



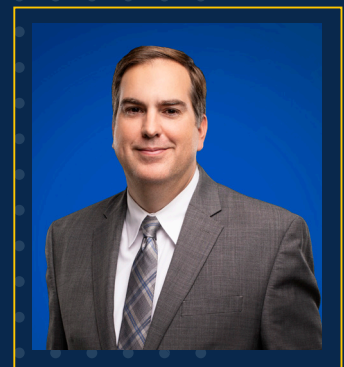
DREXEL UNIVERSITY

LeBow
College of Business

EVALUATING THE EFFICACY OF COMPUTER- BASED LEARNING

80% OF COMPANIES are
planning to adopt a hybrid
work model.

*Hybrid Work Statistics 2023: The New Working Style,
GitnuxBlog, 2/28/2023*



Jeremy J. Ray, DBA '23
IT Program Manager
United States Secret Service

Knowledge Transfer: A True Process

In the modern-day, post-pandemic world, where hybrid and remote work are more prevalent than ever before, organizations worldwide are challenged by the knowledge transfer process. Identifying ways to improve — and even master — the knowledge transfer process, enhance real-time feedback and overcome existing barriers, such as bandwidth issues and distractions, will provide organizations with a competitive advantage and an increased efficiency in geographically dispersed workforces at a time when they are needed most.

“My motivation for pursuing the topic was based on my own frustrating experience with limitations of current tools, and how they facilitated knowledge transfer.”

JEREMY J. RAY, DBA '23

Jeremy J. Ray, DBA '23, said platforms for computer-mediated communications (CMC) — any human interaction that occurs when two or more people communicate over electronic devices, such as a computer or smartphone — have become essential in industries and enterprises of all types and sizes, especially now that the work-from-home posture has become commonplace. There has been much handwringing about productivity when employees are not in the office, but empirical evidence is often lacking — especially as it relates to knowledge transfer over CMC platforms.

“We now communicate just as much online as we do in person.”

Introduction to Computer Mediated Communication (CMC) and Speaking Online: 14.1, LibreTexts, 4/1/2023

In his recent study, “Evaluating Knowledge Transfer During Computer-mediated Communications,” Ray sought to understand the common communication barriers that exist when working with CMC technologies and how to overcome them.

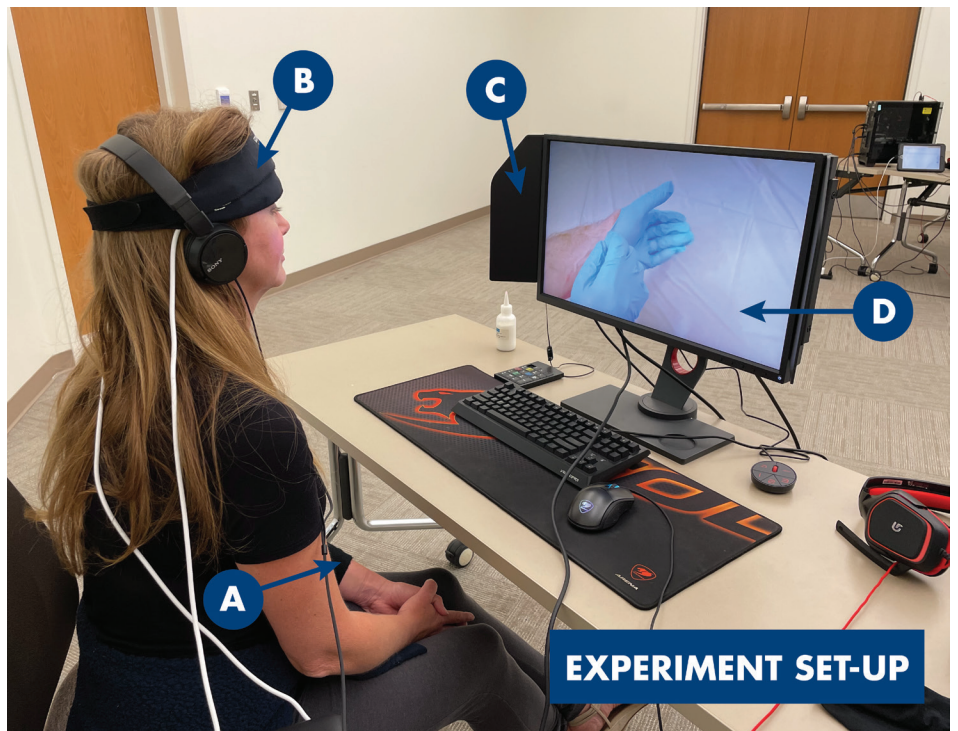
How can using neuroergonomic approaches (the application of neuroscience to ergonomics; a field that studies the brain and behavior at the workplace) and biomedical technologies help improve the understanding of knowledge transfer in the hybrid and remote work settings?

