NeuroIS SOCIETY

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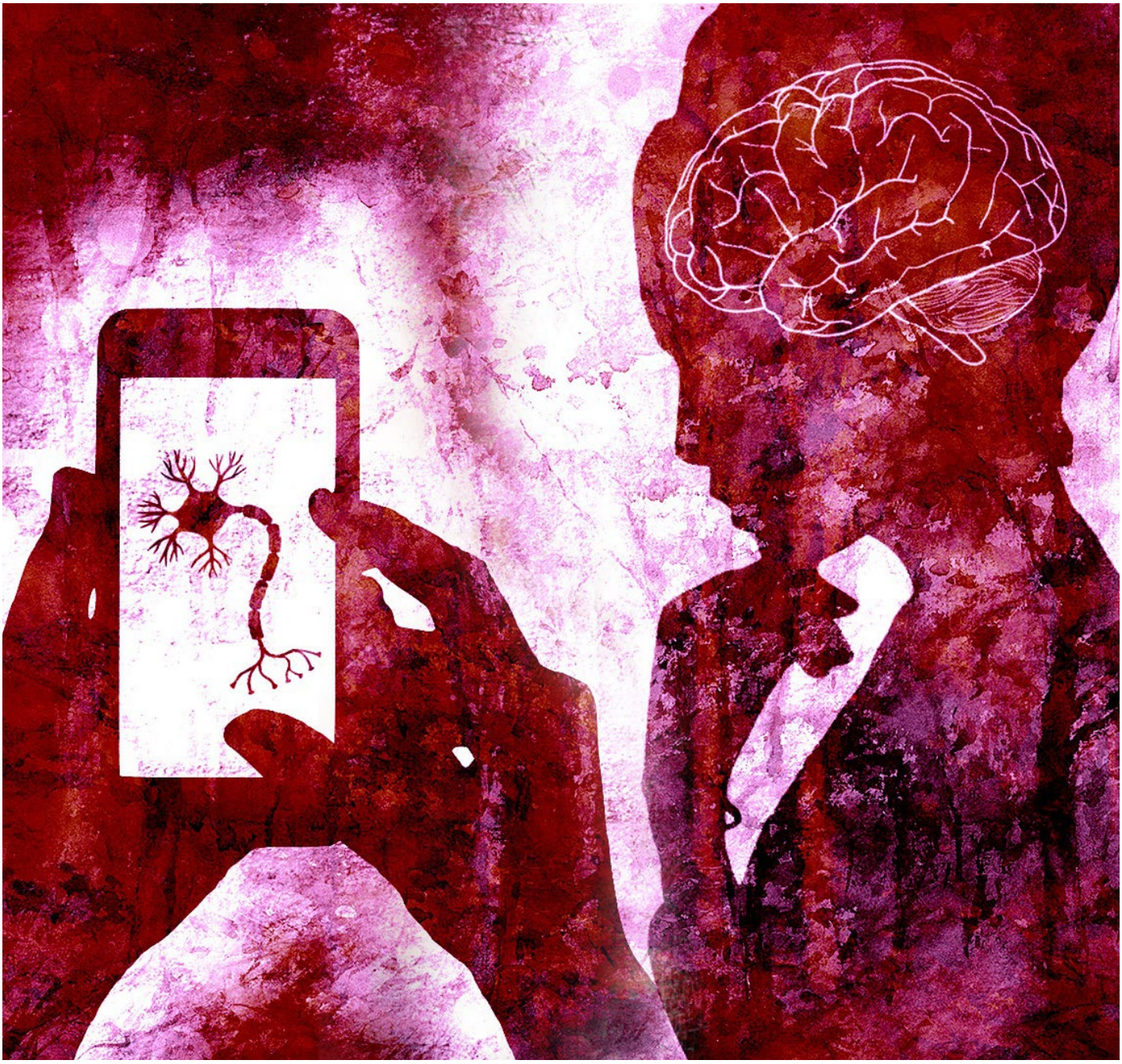

COVER STORY

Improving Security Warnings through NeuroIS Research

IN THE SPOTLIGHT

Karlsruhe Decision & Design Lab (KD²Lab)

DIGITAL PHENO-TYPING & DIGITAL BIOMARKERS

by Christian Montag & Paul Dagum

Preface

Dear Readers!

In spring 2022 we published the inaugural issue of the NeuroIS Society Magazine, including a number of stimulating contributions, reports, and background information on research groups and community members. The response to this issue was overwhelming! Many people positively commented on the quality of the magazine and the usefulness of such a publication medium.

Now you are reading the second issue. Just as in the first issue, in the current one you can find several stimulating contributions and reports. Bonnie Anderson, Jeffrey Jenkins, Brock Kirwan, and Anthony Vance—four North American researchers—co-authored this issue's cover story entitled "Improving Security Warnings through NeuroIS Research". In the context of IT security, one of the most fundamental questions is "What makes a person more or less likely to ignore security warnings?". Some time ago, the research group started to investigate this and other important questions based on multi-method research designs. Importantly, their designs do not only comprise self-reports and behavioral methods, but also neuroscience tools such as fMRI and EEG. Several publications in the Information Systems (IS) discipline's flagship journals MIS Quarterly and Information Systems Research, among many other articles which appeared in high-quality journals, substantiate the research group's contribution to knowledge. This knowledge is not only of great importance for theoretical progress, but also holds significant value for the design of security warnings in practice. Hence, this group's research program is a perfect example for the significant application potential of NeuroIS knowledge.

Moreover, we highlight the report on the Karlsruhe Decision & Design Lab (KD²Lab). This research lab, which was created with the support of the German Research Foundation DFG, is one of the largest computer-aided experimental laboratories in the world. We looked behind the scenes. As outlined in the report in detail, this lab offers researchers an excellent infrastructure for economic, neuro- and psycho-physiological experiments. This enables the study of human decision-making behavior under controlled laboratory conditions. Many experiments conducted in this lab have resulted in high-caliber publications and hence KD²Lab's contribution to knowledge has been substantial over the years.

Another highlight in the current issue is Christian Montag's and Paul Dagum's contribution on digital phenotyping and digital biomarkers. Christian, head of the department of Molecular Psychology at Ulm University, Germany, is well-known in the NeuroIS community due to his keynote and hot topic talk presentations at several NeuroIS Retreats. Together with Paul Dagum, CEO and co-founder of Applied Cognition, a US-based company providing a digital health management platform, Christian outlines the enormous potential of studying digital footprints left from the interaction with smartphones, social media platforms and various devices being linked to the Internet of Things (IoT). In essence, as outlined in more detail in the report, this pioneering approach provides both scientists and practitioners with a myriad of unforeseen opportunities to better understand diverse human conditions.

In the category "The Practitioner's Perspective" we interviewed Julius Frohlich, CEO of Language Research and Development Group (LRDG), Canada. Among others, Julius describes his successful cooperation with Tech3Lab at HEC Montréal. In a recent project, the company and the lab have been working on a NeuroIS mobile application designed to take iterative snapshots of an individual's cognitive function which could then be linked to cognitive changes due to learning or other factors such as aging. Moreover, Julius describes his experiences related to his participation at the NeuroIS Retrat 2022 in Vienna. In the category "Young Academics" we interviewed Anika Nissen, who works at the Institute for Computer Science and Business Information Systems, University of Duisburg-Essen, Germany. In the interview, Anika talks about her start with NeuroIS research, why she believes that this kind of research is important, and about challenges for young NeuroIS researchers. In the category "Looking Back" this time we present the first winner of the Dr. Hermann Zemlicka Award, which was brought into being in 2013 in honor of an outstanding person who significantly contributed to the development of the NeuroIS Retreat as high-caliber academic conference.

