NeuroIS SOCIETY

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COVER STORY

Cybersickness
in Virtual Reality
by Silvia E. Kober

IN THE SPOTLIGHT

The UX &
Biometrics Lab
Loyola University Chicago

YOUNG ACADEMICS

Sophia Mannina
Queen's University
Kingston, Canada

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Preface

Dear Readers!

We are pleased to present the first issue of the NeuroIS Society Magazine in 2026. As in previous years, this issue reflects the continued evolution of the NeuroIS field, which remains characterized by its unique integration of neuroscience and information systems. At a time when digital technologies are advancing at an unprecedented pace, the need to better understand the cognitive and affective processes underlying human-technology interaction has never been more pressing.

Recent developments – particularly in areas such as artificial intelligence, immersive environments, and biometric sensing – are reshaping how individuals interact with digital systems. These technologies are not only transforming organizations and societies, but are also challenging long-standing assumptions about cognition, decision-making, and user experience. As NeuroIS researchers, we are uniquely positioned to explore these changes by combining methodological rigor with interdisciplinary perspectives.

This issue brings together a diverse set of contributions that illustrate both the breadth and depth of current NeuroIS research. The articles featured here span conceptual reflections, empirical research, methodological advances, and community insights. Together, they provide a multifaceted view of how neurophysiological approaches can deepen our understanding of digital behavior and inform the design of human-centered technologies.

Our "Cover Story" addresses an increasingly relevant topic: the use of virtual reality (VR) in research and practice, alongside the challenges associated with it. While VR offers powerful opportunities to create immersive and controlled experimental environments, it also introduces potential side effects, most notably cybersickness. The article by Silvia E. Kober provides a comprehensive overview of the advantages of VR for NeuroIS research, while also critically examining the causes, measurement, and mitigation of cybersickness. Importantly, the contribution highlights how neurophysiological data can be used not only to study user experience in VR, but also to identify and potentially predict adverse effects, thereby advancing both theory and application.

In our "In the Spotlight" section, we present the UX & Biometrics Lab at Loyola University Chicago. This contribution illustrates how NeuroIS research can be embedded within a business school environment while maintaining strong methodological rigor and societal relevance. Particularly noteworthy is the lab's integration of teaching and research, where undergraduate students actively participate in the design and execution of empirical studies. This model demonstrates how the next generation of researchers can be engaged early in the research process, contributing meaningfully to ongoing scholarly conversations.

In another article, we turn our attention to one of the most transformative developments of recent years: generative artificial intelligence. René Riedl's conceptual contribution invites us to rethink human-AI interaction through the lens of cognitive neuroscience. By distinguishing between cognitive offloading and cognitive scaffolding, the article offers a nuanced perspective on how AI systems can either reduce or enhance cognitive engagement. This distinction has important implications for the design of intelligent systems and for future NeuroIS research, as it emphasizes that the impact of AI depends not only on the technology itself, but also on how it is used.

Another article provides insight into the evolving landscape of user experience research. Constantinos K. Coursaris reflects on the future direction of Tech3Lab and, more broadly, on the challenges and opportunities that arise as digital technologies become more adaptive, autonomous, and pervasive. His contribution underscores the importance of integrating self-reported, behavioral, and physiological data to gain a richer understanding of user experience, while also highlighting the growing role of AI in analyzing complex human data. Together, these perspectives point to a future in which NeuroIS research becomes increasingly central to both scientific inquiry and practical innovation.

The "Young Academics" section features an interview with Sophia Mannina that provides valuable insights into the experiences of emerging scholars in the NeuroIS community. The interview highlights both the opportunities and challenges associated with NeuroIS research, including the steep learning curve of advanced methodologies and the importance of collaboration and mentorship. Such perspectives are essential for understanding how the field continues to grow and evolve through the contributions of its newest members.

Finally, in our "Looking Back" section, we revisit Hauke Heekeren's keynote from the NeuroIS Retreat 2016, which explored the relationship between social media and the brain. This retrospective reminds us that many of the questions we are addressing today, such as the impact of digital environments on cognition and behavior, have deep roots in earlier research. At the same time, it illustrates how the field has progressed, building on past insights to address increasingly complex and dynamic technological contexts.

Taken together, the contributions in this issue highlight a central theme: the importance of understanding not only what people do with technology, but also how and why they do it. NeuroIS provides the tools and perspectives necessary to examine these questions at a deeper level, bridging the gap between observable behavior and underlying cognitive and neural processes.

We would like to express our sincere gratitude to all NeuroIS researchers for their valuable contributions, and to all NeuroIS supporters for their continued commitment to the discipline and this magazine. Your engagement and collaboration are vital for advancing the field.

We hope that you enjoy reading this issue and that it inspires new ideas, discussions, and research directions. We also look forward to continuing these conversations at upcoming NeuroIS events, including the NeuroIS Retreat, where members of our community come together to share knowledge and foster collaboration.

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Cybersickness in Virtual Reality: Challenges, Mitigation Strategies, and Implications for NeuroIS Research

By Silvia Erika Kober, University of Graz (Austria)

Virtual reality (VR) is increasingly being utilized beyond gaming and entertainment, finding applications in therapy, education, military training, and professional contexts[1]. Moreover, VR serves as a valuable tool for research, providing simulated environments, which are well-suited for empirical studies. Its ability to enhance ecological validity stems from the capacity to simulate diverse scenarios in a controlled and safe experimental setting. Realistic, three-dimensional, and highly immersive VR environments enable users to fully immerse themselves in virtually any simulated world, offering significant potential for both practical applications and scientific investigation.

Advantages of VR

VR headsets are becoming progressively more advanced and affordable, enabling the recording of a wide range of neurophysiological signals (e.g., heart rate, skin conductance, brain activity) in combination with precise tracking of movements (e.g., head and hand movements, eye or facial movements) during VR interactions, capabilities that may not be feasible in real world scenarios[1]. Figure 1 illustrates a schematic representation of a setup combining a neuroscientific measurement using electroencephalography (EEG) with a VR headset. VR allows researchers to precisely control every variable in the environment, such as lighting, sounds, colors, objects, interactions, and other sensory stimuli. This level of control is often unattainable in the real world due to external factors. Furthermore, experiments can be exactly reproduced, as the virtual environment remains consistent. In contrast, external factors in the real world, such as weather, noise, or human interactions, can vary and affect results. Additionally, VR experiments can be more cost-effective and easier to scale than real world experiments, as physical resources like spaces, materials, or travel expenses are eliminated. Regarding safety concerns, VR provides a secure environment where participants can experience potentially distressing or dangerous scenarios without being exposed to actual harm. These advancements create ideal conditions for NeuroIS research by integrating neuroscientific methods with simulated information systems. For instance, the combination of neuroscientific methods and VR research enables the investigation of neural markers associated with decision-making processes in simulated and controlled business scenarios where users interact with VR-supported information systems. Or, VR allows for the controlled manipulation of visual and emotional stimuli to investigate e-commerce platforms, analyzing how users select products and make purchasing decisions in ecologically valid VR scenarios[2].

Figure 1. Schematic setup of a combined VR-EEG measurement, where the VR scenario displayed within the VR headset and the recorded EEG traces are simultaneously shown on a screen in the background.

In our own work, we leveraged the advantages of VR to investigate neuronal correlates of cognitive processes in simulated and realistic scenarios, such as the neuronal correlates of spatial navigation[3] or subjective user experience such as the sense of being in a simulated environment, also referred to as spatial presence or place illusion[4–6]. We could show that event-related responses in the EEG are valuable neuronal markers for attentional allocation in VR[5]. Furthermore, we explored how VR can be utilized as a feedback modality in neurofeedback (NF) and brain-computer interface (BCI) applications to enhance motivation and adherence to training through gamified feedback[7]. Our findings demonstrated that VR-based feedback resulted in better NF training performance compared to traditional 2D feedback. Specifically, participants who received VR-based feedback, where they controlled the movement of a virtual ball through a virtual forest using their brain signals, were more successful in voluntarily modulating their brain activity during NF training than participants who controlled a 2D moving bar on a conventional feedback screen using their brain signals (Figure 2)[8].

