Gmunden Retreat on NeuroIS 2011

Gmunden, Austria | June 26-28, 2011 | www.NeuroIS.org

Fred Davis, René Riedl, Jan vom Brocke, Pierre-Majorique Léger
(Organizing Committee)

I. Introduction

NeuroIS is an emerging field in Information Systems (IS) that makes use of neuroscience and neurophysiological tools and theories to better understand the development, adoption, and impact of information technologies (IT). The *Gmunden Retreat on NeuroIS* is an annual academic conference taking place in June, with the objective to promote the successful development of the field. The event is taking place in Gmunden, Austria, a much frequented health and summer resort providing an inspiring environment for the retreat.

II. History

In 2009, the inaugural conference was organized, the *Gmunden Retreat on the Foundations of NeuroIS* (organizing committee: Fred Davis, Angelika Dimoka, René Riedl). Anja Ischebeck, Gernot Müller-Putz, and Bernd Weber served as keynote speakers, and the following scholars participated: Rajiv Banker, Izak Benbasat, Alan Dennis, David Gefen, Alok Gupta, Peter Kenning, Paul Pavlou, Detmar Straub, and Jan vom Brocke. Two articles, Riedl et al. (*Communications of the AIS*, 2010) and Dimoka et al. (*MIS Quarterly*, forthcoming) summarize important discussions of the inaugural *Gmunden Retreat on the Foundations of NeuroIS*.

In 2010, the second retreat took place, the *Gmunden Retreat on Advances in NeuroIS* (organizing committee: Fred Davis, Peter Kenning, René Riedl, Jan vom Brocke). Robert Savoy and Christa Neuper served as keynote speakers, and the following scholars participated: Walter Brenner, Jens Dibbern, Armin Heinzl, Betsy Howlett, Helmut Krcmar, Alex Kreilinger, Pierre-Majorique Léger, Aleck Lin, Peter Loos, Roger McHaney, Sarah Spiekermann, and Eric Walden.

The venue of the *Gmunden Retreats on NeuroIS 2009 and 2010* was Schlosshotel Freisitz Roith, one of the most beautiful small castles in Austria. The website www.NeuroIS.org provides information and videos about the *Gmunden Retreats on NeuroIS 2009 and 2010*.

III. Program

June 26

Boat Trip on Lake Traunsee	*14:00-17:00*
Evening Reception	*19:00-22:00 (Main Dining Area)*

Cocktail hour followed by dinner, welcome remarks by Fred Davis, Barbara Prammer, President of the National Council in Austria and Member of the Senate of the Austrian Academy of Sciences, and Heinz Josef Köppl, Mayor of the Town of Gmunden.

June 27

Breakfast	*7:00-9:00 (Main Dining Area)*
Session 1	*9:00-11:00 (Rittersaal)*
9:00-9:15	NeuroIS Introduction *René Riedl*
9:15-10:30	**Keynote Speech I: Genetic Approaches to the Field of NeuroIS** ***Martin Reuter***
10:30-11:00	Discussion of Keynote Speech I Moderator: *Jan vom Brocke*
Coffee Break	*11:00-11:30*
Session 2	*11:30-13:00 (Rittersaal)*
11:30-12:15	Channel Choice and Human Information Stopping Behavior: On the Applicability of Galvanic Skin Response in Studies on Human Information Behavior *Armin Heinzl, Erik Hemmer*
12:15-13:00	Information Search and Stopping on the Web: A NeuroIS Investigation *Glenn J. Browne, Eric A. Walden*

Lunch	*13:00-14:30 (Main Dining Area)*
Session 3	*14:30-16:00 (Rittersaal)*
14:30-15:15	Understanding Technostress: System Breakdown Increases Stress Hormone Cortisol in Computer Users *René Riedl, Harald Kindermann, Andreas Auinger, Adrija Javor*
15:15-16:00	Memory Networks in the Brain and Possible Implications for Human-Computer Interaction in E-Learning Environments *Manuela Macedonia*
Coffee Break	*16:00-16:30*
Session 4	*16:30-18:00 (Rittersaal)*
16:30-18:00	Understanding Online Payment Method Choice: Insights from an Eye-Tracking Study *Qing Xu, René Riedl, Harald Kindermann*

This session will include a live eye-tracking demo.