In the current issue you can also find a report on the NeuroIS Retreat 2022, which took place in Vienna in June. In short, the conference—after running it in a virtual format in 2020 and 2021—was a great success! For those who were not able to physically participate in Vienna, we also produced a video summarizing the retreat's highlights. This video is available on our website: www.NeuroIS.org. Moreover, on the website you can also find a large number of pictures, documenting the good atmosphere at the conference.

Last but not least, we make an outlook to the NeuroIS Retreat 2023, which will take place in Vienna from May 30 to June 1. Mark this date in your calendar now, the conference is celebrating its 15th anniversary, and follow the conference information provided on our website and via our newsletters.

Enjoy this issue of the NeuroIS Society Magazine!

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Improving Security Warnings through NeuroIS Research

by Bonnie Anderson, Jeffrey Jenkins, Brock Kirwan, Brigham Young University (USA), and Anthony Vance, Virginia Tech (USA)

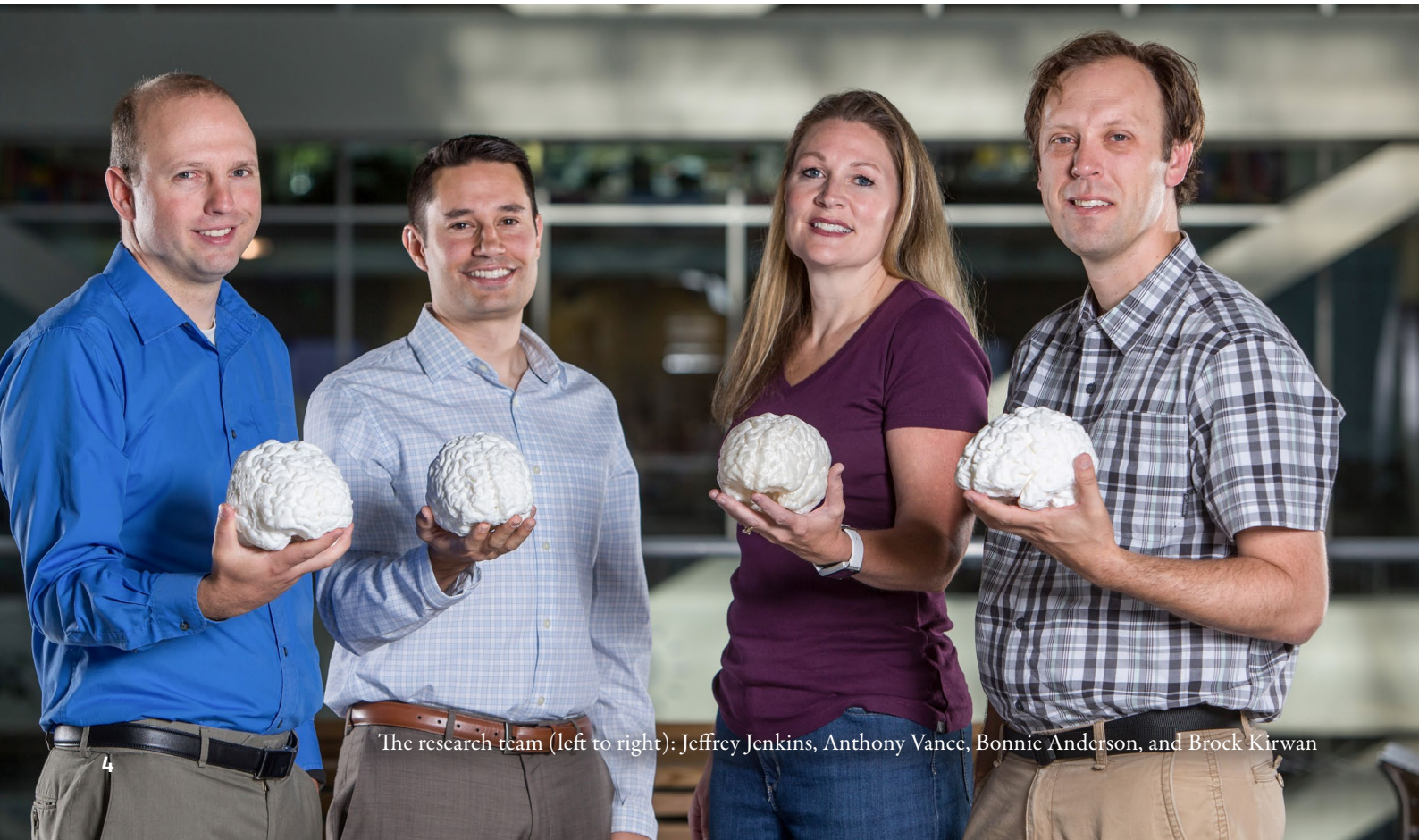
Sometimes students help their professors discover new research areas. Such was the case with the beginnings of the BYU Neurosecurity Lab.

During an undergraduate seminar on IS research methods co-taught by professor Anthony Vance in 2011 at BYU, students were assigned to access an external website as part of their readings. However, when students visited the website, their browsers presented a warning that the site likely contained malware and to not visit the site. Nevertheless, all but one student in the class decided to ignore the warning and visit the website anyway. Fortunately, no harm was done, but the students' choice to ignore the malware warning prompted a question in the seminar: "What makes a person more or less likely to ignore security warnings?"

This question led to the founding of the BYU Neurosecurity Lab (neurosecurity.byu.edu), with IS professors Bonnie Anderson, Jeff Jenkins, and Vance; and cognitive and behavioral neuroscience professor Brock Kirwan. So far we have published our research on security warnings in seven leading IS journals. We have also received grants for our work from the US National Science Foundation and Google. This success is due in large part to (1) the collaboration of IS and neuroscience researchers and (2) the guidance and mentorship of colleagues at the NeuroIS Retreat over the years.

Our collaboration with Brock Kirwan began early in the project in 2012 when Scott Steffensen, a professor of psychology at BYU, presented to the IS research team about his research on addiction in the brain using electroencephalography (EEG). The team immediately saw the potential to use EEG to study how the brain responds to security warnings to better understand why warnings are often ignored. Although Steffensen was unavailable to collaborate on the research project, he introduced the team to Brock Kirwan, a professor of cognitive and behavioral neuroscience. Brock's expertise in neuroscience methods and theory were complemented by the cybersecurity and human–computer interaction domain expertise of the IS professors.

The research team's involvement with the NeuroIS Retreat began in June 2013 in Gmunden with the JAIS special issue on "Methods, Tools, and Measurement in NeuroIS Research." There were many helpful comments during and after their presentation, especially working with Fred D. Davis, even as everyone was displaced from the Schloss Ort castle due to flooding. This began a long-term engagement with the NeuroIS community. In this article we provide highlights from four papers that benefitted greatly from feedback at the NeuroIS Retreat.



