SUBJECTIVE VALUE OF INFORMATION :

THE ENDOWMENT EFFECT

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ABSTRACT

Value judgments about information and its value are vital for a functioning information society. Subjective valuations, formulated by individuals determine the demand for information and trading in it. Theoretically, these subjective value determinations should be influenced by ownership rights, a phenomenon coined the "Endowment Effect" in psychological study of trading situations. This study examines the Endowment Effect in the context of evaluating information. In a simple computer simulated game fifty five participants conducted a task in which they were provided opportunities to buy or sell information. The bidding mechanism was incentive compatible. Results show that, in agreement with Endowment Effect theory, people value information they own much more than information not owned by them. Our findings indicate that the ratio between Willingness to Accept (WTA) and Willingness to Purchase (WTP) for information is similar to that for market goods, and as with market goods, other than rational. Participants exhibited a strong inclination to purchase but not to sell information even though profit data suggests that the use of information had no objective benefit for profit-making. This preference is attributed to risk aversion rather than to loss aversion which is the most widely-accepted explanation of the Endowment Effect. Holding on to information and undertrade in it have strong implications for the information society.

KEYWORDS

Information economics, perceived value, ownership, endowment effect.

1. INTRODUCTION

The information society is often defined by the centrality of information production and consumption functions (Machlup 1962; Porat 1977; Toffler 1980). Information's centrality is determined in the demand for it, and by the degree this demand is met. Hence, another way to view the viability of the information society is by assessing the vitality of information exchange and flow within it. This paper is an investigation of the subjective value attached to information by prospective users of it. The perceived (subjective) value of information affects the demand for it, and is therefore a critical condition for the information society.

What is the value of information? How can that value be determined? How does this translate into the demand for information? Is the demand for information rational? The present research proposes to

investigate the subjective value of information by combining economic and psychological theory with information systems research. We use an experimental/simulation approach to suggest possible answers to these questions.

Information has several unique characteristics which render it difficult to valuate. Information is an unusual good in many aspects - production, distribution, cost, and consumption. Information is both an end-product and an instrument or input into the production of other goods, decisions and information. It is expensive to produce and cheap to reproduce (Bates 1989; Shapiro and Varian 1999). In fact, distribution is accomplished mainly by reproduction or copying. The same content can be distributed by different media, and the price is often derived from the medium rather than from the value delivered by the content itself. In point of fact, people consume information both by sharing and by purchasing, while most other goods are consumed via purchasing only. The cost of information can be either direct or indirect. The quest for the value of information is further complicated by the fact that information is an experience good, meaning that its value is revealed only after consumption (Shapiro and Varian 1999; Van Alstyne 1999).

Information is transmitted via two main routes: Sharing and trading. The value of information is believed to be a central determinant of the propensity to share and of the willingness to buy or sell information (Steinfield and Fulk 1988; Rafaeli and LaRose 1993; Newhagen and Rafaeli 1996; Butler 2001). Furthermore, the flow and exchange of information via trading or sharing are important qualities of the information society.

A central antecedent of sharing is the perception of the locus of ownership (Constant, Kiesler et al. 1994; Constant, Sproull et al. 1996; Jarvenpaa and Staples 2000; Jarvenpaa and Staples 2001). In this paper, we focus on trading rather than sharing, but are still interested in ownership of information. While perceived ownership has been widely documented to affect trading of a host of private and public goods (Kahneman, Knetsch et al. 1990; Thaler, Kahneman et al. 1992; Horowitz, McConnell et al. 1999), the effect of the locus of perceived ownership has not yet been explored in an information trading scenario. Specifically, prior findings suggest that ownership leads to higher valuations of goods. An owned object is valued higher than the same object lacking an assigned ownership. This effect was called the Endowment Effect (EE) (Thaler 1980).

The purpose of the present research is to explore the effect of ownership on the perceived, or subjective, value of information in a trading environment. If ownership is an antecedent to value formation in trading, then this will form common ground for information sharing and trading behavior. It will also provide a broad understanding of users' behavior toward information in many situations: Consumption and provision of information for free or for a fee.

