presentation, participants played two warm-up training games and four competitive games. Every game was preceded by one of four bid types: buy original content or expertise, sell original content or expertise. Each participant gave one bid on each of the four dependent variables (WTA, WTP, WTAC, and

WTPC; Raban & Rafaeli, 2006). Market prices were incentive-compatible according to the Becker-DeGroot-Marschak principle, known in the literature as the BDM method (Becker, DeGroot, & Marschak, 1964).

In the sharing variation of the game, the bidding mechanism was removed. The game was presented in a split screen that included in its other part an instant messaging application for the exchange of information among the players during the game session. All interactions were logged and included the responses to the predefined questions eliciting WTS responses (Raban & Rafaeli, in press).

Two hundred ninety-four students participated in the information trading game variation. The experimental design was, therefore, 2 (buy vs. sell) × 2 (original vs. copy) × 2 (content vs. expertise). One hundred seventy-three students participated in the information sharing variation of the LEMONADE STAND.[1]

HULIA: Supply chain management

To study the information sharing behavior of teams, we computerized and implemented a variation on the well-known production-distribution BEER GAME simulation in an Internet-based environment. The BEER GAME was developed by the Systems Dynamics Group, of the Sloan School at MIT, in the 1960s. The manual version of the game is fully described by Sterman (1989, 1992a, 1992b) and by Senge (1990). We added optional electronic mail functionality to the computerized game. The purpose of this development was to create an opportunity to follow the process of electronic mail use in the connected chain of orders and supply. Doing this in a simulation context allows better control over several internal and external validity dimensions of the research question.

The game simulates a distribution system and can be used as a competition between teams. The original idea of the game was to demonstrate the complex relationships between structure and behavior in supply-chain management. Each team works toward maximizing net team profit as the team goal and is the central dependent variable in this analysis. Each team includes four role-positions, down the line of echelons in the supply chain: Factory, Distributor, Wholesaler, and Retailer. The participants send product orders (information) up the supply chain and push products down the supply chain (see Figure 1). The game is played in multiple repeated simulated days. Every simulated morning, the Retailer is informed of the daily demand. Players may not communicate anything except order quantities up the line to the next player in the information order chain. As can be seen in Figure 1, the Retailer is closest to the market, in the sense that the Retailer is the only one in contact with the (simulated) customer, and knows the actual demand at any point in time. As the Retailer has possession of the vital demand information, it is up to the person in the retail position to share this information up the supply chain.

The BEER GAME has simple rules. The players make one decision per (simulated) game day. We developed an online implementation of the BEER GAME (Rafaeli & Ravid, 2001, 2003; Ravid & Rafaeli, 2000). The HULIA game used here (*hulia* is the Hebrew word for link) is Internet-based, multilingual and international,

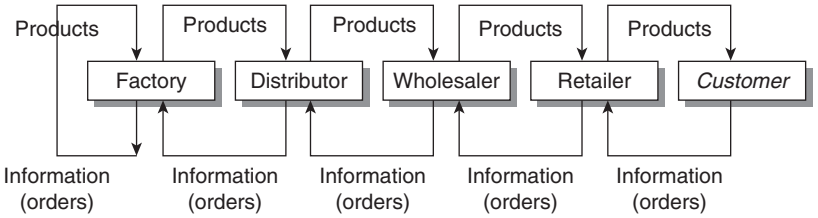

FIGURE 1: Supply Chain Topology

and synchronous in orientation. HULIA also has an e-mail-enabling feature that is the focus of information sharing in groups. The game system used here can be played entirely on the Internet, with participants located anywhere, although we applied it in a computer lab for experimental control.

This online version addresses some of the manual implementation issues with the computerized game. The players sit facing a computer screen rather than at a round table, as in the board game version. Playing over the Internet is even better because game administrators can completely manipulate, control, collect, and research the informal channels of information transfer within teams. The online game keeps logs of all the transactions, including information flows. The BEER GAME, administered as a board game, has high detail complexity, very low interface complexity, and a medium level of dynamics complexity. Computerizing the game did not change the mathematical model—hence, no change in the dynamic complexity. However, by moving online, we did provide a more sophisticated interface, higher interface complexity, and lower detail complexity.[2]

AUCTION SIMULATION

Auctions are a very well-known and established market mechanism. In the physical world, where people interact face-to-face, an auction is a social happening (Smith, 1989). Auctions are at the center of research in the field of economics and of tremendous interest in the areas of marketing and consumer behavior (Kagel, 1995; Kagel & Levin, 1986; Wilson, 1992).