The research team (left to right): Jeffrey Jenkins, Anthony Vance, Bonnie Anderson, and Brock Kirwan

Using EEG risk measures to predict security warning disregard behavior

In seeking to understand why people ignore security warnings, we examined perceptions of risk. Security researchers have observed that people often say that they are concerned about a cybersecurity threat, but later act contrary to their intentions. Because emotions related to risk perception—such as fear, uncertainty, and distrust—are difficult to measure accurately through self-report measures, we used EEG to measure perceptions of risk and compare how EEG measures predicted security warning disregard behavior vis-à-vis self-reported measures of risk.

We conducted this study in two stages. First, we measured ERP amplitudes in response to positive and negative outcomes in a version of the Iowa Gambling Task. Second, in a separate experiment, subjects performed a web-based an image classification task on their own laptops in which they classified images on websites as a drawing or photo. During the experiment, some of the websites visited displayed a malware warning which subjects were free to heed or ignore. Then, midway through the experiment, we simulated an incident in which malware threatened to erase the subjects' laptops before disappearing without explanation.

We found that ERP amplitudes predicted security behavior both before and after the simulated hack, while self-report measures only predicted behaviors after the simulated hack. This finding was an important contribution to the literature, particularly as it demonstrated the utility of neurophysiological measures to predict behavior above and beyond what is accessible via self-report measures. This study was presented at the 2013 NeuroIS Retreat and subsequently published in the 2014 JAIS special issue on NeuroIS [1].

Understanding habituation to security warnings

Another research question we investigated within our overall research framework is, "why do people ignore security warnings that are repeatedly seen?" This problem, known as habituation in the cybersecurity literature, has been recognized for many years but is difficult to measure directly using conventional behavioral measures. Thus, this problem was ripe for investigation using a NeuroIS approach.

Crucially, Brock Kirwan's previous work on memory used fMRI to observe neuronal habituation in response to repeated stimuli [2]. By applying a similar approach, we were able for the first time to directly measure the occurrence of habituation in the brain in response to security warnings. This allowed us to develop warning designs that resist habituation and thereby help users to be more secure.

First presented at the 2014 NeuroIS Retreat, we demonstrated using fMRI how the human brain quickly habituates to security warnings even after a few exposures to warning stimulus. This suggests that people ignore warnings not because they are lazy or inattentive, but because this behavior is a natural consequence of the brain's habituation process [3].

Next drawing on habituation theory from neurobiology, we designed warnings that were resistant to habituation by changing their appearance after each warning exposure, termed polymorphic warnings. We conducted a series of studies using fMRI and mouse cursor tracking [4, 5], as well as eye tracking [6]. We found that the polymorphic warnings were successful at reducing the occurrence of habituation.

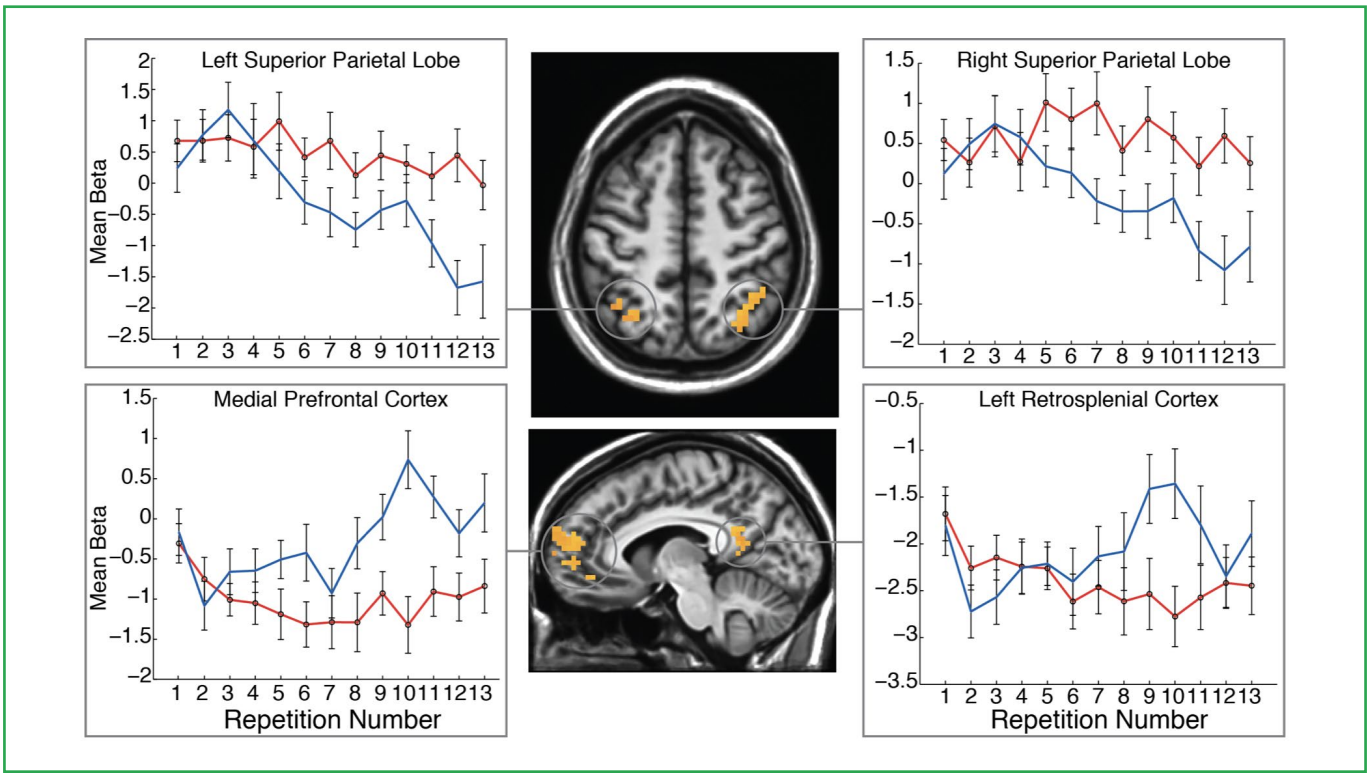


Figure 1. fMRI activation changes (y-axis) with subsequent presentations (x-axis) of polymorphic (red) and non-polymorphic warnings (blue). Top: habituation in brain areas implicated in attentional processing. Bottom: increased activation in major nodes of the default-mode network, showing decreased attention with repeated exposure to warnings.