Dinner	*19:00-22:00 (Main Dining Area)*

June 28

Breakfast	*7:00-9:00 (Main Dining Area)*
Session 5	*9:00-10:30 (Rittersaal)*
9:00-9:45	Information Systems and Activity Modalities: A Coordination Perspective on the Interaction between the Neural and the Social *Lars Taxén*
9:45-10:30	Get Real: Portable Neurophysiological Measurement Tool for NeuroIS Research in Natural Work Settings *Pierre-Majorique Léger, Julien Perret, Ana Ortiz de Guinea*
Coffee Break	*10:30-11:00*
Session 6	*11:00-12:30 (Rittersaal)*
11:00-12:00	**Keynote Speech II: NeuroDesign Research in Information Systems: A Proposal** ***Alan R. Hevner***
12:00-12:30	Discussion of Keynote Speech II Moderator: *Jan vom Brocke*
Lunch	*12:30-14:00 (Main Dining Area)*
Session 7	*14:00-16:30 (Rittersaal)*
14:00-14:45	Cinema as a Research Tool: From Neurocinema to Implicit Interaction Paradigms *Aleksander Väljamäe, Christa Neuper*
14:45-15:30	Neurophysiological Correlates of Perceived Cognitive Absorption in an IT Training Context *Pierre-Majorique Léger, Fred Davis, Julien Perret, Paul Cronan*
15:30-16:15	Neuroscience in Design-Oriented Research: Triangulating with Neuro-Physiological Data for ERP-System Design *Jan vom Brocke, René Riedl, Pierre-Majorique Léger*
16:15-16:30	Summary, Conclusion, and Outlook *Fred Davis, René Riedl*

IV. KEYNOTE SPEECHES

Keynote Speech I, Martin Reuter
Genetic Approaches to the Field of NeuroIS

Martin Reuter
Professor, Personality & Biological Psychology, Department of Psychology, and Center for Economics and Neuroscience, University of Bonn, Germany

Abstract

The new scientific discipline Neuro-Information-Systems (NeuroIS) brings together the fields of Information Systems (IS) and Neuroscience. Traditionally, IS studies the development and use of information and communication technologies in organizations and society. In the same way as economic research has identified the use of approaches from Cognitive Neuroscience resulting in the birth of Neuroeconomics, also NeuroIS is interested in the role of the brain for human decision making and information processing. Until now the predominant techniques used are magnetic resonance imaging (MRI) and electroencephalography (EEG) relating brain activity and structural differences in brain anatomy to behavior. However, the use of MRI and EEG is currently limited to laboratory settings, whereas genetic studies that are used very seldom until now are not. Thus, the ecological

validity of genetic studies is high, a factor that could promote the application of genetic approaches in the IS discipline, similarly to recent developments in neuroeconomics and social neuroscience. The talk will give an introduction into the field of behavioral genetics addressing fundamental questions like "Is a certain phenotype heritable and how can I prove this?", "How can I quantify heritability?", and "Which genes are related to a certain phenotype and how can I genotype?". Moreover, empirical studies are presented that demonstrate how gene variations can influence human decision making. The focus will be on molecular genetic studies investigating human trust and altruism. Further research directions will be outlined that combine genetic and MRI data or prove the functionality of candidate genes.

Keynote Speech II, Alan R. Hevner
NeuroDesign Research in Information Systems: A Proposal

Alan R. Hevner
Professor and Eminent Scholar, Citigroup/Hidden River Chair of Distributed Technology, Information Systems and Decision Sciences, College of Business, University of South Florida, USA

Abstract

The use of neuroscience to investigate research questions in the Information Systems (IS) field has grown rapidly with the availability of methods and tools adapted to IS research and application environments. Design science research in IS centers on the activities of Build and Evaluate performed in design cycles followed by more extensive evaluations in a field setting. The majority of current NeuroIS work focuses on the Evaluate activity while little has been studied on the Build activity. In this keynote, I propose a framework for bringing neuroscience to bear on the activities of building IS design artifacts. Drawing from the development of software-intensive systems, a set of key design principles is identified and examined (creativity, complexity, control, composition, collaboration, and communication). NeuroDesign research questions are posed for the study of how each impacts the Build activity in design science research. The goal is to expand the influence and impact of NeuroIS research to important questions of how to discover (e.g. build) the best design artifacts for innovative IS solutions.