Online auctions, which are a computerized Internet-based implementation of the brick-and-mortar auction format, are one of the most dominant examples of online behavior. In the past few years, they became a prominent example for both an online meeting place and electronic-commerce arena. Online auctions have been studied from the early days of the Internet. Their popularity as a trade mechanism among a wide range of users, the availability of public data, and the commercial success of several Internet companies founded a basis for many empirical field studies.

In online auctions, the social cues that enrich their brick-and-mortar counterparts disappear (Erickson, Halverson, Kellogg, Laff, & Wolf, 2002) and social influence, which is a key theme of the traditional format, may have no effect.

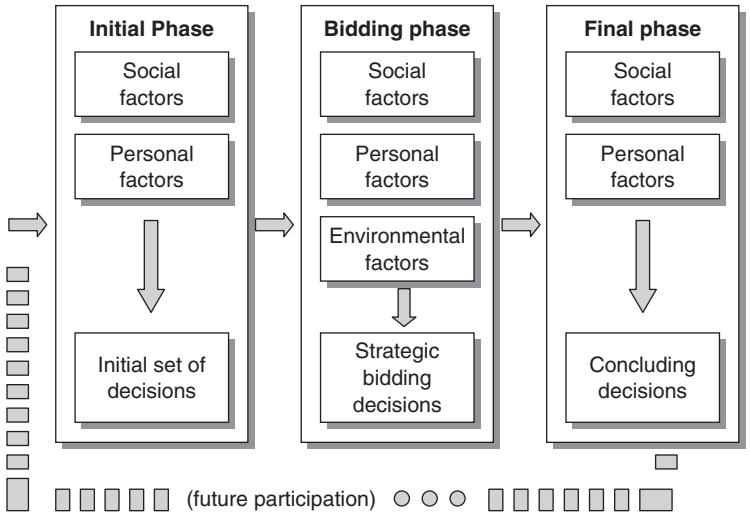

FIGURE 2: Phases of Online Auction

The process of online auctioning and the influencing factors on bidders may be viewed as a three-phase procedure, as described in Figure 2.

The initial phase is mostly used to collect information, and the bidder is influenced by both social factors, as family members and other consumers on the Web, and by personal factors, such as perceived risk, internal independent estimates, and prepurchase information search. The bidding phase includes social factors, such as the seller and the other bidders, as well as additional personal factors. In this phase, the environmental factors, which are the auction's mechanism and rules (Pinker, Seidmann, & Vakrat, 2003), come into play. The final phase, after the completion of the auction, serves as a concluding stage and may influence future auctioning. Social and personal effects accompany this phase as well.

The focus of our study was to test online behavior and the effect of social cues during the bidding process (Rafaeli & Noy, 2005). Do virtual social factors affect the strategic behavior of bidders in online auctions?

The research model presented in Figure 3 captures the influencing process of virtual bidders on auction participants and correlates between the influencing factors—two types of social influence: normative and informational—and the resulting bidding behavior as expressed in several bidding decisions.[3] The social influence was explained, among the other justifications of bids, by social presence and media richness theories.

Testing social influence in an experimental design, while replicating bidding behavior in multiple sessions, was achieved using a simulated environment. Autonomous agents, which modeled real bidders, competed against human participants in a simulated

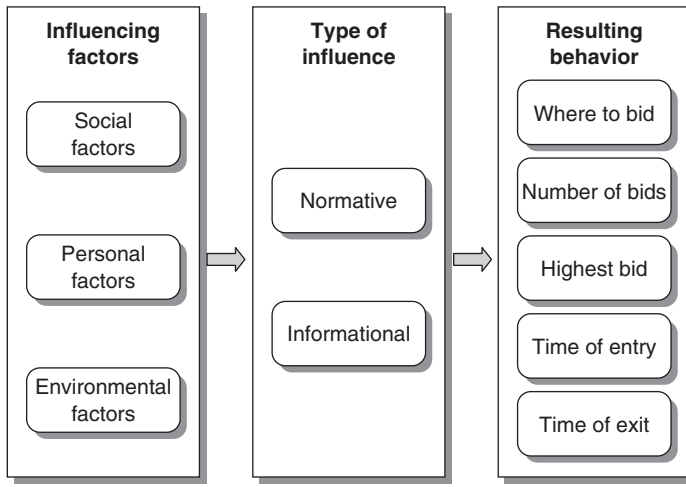

FIGURE 3: Research Model

online environment. To test for the social effect, a mixture of virtual presence and virtual information cues were incorporated in some of the experimental settings, such as online chat, recommendation, and personal information. Two types of auction models were included in the study—English (ascending price) and Dutch (descending price)—to test for a difference in the level of bidders' involvement throughout the process.