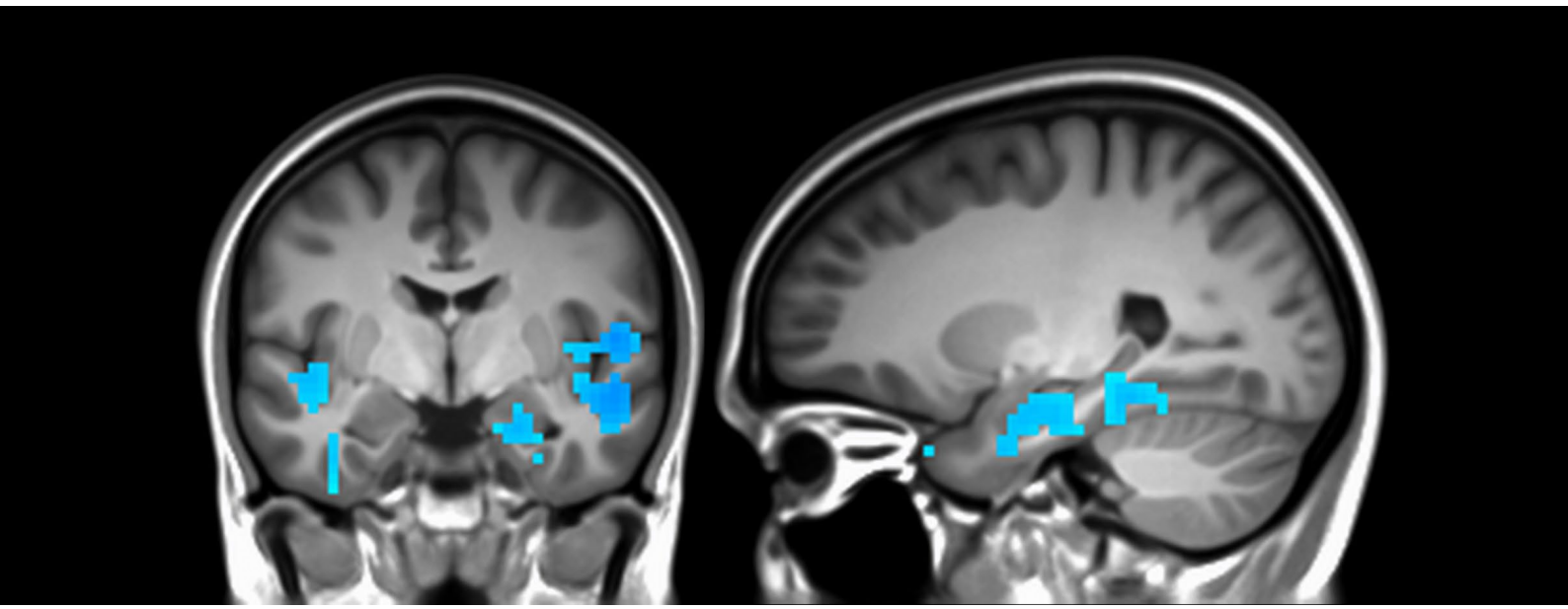


Figure 2. Decreased activity in response to the high-DTI condition compared with the warning-only condition—cool colors indicate decreased blood flow

We extended this work in a follow-up study in two ways. First, we conducted a longitudinal experiment over five days to show the extent to which people recover from habituation between exposure to warnings. Using a combination of fMRI and eye tracking methods, we found that people recover from habituation to warnings from one day to the next, but this recovery was not enough to offset the trend of habituation over time. In contrast, people who received a polymorphic warning showed resistance to habituation over the week. We also conducted a field experiment using an ecologically valid task and setting across three weeks and found similar results. People who received the polymorphic warning showed substantially higher warning adherence behavior over time [7].

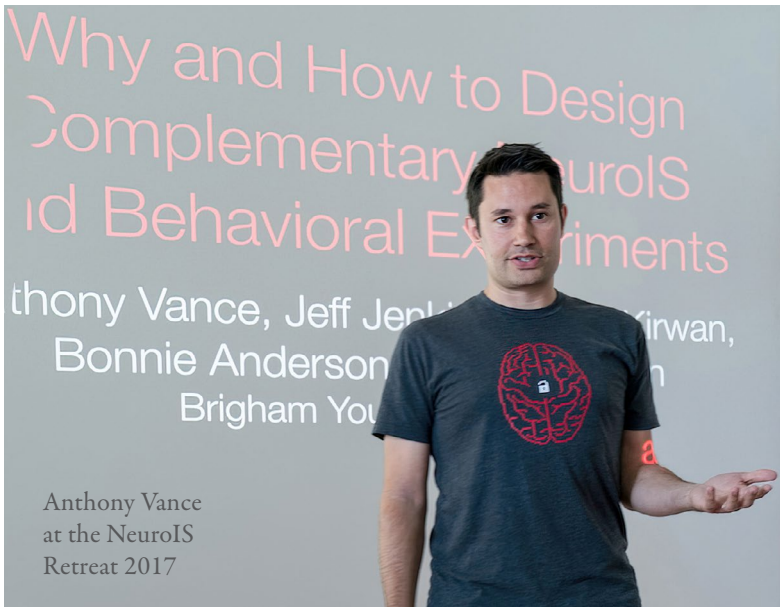
Understanding what happens when security warnings interrupt users

Based on our success in creating warnings that are resilient to habituation, we sought to understand how other cognitive processes influence security warning disregard. We began theorizing how dual-task interference (DTI)—degradation of task performance when two or more tasks are performed at the same time—could influence how users respond to security warnings. We targeted the study to the Information Systems Research (ISR) special issue, "Ubiquitous IT and Digital Vulnerabilities."

We chose to examine how intelligent timing of security warnings could reduce interference with everyday computer tasks and improve warning adherence. First, we conducted an fMRI experiment to explore how the timing of warnings influences DTI in the brain, and how DTI in turn increases security warning disregard. We found that when security warnings interrupt a task, activation in the medial temporal lobe is substantially reduced. However, when displaying a security message immediately following a task, neural activity in the medial temporal lobe is comparable to when attending to the message is the only task. Further, activation in the MTL predicted security warning disregard behavior. We presented our results at the NeuroIS Retreat in June 2015.

Second, we conducted a field experiment to demonstrate the impact of the timing of warnings on security

Bonnie Anderson
at the NeuroIS Retreat 2014



Anthony Vance
at the NeuroIS
Retreat 2017

warning disregard. A grant we received from Google led to collaboration with Google engineers to improve adherence to the Google Chrome Cleanup Tool (CCT), a Chrome browser warning that prompts users to remove suspicious software. This type of warning didn't have to be displayed immediately and could be delayed for an opportune time with little task interference. In an online field experiment on participant's own computers, we simulated the appearance of the CCT warning during browser-based tasks. The results showed that during low DTI times security warning disregard was as low as 22%. In contrast, during high DTI times, security warning disregard was as high as 87%. Analysis of mouse-cursor movements showed that people elaborated much less on the CCT warning during high DTI times. This paper was published in the ISR special issue and later won ISR's "Best Published Paper Award" for 2016 [8].

Sharing lessons learned

Over the past ten years we have learned many lessons from trial and error, reviewer comments, and feedback from the NeuroIS community. We distilled these lessons and strategies in an article presented at the 2017 NeuroIS Retreat and later published in Information Systems Journal [9]. This article explains how behavioral and NeuroIS experiments can complement each other and provides strategies for this approach.

Across our research program, Brock's expertise in neuroscience theory and neurophysiological tools has been essential. For his part, Brock has appreciated the opportunity to use neuroscience techniques in an applied, practical context, namely the study and improvement of security warnings. Much of neuroscience has a basic science focus without immediate real-world application.

Also critical to the success of our work has been the support of our NeuroIS community over the past 10 years. We appreciate the pioneering work of Fred D. Davis, Angelika Dimoka, Pierre-Majorique Léger, Gernot R. Müller-Putz, Adriane B. Randolph, René Riedl, and many others who inspired us to conduct NeuroIS research and coached and guided us along the way.