V. Abstracts

Channel Choice and Human Information Stopping Behavior: On the Applicability of Galvanic Skin Response in Studies on Human Information Behavior

Armin Heinzl, Erik Hemmer | University of Mannheim

A clear understanding of behavioral patterns exercised when human beings seek for information in computer-mediated settings is key for designing more effective and user-centered information systems. Although this topic deserves attention—and has been investigated in other disciplines—there is no coherent and cumulative research tradition within the IS domain. Therefore, we explore these behavioral patterns in the context of information seeking in a web-based laboratory environment, to get answers on the question (1) which information channels are chosen depending on properties of specific tasks, and (2) when do humans stop seeking for information depending on task properties and the selected information channel. As a consequence, it will be possible to extend the Task Technology Fit model by the highly important human factor. Since the extensive use of questionnaires would influence and bias the results of the laboratory experiments, galvanic skin response is used as one means for complementing the data by biofeedback signals. Those data represent the subject's state of cognitive and affective arousal and are available in real time and throughout the entire experiment. Thus, they help to corroborate the research findings substantially. In a first step, the suitability of this measure is evaluated by experimentally comparing it with traditional, questionnaire-based approaches. On the long run, we plan to integrate additional, more precise techniques, such as electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) to get deeper insights into the cognitive and affective patterns arising while humans seek for information. In the sense of Philosophy of Science, those modern approaches of observing reality are intended to further enhance existing theories or falsify them.

Information Search and Stopping on the Web: A NeuroIS Investigation

Glenn J. Browne | University of Virginia
Eric A. Walden | Texas Tech University

Information search and the decision making it ultimately supports are ubiquitous behaviors in everyday life, and these activities have been enhanced tremendously by the world wide web and its underlying information technology. Because information is now abundant,

understanding when and how people stop search to construct an alternative set and/or make a choice is of critical importance. A "stopping rule" is a heuristic or tactic used to cease an activity. Past research has investigated information search and stopping rules in several information systems contexts (web search, requirements elicitation) using behavioral measures and has identified characteristics of search and various heuristic rules that people use to stop search (Browne and Pitts 2004; Browne, Pitts, and Wetherbe 2007; Pitts and Browne 2004). In the present research, we investigate information search and stopping rules using everyday web-based tasks designed in ways to take advantage of brain imaging capabilities. Theories from cognitive psychology, decision making, and neuroscience are used to generate hypotheses about the cognitive nature of search and stopping. A literature review revealed that little research has examined information search behavior using brain imaging methodologies, and no prior research has investigated stopping behavior in the decision-making process using such methodologies. Investigating information search and filtering is critical in the age of information abundance. Filtering at the individual level is accomplished through the use of stopping rules (Browne et al. 2007). Stopping behavior is related in part to the issue of information overload, which Dimoka et al. (2010) identified as an example of an important topic to investigate in the IS domain using brain imaging methods. Information overload is a ubiquitous problem with information abundance; when a person encounters too much information in a short period of time, the information overwhelms working memory. In such cases, the person must stop his behavior. However, stopping occurs for many reasons other than information overload, including other cognitive reasons (e.g., the person is not learning anything new, the person satisfies items on a mental list, Browne and Pitts 2004) and motivational reasons (Browne and Jones 2011). In the present study, we use EEG measures to examine the changes in the cortical regions and cortical rhythms that occur when people stop their information search. Prior research has been able to observe the point of stopping, but not the duration or neural correlates of the change from searching to stopping. Although these prior studies have advanced our understanding of search and stopping behavior significantly, as with all purely behavioral studies they do not provide a full understanding of the phenomena. Thus, the present study provides an opportunity to investigate search and stopping beyond behavioral approaches and to provide insight into the neural bases of these critical aspects of information processing for decision making. We present the results of our study and implications for research.