Ray’s research explored the relationship among bandwidth, content complexity and distractions; how these factors impacted the ways information was sent and received between the speaker and the listener; and how this impact affected performance, cognitive workload, emotional valence and emotional arousal.

Experiment

To explore potential CMC barriers, Ray conducted a human subject experiment with 33 adult participants. Participants were seated in front of a computer and watched sixteen 60-second audio and video clips of basic DNA and fingerprint evidence-collection methods used by law enforcement agencies for online training. Participants attempted each task under conditions with high and low bandwidth (video and screen sharing on/off), simple and difficult content, and with and without distractions — each with two repetitions. During the entire session, their prefrontal cortex brain activities were monitored with a functional near-infrared spectroscopy (fNIRS) ultra-thin flat sensor; their heart rates (HR) were monitored with a wrist-based optical heart rate monitoring (OHRM) sensor; and their electrodermal activities (EDA) were measured using finger-based electrodes with battery-operated, wireless and wearable hardware.

- A.** Electrodermal Activity (EDA) Electrodes & Optical Heart Rate Monitor (OHRM)
- B.** fNIRS
- C.** Computer and Peripherals
- D.** Video



Ray, J. J. (2023). Evaluating Knowledge Transfer During Computer-mediated Communications. *ProQuest*.

Results

THE BANDWIDTH IMPACT

Hybrid and remote work offer many advantages, but they can also present disadvantages based on the technology and bandwidth available. Consider your next important meeting being held in a virtual setting: You could be meeting with top-tier clients to discuss a proposal, your organization's leader could be attempting to convey a prominent message or a colleague could be trying to deliver a visual presentation to stakeholders. Operating with less-than-ideal capabilities is not only a concern, but it can also translate to a lack of productivity, poor communication, or even a bad personal or company reputation. Having low bandwidth in a virtual meeting (which can often result in choppy audio, cameras off and a lack of screen sharing) will likely have a negative impact on participants' ability to engage and understand the material.

Ray's research explored knowledge transfer during online communications and evaluated the emotions elicited from a variety of positive and negative outcomes. Results from his research highlighted that bandwidth consistently had the most impact among the dependent variables. Across the board, the high-bandwidth scenarios outperformed the low-bandwidth scenarios in nearly every case.

Improved Areas with High Bandwidth:

- Understanding
- Accuracy
- Ease and satisfaction
- Response time
- Mental effort (lower cognitive workload)

"I also noticed conversations are different over hybrid Teams calls — when some people are in the office and some are at home — and some may have video on, and others not," Ray said in an interview with Drexel LeBow in 2023. "Many times, after a speaker finishes, there are no questions from the audience. If everyone was in the same room, usually there would be a handful

of questions. Are the listeners tuned out? Disengaged? Uninterested? Working on something else? It's hard to know the answers to all these questions and more research is needed, but clearly, bandwidth (video and screen sharing on/off) plays a role in the communication process.”

CONTENT COMPLEXITY

Content complexity had an effect, especially when the content of the task was deemed difficult. Examples of difficult content used in Ray's research experiment included forensic material and details on DNA collection, whereas an example of simple content was how to put on a latex glove. With low bandwidth, more mental effort was required for difficult content compared to simple content. When content was difficult, accuracy improved when bandwidth was high. These are notable findings, as they relate to knowledge transfer associated with difficult topics that often require visualization.

