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# Emotions in Electronic Auctions - A Physio-Economic Approach on Information Systems

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# EMOTIONS IN ELECTRONIC AUCTIONS A PHYSIO-ECONOMIC APPROACH ON INFORMATION SYSTEMS

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## Abstract

*Though auctions show a prevailing dominance in electronic markets, our understanding of how auctions affect human behaviour is still rather limited. In this paper we analyse the impact of emotional processes on the decision making of human agents in electronic auctions. The analysis is based on a physio-economic study, in which human agents take part in a Dutch auction experiment, while their physiological parameters are recorded simultaneously. Parameters evaluated in this study are the electrodermal activity and the heart rate of the experiment participants. Based on the physiological results, we conclude that human agents tend to cognitively set a price at which they want to end the auction, but once they reach that specific price, they are tempted due to emotional processes to wait a little longer in order to increase their nominal payoff. Further we argue that the adaption of psychophysiological methodologies is not limited to mechanism design, but can be of considerable assistance for successful design of information systems in general.*

*Keywords: Auction, Emotion, Design Research Methods & Methodologies, Market Engineering, Physio-Economics*

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# 1 INTRODUCTION

The rapid penetration of Information and Communication Technologies has also effected into a raise of auction mechanisms. Be it transactions between businesses, consumers, the public administration or any combination of these, auctions are *the* primary coordination mechanism, which establishes dynamic prices. The number of electronic market platforms based on auctions is expected to further grow with no end in sight. Amazon, eBay and SupplyOn are just a few prominent examples for the very successful use of auctions in electronic markets. Auctions have been used for the transaction of nearly any imaginable good for several centuries, but their ever-growing and omnipresent use in electronic commerce worldwide is conspicuous.

Even more surprising than the fact that auctions play such a dominant role in electronic business is that our understanding of how auctions work on human behaviour is still rather limited. A substantial literature in the field of game theory tries to explain auctions from an analytical point of view. Economic theory typically describes auctions as non-cooperative games with asymmetric information and provides the market participants (or agents) with a set of normative rules in order to maximize their expected payoff. Correspondingly, agents are assumed to behave rationally in these type of models. Nevertheless experiments in the laboratory and in the field show that the theoretically derived models – though mathematically sound and sophisticated – are not rich enough to capture the behavioral component of auctions. When it comes to explain human behavior, it is imperative to understand the decision making process of the market participants in the first place.

In this paper, we analyse the impact of emotions on the decision making of human agents in the Dutch auction. In a Dutch auction the auctioneer starts the auction by setting an initial high price. The auctioneer then continuously decreases the price until one of the bidders claims the good by accepting the current price. The bidder is then awarded with the good for the last announced price. The analysis is based on an experimental study in which human agents take part in a Dutch auction, while their physiological parameters are recorded simultaneously. By applying methodologies of psychophysiology and psychology, deeper insights into the decision making process and the emotional processing of the market participants can be gained.

In this paper, we start from the intuition that decision making is both a cognitive and an affective process. It comprises strategic considerations of the agents concerning the maximization of their expected payoff on the one hand; rhese aspects are the main focus of auction theory today and are fairly well understood. On the other hand, however, there is an inevitable influence of affective or emotional processes that also have a strong impact on the decision making process. Undisputadely, the decisions of human agents are not fully goverend by rational considerations alone. Recent research addresses the fact that there is a significant correlation between emotion and the economic behaviour of agents. Putting it to the extreme, Bechara & Damasio (2005) argue that taking advantageous decisions is only possible in consequence of a prior accurate emotional processing. Various other studies in the field of neuro-economics and of physio-economics (e.g. Gonzales, Dana et al. 2005, Rilling, Sanfey et al. 2004, McCabe, Houser et a. 2001, Smith & Dickhaut 2005) substantiate the assumption that emotions have a crucial impact on the decision making process of human agents. Lo & Repin (2002) analyse the interrelation of somatic states like the skin conductance or the heart rate with market events on financial markets. Analysing the physiological parameters of traders on the stock exchange in the context of a field experiment, they found a significant correlation between changes in the price and return deviations as well as the maximum volatility with the increasing number of skin conductance responses and the average heart rate.

In line with those studies, we argue that we need a research focus on the emotional aspects of decision making and of human interaction with information systems in general. Methodologies of psychophysiology have to be adapted to the needs of information systems research and experimental economics in order to gain a deeper understanding of human behaviour and its causes. Physiological parameters like the skin conductance or the heart rate provide objective parameters of the market

participants that at least complement traditional techniques. Popular methodologies like the use of questionnaires and interviews often have to deal with the problem of subjectivity and social-desirability bias. Furthermore the interviewed persons often find it very difficult to express their level of arousal by the mere use of words and scales. The elaborated use of physiological parameters offers the opportunity of a supplemental objective perspective, which appears to be a considerable enrichment for the understanding of human decision making. It is important to mention that the analysis of physiological parameters can act as complement to questionnaires rather than a substitute.