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The Karlsruhe Decision & Design Lab (KD²Lab): Understanding and Shaping Human Decision Making


Christof Weinhardt, Head of KD²Lab and Anke Greif-Winzrieth, Manager of KD²Lab

The Karlsruhe Decision & Design Lab, short KD²Lab, is one of the world's largest computer-based experimental laboratories. With its two technically and spatially separable laboratory areas, 40 soundproof and air-conditioned computer cabins equipped with a wide range of multi-sensory biosignal measurement devices, two large team rooms for conducting (interactive) group experiments, and a Virtual and Augmented Reality Lab it offers researchers an excellent infrastructure for economic, neuro- and psycho-physiological experiments.

As implied by the name, research at the KD²Lab evolves around two main topics, namely human decision making and the design of decision environments such as (economic) institutions and information technologies, and their interplay. We are convinced that a thorough understanding of decision-making processes in different contexts on the behavioral and neuro-physiological level is a necessary condition for designing institutions and their IT realizations that are, already today but most likely even more so in the future, shaping our lives. Considering it the other way around, understanding the effects of institutions or IT systems and their design elements on human decision making is crucial. Therefore, the KD²lab provides a unique infrastructure to conduct large-scale interactive studies on decision making behavior in a highly controlled environment.

To get a more concrete idea of where this kind of research applies, think of an auction. More precisely, consider an auction taking place online, like you might know it from Ebay. If you have ever participated in such an auction, try to remember your decision-making behavior. Did you follow a predefined strategy when placing your bids? Were you in control of your emotions? Did you regret your decisions? Carefully studying behavior in such auctions that typically involve large numbers of traders is already a challenge in itself. Collecting biosignals to gain insights in their emotional states during the interaction when buying and selling decisions are made is even harder. However, this is crucial for investigating phenomena like auction fever which has been done by a group of researchers around Marc Adam at the research group of the current head of the KD²Lab Christof Weinhardt. Among other studies they conducted experiments in order to analyze the impact of clock speeds on the bidders' emotional processing and behavior in Dutch auctions collecting biosignals (skin conductivity (EDA) and electrocardiogram (ECG)) from 96 participants. With its size and equipment, the KD²Lab enables such large-scale experiments in a highly controlled environment that would be hardly realizable elsewhere.

At the KD²Lab, we attach great importance to encourage students and young scientists to get involved in our research methods and activities from an early stage on. Thus, the KD²Lab hosts numerous courses for bachelor and master students such as lectures on Experimental and Behavioral Economics, Market Design, Incentives in Organizations, Designing Interactive Systems, or Market Engineering. Based on the theoretical knowledge gained from these courses, students can attend the dedicated hands-on seminar "New ways and tools in experimental economics" where they are invited to use innovative technology such as wearable sensors or new approaches such as Digital Citizen Science. On that alley they go through the entire process of realizing a small research project including the

development of research questions, collecting and analyzing data, and finally write and present a research paper.

Beyond these teaching offers for students in their bachelor and master programs we are particularly proud to host the KD²School (Designing Adaptive Systems for Economic Decision-Making), a structured qualification program for PhD students funded by the German Research Foundation (DFG), since October 2021. With its main focus on the design of adaptive, IT-based systems for supporting economic decision-making in dynamically changing contexts the research program of the KD²School covers research topics at the intersection of humans, information technology, and economic institutions. Thus, the 12 principal investigators, 14 doctoral and post-doctoral students, and 17 associated researchers based at the KIT in Karlsruhe, and the universities in Bremen and Gießen focus on the integration and real-time processing of biosignals in adaptive systems and its impact on human-decision making. As part of the research in the KD²School several complementary laboratories, namely the KD²Lab, the Cognitive Systems Lab (CSL) and the FMRI Lab in Bremen, and the DecIS Lab in Gießen are virtually connected following a LabLink approach. The linking of these laboratories across three locations being currently realized is unique worldwide and promises highly innovative research in terms of applications, methodology, and theory.

To date, 14 research groups with very interdisciplinary backgrounds in economics, psychology, information systems, computer science, marketing, and mechanical engineering have affiliated the KD²Lab. Since the Lab opening in 2016, they have conducted more than 500 experiments with more than 40,000 participations involving about 9.000 participants. Currently, the KD²Lab student panel counts about 4,700 members actively participating in experiments online, on site, and in the field.

To date, the KD²Lab has become a renowned infrastructure and a platform for conducting for cutting-edge research in different fields that has been published in very well recognized journals such as Management Science, PLOS ONE, Journal of Retailing, Business & Information Systems Engineering, Journal of the Association for Information Systems, or Journal of Management Information Systems and at important conferences such as CHI Conference on Human Factors in Computing Systems, International Conference of Information Systems (ICIS), or the NeuroIS Retreat.

As for most experimental labs and research facilities worldwide, the COVID-19 pandemic has posed major challenges for researchers at the KD²Lab. Conducting experiments on site was impossible due to lab closures or at least subject to very strict hygiene regulations, especially when the studies required attaching sensors to the participants' bodies. However, many researchers have taken up the challenge and developed methods to conduct experiments remote and online, e.g., by sending sensors to the participants such that on-site presence was no longer required. On top of enabling experiments despite of strict contact restrictions these new approaches allowed for data collection in realistic environments in the field on which we plan to build on in the future. In several projects we are thus working on enlarging our current student panel, building an additional citizen panel, leveraging methods of Digital Citizen Science, or developing and evaluating wearable sensor systems.

To conclude this article, we want to thank the editors of the NeuroIS Magazine for the invitation to present the KD²Lab in this issue! We would like to invite you all to...

... visit the KD²Lab website: https://www.kd2lab.kit.edu/

... visit the KD²School website: https://kd2school.info/

... take a virtual tour through the KD²Lab: https://www.kd2lab.kit.edu/tour.php

... get in touch with the lab management team via kd2lab-team@iism.kit.edu

Authors: Anke Greif-Winzrieth,
Alexander Maedche, Christof Weinhardt

Virtual and Augmented Reality Lab

View from the experimenter cockpit in lab area A with 20 cubicles.

On Digital Phenotyping and Digital Biomarkers: The Scientist's and Entrepreneur's Perspective

by Christian Montag, Ulm University (Germany) & Paul Dagum, Applied Cognition, Redwood City (USA)

Since several years it can be observed that a growing number of scientists rely on the study of digital footprints to not only get insights in human behavior, but also in psychological traits/states. Studying digital footprints left from the interaction with smartphones, with social media platforms and in general with all devices being linked to the Internet of Things (IoT), provides scientists with a myriad of unforeseen opportunities to better understand diverse human conditions. Therefore, it is not surprising that psychologists and psychiatrists early foresaw the possibilities arising from digital phenotyping, a term which was introduced by Jain et al. [1]. In their paper they stated that digital footprints "have the potential to fundamentally alter our notion of the manifestations of disease by providing a more comprehensive and nuanced view of the experience of illness" (p. 462). As mentioned already, digital footprints not only give insights into illness of a person, but also into psychological characteristics such as cognition [2] and personality [3], with the latter variable being linked to job performance [4] and health behavior [5]. In the realm of personality science, for instance, it has been observed that diverse call variables are robustly linked to the personality dimension extraversion [6]. This comes not as a surprise, because an important part of extraversion is sociality.