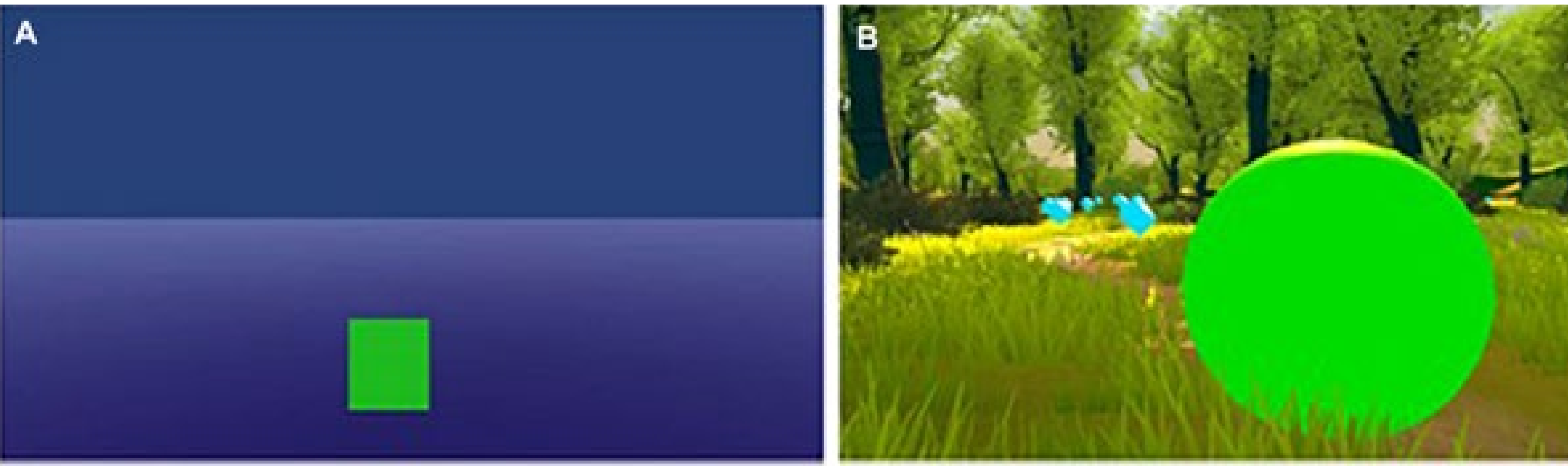

Figure 2. 2D feedback (moving bar, A) vs. 3D VR-based feedback (moving a ball through a virtual forest, B) during a NF training session. Image material reprinted from Berger et al. (2022)[8] under a CC BY license, original copyright 2022.

Side-effects of VR Interaction – Cybersickness

But despite all the advantages of using VR for various applications and research, it is important to acknowledge that VR interaction may not be suitable or enjoyable for everyone. Many individuals who have interacted in a highly immersive virtual environment, such as using a VR headset, are likely familiar with the potential negative side effects of VR interaction - commonly referred to as cybersickness (CS). Various studies report differing prevalence rates, ranging from 30% to 80% of users being affected by CS[9]. Symptoms of CS include nausea, oculomotor issues, and disorientation, which can continue to have an effect hours after the VR interaction[9]. Several theories have been proposed to explain its occurrence, with one of the most prominent being the sensory mismatch theory, which suggests that nausea arises from a mismatch between sensory inputs. For instance, when one moves in the virtual environment but remains stationary in the real world. Other theories include the postural instability theory and the rest frame theory[9].

The causes of CS can be broadly categorized into hardware-related factors (e.g., display types, where head-mounted displays induce stronger CS than 2D monitors; display modes, where stereoscopic views lead to stronger CS than monoscopic views; field of view; latency), content-related factors (e.g., faster movement speed and a longer task duration are associated with increased CS), and human factors (e.g., females tend to experience stronger CS symptoms than males; prior VR experience reduces the risk of CS)[10]. Our own research also shows strong sex differences in CS, with females showing higher sickness symptoms than males (Figure 3)[11, 12]. Reasons for these sex differences might be differences in the field of view, head size, interpupillary distance, or hormonal levels[10].

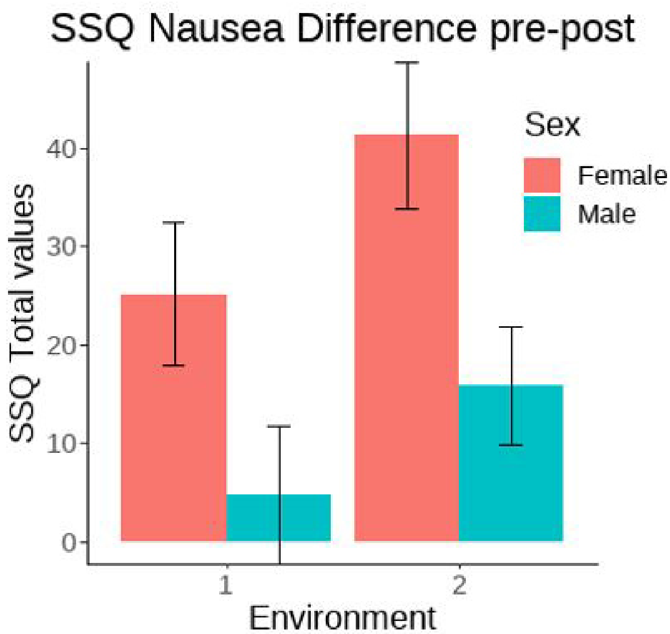

Figure 3. Sex differences in CS (assessed with the Simulator Sickness Questionnaire, SSQ[13]), specifically the increase in CS over the course of the VR interaction, during NF training in a highly CS-inducing VR scenario (Environment 2) compared to a low CS-inducing VR scenario (Environment 1). Image material minimally modified and reprinted from Berger et al. (2025)[11] under a CC BY license, original copyright 2025.

In most cases, subjective questionnaires are used to assess the presence of CS symptoms after VR interaction (e.g., the Simulator Sickness Questionnaire, SSQ[13]). However, there is growing interest in identifying objective measures of CS that can be recorded during VR interaction without disrupting immersion, such as postural sway, heart rate, skin conductance, or changes in brain activity[10]. Neuroscientific studies are increasingly focused on uncovering the neural correlates of CS or identifying neural markers that can detect the onset of CS during VR interaction[14, 15], or ideally predict its occurrence before VR exposure[16]. However, findings in this area remain highly heterogeneous, and no definitive or valid neurophysiological markers for CS have yet been established[14].

The conclusion is that CS poses significant challenges for VR-based applications and research, particularly regarding inclusion, as women are disproportionately affected. This raises concerns about the suitability of VR as a training and therapeutic tool, as it may not be accessible or effective for everyone. Additionally, research often systematically excludes individuals who experience severe CS, which can lead to potential biases in study outcomes and limit the generalizability of findings. Especially in the context of NeuroIS research, CS may influence brain activity and, consequently, confound the results. This brings forth an important question:

Can Anything Be Done to Mitigate Cybersickness?

Ramaseri Chandra et al. (2022)[17] summarized design and development guidelines aimed at reducing CS, including for instance the use of a high frame rate, low latency, avoiding rapid movements and acceleration, limiting the duration of VR sessions, or narrowing the field of view. Furthermore, in their review article, they also highlight best practices for users, such as focusing on rigid, distant objects on the horizon, which is consistent with the rest frame theory, or using VR only when in good health and maintaining proper balance[17]. A recent study revealed that multi-strategy approaches combining for instance hardware-related factors and Cognitive Behavioral Therapy (CBT) might be the most effective solution[18].