The remainder of the paper is structured as follows. In section 2, we highlight considerations regarding the strategic behaviour of agents in the Dutch auction and point out how this translates to emotional processes. In section 3 we point out the psychophysiological parameters used for the analysis of participants' arousal, before section 4 presents the experimental design that underlies this study. In section 5 we present and interpret the results of our study. Section 6 concludes and provides an outlook on future physio-economic studies in the field of auction design.

# 2 BIDDING IN THE DUTCH AUCTION

In Dutch auctions, the auctioneer sets an initial high price and then gradually decreases the price for the commodity until one of the bidders accepts the current price. Technically speaking the Dutch auction is a descending auction with a first-price mechanism, meaning that the buyer pays the price she actually bid for the good. The Dutch auction originally obtained its name from the flower market in Amsterdam, which is based on that specific auction mechanism. The Dutch auction is especially interesting due to its theoretically equivalence to the first-price sealed-bid auction, in which each of the participants submits exactly one sealed bid and the highest bidder gets the commodity for the price she has bid in the first place. Although the mechanisms are, independent of the participants' risk attitude, theoretically equivalent, they systematically lead to different market outcomes in experiments (e.g. Milgrom 1989). We propose that this difference can be attributed to the increased degree of arousal of the participants in the Dutch auction due to its dynamic characteristic.

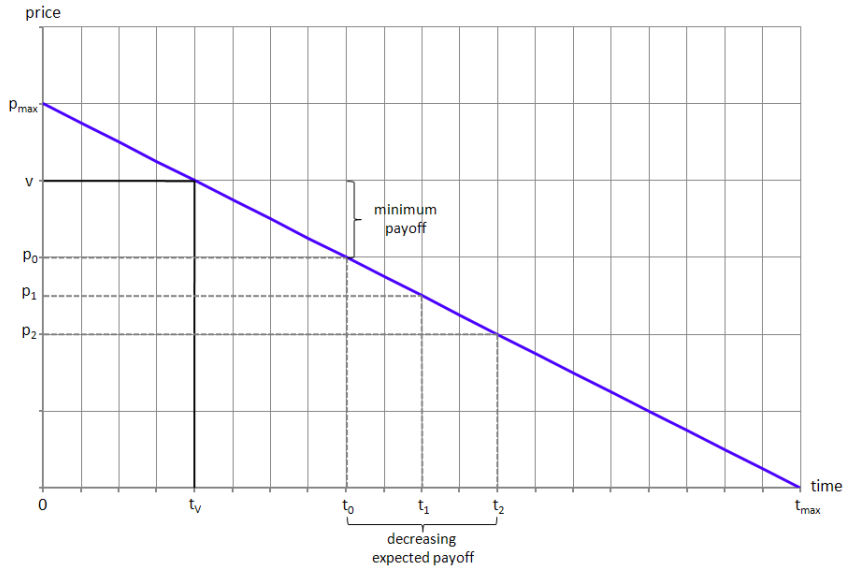


*Figure 1. The decrement of the price in the Dutch auction over the time. The auction starts off at an initial high price $p_{max}$ and hypothetically ends at $t=t_{max}$ if no bids were submitted.*

Auctions are typically analyzed by means of game theory, where best-response strategies are identified. From a strategic point of view, it is very important to specify assumptions regarding the valuations of the bidders participating. Typically three classes of valuations are distinguished: (1) common values, (2) independent private values and (3) affiliated values (Milgrom & Weber 1982). In this study we focus on the case when the commodity has the same common value for each of the

auction participants. Often agents do not observe the common value precisely, but only some (uniform) statistical distribution of it. A very prominent example of the common value assumption is the sale of oil drilling rights, in which each of the auction participants has the same marginal costs for extracting the oil, but no one exactly knows how much oil can actually be extracted and therefore how high the common value of the oil drilling rights is. The winner of a common value auction usually tends to overestimate the real value of the commodity, since all other bidders had a lower estimate. This phenomenon is commonly known as the "winner's curse" (Kagel & Levin 1986, Wolfstetter 1994). To exclude the effect of the "winner's curse" regarding the value of the commodity in our analysis, the exact common value v is made known to all agents participating in advance.