References

- Browne, G.J. and Jones, D.R. "Motivational Stopping Rules." Work in progress, March 2011.
- Browne, G.J. and Pitts, M.G. "Stopping Rule Use during Information Search in Design Problems." *Organizational Behavior and Human Decision Processes*, 95, 2004, pp. 208-224.
- Browne, G.J., Pitts, M.G., and Wetherbe, J.C. "Cognitive Stopping Rules for Terminating Information Search in Online Tasks." *MIS Quarterly*, 31, 2007, pp. 89-104.
- Dimoka, A. et al. "On the Use of Neurophysiological Tools in IS Research: Developing a Research Agenda for NeuroIS." Working paper, Temple University, 2010.
- Pitts, M.G. and Browne, G.J. "Stopping Behavior of Systems Analysts during Information Requirements Elicitation." *Journal of Management Information Systems*, 21, 2004, pp. 213-236.

Understanding Technostress: System Breakdown Increases Stress Hormone Cortisol in Computer Users

René Riedl | University of Linz
Harald Kindermann, Andreas Auinger | University of Applied Sciences Upper Austria
Andrija Javor | Department of Neurology and Psychiatry, Linz General Hospital

Despite the positive impact of information and communication technology (ICT) on an individual, organizational, and societal level (e.g., increased access to information, enhanced productivity), both scientific research and anecdotal evidence indicate that human-machine interaction, both in private and organizational contexts, may lead to notable stress perceptions in users. This type of stress is referred to as technostress. A review of the literature shows that most studies used questionnaires to investigate the nature, antecedents, and consequences of technostress. Despite the value of the vast amount of questionnaire-based technostress research, we draw upon a different conceptual perspective, namely biology. Specifically, we report on a laboratory experiment in which we investigated the effects of system breakdown on changes in users' levels of cortisol, which is a major stress hormone in humans. The results of our study show that cortisol levels increase considerably as a consequence of system breakdown in a human-computer interaction task. In demonstrating this effect, our study has major implications for ICT research, development, and management. We confirm the value of a category of research heretofore largely neglected in ICT-related disciplines (particularly in information systems research), and argue that future research investigating human-machine interactions should consider the biological perspective as a valuable complement to traditional concepts.

Memory Networks in the Brain and Possible Implications for Human-Computer Interaction in E-Learning Environments

Manuela Macedonia | Max Planck Institute for Human Cognitive and Brain Sciences Leipzig

How does the brain learn, store and retrieve information? Memory experiments show that the brain favours redundant and interconnected information. For example, German-speaking subjects learning the Japanese word for house "ie" and accompanying it with a symbolic gesture retrieve the word significantly better than by only reading or hearing it. Thus, in order to learn verbal information, one should perform gestures. This might seem redundant and unrelated to the goal. However, experimental evidence from the last three decades has proven that verbal information accompanied by gestures is better retrieved in quantity, is faster and more accurately accessed and it decays more slowly (Zimmer 2001). How can this be explained? Traditional connectionist theories on memory such as ACT or ACT* (Anderson 1983, 1996) processed information in (strictly) hierarchical networks consisting of binary nodes and connecting links. These networks could not explain the better retention of verbal information encoded multimodally, i.e. "redundantly" because of the paradox of retrieval interference. Thereafter, the more information is stored in memory, the slower it works. In the late 1980s, a non-connectionist theory, the Connectivity Model (CM) by Klimesch (1987) finally provided an explanation. The CM assumes that connections in the human brain are non-hierarchical, that is that nodes in the network are interconnected, can be indirectly activated, and the capacity to spread activation within the network is unlimited. This explains how the degree of complexity in the network (number of interconnected nodes) directly influences the speed of search processes in the human brain. In other words, the degree of processing speed is a function of the degree of complexity of the network. Considering the data on learning novel words with gestures, an explanation could be that the different sensorial components acquired during encoding create complex networks with interconnected nodes, thereby explaining better retrieval and slower decay (Klimesch 1994). Data from a recent functional magnetic resonance imaging (fMRI) experiment (Macedonia et al. 2011) provide evidence of the interconnectedness of sensorial information within a memory code, specifically a word, and support Klimesch's CM. Participants learned 92 words of an artificial language created for experimental purposes and accompanied each of them by a corresponding gesture. In the fMRI scanner, participants performed a word recognition task by reading the words and listening to them. During word recognition, extended multisensorial networks were detected. Mere listening and reading of the words not only activated auditive and visual regions of the brain but also triggered activity in language production areas, pre-motor and motor cortices and, interestingly, even in areas involved in biological motion perception, although no training video was shown presenting the actress. These results show that the brain stores and retrieves information in interconnected networks and that indirect spreading activation occurs as triggered by activity in some components of the network. Taken together, the research presented suggests possible applications in human-computer interaction. For example, within learning contexts like online language classes in learning platforms, better performance could be achieved through specifically designed user interfaces providing multimodal "redundant" training. Being instructed and coached to perform gestures when learning Japanese by an avatar could substitute boring listening and comprehension activities and pave a new, more efficient way in foreign language learning.