In our research, we experimentally manipulated CS using VR design factors, such as varying movement speed, field of view, and camera angle leading to strong differences in CS (Figure 3)[11]. Our findings indicate that CS reduces performance in a NF task, in which participants are required to modulate brain signals in a desired direction while receiving real-time feedback, with movement through the VR environment controlled by changes in the users' brain signals[11]. In another NF study, we employed sham electrical brain stimulation as a placebo and investigated its effects on CS and NF performance[19].

In an ongoing research project, we aim to reduce CS in a highly CS-inducing VR environment by using a placebo intervention (sham electrical brain stimulation) before the VR task. Preliminary data suggest that a placebo can indeed reduce CS and also lead to differences in brain activation patterns. Figure 4 shows topographic plots of EEG data from a participant who received a placebo intervention before the VR interaction and a participant who did not. Both participants initially had the same tendency to develop CS symptoms during VR interactions. The participant who received the placebo exhibited no CS symptoms during VR interaction and a corresponding reduced EEG Delta (1–4 Hz) activity, compared to the participant who did not receive the placebo and experienced severe CS symptoms. Previous studies have partially identified a correlation between increased slow EEG Delta activity and CS symptoms[14]. Hence, it seems plausible that CS could be mitigated using placebos.

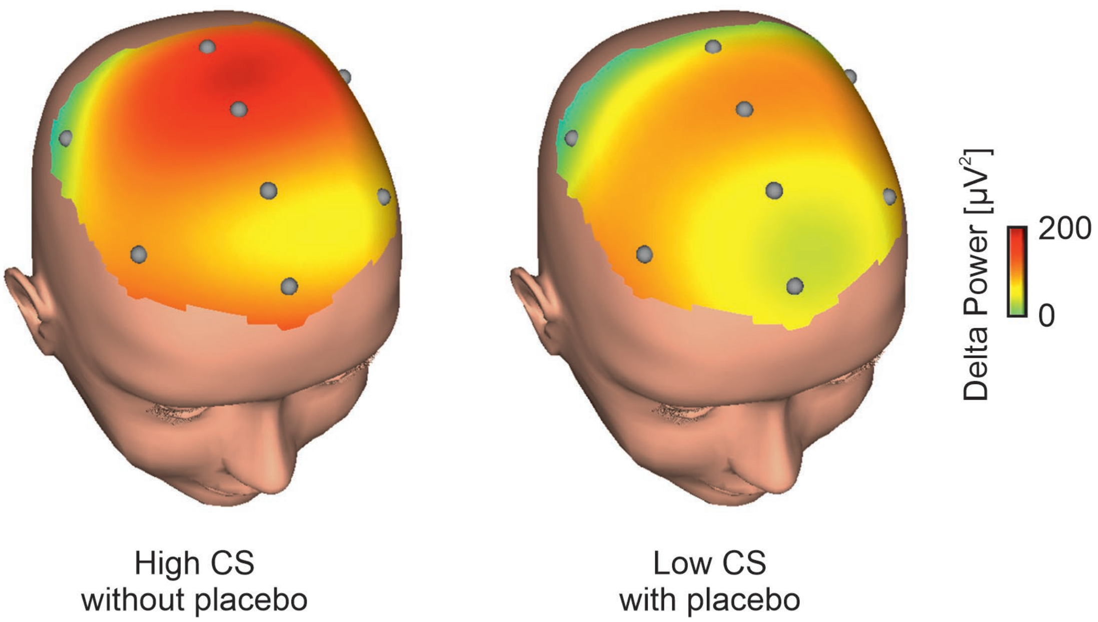

Figure 4. Topographic maps of EEG Delta power in a participant who did not receive a placebo before the VR interaction, showing strong Cybersickness (CS) symptoms and increased EEG Delta activity (left), compared to a participant who received a placebo intervention prior to the VR task, consequently showing no CS symptoms and reduced Delta activity (right).

What Does that Mean for Future VR Applications and Research?

CS should always be accounted for in VR studies, as it can significantly impact both user experience and research outcomes. Whenever possible, measures should be implemented to reduce CS, such as optimizing VR design factors or employing interventions like placebos. Additionally, researchers must remain vigilant about potential biases, particularly those arising from the exclusion of participants who experience severe CS, as this can limit the generalizability of findings and hinder progress in the field.

Dr. Silvia Erika Kober in her VR-EEG lab at the Department of Psychology, University of Graz, Austria

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The UX & Biometrics Lab: Where Biometrics, Digital Behavior, and Student Research Converge

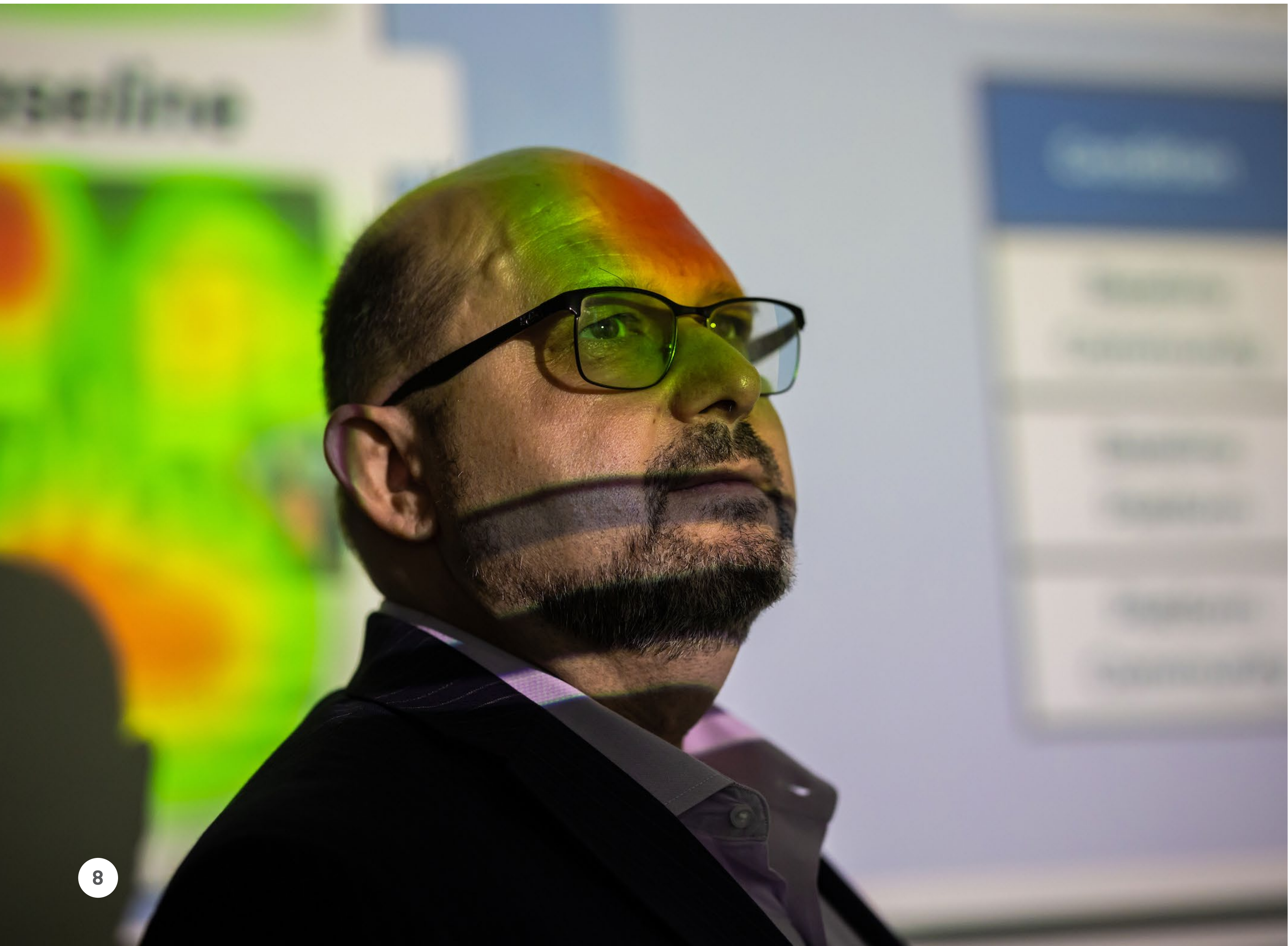
By Dinko Bačić, Loyola University Chicago (USA)

The UX & Biometrics Lab at Loyola University Chicago is housed within the Quinlan School of Business and offers a distinctive example of NeuroIS research in a business school. Founded and led by Dr. Dinko Bačić, the lab operates at the intersection of user experience, biometrics, and information systems, using biometric and behavioral methods to study human behavior, decision-making, and digital interaction. Its work examines how people allocate attention, respond physiologically to digital stimuli, and engage with interfaces, media, and AI.