The decrement of the price in a Dutch auction over the time is depicted in figure 1. The auction starts off at t=0 with the initial high price $p_{max}$ and hypothetically ends at $t=t_{max}$ with the price 0, if no bidder submitted a valid bid in the meantime. The common value v is reached by the time $t_v$. A fully rational agent would submit a bid and consequently stop the auction at a price just below the common value v. However the payoff of the agent if she obtains the commodity for a price just below v is converging to zero. Therefore we assume that in this specific setting, each auction participant i sets a price $p_{i0}$ at which she intends to bid for the commodity and consequently end the auction. Taking all prices $p_{i0}$ of the agents into account, we expect an average price of $p_0$. That is the price the agents would bid in the strategically equivalent first-price sealed bid-auction, in which each agent submits a single bid in a sealed envelope and the highest bidder gets the commodity for the price she bid. We assume that each agent cognitively considers these aspects before the Dutch auction starts and ends up with her price $p_{i0}$.

The probability of winning the Dutch auction over the bidding-price is depicted in figure 2. We assume that the probability has a convex characteristic between 0 and the price $p_0$. This seems reasonable, as it is gradually unlikely to win the auction at a price below $p_0$. In contrast we assume a concave characteristic in the interval between $p_0$ and the common value v, since participants want to gain at least some minimum payoff v minus $p_0$. It seems more than plausible that the probability of winning the auction with a bidding-price between v and $p_{max}$ is 1, because such a price would result in a negative payoff for the winner. Here it becomes clear why the common value regarding the value of the commodity has been set to a fixed value. Hence, bidding above v – which may cause the "winner's curse" effect – has been excluded in this specific setting.

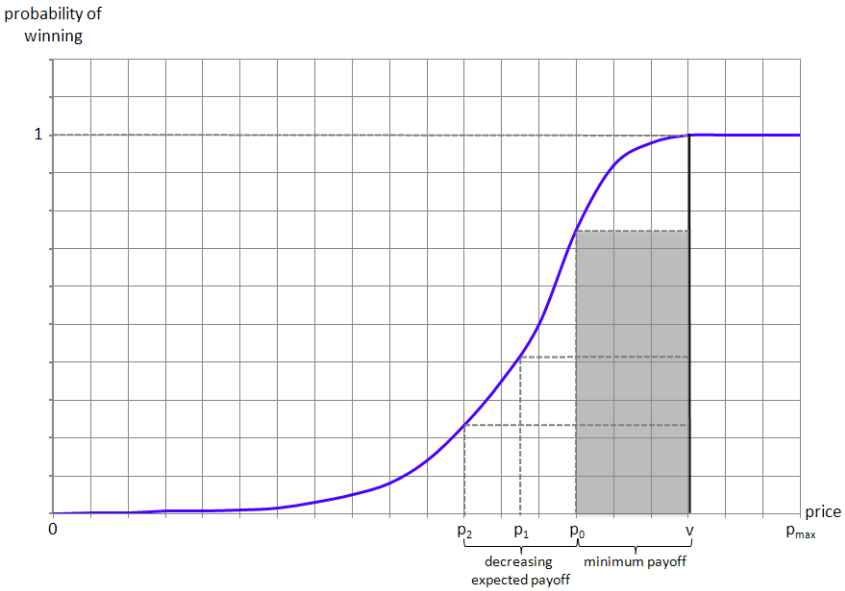


*Figure 2. The probability of winning the auction and the expected payoff of the auction participants. The expected payoff has its maximum at the price $p_0$.*

However, when the auction has started and gradually reaches the time $t_0$, we assume that an emotional process begins inside the human agents, which results in prices below $p_0$. The auction participants might be tempted to wait a little longer and set a new price $p_1$ and a corresponding time $t_1$ in order to gain a higher payoff than the minimum payoff. This reassessment of the bidding-price might iteratively occur until one bidder decides to stop the auction. The probability of winning the auction however, has a convex characteristic in the interval between 0 and v. Thus, the *expected* payoff for all auction participants is decreasing over time while the *nominal* payoff for the winner increases. The expected payoff is illustrated in the figure as the gray area and obviously it reaches its maximum at $p_0$.

The behaviour of waiting for the *nominal* payoff to further increase while the *expected* payoff decreases at the same time cannot be explained with cognitive or rational behaviour alone. We interpret this behaviour as some kind of "auction fever" as it has already been observed in English Auctions under different circumstances (Ku, Malhotra & Murnighan 2005, Heyman, Orhun & Ariely 2004, Abele, Ehrhart & Ott 2006). We claim that affective or emotional processes, induced by the iterative mechanism of the Dutch auction, are responsible for the lower results. This might also explain why the Dutch auction yields on average lower revenues for the seller compared to the strategically equivalent first-price sealed-bid auction in laboratory experiments (e.g. Milgrom 1989).