Beyond a growing number of digital phenotyping studies touching upon personality science, in particular depression has been investigated in the context of digital footprints, among others showing that more staying at home (as captured via the GPS signal; [7]) is associated with more depressive tendencies. Beyond this, it has been shown that Facebook data could be exploited to diagnose a depressed state of mind: perhaps it is even possible to catch such a diagnosis up to three month earlier than the psychiatrist when considering digital footprints from Facebook [8].

In sum, much research is going on trying to sense many relevant variables in the psychological and psychiatric sciences from data left on mobile devices (so called "mobile sensing") or other digital footprints from a rapidly evolving IoT.

In a recent review it became apparent that although psychological/psychiatric disciplines from early on embraced digital phenotyping principles, the neurosciences at this time interestingly seem to be (rather) late adopters [9]. This is at first glance surprising, because we deal in the brain sciences with a research area strongly relying on innovative methods to grasp the complexity of the (human) brain. We believe the lack of digital phenotyping studies in the neurosciences to be a lost opportunity because the mind arises from the matter and we believe that it is not only possible to sense psychological and psychiatric variables from the available digital footprints, but also the underlying neurobiology.

Related research ultimately might result in digital biomarkers [10], hence patterns of digital footprints giving direct insights into human (neuro-)biology. Although the term digital biomarker is ill-defined in the literature at the moment [11], we are convinced that studies in the field need to first establish direct links between digital footprints on the one hand and biological variables such as stemming from endocrinology, immunology or neural processes on the other hand before we can speak with some certainty of a digital biomarker. There will be plenty of possibilities to also combine study designs in the field of molecular genetics with digital footprints, either with the aim to perhaps link digital footprints to monogenetically inherited disorders or to study gene by environment interaction effects, whereas environmental factors are sensed via smartphones and other devices [12]. Please note that it is possible to infer much information on a person's surrounding such as loudness, temperature, brightness and so forth via the sensors in-built in the smartphones.

Ultimately, the study of digital footprints might be also relevant to better understand how certain psychopharmaceuticals impact on human psyche and behavior. Montag & Quintana [13] outlined recently that pharmacological challenges with oxytocin, SSRIs or ketamine might profit from the inclusion of digital footprints in the respective experimental setup.

Paul Dagum

Christian Montag

With the pervasiveness of telehealth encounters, translational research of digital footprints to remote patient monitoring for chronic mental and neurological conditions is of growing interest to healthcare technology entrepreneurs. From passive and ecological assessment of clinical conditions to early detection of clinical deterioration enables just-in time care that can improve patient outcomes and avoid costly late interventions. The value chain of remote care management begins with passive and continuous monitoring of health and chronic disease, telehealth consultation with healthcare practitioners, remote confirmatory laboratory tests and remote therapy delivery and titration. Ethical, legal and societal implications for harvesting of digital footprints for the purpose of remote clinical assessment and care delivery need to be carefully considered [14,15]. The future of healthcare is likely to be patient centric, value based and looks very different from today's model.

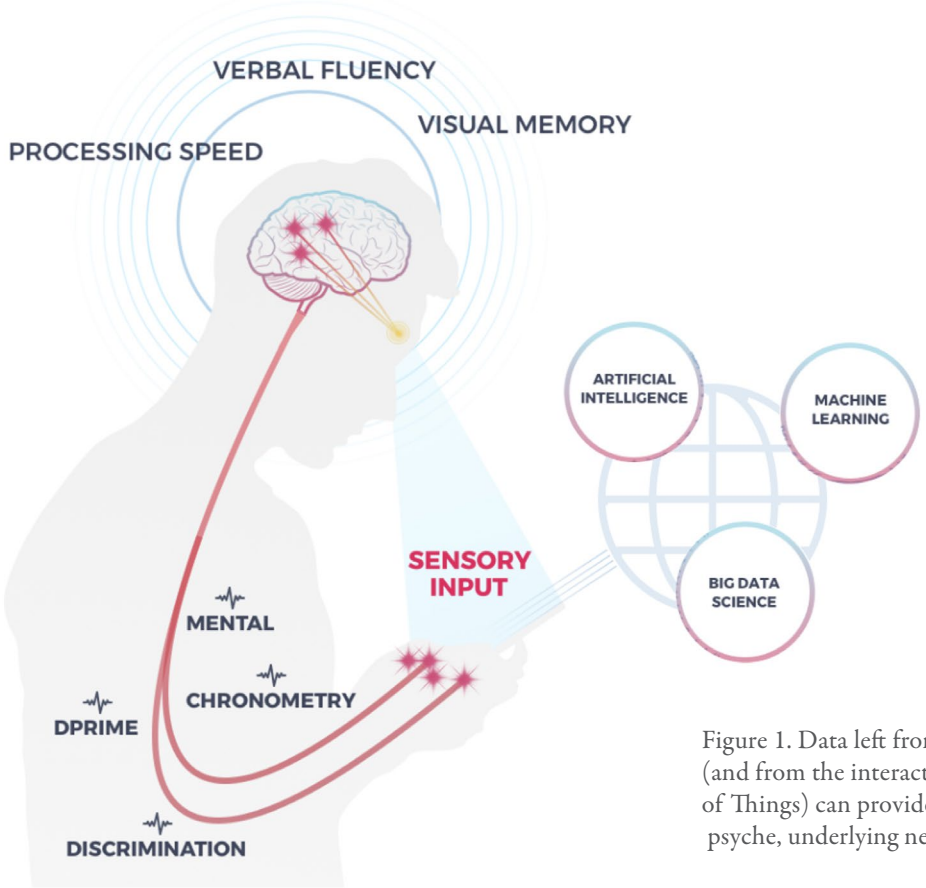

Figure 1. Data left from human-smartphone-interaction (and from the interaction with other devices from the Internet of Things) can provide researchers deep insights into the human psyche, underlying neurobiology and behavior

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Conflict of Interest

Christian Montag is on the scientific advisory board of Applied Cognition. Paul Dagum is CEO of Applied Cognition.

NeuroIS Retreat: 2022 Review and 2023 Outlook

In 2007, a small number of Information Systems (IS) researchers — partly independently from each other — developed the idea of applying neuroscience knowledge and tools with the goal to advance Information Systems (IS) theory and practice. Today we know that NeuroIS has become a prosperous scientific field, and neuroscience constitutes an important reference discipline for IS research.

Shortly after the genesis of the NeuroIS field, an annual scientific meeting was launched, the NeuroIS Retreat. The inaugural meeting took place in Gmunden, Austria, in 2009 and brought together interdisciplinary researchers from around the world to discuss research that leverages neuroscience theories and methods to tackle research problems in IS. Specifically, the meeting brought together a small group of IS and neuroscience researchers to consider the promise of leveraging neuroscience knowledge and tools in IS research. The retreat participants developed a research agenda, published in two papers [1, 2], and proposed continuing the event annually.