References

- Anderson, J.R. "A Simple Theory of Complex Cognition." *American Psychologist*, 51, 1996, pp. 355-365.
- Anderson, J.R. "A Spreading Activation Theory of Memory." *Journal of Verbal Learning and Verbal Behavior*, 22, 1983, pp. 261-295.
- Klimesch, W. "A Connectivity Model for Semantic Processing." *Psychological Research*, 49, 1987, pp. 53-61.
- Klimesch, W. "The Structure of Long-Term Memory: A Connectivity Model of Semantic Processing. 1994, Hillsdale, N.J., Erlbaum.
- Macedonia, M., Muller, K, and Friederici, A.D. "The Impact of Iconic Gestures on Foreign Language Word Learning and Its Neural Substrate." *Human Brain Mapping*, 32, 2011, pp. 982-998.
- Zimmer, H.D. "Memory for Action: A distinct Form of Episodic Memory?" 2001, Oxford: Oxford University Press.

Understanding Online Payment Method Choice: Insights from an Eye-Tracking Study

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René Riedl | University of Linz
Harald Kindermann | University of Applied Sciences Upper Austria

Due to the significance of online payment for the prosperous development of e-commerce, as well as the fact that there are only a few studies available today on this topic, this investigation attempts to extend our understanding of online payment method choice using a multi-method approach (physiological and psychometric measurements). Based on extensive investigation of the literature, we identified important determinants of online payment method choice (e.g., product price). Using the Stimulus-Organism-Response model, we propose that both perceived trust and perceived risk mediate the influence of these determinants on online payment method choice. This study is designed to

enhance the theoretical understanding of the determinants of online payment method choice, as well as corresponding mediator variables (particularly perceived trust and risk) and moderator variables (e.g., gender). To achieve this goal, we do not only use established psychometric measurement instruments. Rather, we complementarily use eye-tracking to strengthen the robustness of the research findings.

Information Systems and Activity Modalities: A Coordination Perspective on the Interaction between the Neural and the Social