This behaviour cannot be explained satisfactorily yet by classical auction theory, which assumes fully rational agents that are not affected by emotional processes at all. A fundamental understanding of the decision making process with all its facets is indispensible though for the design of electronic market platforms. The market engineer has to design the market microstructure with respect to the presumed behaviour of the agents in order to achieve the specified objectives of the market (Weinhardt & Neumann 2003). If the understanding of the agent behaviour is rather limited though, the market outcome may deviate considerably from these objectives and even result in massive losses. Therefore, an elaborate market design, which is essential for a successful electronic market, has to consider the emotional aspects of human decision making as well.

We claim that in order to gain a deeper understanding of these emotional aspects, we have to adapt psychophysiological methodologies to the field of experimental economics and information systems research. In contrast to the mere use of questionnaires and interviews, which often have to deal with the problem of subjectivity and social-desirability bias, the analysis of physiological parameters offers the intriguing opportunity to examine objective parameters that show a strong correlation to emotional processes of human agents. In the next section we will present the physiological parameters used in this study and point out the implications of their use for the experimental design.

# 3 PSYCHOPHYSIOLOGICAL EVALUATION

In this study we focus on the psychophysiological analysis of the electrodermal activity and the heart rate of to experiment participants in order to gain a deeper insight into the decision making process of human agents. These physiological parameters are well known in psychophysiology as excellent indicators of arousal and emotionality (Dawson, Schell & Filion 2000; Brownley, Hurwitz & Schneidermann 2000). Moreover, their relevance for human decision making has already been substantiated in several physio-economic studies (Lo & Repin 2002; Smith & Dickhaut 2005). It is important to state though that, just like other physio-economic studies (e.g. Smith & Dickhaut 2005, Lo & Repin 2002), we cannot distinguish between the different categories of emotions, e.g. fear, anger, sadness, joy, in this analysis. We can however determine the arousal of the market participants; various studies (e.g. Sinha, Lovallo & Parsons 1992) show that there is a strong link between emotions and arousal.

## 3.1 The electrodermal activity

Electrodermal activity is a generic term for the different electrical characteristics of the human skin: skin potential, skin admittance, skin impedance, skin resistance and skin conductance. Most relevant for psychophysiological research are particularly the skin resistance and its reciprocal value, i.e. the

skin conductance. They are exosomatically measured by applying a very small electric current on the human skin. In this paper we emphasize the analysis of the skin conductance.

The skin conductance of human agents has a typical range between 2 µS and 20 µS and shows a strong variation between the different subjects. The characteristic of the skin conductance is distinguished into a tonic level, meaning the absolute level of the skin conductance, when there is no phasic response, and into phasic increases, referred to as responses. The tonic level is denoted as the skin conductance level (SCL) and can be interpreted as the absolute level of arousal in relation to the basic level of the individual subject. In contrast the phasic increases are denoted as the skin conductance responses (SCR), which can either be specific to an identifiable stimulus or nonspecific, if such a stimulus cannot be identified. For a comprehensive breakdown of the electrodermal activity please refer to Boucsein (1992) and Dawson, Schell & Filion (2000).

In this paper we focus especially on the SCL as an indicator for the overall arousal of the auction participants. We presume that it is only slightly increasing from the point when the auction starts until the price $p_0$. From that on, we expect a significant increase of the SCL that finally reaches its maximum when one of the agents ends the auction by accepting the current price. That would strongly substantiate the assumption that the human agents are tempted to bid below the price $p_0$ although their expected payoff rapidly decreases.

### 3.2 The heart rate

The heart rate is another physiological parameter that is well suitable for analysing the arousal of human agents. Lo & Repin (2002) analyse several physiological parameters, ranging from skin conductance, to body temperature, the respiration and the heart rate, in the context of stock traders and find correlates particularly for the skin conductance and the heart rate. Smith & Dickhaut (2005) point out the importance of emotions for institutional design using the heart rate in their analysis. In our analysis we focus particularly on the average heart rate (AHR) of the auction participants as an indicator for the degree of excitement. As well as for the SCL, we expect the AHR to increase significantly from the price $p_0$ on.

### 3.3 Implications for the experiment

In order to analyse the SCL and the AHR there has to be a rest period of approximately four minutes before each Dutch auction. During that rest period the SCL decreases to some basic level that varies from subject to subject. Moreover, the auction is designed in a way that reduces the impact of novelty at the beginning of the auction session. The auction starts off at an initial high price that is considerably above the common value v, leaving the auction participants a sufficient period of time to get acquainted to the auction environment. Since bidding above v results in a negative payoff, the analysis of the physiological parameters starts from the price v at time $t_v$ on.