Simulation components comparison

The three experimental tools enable manipulation of the following constructs:

1. online social cognition level of the players;
2. online interaction level;
3. type of agent: human or computerized;
4. dimension of single versus group participation; and
5. role of the participating parties: competition versus collaboration.

Despite various differences, they all share common

1. usage as a research tool to test social theories;
2. use as games, which enable contending with managerial dilemmas, with a focus on access to and sharing of information;
3. interactive use of computers by human participants; and
4. use of a simulated model that was incorporated to simulate either some of the participating parties and/or the business and process environment.

The games differ in the following elements:

1. dimensions of single versus group participation;
2. role of the participating parties: competition versus collaboration;
3. level of social cognition of the players;
4. type of agent; and
5. level of interaction among agents.

Online social cognition is a fairly recent area of research (Rafaeli et al., 2005). Quantitative data indicating varying levels of social cognition in networked environments are not yet available. However, it is plausible that cognition levels vary in the online medium. Therefore, we have chosen to address varying levels of social cognition online as high or low. Online interaction levels can be classified according to different degrees of social cues supported by the interaction. Agent simulation level differentiates between three types of computerized games and simulations according to the level of human involvement:

1. Computer simulations, where humans are not part of the simulation at all. Software agents acts on behalf of humans, sometimes interacting among themselves;
2. Human-computer simulations where human participants interact with simulated agents as part of the simulation;
3. Human simulations where human actors interact with one another in a CMC environment and the game uses a simulation that imitates the reference system of resources.

Figure 4 maps the three simulations onto a two-dimensional chart according to the level of social cognition and the type of interaction supported by the simulation. In the AUCTION SIMULATION and the LEMONADE STAND information trading game, a human participant interacts with simulated agents. These cases raise another distinction between the simulated games: the role of the simulated agents. The simulated agents of the AUCTION SIMULATION have an equal role as the human participant and compete with them, whereas in the LEMONADE STAND information trading game, the simulated agent has a different role as a mediator between the human participant and the simulated environment. These games were played in a stand-alone environment, where a single participant activated the simulation and did not influence other participants. In the HULIA game and the LEMONADE STAND information sharing game, the focus was on the interaction among the human participants. These games were played in a networked environment where multiple participants played simultaneously and interacted with one another.

Figure 5 highlights the various CMC cues that were incorporated in the three simulations/games discussed here. Although the LEMONADE STAND information sharing game enables only simple textual interaction among players using an Instant Messaging (IM) application, the HULIA game and the AUCTION SIMULATION offered additional social cues. The AUCTION SIMULATION, used for testing the social presence and the media richness theories, provided additional virtual presence cues, such as images of the agents, and informational cues, including names, bidding

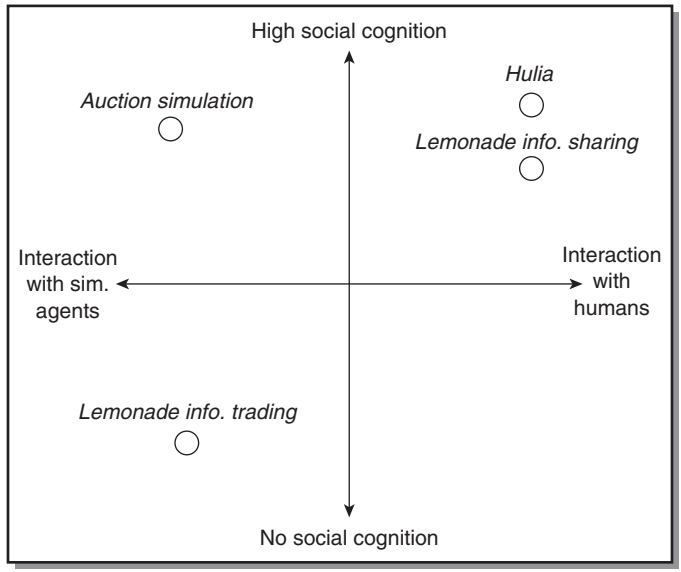

FIGURE 4: Cognition and Interaction Levels

history, and personal background of each of the agents. The HULIA game, which did not use simulated agents at all, provided information on the business behavior of the different groups participating in the game.