Research Themes

The UX & Biometrics Lab's work can be organized into five interrelated research themes that reflect its broader mission:

- *Data visualization, interfaces, and information presentation.* This theme examines how visual structure shapes cognition. It includes work on data visualization design, cognitive fit and misfit, Gestalt principles, disruptions, cognitive effort, and creativity. The emphasis is on how people allocate attention, scan visual material, and prioritize information when interpreting displays and making decisions.
- *Digital judgment, choice, and UX.* This theme examines how people evaluate options and make decisions in digital environments. It includes research on design cues such as color and gender, information overload, misinformation warnings, online judgments, and user responses to digital signals that shape trust and believability. The emphasis is on how UX features and digital cues influence evaluation, comparison, trust, believability, and choice.
- *Human-centered AI.* This theme examines the human side of AI use. It includes work on AI-generated content, deepfakes, AI disclosures, AI language, AI-based recommendations and predictions, and AI-en-



abled cognitive offloading. The emphasis is on how people interpret, trust, rely on, resist, and adapt to AI-mediated systems and outputs.

- *Media engagement and consumption.* This theme examines how users engage with video-based streaming and social-media-like environments. It includes work on subtitles, screen layouts, content formats, virality, and other features that shape attention and emotional activation during media exposure. The emphasis is on combining visual-attention measures with affective and arousal-related responses to better understand engagement.
- *Societal challenges and improved human conditions.* This theme examines how biometric methods can be applied to broader societal concerns. It includes work related to health, learning, caregiving, climate, and sustainability. The emphasis is on using biometric insights not only to understand interaction, but also to improve human conditions and support more effective responses to real-world challenges.

Methods and Infrastructure

The lab is built around a multimodal biometric workflow. Its projects draw on eye-tracking (SmartEye Aurora and AI-X), galvanic skin response (Shimmer GSR+), facial expression analysis (AFFDEX), and emerging work on voice-related measures (Audeering), with future expansion into EEG-based data capture. The iMotions platform is a key part of this infrastructure, supporting synchronized study design, data collection, and initial analysis.

This methodological range matters because the lab is interested not only in outcomes, but also in the processes that produce them. Eye tracking reveals how attention unfolds over time, facial expression analysis offers insight into visible affective response, and GSR captures changes in physiological arousal. These tools make it possible to study interaction as a dynamic sequence rather than as a retrospective summary.

The Course-lab Model

A defining feature of the UX & Biometrics Lab is its close integration with teaching. The lab is closely tied to the UX & Biometrics course, an experiential undergraduate class that functions as a central part of its research ecosystem. In the course, students learn the foundations of biometrics, work directly with biometric tools and software, and complete an original human-subjects research project that culminates in a full empirical manuscript.

The course is structured around the logic of a complete research process. Students form teams, develop proposals, prepare IRB materials, review literature, collect and analyze biometric data, present findings, and produce a substantial final paper. In this sense, the course does more than introduce biometric methods; it inducts students into research practice itself.

Dinko Bačić and Angelika Tokarczyk (2025 Lab Fellow)

Undergraduate Research as a Core Identity

This integration of teaching and research is one of the lab's most distinctive characteristics. Undergraduate students are not treated merely as assistants to faculty-led projects, but as active contributors to the design, execution, writing, and presentation of original studies. Students who complete the course may continue as Lab Fellows, extending their involvement beyond a single semester and often developing conference papers, presentations, and related outputs. As a result, undergraduate research is central to the lab's identity. As a result, undergraduate research is central to the lab's identity. The lab is built around the idea that students can participate meaningfully in knowledge creation, especially in areas such as digital media engagement, advertising, information overload, trust, and emerging technology use

The lab's model also extends beyond campus through participation in international conferences. Lab Fellows have presented work at the HCI conference at the MIPRO Convention in Opatija, the NeuroBusiness Conference in Dubrovnik, and AMCIS. These opportunities place student-led research within wider scholarly conversations and demonstrate that undergraduate-driven work can reach serious academic venues, connecting the lab to broader communities in HCI and NeuroIS.

Angelika Tokarczyk (2025 Lab Fellow) and Dinko Bačić

Recent Notable Work and NeuroIS

Recent projects and publications have further clarified the lab's research profile while showing how its broader logic extends across both emerging and established NeuroIS questions. One important stream centers on AI and builds on the lab's longstanding interest in attention, trust, persuasion, engagement, and decision-making. Current and recent projects examine AI disclosures in digital advertising, comparisons between AI-generated and human-created images, explainability in AI-supported judgments, AI language confidence, student reliance on generative AI, cognitive offloading, and trust in AI predictions. For NeuroIS, this stream is especially important because it brings process-oriented questions such as reliance, trust calibration, cognitive effort, and human response into settings where AI increasingly shapes judgment and behavior.

Another notable line of work concerns video virality (Bačić & Gilstrap, 2024). The study extends virality research by moving beyond self-report and post hoc content features, showing that biometric data and machine learning can help explain and predict viewer engagement. For NeuroIS, its contribution lies in demonstrating that neurophysiological data can be effectively incorporated into predictive analytics in important contexts such as video virality.

A further notable contribution appears in the Decision Support Systems publication on cognitive effort in cognitive fit theory (Bačić & Henry, 2022). This study addresses a long-standing issue in cognitive fit research by examining effort directly rather than inferring it from performance outcomes. Eye-tracking fixation metrics show how biometric evidence can make the underlying cognitive mechanism more visible.this is important because it uses neurophysiological tools to explain the mechanism behind a well-established IS theory, illustrating a key NeuroIS contribution.

Conclusion

The UX & Biometrics Lab offers a distinctive example of NeuroIS research conducted in a business-school setting. Its work combines multimodal biometric methods with an applied research agenda focused on digital behavior, while also embedding undergraduate students deeply into the research process. Spanning attention, affect, media engagement, trust, and AI, the lab illustrates how research, pedagogy, and early scholarly participation can be integrated into a single academic model. In that sense, it offers not only a description of one lab, but also a compelling model for how NeuroIS research can be organized, taught, and extended through student-led inquiry.

Anne Price (2024 Lab Fellow) – MIPRO 2025, Opatija, Croatia

More information on the lab's website: www.luc.edu/uxandbiometricslab-dev/

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Dr. Dinko Bačić is an associate professor of information systems at Loyola University Chicago's Quinlan School of Business. His research interests include information visualization, human-computer interaction, user experience, biometrics, cognition, neuro-information systems, and pedagogy.

He is the founder and principal researcher of the User Experience & Biometrics Lab (UX&B Lab). He is a recipient of Quinlan's Graduate Teaching Award and has been nominated multiple times for the Peter Hans Kolvenbach Award for Engaged Teaching and the St. Ignatius of Loyola Excellence in Teaching Award. He has more than 15 years of corporate and consulting experience in business intelligence, finance, project management, and human resources.

