

University of Cologne
Faculty of Management, Economics and Social Sciences
Information Systems Area



Bachelor Seminar on Information Systems and Digital Technology

Term: Summer 2023

Chair for Information Systems and Systems Development

Contact Information:

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Human-Machine Cognition

Human cognition—defined as the capacity of individuals to perform mental activities (Helfat & Peteraf, 2015)—is important for complex organizational tasks traditionally confined to human actors such as problem solving, idea generation, and decision-making. Due to the extended usage of artificial intelligence (AI) tools in organizations, boundaries between human and machine cognition start to blur and a hybrid cognition emerges (Rai & Sarker, 2019). For instance, AI systems challenge the roles of professionals in decision-making situation (Strich et al., 2021), AI impacts corporate management (Petrin, 2019), and AI tools become more and more essential during idea generation and design (e.g., ChatGPT and DALL-E from openAI @ <https://openai.com>).

Human-machine cognition encompasses phenomena where either machine cognition is extended by human cognition or vice versa (Fügener et al., 2021; Rahwan et al., 2019). For human-extended machine cognition, human agents are recognized as constituent parts of the fabric that realizes machine-based cognitive capabilities (Smart, 2018). While machine-based cognitive capabilities have primarily been investigated from the perspective of automation (Raisch & Krakowski, 2021), investigating human-based cognition has traditionally been an endeavor of areas such as cognitive psychology, cognitive science, social psychology, cognitive neuroscience, and behavioral decision theory.

AI-based systems that influence and shape organizational tasks traditionally confined to humans and their cognition, demand research related to individual and task related factors

(Castelo et al., 2019). These systems also influence and shape organizational factors, guiding us to advance organizational research (Burton et al., 2020). We encourage students to study existing empirical and theoretical evidence in this domain, in order to extend existing IS research (Werder & Richter, 2022). Students are open to investigate topics either from an organizational perspective (Benbya et al., 2020, 2021; Berente et al., 2021) or an individual perspective (Seeber et al., 2020) on cognition in the relationship between humans and algorithms.

Some potential topics include:

- AI-enabled managerial cognition:
 - o What empirical evidence do we have on the effects of managerial cognition and how can this be affected by human-machine collaboration?
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- Microfoundations of AI-enabled organizational capabilities
 - o How does managerial-machine cognition affect organizational capabilities?
 - o What are organizational-level effects vs. individual-level effects of human-machine cognition?
- AI-based organizational capability
 - o What is the role of human-machine cognition in automation vs. augmentation?
 - o What are different conceptualizations of human-machine cognition in AI-based research?
- Human-machine task distribution and delegation:
 - o How do different task types and human-machine cognition relate to each other?
 - o How does human-machine cognition differ for managers and experts?
 - o How are mental activities influenced by different AI-based tools?
 - o How do managers and AI develop a shared mental model?
- AI-induced identity work:
 - o What are role-based implications on human-machine cognition by AI augmentation?
 - o How can different human actors in organizations be supported in their cognition by algorithms?

Fundamentals on Scientific Work

The students learn the fundamentals of scientific work via the Flipped Classroom on Scientific Work. A separate registration (and preparation) is necessary:

- https://www.ilias.uni-koeln.de/ilias/goto_uk_fold_2445676.html

Students are exempted if they have already attended the classroom session of the Flipped Classroom on Scientific Work in the context of another course. If this is the case, students

should contact werder@wiso.uni-koeln.de beforehand providing the course name and semester, in which the classroom session on scientific work has been accomplished.

For more information, please visit:

- <https://www.wirtschaftsinformatik.uni-koeln.de/de/studies/theses/scientific-work/>

Course Activities

The seminar work consists of five main phases:

1. The students acquire the basics of conducting scientific work via the Flipped Classroom.
2. The students learn the fundamentals concerning seminar's topic and literature reviews.
3. The students plan their seminar project by developing a research cycle and study protocol that is presented and discussed.
4. The improved study protocol guides the student to collect their data and assists them in their analysis. Hence, relevant data sources are identified, data is collected and processed in order to develop a key deliverable of the seminar project.
5. The seminar project is documented in a seminar paper. Before the final work is submitted, students give a final presentation of their research project.