Lars Taxén | Linköping University

Information systems (IS) are clearly something we find in the social realm. IS are used by socially organized actors to achieve something. On the other hand, actions related to IS are carried out by individuals that each has developed certain cognitive and physical capabilities to perform such actions. Thus, any model that aspires to cover both IS and individuals must necessarily say something about the interaction between the social and neural realms. Usually, models of the intellect take the individual mind and body as the point of departure, and proceed outward towards the social environment in which the individual is immersed. As a consequence, important social dimensions contributing to the epigenetic development of the individual is less articulated. In this contribution, I suggest to model the intellect from a more balanced perspective that recognizes both social and individual aspects—the coordination of actions. I argue that coordination is made possible by certain innate predispositions that I call activity modalities: contextualization, spatialization, temporalization, stabilization, and transition. Provisional arguments for the relevance of these modalities are discussed in the social, conceptual, and neural realms; the conceptual one as an intermediate realm between the neural and social ones. The activity modalities are derived from experiences from working with coordination of extremely complex development tasks in the telecom industry (Taxén, 2009). The activity modalities can be seen as mediating between the neural and social realms. Since the modalities are assumed to be innate predispositions, these will be reflected in the structure of social reality. We simply construct our world in accordance with abilities that have emerged during the phylogenetic evolution of mankind. Consequently, a central task for modeling the interaction between the social and the individual is to understand how perceptions received through sensory modalities are integrated and transformed into the activity modalities. From this point of view, an IS becomes a mediational means enabling coordinative capabilities in all activity modalities. I discuss some consequences of this view for the development of IS, in particular, large trans-organizational systems like Enterprise Resource Planning systems and Product Lifecycle Management systems. In conclusion, a novel perspective of IS is suggested; a perspective which may have far-reaching implications for how we conceive of and develop IS.

References

- Taxén, L. "Using Activity Domain Theory for Managing Complex Systems." Information Science Reference. 2009, Hershey PA: Information Science Reference (IGI Global). ISBN: 978-1-60566-192-6.

Get Real: Portable Neurophysiological Measurement Tool for NeuroIS Research in Natural Work Settings

Pierre-Majorique Léger, Julien Perret, Ana Ortiz de Guinea | HEC Montréal

NeuroIS offers numerous opportunities for IS research. Hovewer, most neurophysiological measurement tools can only be used in artificial laboratory settings decreasing the potential for generalizability of this research. This communication presents two new neurophysiological devices that allow the measurement of end-user biosignals as they naturally take place in the work place: the B-Alert EEG headset and the Affective skin conductance bracelet. B-Alert (Advanced Brain Monitoring, Inc.) provides researchers with easy-to-use, portable-wireless EEG monitoring and assessment systems which deliver real-time metrics of attention, stress, confusion, fatigue and workload. While EEG use has traditionally been confined to laboratory settings, the B-Alert suite of EEG sensor headsets are designed to allow researchers the study of end-users' biosignals in their natural environment in a comfortable and practical way while delivering accurate data quality. The data they provide can be used to objectively investigate neurophysiological signals across individuals and teams in order to deliver practical recommendations for the improvement of human/computer interfaces and technological learning. As a result, this device provides real-time data via EEG of users' cognitive processes while interacting with any given technological system used in their work activities. The Affectiva Q Sensor (Media Lab) is a wearable, wireless biosensor that measures emotional arousal via skin conductance, a form of electrodermal activity that fluctuates to higher values during states such as excitement, attention or anxiety and to lower ones with boredom or relaxation. It has a washable wristband so it can be used in authentic research contexts. The Q sensor has an onboard event button that allows researchers to mark times of users' significant experiences. This feature along with the onboard clock allows the synchronization of the data with that of other systems to accurately investigate changes in users' cognitive states as a result of different events occurring during their interaction with any given technology.