Cognitive Offloading or Cognitive Scaffolding? Rethinking Human-AI Interaction in the Light of Neuroscience

By René Riedl, University of Applied Sciences Upper Austria & Johannes Kepler University Linz (Austria)

Humans have always expanded their minds beyond the brain. From calculators to search engines, we have continuously developed tools that reduce cognitive effort. This phenomenon, known as cognitive offloading, is not new. It is a cornerstone of human progress. However, something fundamental has changed. With the advent of generative AI systems such as ChatGPT, we are not only outsourcing calculations or storing and retrieving information externally. We are now delegating increasingly complex cognitive processes, such as summarizing, reasoning, structuring arguments, and generating ideas. This shift raises a central question for research: What are the long-term consequences of this for our brain and the cognitive processes it supports?

Cognitive Offloading: Efficiency at a Cost?

Cognitive offloading allows individuals to reduce mental effort by relying on external tools. Classic examples include taking notes, using GPS navigation, or searching the web. Decades of research have shown that this strategy improves efficiency. However, it also changes how the brain processes and stores information.

For example, a paper published in *Science* shows how easy access to online information changes human memory processes.[1] Across four studies, the authors show that the internet functions as a form of external or transactive memory system. When people are faced with difficult questions, they are automatically primed to think about computers or search engines, indicating that digital tools have become integrated into cognitive processes. A key finding is that individuals are less likely to remember information itself when they expect it to be available later online. Instead, they tend to remember where to find the information (e.g., folders or locations) rather than the content. This suggests a shift from internal memory storage to location-based memory strategies. The study further demonstrates that memory performance depends on perceived accessibility: when participants believed information would be saved, recall of the content decreased significantly. Conversely, when they expected it to be deleted, they remembered more. Overall, the paper concludes that the internet reshapes cognition by encouraging cognitive offloading, altering not how much we remember, but what we choose to remember, prioritizing access over retention.

In general, when people rely heavily on external systems, they tend to encode information less deeply, rely more on recognition (i.e., identifying previously learned information when it is presented to you) than recall (i.e., retrieving information from memory without external cues), and shift from internal processing to external interaction.[2, 3] From a neuroscience perspective, this means reduced engagement of neural systems associated with working memory, executive control, and long-term memory formation.

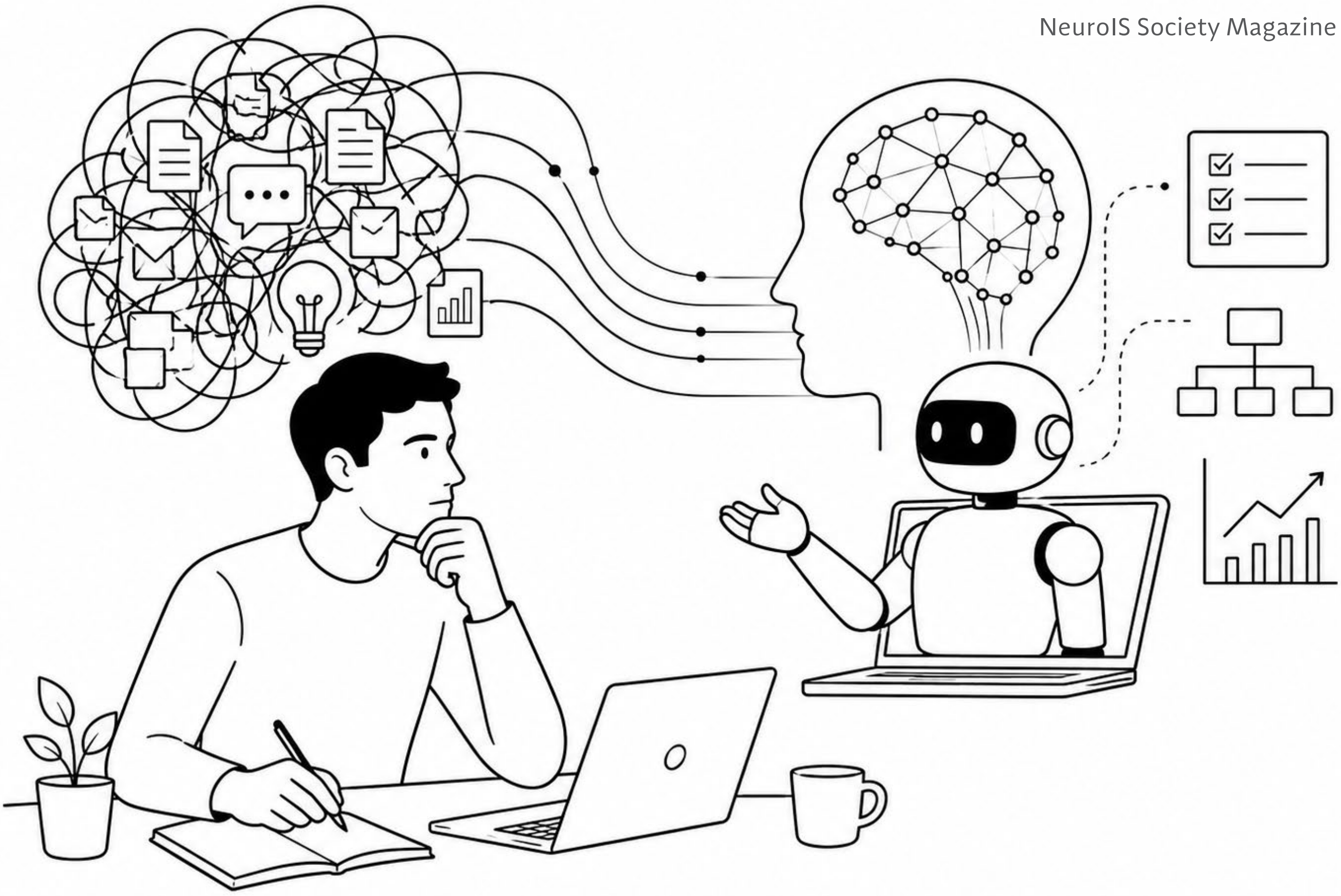
Importantly, offloading is not inherently problematic. It allows humans to allocate cognitive resources more strategically. However, it introduces a trade-off: short-term efficiency versus long-term cognitive engagement. Against this background, the following question is increasingly being raised: Will the growing use of digital technologies, and AI systems in particular, lead to a "dumbing down" of humanity? If the brain receives less and less exercise in terms of key cognitive functions (because we are relying more and more on AI), then there is a risk that these functions will atrophy. Furthermore, recent evidence suggests that using AI tools and resulting cognitive offloading can significantly impact critical thinking.[4]

The AI Shift: From Tool to Cognitive Agent

Generative AI fundamentally transforms this dynamic. Unlike earlier technologies, AI systems do not simply store or retrieve knowledge. Rather, they actively produce it. Recent work from the MIT Media Lab – widely discussed under the title "Your Brain on ChatGPT" – offers early insights into how this affects the brain.[5] In controlled experiments based on electroencephalography (EEG), participants performed writing tasks under three conditions: without tools, with search engines, and with AI assistance. The findings are striking. Participants using AI showed significantly lower brain connectivity, particularly in networks related to attention, memory integration, and executive control. At the same time, they reported lower sense of ownership over their work, reduced ability to recall what they had written, and increasing dependence on AI over repeated tasks. In contrast, unaided participants exhibited stronger, more distributed neural activation, consistent with deeper cognitive processing. In essence, while research findings in this domain are still emerging, they reveal a critical insight: AI does more than just reduce effort. Rather, AI can reshape cognitive engagement and underlying neurophysiological processes.