Course Grading

The course grading is threefold:

- Study Protocol (15%):
Written report including research problem and objective, outline of the paper, and plan of research method. Assessment in accordance with clarity, consistency, and comprehensiveness.
- Final Presentation (15%):
The 10-minute presentation should convey central parts of your research project such as research problem and question, method, results, and contribution to research and practice. Assessment in accordance with organization of content, oral, and overall presentation.
- Seminar paper (70%):
Written report about the research project. Assessment in accordance with evaluation scheme provided in ILIAS.

Timeline

Please kindly refer to the ILIAS course for detailed timeline and materials.

Dates:

- 27 March – 02 April: Study from home preparation, Flipped Classroom ILIAS course on Scientific Work
- 03 April, 08:30 – 11:30: Seminar Kick-off & Q&A Scientific Work
- 07 April, 12:00, Submission of topic proposals in ILIAS
- 10 April, Study from home:
 - Online materials on literature reviews

- Developing a draft study protocol
- 14 April, 08:30 – 11:30: Workshop on literature reviews and developing a study protocol (Room S310)
- 05 May, 08:30 – 16:30, Review and discussion of the study protocols
- 30 June, 08:30 – 16:30, Final presentations
- 10 July, Submission of seminar paper

Our seminar takes place in room S310 in Pohlighaus (Building 411).

Participation Guidelines

Below is a list of mandatory and optional readings. It is imperative that all read all mandatory readings before our first online meeting. A more comprehensive list of readings is available online through the institute's website (https://www.wirtschaftsinformatik.uni-koeln.de/sites/wirtschaftsinformatik/pdfs/teaching/Reading_List-Research_in_IS.pdf).

In preparation for the “Review and discussion of the study protocols” session, you have to submit your own study protocol and review study protocols of your peers. Within this session, you will discuss your own study protocol and the study protocols of your peers that have been assigned to you.

Readings

Mandatory Readings on Literature Reviews:

- Bandara, W., Furtmueller, E., Gorbacheva, E., Miskon, S., & Beekhuyzen, J. (2015). Achieving rigor in literature reviews: Insights from qualitative data analysis and tool-support. *Communications of the Association for Information Systems*, 37, 154-204.
- Kitchenham, B. (2004). Procedures for performing systematic reviews. Keele, UK, Keele University, 33(2004), 1-26.
- Rowe, F. (2014). What literature review is not: diversity, boundaries and recommendations. *European Journal of Information Systems*, 23(3), 241-255.
- Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS quarterly*, xiii-xxiii.

Mandatory Readings on Seminar's Topic:

- Burton, J. W., Stein, M. K., & Jensen, T. B. (2020). A systematic review of algorithm aversion in augmented decision making. *Journal of Behavioral Decision Making*, 33(2), 220–239. <https://doi.org/10.1002/bdm.2155>
- Benbya, H., Pachidi, S., & Jarvenpaa, S. (2021). Special Issue Editorial: Artificial Intelligence in Organizations: Implications for Information Systems Research. *Journal of the Association for Information Systems*, 22(2), 10.

Caro, F., Colliard, J.-E., Katok, E., Ockenfels, A., Stier-Moses, N., Tucker, C., & Wu, D. J. (2021). Call for Papers – Management Science Special Issue on The Human-Algorithm Connection. *Management Science*.

Strich, F., Mayer, A. S., & Fiedler, M. (2021). What Do I Do in a World of Artificial Intelligence? Investigating the Impact of Substitutive Decision-Making AI Systems on Employees' Professional Role Identity. *Journal of the Association for Information Systems*, 22(2), 9.

Further Readings on Research Methods:

Recker, J. (2012): Scientific Research in Information Systems: A Beginner's Guide. Springer, Heidelberg, Germany.