Experimental results

In this section, we will briefly report the highlights of the experimental results obtained, using our games and simulation as research tools to test the various social theories introduced earlier. Some results validate the causality hypothesized, whereas some results do not indicate causal relationships between the independent and dependent variables.

The LEMONADE STAND was used for studying the subjective value of information in trading and sharing scenarios. The experimental design was 2 (buy vs. sell) × 2 (original vs. copy; source status) × 2 (content vs. expertise; source nature). One hundred seventy-three students participated in the information sharing variation of the LEMONADE STAND. The results of the information trading version of the game suggest that source status has a statistically significant effect on the subjective value of information, whereas source nature does not (Raban & Rafaeli, 2006). Therefore, causality is validated only for source status. In the information sharing game version, ownership showed a statistically significant effect on the willingness

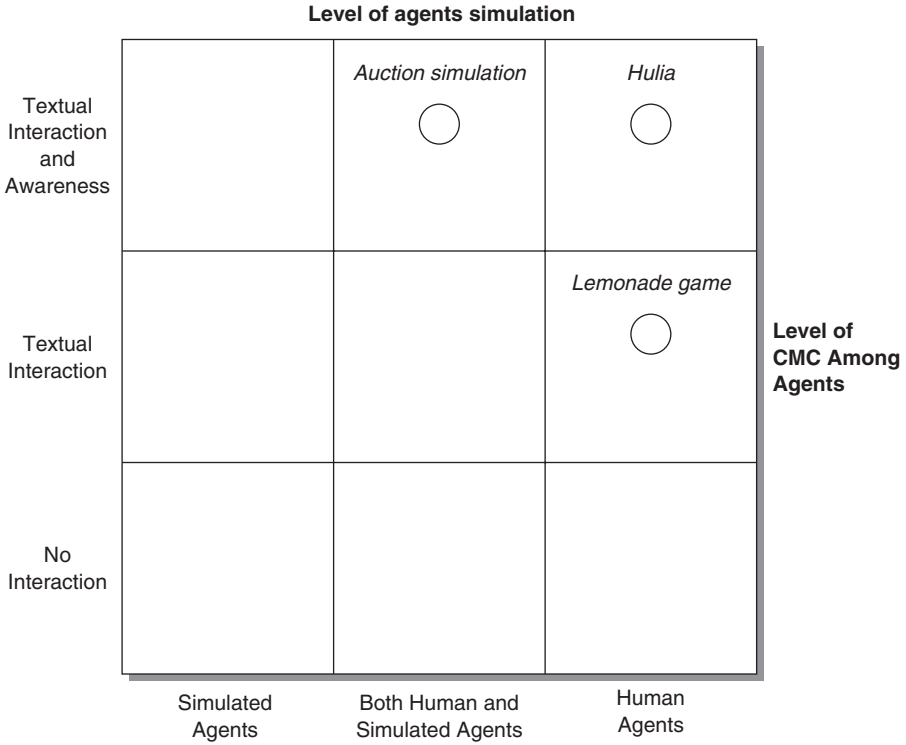

FIGURE 5: Interaction and Simulation Levels
NOTE: CMC = computer-mediated communication.

to share information, again lending support to the causal relations between ownership and subjective value (Raban & Rafaeli, in press).

The supply chain management game, HULIA, was our research tool for testing various aspects of information sharing. One hundred ten groups of four students or managers each played HULIA in Israel, Europe, and the United States. The players played one version of the game with CMC and one version without. We hypothesized that the amount of communication between group members will enhance group performance measured by net group revenue. The causality between communication and performance was statistically significant ($R^2 = .375$, sig. < 0.0009). We used the same data source to learn about the relation between social structure roles in the group and communication. We found that the social structure determined behavior in the group. For example, there is correlation between the number of messages that deal with strategic issues and the number of messages that a group member receives ($\rho = .317$, sig. < 0.025). Players tend to take social roles regardless of the assigned formal roles.

Specific roles have typical communication patterns, for example, the middlemen take the position of coordinators ($\rho = .429$, sig. < 0.02).

The AUCTION SIMULATION was used for studying the effects of virtual presence and interpersonal information as the independent variables on bidding behavior, the dependent variable. Bidding behavior was measured by winning percentage, bid value, and number of bids. Results from two experiments, one with 123 students and the other with 188 students, with a different auction model suggest that virtual presence has a positive effect on the winning percentage (Rafaeli & Noy, 2005). Higher levels of virtual presence are associated with a higher winning percentage. The effect of interpersonal information was similar. Experimental results also validated that with a higher level of virtual presence, bidders lowered their bids and posted fewer bids during the auction session, whereas interpersonal information did not cause such a salient effect. Causal relations were found for virtual presence and only partially for interpersonal information and their effect on bidding behavior.