Today, the NeuroIS Retreat is a leading academic conference for presenting research and development projects at the nexus of information systems, digital technologies, and neuroscience. This annual conference promotes the development of the NeuroIS field with activities primarily delivered by and for academics, though works often have a professional orientation. During the past years, more and more practitioners showed interest in the enormous application potential of NeuroIS knowledge. Therefore, the NeuroIS Retreat provides a platform for both scholars and practitioners to discuss their studies and technologies and to exchange ideas. Academically, it is a major goal of the event to provide feedback for scholars to advance their research papers so that they ultimately result in high-quality journal publications. Hence, the organizing committee welcomes not only completed research, but also work in progress. The NeuroIS Retreat is known for its informal and constructive workshop atmosphere. Many NeuroIS presentations have evolved into publications in highly regarded academic journals.

The NeuroIS Retreat 2022 was a great success

In 2022, researchers from all over the world, ranging from established world-class scholars to young students who seek to develop their own academic identity in a highly innovative research field, participated at the meeting in Vienna in June—thereby they contributed to the advancement of knowledge and the design of innovative systems. After running the conference in a virtual format in 2020 and 2021, the community enjoyed meeting again in a face-to-face format. In his summary of the retreat, René Riedl, conference co-chair, expressed his satisfaction and highlighted the significant progress in the field regarding theory and methodology. Gernot R. Müller-Putz, board member of the NeuroIS Society, expressed similar thoughts. Fred D. Davis, also conference co-chair, tellingly summarized the atmosphere at the event: "It's so great to get back together with friends and colleagues I have known for many years and to see

Group picture of the NeuroIS Retreat 2022

Presentations took place in the venerable conference room in Schlosshotel Wilhelminenberg, Vienna

the new faces that are coming along." Pierre-Majorique Léger, program co-chair, also tellingly expressed his feelings, he indicated that "it's been a fantastic retreat again this year, it was incredible to be back in face-to-face" and he continued arguing that "this is the place where you get constructive feedback, this is a community that is there to support newcomers, people who are striving to try using NeuroIS and we are here to help as a group so that people can develop their papers". Last but not least, Adriane B. Randolph, also program co-chair, said that "this is the one place where I get to be with others who are truly focused on neurophysiological tools use".

A video summarizing the NeuroIS Retreat 2022 is available via the NeuroIS.org website. Also, you can find many conference pictures on the website.

Highlights of the NeuroIS Retreat 2022

In addition to 35 exciting research presentations, and a wonderful social event with great music performance, the keynote presentation entitled "The Neurobiology of Trust: Benefits and Challenges for NeuroIS" was given by Frank Krueger, professor of Systems Social Neuroscience at the School of Systems Biology at George Mason University, USA. Moreover, Jan vom Brocke, professor of Information Systems at the University of Liechtenstein, gave a Hot Topic Talk entitled "From Neuro-adaptive Systems to Neuro-adaptive Processes: Opportunities of NeuroIS to Contribute to the Emerging Field of Process Science". In the inaugural issue of the NeuroIS Society Magazine, published in spring 2022, we already reported on these two topics.

Sponsors of the NeuroIS Retreat 2022

Zemlicka Award winners with organizing committee

Award winners

A further highlight of the conference was the award session, with the following winners: The Dr. Hermann Zemlicka Award for the most visionary paper was given to Florian Popp, Bernhard Lutz, and Dirk Neumann, University of Freiburg (Germany) for their paper entitled "Information Overload and Argumentation Changes in Product Reviews: Evidence from NeuroIS". Moreover, Peter Walla, Sigmund Freud University Vienna (Austria) received the best reviewer award.

Best Reviewer Award winner Peter Walla, handed over by Fred D. Davis

Colonel Erik M. Bauer, US Embassy Vienna, and his wife Izabela

NeuroIS Retreat 2023

We invite scientists, as well as practitioners with an interest in academic research, to participate at the NeuroIS Retreat 2023. Specifically, the organising committee welcomes not only completed research, but also work in progress. If you are interested in presenting your research or development project, please submit your paper (please see the submission guidelines at www.NeuroIS.org). English is the language of the conference and of all submissions.

NeuroIS studies comprise conceptual and empirical works, as well as theoretical and design science research. It includes research based on all types of neuroscience and physiological methods. Submissions must be original, and they cannot have been published in another publication outlet. Contributions may address the following topics, among others:

» Employment of neurophysiological tools to study IS phenomena (e.g., technology adoption, mental workload, website design, flow, virtual worlds, emotions and human-computer interaction, e-commerce, biofeedback, social networks, information behavior, trust, IT security, usability, avatars, music and user interfaces, multitasking, memory, attention, IS design science, risk, knowledge processes, business process modeling, ERP systems)

» Application of psychophysiological approaches to study technostress, information overload, and IT addiction

» Identification of the neural correlates of IS constructs based on neuroscience methods

» Software prototypes of NeuroIS applications, which use bio-signals (e.g., EEG, skin conductance, pupil dilation) as system input

» Discussion of methodological and ethical issues and evaluation of the status of the NeuroIS field

The NeuroIS Retreat 2023 will take place at Schlosshotel Wilhelminenberg in Vienna, Austria, on May 30—June 1. The deadline for paper submission will be in spring 2023 (for details, please see the information on the website). In case of questions, please do not hesitate to contact us at info@neurois.org.

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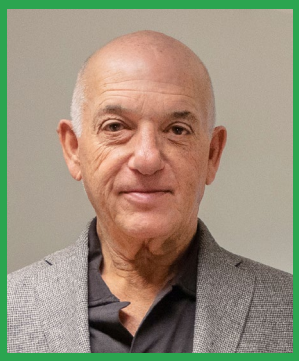
The NeuroIS Retreat Organizing Committee looks forward to the 2023 conference in Vienna

From left to right: Gernot R. Müller-Putz, Jan vom Brocke, Adriane B. Randolph, Fred D. Davis, Pierre-Majorique Léger, and René Riedl

The Practitioner's Perspective

An Interview with Julius Frohlich



NeuroIS Society: So, I am here today with Julius Frohlich, CEO of Language Research and Development Group (LRDG). Julius, thank you so much for making time to meet for this interview.

Julius Frohlich: Thank you for having me, Pierre-Majorique. It's a pleasure to be here.

NeuroIS Society: So, to begin, could you perhaps provide a short statement about your company and its business model?

Julius Frohlich: We are in the online language learning business. Our primary customer is the government of Canada, whom we've worked with for 20 years. During that time, we've established some excellent technology and strategies for teaching English and French to civil servants and the public.

NeuroIS Society: Your company has clearly continued to innovate, with the recent development of a new product called Axon. Can you explain what Axon is, and what your vision is for this product?

Julius Frohlich: The idea was initially inspired by research indicating that learning a second language could be very beneficial to the brain. Considering the public health issues related to cognitive decline and our specialization in language learning, we tried to get involved. But we didn't get much traction until we met Dr. Jared Boasen, a researcher from the Tech3Lab, who proposed the idea of Axon, which is a NeuroIS mobile application designed to take iterative snapshots of an individual's cognitive function which we could then link to changes in cognitive function due to learning or other factors such as aging.

NeuroIS Society: The story is really compelling. I don't think it's easy for companies to establish productive relationships with researchers. What were the key factors for you in this relationship?

Julius Frohlich: First, it was recognizing that our industrial problem was also a science problem, and thus that collaborating with a researcher makes business sense. Then, it was about finding someone with scientific integrity who could not only propose a solution to the problem, but also share my conviction that the solution would have merit both scientifically and, despite the risks, commercially.