A Missing Perspective: Cognitive Scaffolding

Focusing only on offloading tells only half the story. A complementary concept, cognitive scaffolding, is well established in educational psychology, but is underexplored in cognitive neuroscience, neuropsychology, and NeuroIS, among other disciplines. Scaffolding provides



support that enables individuals to perform tasks they could not accomplish alone while actively engaging their cognitive systems. In contrast to offloading, scaffolding maintains cognitive involvement, structures thinking processes, and promotes learning and internalization. Applied to AI, this distinction is crucial. AI can be used in at least two fundamentally different ways. First, offloading mode: the system performs the task for the user, and second, scaffolding mode: the system supports the user in performing the task. While these modes may look similar at the surface, they differ profoundly in their cognitive and neural consequences.

Balancing Offloading and Scaffolding

This perspective therefore distinguishes two fundamentally different ways in which people interact with AI systems, each with distinct cognitive consequences.

In cognitive offloading mode, AI acts as a task executor. Users take on a passive role, typically accepting or copying AI-generated outputs without much mental processing. Although this approach reduces mental effort and possibly increases efficiency, it is associated with more superficial processing. From a neuroscience perspective, it likely involves lower and less distributed brain activation, particularly in networks related to memory, attention, and executive control. Consequently, learning and long-term retention may be impaired.

By contrast, cognitive scaffolding mode allows for a more active and constructive use of AI. In this approach, AI acts as a supporter or coach, helping users structure their thinking, refine their ideas, and engage in iterative reasoning. Users remain cognitively involved by providing prompts, asking questions, and critically evaluating outputs. This approach fosters a deeper understanding and is likely associated with sustained or enhanced neural engagement. It presumably facilitates stronger memory formation, enhances attention, and engages brain networks related to executive control more effectively.

Timing, Granularity, and User Intent

The way people use AI is as important as the technology itself. *Timing* is a key factor. When individuals first engage with a task – generating ideas, structuring arguments, or attempting solutions on their own – and then turn to AI, the system tends to function as a scaffold. It supports and refines existing thought processes, helping users deepen their understanding. In contrast, when AI is used from the outset, it often replaces internal cognition rather than complementing it, leading to cognitive offloading and reduced mental engagement. A second factor is *granularity*. When AI provides hints, guiding questions, or explanations, users remain actively involved in problem-solving. This promotes reflection and learning. However, when AI delivers complete solutions, users bypass the cognitive work, which encourages passive consumption rather than active thinking. Finally, *user intent* also plays a decisive role. Those who approach AI with a learning-oriented mindset are more likely to use it as a tool for exploration and sense-making. Those focused primarily on efficiency or productivity may prioritize speed and convenience, thus increasing their direct reliance on AI outputs.

Taken together, these factors reveal an important insight. The same AI system can either weaken or strengthen cognitive processes and underlying neurophysiological mechanisms. Whether AI becomes a crutch or a catalyst depends on when, how, and why it is used. Moreover, the arguments and evidence presented in this article predict that cognitive offloading leads to reduced large-scale brain network connectivity, while scaffolding maintains or even enhances distributed neural activation.

Directions for NeuroIS Research

The distinction between cognitive offloading and cognitive scaffolding provides a wealth of topics for future NeuroIS research. Some key examples are briefly described.

First, it requires a change in the design of systems: rather than focusing solely on maximizing efficiency, AI systems should be developed to encourage meaningful cognitive engagement. This may entail postponing full automation, prompting users to think before receiving answers, and encouraging reflection and iterative revision. These design choices could help maintain the level of mental effort necessary for learning and deep understanding.

Second, NeuroIS is uniquely positioned to explore the neural consequences of AI use.[6, 7] By combining neuroscience and information systems (IS) insights, researchers can examine how interaction styles with AI influence brain activity, whether long-term use reshapes neural pathways, and how to support sustained cognitive engagement in digital environments.

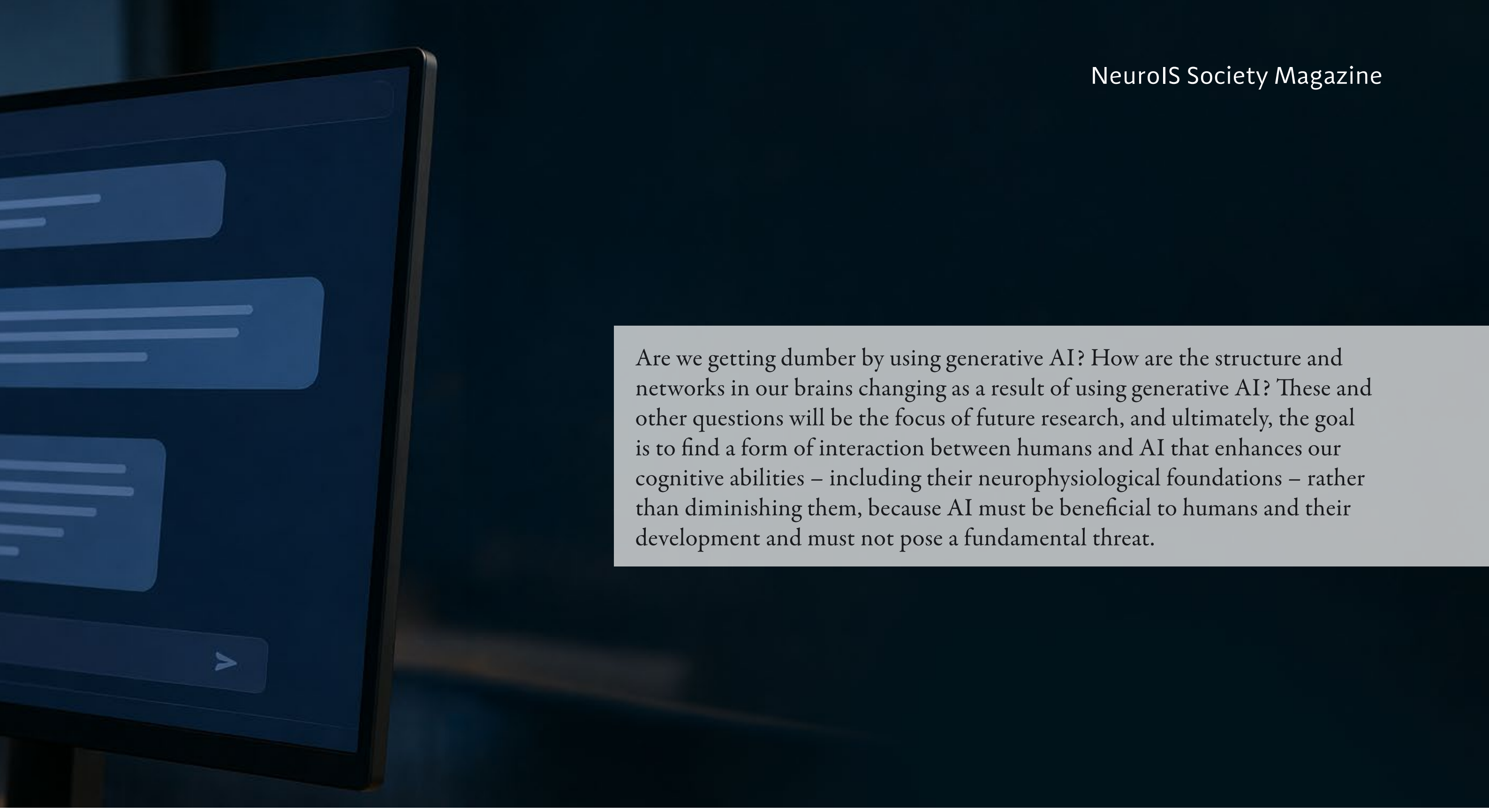
Third, the role of individual differences must be considered. Users vary in expertise, proficiency level, motivation, and cognitive style, among others. These differences likely determine whether AI is used as a shortcut or as a tool for deeper thinking.[8] Moreover, factors such as gender or age should also be considered in future studies.