We begin by explaining why the value of information is subjective, and we then describe the EE and its application to the study of information. Following an outline of our research tool, which is a computerized business game, and the experimental procedure, we present findings that support the significance of ownership on the perception of the value of information.

1.1 The value of information

The E-economy is predicated, to a large extent, on the value of information. Information is costly to produce but very cheap to reproduce. It is therefore difficult to assess its value (Shapiro and Varian 1999). Neither cost nor the value of the information produced are related to the quantity of the product. As information has indirect utility in the support of decisions, direct utility measurement is inappropriate (Van Alstyne 1999). Theoretically, there are three ways to assess the value of information (Ahituv and Neumann 1986): Normative, realistic, and subjective. While user utility should be the base for calculating the price of information, utility varies by person and circumstance. Information is an "experience good", the value of which is revealed only after use (Shapiro and Varian 1999). Realistic methods are ex post and consequently inappropriate for evaluating information content (also referred to as the "inspection paradox") (Van Alstyne 1999). We therefore focus on the subjective value of information.

The tradition of studying decision-making under uncertainty has addressed patterns of information use and the value assigned to information. This literature sets the backdrop for understanding information society trends. The heuristics experiments (Tversky and Kahneman 1982) as well as later studies (Kahneman and Lovallo 1993) demonstrated that people tend to ignore available information such as prior probabilities, sample size and the like. Instead, decisions are based on other subjective methods such as

representativeness, availability, and adjustment and anchoring (also known collectively as heuristics). Earlier experiments have also shown that people tend to be conservative and undervalue information available for the revision of a prior opinion (Branthwaite 1975). A recent study (Bastardi and Shafir 1998) tested the pursuit of information for daily decisions. Participants preferred to seek information and to base their choices on (objectively) noninstrumental information. In other words, people assigned positive subjective value to objectively worthless information. Theory also suggests that people seek information because it seems the right thing to do (Feldman and March 1981), implying over-demand for information and a high subjective value. People tend to accumulate information "just in case" they may need it in the future, again leading to excessive demand (Van Alstyne 1999). The theoretical tension is, therefore, between studies indicating that information is under-valued and research showing that information to be over-valued.

1.2 Value measurement

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. 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, since they represent an individual's personal perception of an object's worth for him or herself. We apply the WTA/WTP methodology as used for various types of goods in order to investigate the subjective value of information with a view to determining what characterizes information as a good.

1.2.1 The WTA/WTP disparity

The consistent, unexpectedly large and uni-directional difference between WTA and WTP observed in relation to traditional goods and services has generated much research interest. Attempts were made to explore whether the discrepancy can be explained by economic theory or whether the difference belongs to the realm of less than- or bounded- rational choice and is rooted in psychological origins. We will summarize some of the pertinent literature on the WTA/WTP disparity and the explanations offered by economists and psychologists highlighting the common denominators of these two approaches.

Commonly, bidding is employed as the general experimental approach for researching the values of WTA and WTP . Participants in experiments are offered the opportunity to bid for the purchase of an item, or to state a reserve price for the sale of an item. There are many bidding mechanisms and there is no specific experimental design common to all the experiments described below. A comprehensive methodological review detailing the types of bids used in different papers can be found in (Horowitz and McConnell 2000). Using the various bidding mechanisms, researchers have demonstrated a significant disparity to exist between the values of WTA and WTP for common market goods such as chocolates, pens, and mugs (Kahneman, Knetsch et al. 1990; Bateman, Munro et al. 1997), and a much larger disparity with regard to nonmarket goods such as health (Thaler 1980; Shogren, Shin et al. 1994). Trading induced-value tickets, or tokens of known value, have not shown a WTA/WTP disparity (Kahneman, Knetsch et al. 1990; van Dijk and van Knippenberg 1996; Irwin, McClelland et al. 1998). Induced value tickets or tokens are characterized by having only pure monetary value. In this case, of "induced value" items, the expected number of trades took place, the expected number of trades being half of all possible trades. Herein lies one of the important implications of the disparity, namely that the existence of a significant difference between WTA and WTP leads to a reluctance to trade and results in undertrading. This was further confirmed by trading induced-value tickets of unknown value (van Dijk and van Knippenberg 1996; Irwin, McClelland et al. 1998) as well as lottery tickets (Knetsch and Sinden 1984; Bar-Hillel and Neter 1996), which resulted in a WTA/WTP disparity and undertrading. Interestingly, uncertainty was not the cause for the disparity observed in the mugs experiment (Kahneman, Knetsch et al. 1990), since the bids were made on mugs marked with clearly visible price labels.