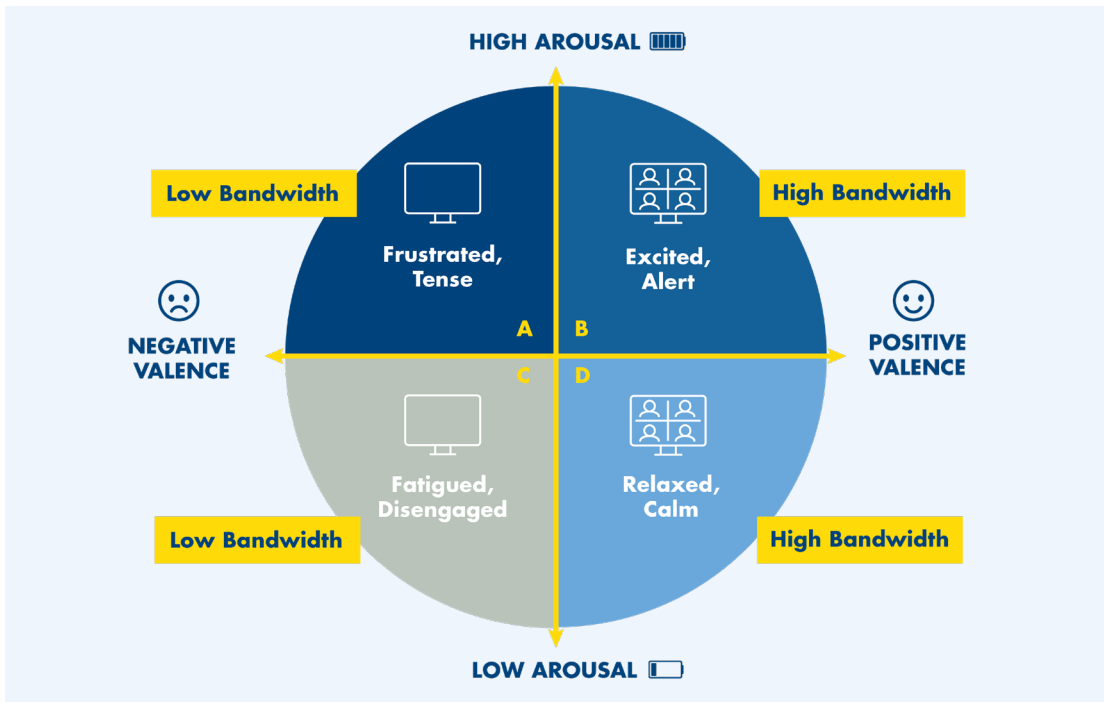
Ray's experiment also gauged emotional valence, the extent to which an emotion is positive or negative. When bandwidth was low, results showed the emotional valence of the participant was negative and vice versa. Results for emotional arousal were similar to emotional valence; participants showcased a dampened level of emotional arousal when dealing with low bandwidth.

DISTRACTIONS

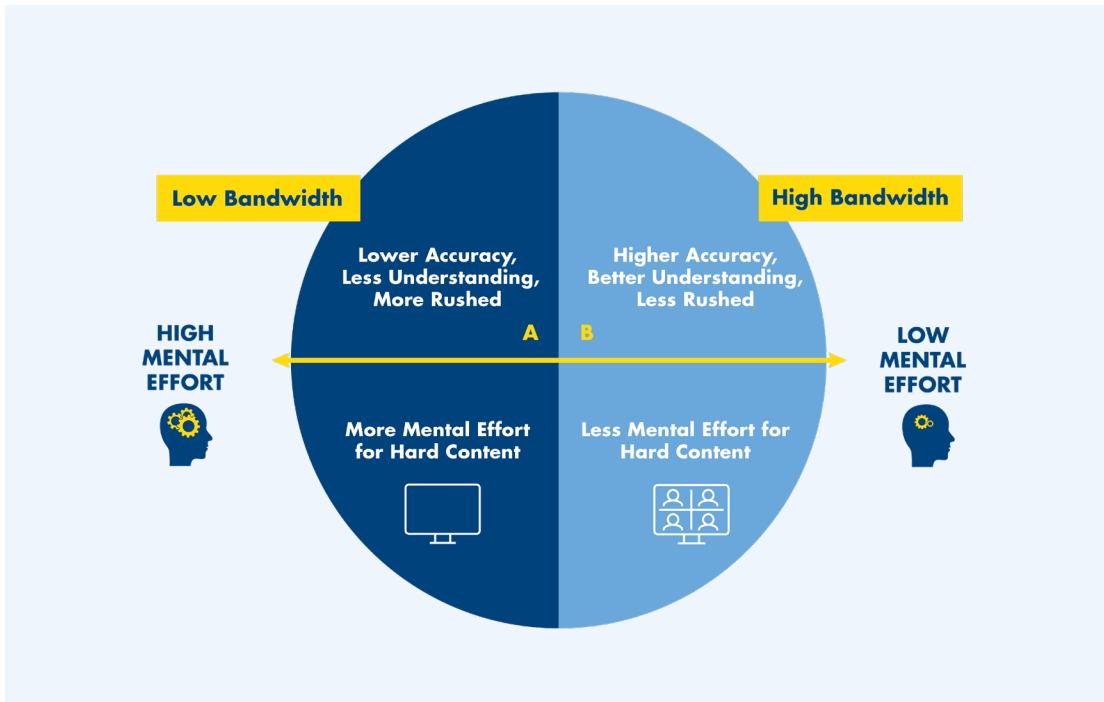
In Ray's research, distractions also had a bearing on mental effort. When distractions (e.g., antivirus pop-up notifications and outside sounds, such as dogs barking or construction) were present, difficult content required more mental effort. However, distractions were the least influential in respect to testing variables, which also included bandwidth and content complexity.