Further a rather long interval of five seconds for each step in the Dutch auction is set with respect to enabling the psychophysiological evaluation. A clear trade-off turns out here. On the one side there is the need for long intervals between the relevant stimuli that can be mapped to the SCRs. On the other hand the auction participants should not get bored during the experiment, because that would very likely have an impact on their decision behaviour. The selected interval of five seconds seems to be a good solution here.

Extending experimental economics by methods of psychophysiology inherently results in a reduced number of observations. The experiments demand supplemental preparation time for each individual subject and the number of participants that can be measured simultaneously is limited as well due to technical restrictions of the measurement system. The rest periods further extend the experimental sessions and leave less time for additional sessions. The experimental design will be discussed in detail in the next section.

# 4 EXPERIMENTAL DESIGN

## 4.1 General environment of the experiment

The experiment has been conducted in a computer laboratory with undergraduate students with economic background. Inviting students for economic experiments is a common practice in experimental economics (e.g. Kagel 1995, Abele, Ehrhart & Ott 2006). Due to technical restrictions of the psychophysiological equipment, there have been a limited number of experiment participants. Altogether 8 participants have been invited to the experiment and were then assigned randomly into groups of two. Each group then played 3 Dutch auctions against each other, resulting in a total number of 24 observations. The ratio of female and male students is balanced. In order to reduce the influence on each other and minimize the number of measurement artefacts, the participants are isolated with a dividing wall during the experiment and are not allowed to move or speak.

The participants receive an instruction sheet that is read out aloud by a neutral facilitator. Before the actual start of the experiment, the students have to successfully complete a quiz regarding the rules in order to verify comprehension. Before the instructions are handed out, the measuring technology for skin conductance and heart rate measurement has to be attached. This is very important to assure a sufficient residence time for the electrode gel. To further reduce the possibility of measurement artefacts and to ensure full attentiveness of the students for the experimental system, anything that could distract the participants is removed from the laboratory before the experiment.

## 4.2 Structure of the experiment

After all of the participants have successfully completed the quiz the actual experiment starts. As pointed out earlier, each group played 3 Dutch auctions together. The within-subject design did not lead to significant differences in the market outcome between the three different rounds; therefore the data will be analyzed jointly. Each auction session is divided into three consecutive stages. The first stage consists of a rest period in which the participants have to wait for four minutes. In order to analyse the physiological parameters and the arousal of the participants, such a rest period is indispensible (Dawson, Schell & Filion 2000). In the second stage the Dutch auction itself takes place, which is going to be discussed in detail in the next subsection. The first period of time in the Dutch auction is designed again in a way that reduces the degree of novelty for the participants, which leads to less measurement artifacts of the physiological parameters. After the auction was finished, the auction results are displayed to the participants in the third stage.

## 4.3 The design of the Dutch auction

In each auction the two participants bid for a commodity with a fixed common value v of 6.00 €. The auction starts at an initial high price $p_{max}$ = 7.00 € and then gradually decreases the price every 5 seconds by 0.10 €. The common value v is reached after a period $t_v$ of 50 seconds, leaving the auction participants with a sufficient amount of time to get acquainted with the auction environment and thus reducing the impact of novelty to the physiological parameters. The auction ends after one of the bidders placed a valid bid by accepting the current announced price. If both agents simultaneously place a bid at a technologically indistinguishable point of time, the winner of the auction is determined randomly by a coin toss. The winner of the auction receives 6.00 € less her own bid. The students were paid off their accumulated personal payoff at the end of the experiment. This information is common knowledge to all auction participants before the auction was started.

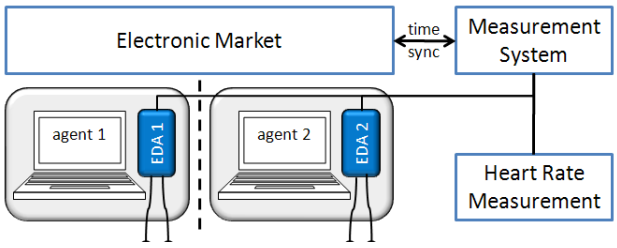


*Figure 3. The experimental setup with the electronic market and the measurement system for the physiological parameters (EDA = electrodermal activity)*

As depicted in figure 3, the Dutch auction is implemented as a simplified electronic market on a single computer. The participants follow the auction on their monitor and can place a bid by pressing a single button. To exclude collusive behaviour, the students were not allowed to speak before or during the experiment, furthermore the group allocation as well as the position in the lab was randomly assigned. The auction computer and the measurement system were automatically adjusted using appropriate time synchronizing software. The measurement system comprised a constant-current amplifier for skin conductance measurement, using silver-silver chloride cup electrodes, and a heart rate recording kit. The electrodes for skin conductance were attached on the thenar and hypothenar eminences of the palm.