The studies mentioned here as well as dozens of others (Horowitz and McConnell 2000) reveal a continuum ranging from induced (known) value tickets, where WTA is found to equal WTP, through market

goods, where the disparity exists, and on to nonmarket goods where the disparity is largest. The WTA/WTP ratio approaches unity for induced value items, being usually about 3 for market goods, while for nonmarket goods that ratio is very large, usually about 10.

1.2.2 Theoretical foundation of the WTA/WTP disparity

The main psychological explanations of the WTA/WTP disparity are loss aversion (Kahneman, Knetsch et al. 1990; Thaler 1991; Bateman, Munro et al. 1997) which is based on Prospect Theory (Kahneman and Tversky 1979), and the degrees of similarity and uncertainty in the cases of induced value tokens and lottery tickets (Knetsch and Sinden 1984; Bar-Hillel and Neter 1996). The main economic explanations are the substitution effect (Hanemann 1991; Shogren, Shin et al. 1994), the tradeoff between the price of information and the expected payoff (Kolstad and Guzman 1999) and intrinsic value (Boyce, Brown et al. 1992).

The Prospect Theory approach received experimental economic substantiation (Horowitz, McConnell et al. 1999). Similarity observed in psychological experiments (Chapman 1998) is equivalent to economists' explanations of the substitution effect. Psychologists also acknowledged that lack of commensurability is necessary for the EE to manifest itself (Kahneman, Knetsch et al. 1990), again a hint for the substitution effect. The immunity of induced value tickets to the Endowment Effect also supports the substitution effect explanation as such tickets have perfect substitutes when their values are known. The degree of uncertainty or the amount of information provided have also been researched both by psychologists and by economists. The results in all cases show similar trends. Psychological theory proposed in order to explain the WTA/WTP disparity is based on observations of human behavior. This is in line with economic models, which in this area of research are inductive and based on experimental markets rather than on traditional economic assumptions. Overall it can be said that economic and psychological research are moving in the same direction, thus lending support to each other. The main underlying causes of the EE seem to be loss aversion and the substitution effect with their respective outgrowths. Variables that influence the EE are the type of good traded (induced-value, market, nonmarket) and the existence and availability of substitutes, which imply the availability of information on the market.

1.2.2 Implications for the subjective value of information

A choice to pursue information for decision making is a result of the desire to reduce the uncertainty that characterizes certain decisions. Information in this sense is not a regular consumer good; it is more like a raw material consumed in the production of other goods down the value chain. The decisions as to what kind of information will aid in reducing the uncertainty, where to look for information, and what is the information worth are in themselves made under uncertainty. One rarely knows in advance what kind of information one will find, what will be the quality of that information, and to what extent will it actually reduce uncertainty. All this stems from the fact that information is an experience good, the value of which is revealed only after consumption and from a lack of access to meta-information. Research that would shed light on the value of information prior to consumption or what influences value formation will be of importance to information consumers, content providers, decision makers, and information system designers.

The result of the WTA/WTP disparity, or of the EE, is that it creates undertrading. Fewer trades take place than should have occurred under standard economic assumptions. As cited earlier, lack of information contributes to an increase in the WTA/WTP divergence and hence leads to undertrading. Conversely, abundance of information suggests an accelerated pace of trade. Information is an economic catalyst. Increasing its perceived value and the demand for it should be the objective of any market-oriented organization in wishing to increase the number of trades. Naturally, this is especially true for information vendors. Since information is often a crucial component of market goods, enhancing the value of that information would enhance the overall value of the goods and diminish undertrading.