Fourth, these developments challenge traditional notions of productivity. If efficiency gains come at the expense of cognitive engagement, then the value of such gains must be reconsidered. Ultimately, AI is a double-edged sword – a cognitive amplifier whose impact depends on how it is used.

Conclusion: Designing the Future of Thinking

We are entering a new phase of human-technology interaction in which cognition itself is distributed between the brain and AI systems. In this emerging landscape, thinking is no longer confined to the individual mind; rather, it increasingly unfolds across hybrid systems that integrate human and artificial intelligence. The challenge is not to strictly prevent cognitive offloading nor to reject the possible efficiency gains that such delegation provides. Offloading has always been part of human evolution. Rather, the objective should be to balance offloading with scaffolding, ensuring that AI systems support, guide, and enhance human cognition, rather than replace or render it passive.[9, 10]

For the NeuroIS community and beyond – including disciplines such as cognitive neuroscience, neuropsychology, and neuroergonomics – this represents a unique and timely opportunity. Researchers and designers can contribute to the development of intelligent, efficient, and cognitively sustainable technologies that preserve engagement, foster learning, and strengthen human capabilities rather than diminish them. This requires a deeper understanding of how interaction design influences cognitive processes and neural dynamics over time. Ultimately, the question is not whether AI can think for us. Rather, it is whether, in doing so, it will allow us to continue thinking for ourselves and how we can ensure this balance is maintained.



Are we getting dumber by using generative AI? How are the structure and networks in our brains changing as a result of using generative AI? These and other questions will be the focus of future research, and ultimately, the goal is to find a form of interaction between humans and AI that enhances our cognitive abilities – including their neurophysiological foundations – rather than diminishing them, because AI must be beneficial to humans and their development and must not pose a fundamental threat.

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Tech3Lab at a Turning Point: Advancing User Experience Research in the Age of Intelligent Systems

By Constantinos K. Coursaris, HEC Montréal (Canada)

Having served as Co-Director of Tech3Lab since joining HEC Montréal in 2019, I now step into the role of Director with deep gratitude for the leadership of Pierre-Majorique Léger and Sylvain Sénécal, whose vision and dedication have shaped the laboratory into what it is today. This transition is both an honor and a responsibility that I embrace with great enthusiasm.

It is also a moment that feels especially significant, not only for our laboratory, but for the broader fields of human–computer interaction, user experience, and NeuroIS. We are living through a period in which digital technologies are evolving so quickly, and so fundamentally, that many of the assumptions that guided earlier generations of research can no longer be taken for granted.

For decades, the study of user experience benefited from relatively stable interaction paradigms. Much of our understanding was built around screen-based interfaces and forms of interaction that, while increasingly sophisticated, still allowed us to rely on a strong foundation of theory and method. That foundation has been extraordinarily valuable. It has informed not only academic research, but also the practical design, development, deployment, and maintenance of digital systems. It has helped organizations make more informed investment decisions and has provided a basis for understanding how technology can be aligned with human needs.

Today, however, the context is changing in profound ways. The growing pervasiveness of digital systems, combined with their increasing agency, is transforming how we need to think about user experience. With the rise of artificial intelligence, especially generative AI, as well as the emergence of non-screen and ambient forms of interaction, we are entering interaction contexts that differ radically from those that shaped earlier research. In these settings, the old questions do not disappear, but they are no longer sufficient. The factors that matter are changing. The nature of the interaction is changing. And as a result, the frameworks and tools we use to study user experience must also evolve.

This is precisely why I believe Tech3Lab is uniquely positioned to make an important contribution at this moment. Our laboratory has long been dedicated to understanding user experience with digital technologies through rigorous, multimethod research. What makes this mission particularly exciting today is that we are not starting from scratch. We are building on years of accumulated expertise, advanced methodological capabilities, and a team of exceptionally talented individuals who are deeply committed to understanding how people experience technology in increasingly complex contexts.

What excites me most in this new leadership role is the opportunity to help guide that next phase. At its core, my vision is about ensuring that Tech3Lab remains at the forefront of user experience research as the technological landscape changes. This means not simply extending existing methods to new technologies but rethinking what it means to study user experience when technologies become more adaptive, more autonomous, and less visible in the traditional sense.

A first major priority for me concerns our approach to the study of user experience itself. Historically, much of UX research has relied on self-reported data and observable behavior. Surveys, interviews, focus groups, and direct observation have all been essential methods, and they remain invaluable. They allow us to understand what users say, what they do, and how they make sense of their experiences. Over time, however, Tech3Lab has also developed strong capabilities in going beyond those traditional approaches. In recent years, we have significantly advanced our ability to capture and interpret physiological signals during technology use. This has enabled us to triangulate among three major streams of data: self-reported, behavioral, and physiological.

That triangulation is important because it allows us to reach a richer and more nuanced understanding of user experience. It moves us beyond purely descriptive accounts toward more granular and diagnostic insights. Rather than only knowing whether a person liked or disliked a system, or whether a task was completed efficiently, we can begin to understand more precisely where friction occurs, when cognitive load increases, how emotional responses unfold, and what aspects of an interaction support or hinder meaningful engagement.

Now that we have built a sophisticated infrastructure for capturing and interpreting these forms of data, I see the next challenge as equally exciting: using AI to make these insights more scalable, actionable, and timely. In other words, the goal is not only to collect rich UX data, but also to develop systems that can analyze that data and translate it into meaningful forms of decision support. This includes leveraging recent advances in AI, including deep learning, to create models that are not only predictive but also diagnostic in what they can infer about a user's experience with technology.

I see enormous potential here. Organizations increasingly need to move from data to insight to action at a much faster pace than before. If we can develop systems that accelerate that process responsibly and rigorously, we can help reduce the time between observing a user experience issue and acting on it. This has important implications for both research and practice. Scientifically, it enables us to ask more ambitious questions about the dynamics of experience. Practically, it allows organizations to make more informed, evidence-based decisions about digital design, implementation, and improvement.

At the same time, AI is not only changing how we study interactive systems, but also how quickly they can be built. As emerging tools make it possible to generate prototypes and even fully functional systems with minimal technical expertise, we are likely to see a rapid acceleration in digital design and development. Yet faster production does not guarantee better usability. On the contrary, it may increase the risk of poorly designed interactions reaching users more quickly and at greater scale. For that reason, the need for rigorous user testing and real human-system interaction data will only grow. Far from reducing the importance of UX, these developments are likely to make core UX activities even more essential in the years ahead.

More broadly, my vision for Tech3Lab is not limited to methodological innovation. As an academic research lab, our mission is fundamentally twofold: to advance science and to train the next generation of researchers. That training mission matters deeply to me. One of the most rewarding aspects of leading Tech3Lab is the opportunity to work with students and research professionals who are passionate about understanding digital experience and who will go on to shape the future of this field, whether in academia or in industry. My hope is that we will continue to strengthen this role by fostering an environment where methodological rigor, intellectual curiosity, and societal relevance come together.

Under my leadership, I hope to build on this strong foundation and continue expanding the scholarly reach and influence of Tech3Lab's work. Scholarly excellence remains central to our identity, and through strong scientific contributions, we can continue to shape emerging debates and advance the evolution of the field.

Yet scholarly impact is only part of the picture. A second enhancement I hope to foster concerns the broader societal impact of our work. Historically, much of UX research has been conducted in commercial contexts, and these remain important settings for both study and collaboration. But some of the most meaningful opportunities ahead lie in domains where the primary objective is not commercial gain, but the improvement of quality of life. We have already been fortunate to work with partners in areas such as education and training, where the stakes involve enhancing learning and supporting human development. I would like us to continue expanding in this direction by growing our network of partners and research collaborations in areas of social impact—from access and inclusion to human empowerment and wellbeing—while continuing to support and learn from the strong network of commercial partners that has long been integral to Tech3Lab's mission. I believe Tech3Lab has both the expertise and the responsibility to contribute meaningfully to such areas.