References

Benbya, H., Davenport, T. H., & Pachidi, S. (2020). Artificial intelligence in organizations: Current state and future opportunities. *MIS Quarterly Executive*, 19(4).

Benbya, H., Pachidi, S., & Jarvenpaa, S. L. (2021). Special issue editorial: Artificial intelligence in organizations: Implications for information systems research. *Journal of the Association for Information Systems*, 22(2), 281–303.
<https://doi.org/10.17705/1jais.00662>

Berente, N., Gu, B., Recker, J., & Santhanam, R. (2021). Managing artificial intelligence. *MIS Quarterly*, 45(3), 1433–1450.

Burton, J. W., Stein, M., & Jensen, T. B. (2020). A systematic review of algorithm aversion in augmented decision making. *Journal of Behavioral Decision Making*, 33(2), 220–239.
<https://doi.org/10.1002/bdm.2155>

Castelo, N., Bos, M. W., & Lehmann, D. R. (2019). Task-Dependent Algorithm Aversion. *Journal of Marketing Research*, 56(5), 809–825.
<https://doi.org/10.1177/0022243719851788>

Fügener, A., Grahl, J., Gupta, A., & Ketter, W. (2021). Cognitive Challenges in Human–Artificial Intelligence Collaboration: Investigating the Path Toward Productive Delegation. *Information Systems Research*, December.
<https://doi.org/10.1287/isre.2021.1079>

Helfat, C. E., & Peteraf, M. A. (2015). Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal*, 36(6), 831–850. <https://doi.org/10.1002/SMJ.2247>

Petrin, M. (2019). Corporate Management in the Age of AI. *Columbia Business Law Review*, 2019(3), 965–1030–1965–1030. <https://doi.org/10.7916/CBLR.V2019I3.5118>

- Rahwan, I., Cebrian, M., Obradovich, N., Bongard, J., Bonnefon, J.-F., Breazeal, C., Crandall, J. W., Christakis, N. A., Couzin, I. D., Jackson, M. O., Jennings, N. R., Kamar, E., Kloumann, I. M., Larochelle, H., Lazer, D., McElreath, R., Mislove, A., Parkes, D. C., Pentland, A. 'Sandy,' ... Wellman, M. (2019). Machine behaviour. *Nature*, *568*(7753), 477–486. <https://doi.org/10.1038/s41586-019-1138-y>
- Rai, A., & Sarker, S. (2019). EDITOR'S COMMENTS Next-Generation Digital Platforms: Toward Human-AI Hybrids. In *MIS Quarterly* (Vol. 43, Issue 1). <https://android-developers.googleblog.com/2018/01/how-we-fought-bad-apps-and-malicious.html>;
- Raisch, S., & Krakowski, S. (2021). Artificial intelligence and management: The automation–augmentation paradox. *Academy of Management Review*, *46*(1), 192–210. <https://doi.org/10.5465/AMR.2018.0072>
- Seeber, I., Bittner, E., Briggs, R. O., de Vreede, T., de Vreede, G. J., Elkins, A., Maier, R., Merz, A. B., Oeste-Reiß, S., Randrup, N., Schwabe, G., & Söllner, M. (2020). Machines as teammates: A research agenda on AI in team collaboration. *Information and Management*, *57*(2). <https://doi.org/10.1016/j.im.2019.103174>
- Smart, P. R. (2018). Human-extended machine cognition. *Cognitive Systems Research*, *49*, 9–23. <https://doi.org/10.1016/J.COGSYS.2017.11.001>
- Strich, F., Mayer, A. S., & Fiedler, M. (2021). What Do I Do in a World of Artificial Intelligence? Investigating the Impact of Substitutive Decision-Making AI Systems on Employees' Professional Role Identity. *Journal of the Association for Information Systems*, *22*(2), 9. <https://doi.org/10.17705/1jais.00663>
- Werder, K., & Richter, J. (2022). A meta-analysis on the effects of IT capability toward agility and performance: New directions for information systems research. *PLOS ONE*, *17*(10), e0268761. <https://doi.org/10.1371/journal.pone.0268761>