Substitution effect theory should predict a large WTA/WTP disparity for information. This is due to its inherent nature as an experience good, each item of content being unique. On the other hand, the abundance of free information on the Internet and searchers' inclination to seek free content suggest a low subjective value for information producing parity between WTA and WTP. In light of this contradiction we have chosen to begin our investigation with a fundamental question about the WTA and the WTP for information in order to form a basis for further research on factors influencing these values and other issues of importance. Our research question is : Where is information found on the WTA/WTP disparity continuum?

Our hypothesis is that the WTA/WTP ratio for information is greater than unity. We expect the ratio to be similar to the standard set for market goods because the experiment involves a very simple market situation.

2. RESEARCH METHODS

2.1 Experimental instrument

A Java-based computer simulation of an easy-to-understand business game called "The Lemonade Stand" was used as the experimental instrument. In this simulation the player owns a lemonade stand and must operate it so as to maximize his/her profits by selling to passers-by. A detailed description of the simulation game can be found in previous manuscripts ((Rafaeli and Raban under review; Rafaeli, Raban et al. under review).

2.2 Procedure

The experiment was preceded by a detailed in-class presentation of the simulation along with handouts that consisted of the instructions and sample screenshots. A prize was offered to the player who would achieve highest profits. Participants were told that profits could be made in two ways: 1. By trying to optimize the inventory, lemonade quality, and price per cup depending on the weather data (if available). 2. By trading information (selling generates direct income, while buying information can generate indirect payoffs if played wisely).

A description of the experimental session can be found elsewhere (Rafaeli and Raban under review). Market prices of the information trades were built into the simulation but were not known or revealed to the players. They were only told that market prices were to be determined randomly and that trades would be executed at market prices if the bids they offered were acceptable. This was done to ensure incentive compatibility according to the Becker-Degroot-Marschak principle (Becker, DeGroot et al. 1964), known in the literature as the BDM method. In BDM, trade takes place only if bids are compatible with current market prices. BDM is therefore a useful method in eliciting private values and is a popular tool in studies of the Endowment Effect.

Participants: Fifty five students in two groups of, respectively, thirty one and twenty four participated in the experiment as part of a class requirement. One group was presented first with the selling scenario, the other started with the buying scenario. The players were seated in a computer lab with an individual computer for each player. They were not allowed to interact with each other but were allowed to ask the experimenter for clarifications. The experiment yielded two or three WTA values and two or three WTP values of the weather information for each participant. All results were combined into one set based on the finding by us and by others ((Boyce, Brown et al. 1992; Morrison 2000; Rafaeli and Raban under review) that there is no learning effect in bidding. The entire experiment lasted an hour and a half, which included the presentation, the warm-up games, and the six games with bidding.

A brief introduction to the game, a Powerpoint presentation, and a link to the game itself are available at: http://gsb.haifa.ac.il/~draban/lemonade/

2.3 Measures

Two measures were collected by asking the players for input into the computerized simulation of The Lemonade Stand: Stated value for the willingness to pay (WTP) and willingness to accept payment (WTA) for weather information . WTA and WTP bids were entered in response to an online question such as: "Please state the price you are willing to pay in order to purchase weather data for the entire game period. The trade will take place only if your bid complies with the current market price." Participants were asked to reconfirm their bid (with an option to change) prior to proceeding with the game.

Data recorded automatically included: Game profits, all quality and inventory parameters entered, use of the online help option, reputation (number of clients who came following a recommendation by satisfied

clients) and popularity (derived from the number of clients who bought lemonade out of the total number of clients).

2.4 Analysis

Paired samples t-tests were performed to compare the means of WTA and WTP within the group. T-tests were performed to place the WTA/WTP ratio on the ratio continuum described in the introduction comparing the ratio to a value of 1 (WTA=WTP) and to a ratio of 3, the ratio for market goods. Independent samples t-tests were performed to establish whether the use of information was associated with a larger profit from selling lemonade.

3. RESULTS

The present results reveal that the WTA/WTP ratio for weather information in the Lemonade simulation is about 3 and that there was a strong preference to play with information. Results shown here represent 135 observations collected from 55 participants. Six extreme outliers were removed from the original set of 141 observations. The criterion for removal was an input of two or more extreme values. Table 1 lists the results of the paired-comparisons t-test comaring the values of WTA and WTP.