“Based on my research, there is certainly evidence that these [bandwidth, content, distractions] and other types of factors impact the knowledge transfer process as compared to face-to-face communications.”

JEREMY J. RAY, DBA '23



Neuroergonomics Knowledge Transfer Model, Part 1



Neuroergonomics Knowledge Transfer Model, Part 2

Ray, J. J. (2023). Evaluating Knowledge Transfer During Computer-mediated Communications. *ProQuest*.

Conclusion

In the neuro-bio-behavioral analysis (which studies the function of brain behavior and other biomedical indicators, such as heart rate) of computer-mediated information exchange, Ray's study demonstrated the use of biomedical signals. Ray used real-world scenarios (i.e., DNA and fingerprint evidence collection instructions) to assess the efficacy of knowledge transfer during various types of communication. It is notable that the high-bandwidth scenarios outperformed the low-bandwidth scenarios. According to Ray, organizations looking to improve their knowledge transfer may see immediate improvements by ensuring employees have access to high bandwidth and by emulating in-person scenarios when dealing in the virtual realm.

“I would urge people to turn on their video camera,” Ray said.

“If nothing else, it helps others to see you, providing real-time feedback in the form of facial expressions and body language, and gauge whether you are understanding and listening to them, and it likely would help to ensure you yourself remain engaged in the conversation. It can be quite tempting to engage in another task when the camera is off.”

Looking ahead, Ray's research on improving knowledge transfer using CMC technologies in the workplace can be used to refine a multitude of industries and companies. These improvements can address telemedicine user interfaces, strengthening the health care provider/patient portal experience; workplace video conferencing and all-in-one collaboration platforms; and online training and other computer-mediated knowledge transfer capabilities.



About

Jeremy J. Ray, DBA, is a senior IT management professional with over 20 years of, including assignments within state and federal government, private industry, the federal judiciary and law enforcement. He has been with the federal government for 15 years and is an IT program manager with the U.S. Secret Service within the Department of Homeland Security.

Ray would like to thank his dissertation chairs, Hasan Ayaz, PhD, and Rajneesh Suri, PhD, for their significant insight and support as Ray embarked on his research journey and pursuit of a DBA.

Hasan Ayaz, PhD, is an associate professor at Drexel University, School of Biomedical Engineering, Science and Health Systems, with affiliations at the Department of Psychological and Brain Sciences, AJ Drexel Autism Institute and Solutions Institute of Drexel University; adjunct professor at the University of Pennsylvania; associate fellow at the Center for Injury Research and Prevention of Children's Hospital of Philadelphia; and a core member of the Cognitive Neuroengineering and Quantitative Experimental Research (CoNQuER) Collaborative. Ayaz's research involves understanding the neural mechanisms related to human perceptual, cognitive and motor functioning with a focus on real-world contexts, utilizing mobile neuroimaging, and deploying neuroengineering approaches for neuroergonomics applications. His research aims to design, develop and utilize-generation brain imaging for neuroergonomic applications over a broad spectrum, from aerospace to health care.

Rajneesh Suri, PhD, is the senior vice provost for Academic Industry Partnerships at Drexel University's LeBow College of Business. He was previously the vice dean for Research and Strategic Partnerships and a professor of marketing at LeBow. Suri has authored several research publications, presentations and book chapters. His research has been presented before various international associations in Asia, Europe and North America, and his teaching and research have received national awards. Suri's work focuses on how consumers form value using price and brand drivers. His work examines consumer experiences, and the effects of price and other marketing communications on consumer decision making.



At Drexel LeBow, our rigorous and experience-based business education is custom built for the driven and determined. Propelled by an over 100-year history of uniting academia and industry, we connect passionate students, expert faculty and leading organizations to ignite the potential in all.

The Executive Doctorate in Business Administration (DBA) at Drexel University's LeBow College of Business is an immersive business education rooted in partnership, research and innovation. The Drexel DBA equips executives and senior managers with scientific methods to address complex industry and organizational challenges through an integrative framework of empirical exploration and evidence-based decision-making. Offered by an AACSB-accredited business school at an R1 University, the part-time, cohorted DBA is led by an interdisciplinary team of research-active faculty, leverages a hybrid residency delivery structure and employs a mentored dissertation model.

lebow.drexel.edu