# 5 RESULTS

On average, each auction ended after $t_{AVG}$ = 180 seconds at a price $p_{AVG}$ of 3.30 €. Remarkably, this price is far below the price predicted by auction theory. A fully rational player would bid just below the common value v, yielding a payoff converging to zero. The analysis of the psychophysiological recordings impose the assumption that agents select their price $p_{i0}$ in the interval between 4.30 € and 4.60 €. This could be substantiated to some extent in interviews with the auction participants after the experiment. Based upon the considerations of section 2, we assume that the auction participants initially intend to end the auction at their individual price $p_{i0}$. Having reached the price $p_{i0}$ though, the agents are tempted to wait a little longer and thus increase the *nominal* payoff while decreasing their *expected* payoff. We assume that this irrational behaviour can be attributed to the excitement during the auction, which leads us to the following hypotheses:

- Hypothesis H1. The slope of the skin conductance level of the auction participants in the interval between $t_0$ and the end of the auction is greater than in the interval between $t_v$ and $t_0$.
- Hypothesis H2. The slope of the heart rate of the auction participants in the interval between $t_0$ and the end of the auction is greater than in the interval between $t_v$ and $t_0$.

In each case the null hypothesis is that the slopes are equal in both intervals.

Of the 24 observation, only 15 could be evaluated for the analysis of the experiment due to technical difficulties and measurement artefacts. The typical characteristic of a skin conductance measurement, which could be observed during most of the Dutch auctions, is depicted in figure 5. One can see a strong SCR right after the start of the auction, which can be traced back mostly to novelty. Another strong SCR can be observed at the time $t_v$, at which the auction for the first time results in a non-negative payoff for the winning bidder. In the interval between $t_v$ and $t_0$, the SCL increases only slowly and sometimes even shows a decreasing slope. In contrast, from the time $t_0$ until the auction ends a strong increase of the SCL can be observed.

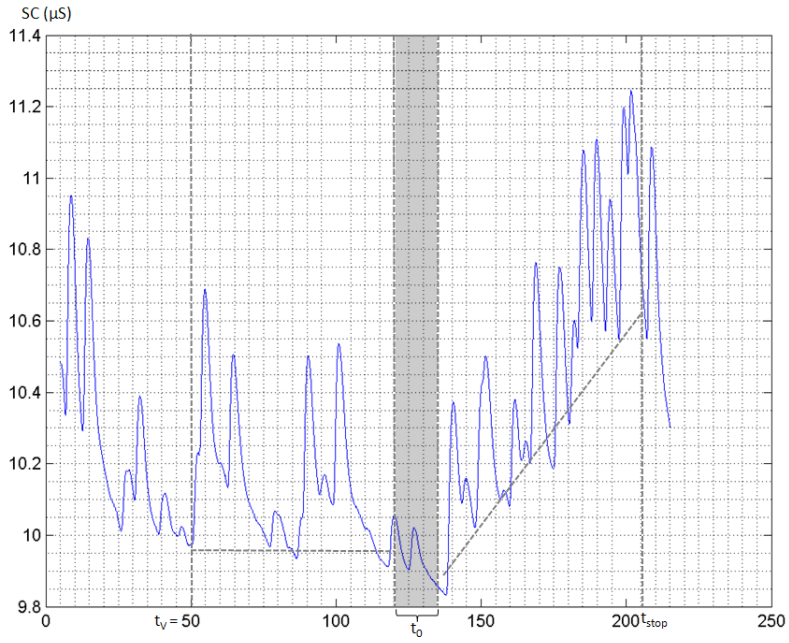


*Figure 5.* *Typical characteristic of a skin conductance measurement during the Dutch auction (SC = skin conductance)*

The null hypothesis was rejected in favour of H1 using a one-sided Wilcoxon-Mann-Whitney test at the 99 percent confidence level. Thus, the slope of the skin conductance level in the interval between $t_v$ and $t_0$ is significantly lower than the slope of the skin conductance in the interval between $t_0$ and the end of the auction. The typical characteristic of a heart rate measurement, which could be observed during most of the Dutch auctions, is depicted in figure 6. As well as in the skin conductance measurement, one can see a clear increase of the heart rate from the time $t_0$ on until the end of the auction. However, the null hypothesis could not be rejected in favour of H2 using the same test at the 95 percent confidence level. We largely attribute this result to measurement artefacts and the small number of observations that could be evaluated.