Table 1. Paired samples statistics to test differences between WTA and WTP

Variable	N	Mean	Std. Dev.	t	df	p
WTA	135	18.84	20.44	5.04	134	.00
WTP	135	11.56	16.99			

Table 2 shows the mean values of the WTA/WTP ratio (mean of ratios), the t-value and its significance for a one-sample test once with the test value being one and once with the test value equaling three. The results indicate that the mean ratio is significantly different than one but not significantly different from three.

Table 2. One sample statistics to test differences between the mean WTA/WTP ratio (denoted "ratio" in the table) and values of 1 (meaning WTA=WTP) or 3

Test Value	Mean Ratio	Std. Dev.	t	p
1	2.68	3.11	6.29	.00
3			-1.19	.235

In order to examine whether the use of information produced an objective benefit for the participants we examined the players' profit data. These data with the results of an independent samples t-test are summarized in Table 3. The difference in profits with and without information was not statistically significant for lemonade profits alone but was statistically significant when the profit accounted for the trading of information. In fact, the results presented here suggest an advantage for playing without information. Nevertheless, participants showed a strong preference for purchasing and not selling information as shown in Table 5.

Table 3. Mean profits in the warm-up games with and without weather information.

Profit Elements	Mean game profits				
	With Information (N=181)	Without Information (N=89)	t	p	df
Lemonade sales	7.47	9.48	-1.92	.06	268
Lemonade sales+information trading	4.62	11.46	-5.38	.00	

Table 4 summarizes the percent of trades that took place indicating a strong preference to use information despite its seeming lack of usefulness for the bottom line profit. The data reveal a stronger tendency to purchase than to sell information.

Table 4: Percent of games played with weather information

Type of bid	Percent of successful trades
WTA	23.70
WTP	57.78
Total	40.74

4. DISCUSSION

Both WTA and WTP averaged higher than the market price set under game conditions. This indicates a high overall subjective value for information. While both WTA and WTP are high, interestingly players did not strategize toward the market price. Rather, they demonstrated true private values as reflected by the WTA mean. As predicted by the Endowment Effect theory, WTA for information was significantly larger than WTP for information (Table 1). In other words people assign higher subjective value to information they own, as compared to the same information that is only a prospective purchase. This finding places information in line with other consumer products, subject to the endowment effect identified by contemporary literature. The high value of WTA implies not only the reluctance to sell but also the value assigned to non-use of information for the purpose of playing the game.

Further support for the existence of a substantial disparity is found by the mean of ratios (Table 2) which was found to significantly diverge from unity but was not different from the repeated research-reported level of about three. This means the numerator (willingness to accept payment for information, WTA) is three times larger than the denominator (willingness to pay for information WTP).

A widely used slogan is that information is (or is becoming) a commodity. Nevertheless, information still has its peculiarities. It is easier to duplicate, easy to share, and ownership of it proves more difficult to enforce. A weighted overall mean ratio of 2.68 obtained here for WTA / WTP is typical of regular market goods (Horowitz and McConnell 2000). Does this imply that information is a regular market good? The relatively low WTA/WTP ratio for market goods is usually attributed in the literature to the existence of fairly good substitutes. But does information, which is an experience good, have substitutes? We believe further interpretation of the results as well as further research is called for before making conclusions about the nature of information as a good.

Mean profit values with and without the use of weather information in the games were not significantly different when looking at game performance only as seen by profits from selling lemonade (Table 3). The difference became significant when the trading of information was accounted for. Table 3 clearly shows that over-buying of information had a negative effect on total profits. High subjective values were assigned to information despite the lack of objective value for the information presented. The players were shown their profit data at the end of each game so they were free to avoid purchasing information that did not prove instrumental. However, results show that even in the face of objective uselessness of the information, participants valued information and wanted to buy it. They exhibited a bias in favor of buying more than selling, although buying and not selling had an effect on subsequent profits (buying meant paying from one's budget while selling meant earning and enlarging one's budget). This is in agreement with the observations of (Bastardi and Shafir 1998) and with (Grant, Kajii et al. 1998) who found that preference for information does not imply expected utility.