Ultimately, what I hope to bring to Tech3Lab as Director is a commitment to both continuity and transformation: continuity in our scientific rigor, our multimethod strengths, and our training mission; and transformation in how we study emerging technologies, how we use AI to derive insight from complex human data, and how broadly we envision the impact of our work across science, business, and society.

This is a particularly exciting time for NeuroIS scholars and for all researchers interested in the future of human-centered technology. As technologies become more pervasive, agentic, and intelligent, the need for deeper, more precise, and more human-centered forms of understanding becomes even more urgent. My aspiration is for Tech3Lab to help lead that effort: to generate knowledge that is scientifically robust, methodologically innovative, and socially meaningful.

Pierre-Majorique Léger   Sylvain Sénécal   Constantinos K. Coursaris

Young Academics

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

Sophia Mannina
Queen's University (Canada)

Why did you start NeuroIS research?

NeuroIS research appeals to me because of its unique capacity to capture rich insights into users' cognitive and emotional processes. Given that my research focuses on individual-level interactions with digital technologies, NeuroIS methods provide a depth of understanding that traditional self-report or behavioural measures alone cannot achieve. By directly measuring attention, affect, and physiological responses, these tools have allowed me to observe user processes as they unfold in real time.

In my research on misinformation, I have used NeuroIS tools to monitor how users engage with social media content. By leveraging eye-tracking data and facial expression analysis, my research examines how elements of social media posts capture user interest and contribute to misinformation susceptibility. Monitoring pupil diameter, for instance, allows me to assess user attention and cognitive effort. These real-time insights provide a more nuanced understanding of deception in social media environments.

How did you start with NeuroIS?

I began developing expertise in NeuroIS methods as a PhD Candidate at the Smith School of Business, Queen's University. My supervisor, Dr. Shamel Addas, had a pivotal role in introducing these methods to our department. Recognizing the potential of NeuroIS for advancing research on user behaviour and digital interactions, he provided me with the opportunity to work with eye-tracking technology and facial expression analysis software. It has been a rewarding experience to explore this methodological space together.

I was also fortunate to learn from Dr. Joey F. George, who visited Queen's as a Fulbright Scholar. He generously shared his expertise and included me in a project that allowed me to gain first-hand experience conducting studies using eye-tracking equipment. Working with an established scholar in the NeuroIS field accelerated my methodological development and deepened my appreciation for rigorous experimental design. These experiences laid the foundation for integrating NeuroIS methods in my research.

What are challenges for young NeuroIS researchers?

One of the most significant challenges in NeuroIS research is the steep learning curve associated with mastering specialized tools and methodologies. Acquiring technical proficiency requires a substantial investment of time, and designing experiments with high internal and ecological validity can be a challenge. NeuroIS studies often require careful control of environmental and procedural factors that may be less critical in traditional experiments.

For example, in my dissertation research using eye tracking and facial expression analysis, I had to carefully consider elements such as lighting conditions, screen positioning, and the height of participants' chairs to ensure consistent and reliable data collection. Small inconsistencies could compromise data quality. These technical and design considerations were essential for producing valid and replicable findings.

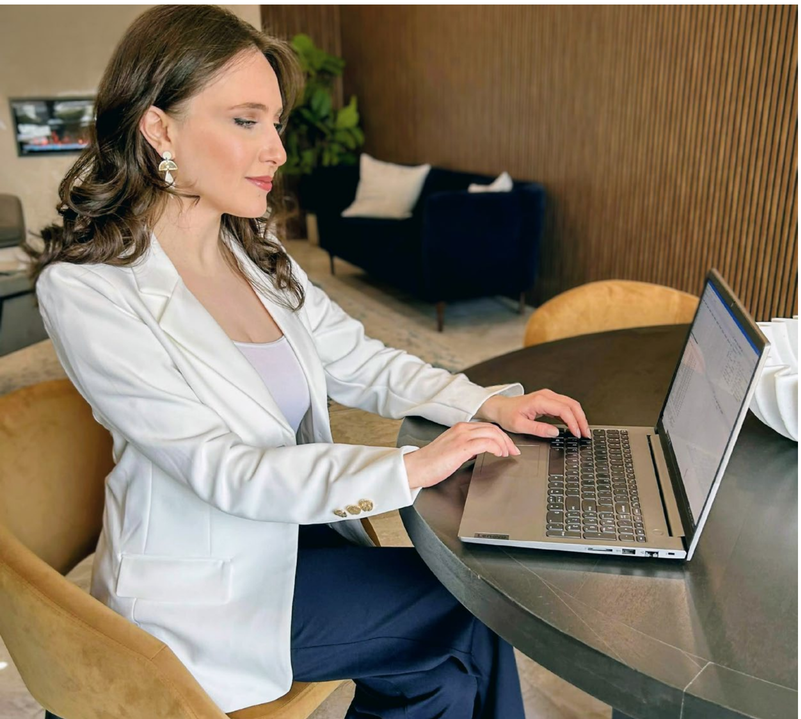
Fortunately, I have found the NeuroIS community to be exceptionally collaborative. Mentors and colleagues have been willing to share advice and practical insights. Their guidance has been invaluable in helping me navigate methodological challenges, refine experimental designs, and strengthen the rigour of my work.

What were the most important moments in your academic career?

Participating in conferences within the Information Systems (IS) community has been a defining aspect of my academic journey. My first conference was the 2022 International Conference on Information Systems (ICIS) in Copenhagen. As a member of the "COVID cohort," attending ICIS was particularly meaningful because it was my first opportunity to engage with the broader IS community in person and receive live feedback on my research.

Since then, I have presented at several major conferences, including the Hawaii International Conference on System Sciences (HICSS), the Americas Conference on Information Systems (AMCIS), and the NeuroIS Retreat. Through these experiences, I have developed a strong international network of colleagues and collaborators who share my research interests.

Becoming part of the NeuroIS community has been especially impactful. The 2025 NeuroIS Retreat provided an intimate setting where I was able to receive in-depth feedback, engage in methodological discussions, and build meaningful relationships with leading scholars in the field. These interactions have not only strengthened my research but have also reinforced my commitment to contributing to and growing within the NeuroIS community.



Looking Back

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

NeuroIS Retreat 2016: Social Media and the Brain

Organizing committee and Hauke Heekeren at NeuroIS Retreat 2016

Hauke Heekeren, 2016 keynote speaker

The NeuroIS Retreat 2016 featured a forward-looking keynote by Hauke Heekeren titled "Social Media and the Brain." At a time when social media had already reached billions of users worldwide, Heekeren highlighted its immense potential as a natural laboratory for studying human social cognition.

His talk emphasized how fundamental social motives—such as the need for belonging, approval, and self-presentation—drive engagement on these platforms, and how these behaviors can be mapped onto underlying neural systems.

Drawing on his background at Freie Universität Berlin and training at Charité – Universitätsmedizin Berlin, Heekeren connected insights from decision neuroscience with emerging digital behaviors. He outlined how researchers could leverage large-scale, real-world social media data to complement traditional laboratory studies, opening new avenues for NeuroIS research.

Looking back, the keynote anticipated many of today's central research directions at the intersection of neuroscience, digital technology, and society. In particular, it foreshadowed the growing importance of understanding how large-scale digital environments shape human cognition, behavior, and social interaction. The ideas presented highlighted the value of combining real-world data from social media platforms with controlled experimental approaches, thereby enriching traditional research methods and enabling more ecologically valid insights. Now serving as President of the University of Hamburg, Germany, Hauke Heekeren continues to influence both academic and institutional developments in this field. His work remains highly relevant, as digital environments increasingly shape—and at the same time provide unprecedented insight into—the functioning of the social brain in everyday contexts, offering new opportunities for interdisciplinary research and innovation. NeuroIS research makes a significant contribution to a better understanding of social media and to its more responsible design.