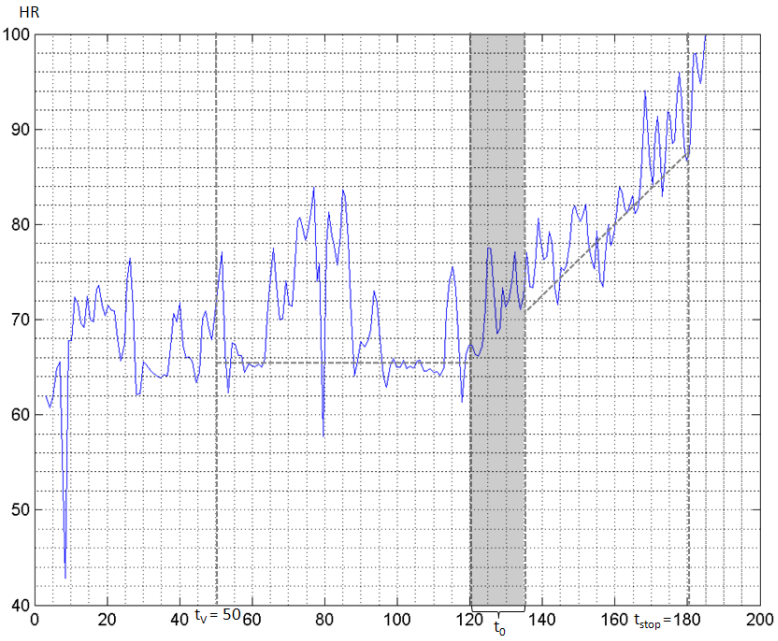


*Figure 6.* *Typical characteristic of a heart rate measurement during the Dutch auction (AHR = average heart rate)*

# 6 CONCLUSION & OUTLOOK

Based on the market results, the interviews and especially the physiological data, we conclude that due to emotional processes, the auction participants are tempted to prolong the Dutch despite their simultaneously decreasing expected payoff. We claim that this behaviour can be interpreted as some kind of "auction fever" and attribute it to the iterative characteristic of the Dutch auction. The increase of arousal can be substantiated by a significant increase of the skin conductance level. Though the evaluation of the heart rate shows no significant increase of arousal, it could nevertheless be observed in several measurements. We attribute this result to measurement artefacts and the overall small number of observations.

Further we conclude that the adaption of psychophysiological methodologies to experimental economics and information systems research in general shows promising results for future studies. Of course physio-economic studies still have to deal with technological and methodological difficulties, which results in a small number of observations yet. We are very confident though to overcome these challenges and conduct future experiments with a greater number of observations. Especially for the design of electronic markets, a fundamental understanding of decision making with all its facets is indispensible for its success. We claim that physio-economic studies can provide a considerable contribution here. Based on our results, future experiments have to further analyse the impact of mechanism variations on the agents' emotionality. We even argue that emotions are a major quality characteristic for electronic markets. Ebay even advertises to "make shopping exciting" in Australia or with "3.. 2.. 1.. mine" in Germany. Therefore it is vital to know how electronic markets can trigger emotions, and, perhaps even more importantly, how the triggered emotions affect the market outcome.

It is important to state though that with EDA and AHR measurement, we can only determine the level of arousal of the market participants; we cannot distinguish between the different categories of emotions, e.g. fear, anger, sadness and joy. There is however a strong link between emotions and arousal (e.g. Sinha, Lovallo & Parsons 1992) and it is an important issue for future research to understand what kind of emotions are triggered by variations in the market mechanisms. We propose that this can be achieved by the sophisticated combination of psychophysiological methodologies and questionnaires. For our analysis though, it is only important that emotions in general have a significant influence on the behavior of market participants in electronic auctions.

Moreover, the use of psychophysiological methodologies is not limited to mechanism design alone. It may also be applied for the comparison of electronic markets and information systems in general. Recent studies show that the design of the information system has an impact on the market outcome as well, even if the markets use the exact same market mechanism (Kersten et al. 2007, Kolitz 2007). Thus the design of an electronic market must not be limited to the microstructure and the business structure, but has to comprise a sophisticated approach for the information system design as well. The different outcomes of identical market mechanisms cannot be explained with auction theory and thus are most probably related to the agents' arousal. Therefore, physio-economic methodologies can be of considerable assistance for the information systems design of electronic markets as well. Correspondingly, we argue that the adaption of psychophysiological methodologies is not limited to electronic markets alone, but can be applied to any kind of information system with human interaction. In complementary combination with sophisticated interviews and questionnaires, a deeper understanding of the users' emotional processes can be gained, which is undoubtedly essential for an elaborated design of information systems.