The strong preference to purchase information is also reflected in the percent of trades which actually took place as seen in Table 4. We assume a 50% expected percentage for trades. For WTA we see major undertrading while for WTP we observe considerable overtrading. Participants were reluctant to sell and eager to buy information for the game as also manifested in the number of games played with information

(67.04% of the games played with information). The overall average of the trades that took place was about 41% which shows a fairly small trend for undertrading. These results suggest that information may be a more marketable good than many other market goods because the desire to buy information is very high.

It can be argued that the relatively high bids are a result of the BDM procedure which is incentive-compatible only for the market value. In the Lemonade game a player can enter a high bid but is assured of actually paying only the market price so the player bids high strategically out of risk aversion and his/her will to verify that the bid will achieve its goal (buying or not selling). Possibly the high bids both for WTA and for WTP for information and the moderate ratio of these values can be better explained by risk aversion rather than loss aversion which is the most widely-accepted explanation for the EE. Bidders wanted to ensure access to information and did not want to risk playing without it. The relationship between information and risk aversion has been addressed by a theoretical model (Grant, Kajii et al. 1998) establishing that intrinsically information-loving people are also risk-averse. Risk aversion has also been linked empirically to lack of information (Kahneman and Lovallo 1993). The present results do not, however, demonstrate strategic bidding because the number of extreme values was low as reflected by the mean and the standard deviation.

Another explanation for the high bids is that bidders had no information about the market price and received only indirect feedback whether they succeeded in purchasing or selling information from the new game settings presented to them after the bid. Lack of information tends to produce higher bids (Kagel 1995). This corresponds well to the theory put forth by (Kolstad and Guzman 1999) who showed there is an inverse relationship between the amount of available information and value of goods traded.

The present research gives rise to many questions. Information as content is an experience good. We neither have prior information on information nor do we have substitutes. How, then, can we explain the information economy in light of these findings? Can the EE phenomenon be related to the decrease in the relative demand for information while production is increasing (Lyman and Varian 2000)? One explanation can be the problem of information overload. We cannot handle and absorb the very large amounts of information at our disposal. Perhaps we suffer from information overload, as suggested earlier (Bastardi and Shafir 1998), because we misuse information, and, as shown in this paper, we tend to hoard information. We pay attention to the wrong information for the wrong reasons. How can we reduce uncertainty regarding information and be better consumers of information? If we value our time so dearly as suggested by experiments (Ortona and Scacciati 1992; Hoorens, Remmers et al. 1999), why do we spend so much of it looking for useless information?

4. CONCLUSION

The findings reported here suggest that society has not yet adjusted its information consumption patterns to the present situation of information abundance. Further research into the value of information may help in developing better training programs for information consumers as well as in designing information systems that account for bounded-rationality behavior.

Clearly, a viable information society should be fueled by lively information exchange. An imperfect information flow scene is to the detriment of many of the optimistic predictions and expectations of the information society. The endowment effect predicts undertrading in information, has been shown to operate here, and is therefore one possible explanation for less than utopian outcomes in reality. This line of study points to less than optimal attitudes toward information and its use. These findings could shed light on suggested policy and information literacy interventions.

In the experiment presented here a certain type of information was used in a specific setting. In order to generalize or differentiate various types of information and find their places on the WTA/WTP ratio continuum further experiments are needed using different types of information in different settings. For example, it can be hypothesized that information regarding a person's health will yield a high WTA/WTP ratio, possibly similar to that of public goods. Variations of the present or other simulations may be developed for training purposes to highlight the value of information and suggest ways for more efficient utilization of it.

We elicited the subjective value of information by developing a theory-based experimental procedure. The main contribution of the present research is to suggest that ownership influences the subjective value of

information in trading. Future research may seek out the effect of ownership both in trading and in sharing information. Additionally, the present research shows the subjective value of information to be consistently high by a number of parameters, including the WTA/WTP ratio and the number of games played with information. This experiment also indicates that the consumption of information may be less than rational. Decisions related to such consumption are possibly caused by risk aversion. Several experimental variations and refinements are called for in order to establish a coherent theory about the subjective value of information.

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