Cinema as a Research Tool: From Neurocinema to Implicit Interaction Paradigms

Aleksander Väljamäe, Christa Neuper | Graz University of Technology

Current neuroscience research increasingly relies on naturalistic experimental stimuli and taps into different temporal scales of our perceptual, cognitive and emotional experiences. Both virtual reality scenarios and cinematic materials are used for such experiments. Recently, Uri Hasson and his colleagues have introduced the term *neurocinematics* when presenting the studies that used inter-subject correlations of brain activity to assess film-viewing experiences (Hasson et al. 2008). Close to neuromarketing ideas, neurocinematic approach is rapidly drawing attention of big film studios across the world which now use scientific studies to assess viewers experiences combining different brain imaging techniques, eyegaze tracking and peripheral physiology recordings (Rendall 2011). From the perspective of our own studies and reviewing other scholars work, we aim at triggering a multidisciplinary discussion on neurocinema research questions, interesting methodologies, and common experimental stimuli. The neurocinema studies may embrace a number of research topics including temporal dynamics of the brain during cognitive, perceptual and emotional processes, unconscious processing, decision making, spatial presence, emotional synchronization, processing of narrative structures, or cross-modal emotional conditioning when combining visuals and sounds. So far neurocinematic studies have been mainly using commercial films as experimental stimuli. The creation and usage of the standardized film clip collections similar to IAPS (International Affective Picture System) would allow easier comparisons between different studies. In addition, the *experimental cinema* might provide researchers with ecological yet challenging and novel stimuli. New filmmaking trends may emerge, guided by better knowledge of brain unconscious processing and extending the boundaries of viewers' perceptual and emotional capabilities. Consider, for example, the potential cinematic usage of an experimental paradigm of rapid serial visual presentation (RSVP) from perceptual and cognitive psychology. Visual stimulation techniques such as RSVP are also deployed in *BrainComputer Interfaces* (BCI) where real-time processing of brain signals provides novel tools for communication and control. Encompassing other physiological signals these hybrid BCI systems are becoming even more robust and versatile (Pfurtscheller et al. 2010). When combined with interactive cinema technologies, these technologies allow for implicit and unconscious interaction with audio-visual media. Such new interactive media applications can be called *enactive* since the impact of the technology on the human agent and the immediate effect of the human experience on the technology are inter-coupled (Kaipainen et al. 2011). Providing a whole new dimension to entertainment industry, *enactive media* can also become a powerful addition to neurocinema research agenda.

References

- Hasson, U., Landsman, O., Knappmeyer, B., Vallines, I., Rubin, N., and Heeger, D.J. "Neurocinematics: The Neuroscience of Film." *Projections: The Journal for Movies and Mind*, 2, 2008, pp. 1-26.
- Kaipainen, M., Ravaja, N., Tikka, P., Vuori, R., Pugliese, R, Rapino, M., et al. "Enactive Systems and Enactive Media. Embodied Human-Machine Coupling beyond Interfaces." *Leonardo*, 44, 2011.
- Pfurtscheller, G., Allison, B.Z., Bauernfeind, G., Brunner, C., Solis Escalante, T., Scherer, R., et al. "The Hybrid BCI." *Frontiers in Neuroscience*, 42, 2010, pp. 1-11.
- Rendall, K. "Rise of Neurocinema: How Hollywood Studios Harness Your Brainwaves to Win Oscars." 2011. http://www.neurofocus.com/pdfs/FastCompanyNeuromarketingOscars.pdf

Neurophysiological Correlates of Perceived Cognitive Absorption in an IT Training Context

Pierre-Majorique Léger | HEC Montréal
Fred Davis | University of Arkansas
Julien Perret | HEC Montréal
Paul Cronan | University of Arkansas

End-user IT training has long been recognized as a key factor in the acceptance and the effective use of information systems. The objective of this communication is to investigate the extent to which neurophysiological factors represent a marker of a trainee's perception of cognitive absorption, specifically his or her perceived control in an information systems context. Neuroscience provides insights into how the brain activity changes during the acquisition of a new skill or competence. As a learner becomes more effective at a task, activity in the prefrontal areas of the brain reduces significantly, specifically in the region related to task control and working memory. As a new cognitive skill is acquired, one evolves from a state of controlled processing of stimuli to an automatic and effortless processing. Previous research using electroencephalographic (EEG) data suggests that as an individual becomes calmer, more relaxed and less vigilant during a task, the density of the EEG signal changes significantly (i.e., the alpha band increases while the beta band decreases). In order to assess the impact of these neurophysiogical changes on the experience of the IT trainee, 36 right-handed male and female subjects took part in a two-hour simulation based training on an ERP system. All subjects were undergraduate students from an AACSB institution in the United States, and 50% of the subjects had never used this ERP before. EEG and skin conductance data were gathered using the Procomp Infinity encoder from Thought Technology. Controlling for the difficulty of the task and the level of expertise of

the trainee, we found that perceived control is positively related to the more relaxed, less alert state of the learner. We also found that subjects that were less emotionally reactive also had a better perception of control. These findings, although preliminary in nature, point to the importance of considering neurophysiological factors and trainees' experience when developing effective IT curriculum.