## References

Abele, S., Ehrhart, K.-M., & Ott, M. (2006). An Experiment on Auction Fever. In S. Seifert, & C. Weinhardt (Eds.), Group Decision and Negatiation (GDN): International Conference, Germany, Jun 25 - 28 (pp. 86–88). Karlsruhe: Universitätsverlag Karlsruhe.

Bechara, A., & Domasio, A. R. (2005). The somatic marker hypothesis: A neural theory of economic decision. Games and Economic Behavior, 336–372.
Boucsein, W. (1992). Electrodermal Activity. Berlin: Springer-Verlag GmbH
Brownley, K. A., Hurwitz, B. E., & Schneiderman, N. (2000). Cardiovascular Psychophysiology. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), Handbook of Psychophysiology. 2. ed (pp. 224–264). Cambridge: Cambridge Univ. Press.
Dawson, M. E., Schell, A. M., & Filion, D. L. (2000). The Electrodermal System. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), Handbook of Psychophysiology. 2. ed (pp. 200–223). Cambridge: Cambridge Univ. Press.
Elster, J. (1998). Emotions and Economic Theory. Journal of Economic Literature, 36 (1), 47–74.
Gonzales, C., Dana, J., Koshino, H., & Just, M. (2005). The framing effect and risky decisions: Examining cognitive functions with fMRI. Journal of Economic Psychology, 26, 1–20.
Hagenau, M.; Seifert, S., Weinhardt, C. (2007). A primer on Physio-Economics, Group Decisions and Negotiations, Montreal 2007
Heyman, J. E., Orhun, Y.; Ariely, D. (2004). Auction Fever: The Effect of Opponents and Quasi-Endowment on Product Valuations. Journal of Interactive Marketing, 18(4), 7–21.
Houser, D. & Wooders, J. (2004). Hard and Soft Closes: A Field Experiment on Auction Closing Rules. University of Arizona.
Kagel, J. H., & Levin, D. (1986). The Winner's Curse and Public Information in Common Value Auctions. AER, 76(5), 894–920.
Kagel, J. H. (1995). Auctions: A Survey of Experimental Research. In J. H. Kagel & A. E. Roth (Eds.), The Handbook of Experimental Economics (pp. 501–585). Princeton, NJ: Princeton University Press.
Kersten, Chen, Neumann, Vahidov (2007). Technology Assessment and Comparison: The Case of Auction and E-negotiation. Journal of AIS Sponsored Theory Development Workshop, Montreal
Klemperer, P. (2004). Auctions: Theory and Practice. Princeton, NJ: Princeton University Press.
Kolitz, K. (2007). „Systemdesign im Market-Engineering – Experimente zu Teilnehmerverhalten und Technologieakzeptanz“, Dissertation, Universität Karlsruhe (TH), Karlsruhe, Germany
Ku, G., Malhotra, D., & Murnighan, J. Keith. (2005). Towards a competitive arousal model of decision-making: A study of auction fever in live and Internet auctions. Organizational Behavior and Human Decision Processes, 96, 89–103.
Lo, A. W., & Repin, D. V. (2002). The Psychophysiology of Real-Time Financial Risk Processing. Journal of Cognitive Neuroscience, 14 (3), 323–339.
McCabe, K., Houser, D., Ryan, L., Smith, V. L., & Trouard, T. (2001). A functional imaging study of cooperation in two-person reciprocal exchange. PNAS, 98(20), 11832–11835.
Milgrom, P. Robert. (1989). Auctions and Bidding: A Primer. The Journal of Economic Perspectives, 3(3), 3–22.
Milgrom, P. Robert, & Weber, R. J. (1982). A Theory of Auctions and Competitive Bidding. Econometrica, 50(5), 1089–1122.
Rilling, J. K., Sanfey, A. G., Aronson, J. A., Nystrom, L. E., & Cohen, J. D. (2004). The neural correlates of theory of mind within interpersonal interactions. NeuroImage, 22, 1695–1703.
Sinha, R., Lovallo, W. R., & Parsons, O. A. (1992). Cardiovascular Differentiation of Emotions. Psychosomatic Medicine, 54, 422–435
Smith, K., & Dickhaut, J. (2005). Economics and emotion: Institutions matter. Games and Economic Behavior, 52, 316–335.
Weinhardt, C.; Neumann, D. et al. (2003). Market Engineering. Wirtschaftsinformatik, 45 (6), 635–640.