Lessons learned from games as research tools

Using our simulation and games to study social theories in online settings encompasses several advantages as well as disadvantages and limitations. The major benefit lies in the design of the experimental procedure. All theories discussed earlier were tested in a CMC, virtual environment where two of the three cases were an imitation of the physical world (HULIA and the LEMONADE STAND). The AUCTION SIMULATION was a replication of virtual auctions. A second advantage is the ability to model only major components of the environment while neglecting, or keeping constant, others. An example of this attribute is limiting the duration of the bidding phase in the AUCTION SIMULATION to only 2 to 3 minutes (far from real online auction average bidding duration), which ensures that all participants are exposed to exactly the same effect. A third advantage is an ability to use simulated agents either as co-actors as in the LEMONADE GAME or as competitors as in the AUCTION SIMULATION. Use of software entities enables the researcher to plan and determine how agents will act prior to running an experiment. In the AUCTION SIMULATION, agents were programmed to have and display varying levels of social presence and of interpersonal information according to the experimental setup. However, their bidding behavior rules did not change between arrangements, and the purpose of the experiment was to test their effect on human participants. Such behavior can be replicated in multiple experimental sessions, thus diminishing the effort of dealing with additional variables or the recruitment of additional participants. Careful design can reduce the number of human players required to participate in the experiment.

The use of a simulation approach in our studies suffers from several weaknesses and limitations. First, the simulation model is not an accurate representation of reality. As such, behavior of the groups that participated in HULIA or individuals who played the AUCTION SIMULATION may deviate from their behavior in real scenarios. For example, the auction rules of the AUCTION SIMULATION were not identical to real

online auctions. Participants did not bid with real money; neither had they won real goods, suggesting that the perceived risk and benefit may have been biased. Second, when playing with simulated agents, or simulated environments, players may learn the underlying rules that control the agents or the built-in dynamics of the system of resources. Repeated or lengthy participation may have caused players to modify their behavior to improve their results. In real life, often people learn and modify behavior, but the price is usually much higher than in games and simulations. In this respect, the simulation may not be completely valid with regard to real business situations. However, the advantage is that it aids in preparing participants for such situations.

Summary and conclusions

In the preceding sections, we described the application of instrumental games and simulations to study theoretical social constructs, which are related to CMC. Three online, Internet-based simulations and games used in teaching and research were discussed. The applications described ranged from individual-level, one-person tasks to real group simulation. Common to all these simulations is

1. usage as a research tool to test social theories;
2. use as a game that enables contending with managerial dilemmas with a focus on access to and sharing of information;
3. interactive use of computers by human actors; and
4. use of a simulation that was incorporated to either simulate part of the participating parties and/or the business and process environment.

The distinctions between the simulations exist both in the design of the simulation and in dimensions of game design and usage and

1. online cognition level of the players;
2. online interaction level among players;
3. degree of agent involvement in the simulation;
4. whether the simulation was designed to imitate participating parties or emulate the business environment (or both);
5. dimension of single versus group participation; and
6. role of the participating parties, either real or simulated: competition versus collaboration.

In summary, games provide a rich experimental setup, bringing controlled laboratory experiments closer to real life. Control and causality are provided by the experimental paradigm, whereas the game/simulation lends external validity. Games and simulations can be very elaborate research and learning environments; thus, care should be taken to run experiments using artifacts with a level of complexity that is compatible with experimental design and control.

Despite the distinctions listed above, all simulations/games discussed here were a main research tool in testing such social science theories as the endowment effect, the mere ownership effect, group information sharing, social presence theory, media

richness theory, and social influence theory. The CMC environment offers several advantages to the testing of these theories over a brick-and-mortar environment. The ability to use simulated agents instead of human participants and to model only part of the business environment, the attenuation of the degree of interaction among the participating parties, and the ability to reproduce experimental sessions all contribute to the regularity conception of causality (Klabbers, 2004b, 2006). Although the games and simulation discussed here have their limitations, they have nevertheless shown to be reliable and efficient analytical tools.

Notes

1. A brief introduction to the game, a PowerPoint presentation, and a link to the game itself are available at http://valueofinformation.rafaeli.net.

2. Further information and a demo are available at http://hulia.haifa.ac.il.

3. These decisions are highlighted on the right part of Figure 3.

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