NeuroIS Society: We had the rare privilege to have you, someone from industry, with us at our scientific conference in Vienna this past June. Could share what insights, if any, you took away from the conference?

Julius Frohlich: It was a great privilege being the only person from industry in attendance. I had the opportunity to network with scientists and exchange ideas on the intersection between neuroscience and technology. I think you should try inviting other businesspeople to potentially spur new collaborations. The best results, I think, come when scientists apply their research to the practical realities of world problems.

NeuroIS Society: What would you recommend to scientists from this community, when preparing to reach out to industry?

Julius Frohlich: I think the best way forward would be to develop a collaborative space or forum within the NeuroIS Retreat with the aim of brainstorming ideas for solving technological and industrial problems with neuroscience. And, if you put in place the right creative spirit, business and technology executives will clearly see the potential. And especially if the venue is that amazing palace up on the hill in Vienna, whether it's business, science, or otherwise, businesspeople will see your conference as just the perfect way to spend a few days.

Julius Frohlich

Julius Frohlich is CEO of LRDG Inc, Language Research Development Group, a Canadian company that provides online second language instruction in English and French. More information about the company can be found at https://lrdgcampus.com/.

Julius Frohlich (left), CEO of LRDG, holding his company's new cognitive function testing app, Axon, and Dr. Jared Boasen (right) of the Tech3Lab, HEC Montréal.

Note: The interview was conducted by Dr. Pierre-Majorique Léger, HEC Montréal, in his role as board member of the NeuroIS Society.

Young Academics

In each issue of the magazine, the NeuroIS Society presents a young and aspiring academic.

Anika Nissen

Institute for Computer Science and Business Information Systems
University of Duisburg-Essen (Germany)

Why did you start NeuroIS research?

Already in young years, I was fascinated by the power and complexity of emotion and how they drive our decisions in everyday life. The connection between experienced emotions during IT use and their impact on our behavior began to interest me during my studies of Information Systems. At that time, I was also quite interested in the physiological signals that the body can tell us, as I used these signals for myself to improve my training for 10k runs and half-marathons. I typically used my heart rate and heart rate variability as indicators for the impact of my training and the performance I could expect from myself that day.

But what more could such physiological signals tell me about myself that day? And if they can tell me more about myself, can they also tell me more about others? When I learned of the field Affective Computing in 2015 that would use the same physiological signals I did – but as a means to better understand users and to adapt our applications to the user – I was in absolute awe, and I knew that this is what I wanted to dedicate my research to.

How did you start with NeuroIS?

Under the frame of Affective Computing and Affective Gaming, I began my first investigations in the frame of a seminar paper during my master studies. This paper became my very first conference poster presentation in 2018. My research at that time had a heavy focus on emotion theory, emotion measurement, and the idea of emotion-adaptive computer applications and video games. The ultimate goal of this was always to better understand users; not only in their reflective evaluations of IT artefacts, but also through their (neuro)physiology.

During my PhD, I continued this passion and presented my first proposal for NeuroIS research on the aesthetics of web design at the NeuroIS Retreat in 2019 in Vienna. Since then, I focused on different aspects of website design and how they are processed in decision making areas of the brain. Even now, I am still fascinated by the insights we can generate out of neurophysiological signals, and also by how little we know and how much more there is to uncover.

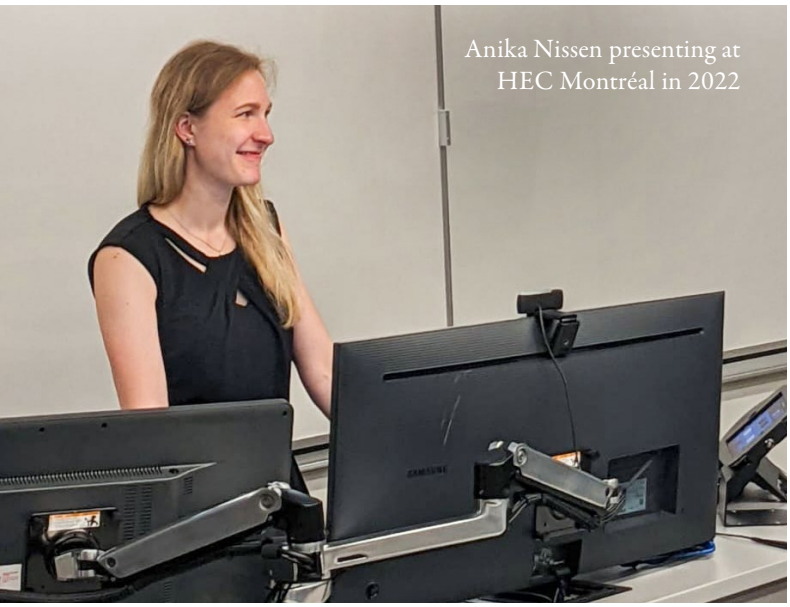
What are challenges for young NeuroIS researchers?

I think one of the main challenges is that we need to satisfy readers from diverse scientific backgrounds which reach from computer science to cognitive psychology. Each community has a slightly different style in how theory and hypotheses are derived, and in which results are discussed. Especially in the beginning, it therefore poses a particular challenge to find a best of both approaches to this field. And with this, to find a way that makes NeuroIS research fruitful not only for the IS community, but also for psychology and neuroscience. But fear not – all it takes to overcome this challenge is compassion for the topic and connecting to the NeuroIS community.

What were the most important moments in your academic career?

The most important moments in my career were my discovery of Affective Computing and fascination for the field, which has led me to NeuroIS research and its community in 2019. Through this, I got to visit the NeuroIS Retreat which is the most fruitful conference for young researchers you can go to. I just love the feedback culture and constructive remarks given, as well as the whole atmosphere which makes it joyful to connect to other researchers with similar interests. This has helped me frame and improve my research during my PhD years. Another important step was my research semester abroad at Dalhousie University in Canada in 2022, where I got to work with Aaron Newman and Colin Conrad. Both of them are fantastic NeuroIS researchers and I learned a lot from them for my future work.

Anika Nissen with fNIRS measurement device



Anika Nissen presenting at HEC Montréal in 2022

Anika Nissen as EEG researcher at Dalhousie University in Canada in 2022

Anika Nissen with Aaron Newman at the NeuroIS Retreat 2019

Looking Back

On this last page, we look back to a highlight in the history of NeuroIS.

First Dr. Hermann Zemlicka Award Winner: Jacek Gwizdka

Handover of the first Dr. Hermann Zemlicka Award at the NeuroIS Retreat 2013 (left: Fred D. Davis, right: Jacek Gwizdka)

Dr. Hermann Zemlicka was an Austrian politician, member of the Gmunden City Council, and an entrepreneur. He significantly contributed to the establishment of the NeuroIS Retreat. Without his visionary support, it would not have been possible to bring the conference into being. He passed away at age 55 in June 2012. In memoriam of this outstanding person, the Dr. Hermann Zemlicka Award is given to "the most visionary paper" by the Conference Committee each year. Jacek Gwizdka, professor at the University of Texas at Austin, USA, won the first Dr. Hermann Zemlicka Award in 2013, paper title: Looking for information relevance in the brain.

Organizing Committee with Jacek Gwizdka