Neuroscience in Design-Oriented Research: Triangulating with Neuro-Physiological Data for ERP-System Design

Jan vom Brocke | University of Liechtenstein
René Riedl | University of Linz
Pierre-Majorique Léger | HEC Montréal

Design-oriented research concerns the design of innovative and useful IT artifacts, i.e., constructs, models, methods and instantiations (Hevner et al. 2004; March and Smith 1995). The design of process models at an enterprise-wide scale provides an example (Bandara et al. 2005). Aiming at IT artifacts that are both perceived as useful and easy to use the concept of 'user perception' is of particular relevance for design-oriented research. How to represent process models best? Or, what is the right level of detail? These are typical questions related to the construction of process models that are highly depending on user perception (Recker, 2007). In design-oriented research, traditional qualitative and quantitative approaches such as interviews and surveys have been suggested as tools to assess the appropriateness of artifacts based on conscious perceptions of users (Hevner et al. 2004). However, the use of such methods may be associated with limitations (Riedl et al. 2010a) since interview and survey data, for example, are typically subjective and possibly influenced by hidden intentions of the informants. Hence, the reliability of such evaluations is a topic of major interest in design-oriented research. In this regard, neurocience may offer a new lens to analyze and understand user perception (Dimoka et al. 2011, Riedl et al. 2010b). Hence, we set out exploring the potential of neuroscience in design-oriented research in more detail (vom Brocke et al. 2011). In this presentation we discuss how to use both neuroscience tools and neuroscience theories to build better artifacts. We argue that neuroscience should complement rather than substitute traditional research approaches and we also discuss that results require thorough interpretation. Illustrating this approach, we discuss an ongoing study that triangulates quantitative and neuro-physiological data in the area of enterprise resource planning systems (ERP-systems) and indicate directions for future research.

References

- Bandara, W., Gable, G.G., Rosemann, M. "Factors and Measures of Business Process Modelling: Model Building through a Multiple Case Study." *European Journal of Information Systems*, 14, 2005, pp. 347-360.
- Dimoka, A., Banker, R.D., Benbasat, I., Davis, F.D., Dennis, A.R., Dimoka, A., Gefen, D., Gupta, A., Ischebeck, A., Kenning, P., Müller-Putz, G., Pavlou, P.A., Riedl, R., vom Brocke, J., Weber, B.: "On the Use of Neurophysiological Tools in IS Research: Developing a Research Agenda for NeuroIS." *MIS Quarterly*, 2011, forthcoming.
- Hevner, A.R., March, S.T., Park, J., Ram, S. "Design Science in Information Systems Research." *MIS Quarterly*, 28, 2004, pp. 75-105.
- March, S.T., Smith, G.F. "Design and Natural Science Research on Information Technology." *Decision Support Systems*, 15, 1995, pp. 251-266.
- Recker, J. "A Socio-Pragmatic Constructionist Framework for Understanding Quality in Process Modelling." *Australasian Journal of Information Systems*, 14, 2007, pp. 43-63.
- Riedl, R., Banker, R.D., Benbasat, I., Davis, F.D., Dennis, A. R., Dimoka, A., Gefen, D., Gupta, A., Ischebeck, A., Kenning, P., Müller-Putz, G., Pavlou, P.A., Straub, D.W., vom Brocke, J., Weber, B. "On the Foundations of NeuroIS: Reflections on the Gmunden Retreat 2009." *Communications of the AIS*, 27, 2010a, pp. 243-264.
- Riedl, R., Hubert, M., Kenning, P. „Are There Neural Gender Differences in Online Trust? An fMRI Study on the Perceived Trustworthiness of eBay Offers." *MIS Quarterly*, 34, 2010b, pp. 397-428.
- vom Brocke, J., Riedl, R., Pierre-Majorique, L. "Neuroscience in Design-oriented Research: Exploring New Potentials." *Lecture Notes in Computer Science*, 6629, 2011, pp. 427-439.

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