

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



Bachelor Seminar on Information Systems and Digital Technology

Term: Winter 2022/23

Chair for Information Systems and Systems Development

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The Human-Algorithm Relationship

AI-based systems relying on the use of machine learning techniques have become ubiquitous. They are increasingly used in daily activities that shape production and provision processes of digital services and products. Examples are AI-systems that predict sepsis (Wong et al., 2021), identify diabetes from retinopathy images (Gulshan et al., 2016; Ting et al., 2017), product use through digital twins (Tao et al., 2018), and shape organizational processes (Burton et al., 2020). However, they also come with and introduce new challenges. For instance, AI-systems might be prone to biases (Werder et al., 2021) and humans may develop an aversion to such systems (Dietvorst et al., 2015, 2018) or feel threatened in their professional role identities (Strich et al., 2021).

Given the plentiful application context of AI-systems and their manifold benefits and challenges, we need to better understand the current state-of-the-art of the literature. For instance, AI-systems come with their own design challenges, requiring careful attention to system characteristics (Werder et al., 2021). They also influence and shape human decision making, demand research related to individual and task related factors (Castelo et al., 2019). AI-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. Students are open to investigate topics either from an organizational perspective (H. Benbya et al., 2020; Hind Benbya et al., 2021; Berente et al., 2021) or an individual perspective (Seeber et al., 2020) on the relationship between humans and algorithms. Some potential topics include (Caro et al., 2021):

- Algorithm aversion: How to increase the adoption and adherence to analytics embedded in decision support systems?
- Algorithmic fairness, bias, discrimination and amplification: How algorithms, data, experiments and human interactions can mitigate or contribute to these issues.
- Algorithm transparency: The trade-off between optimality and interpretability (the black box issue).
- Customer satisfaction in machine-driven communication (e.g., chatbots) and services (e.g., autonomous last-mile delivery).
- Data privacy: How data privacy considerations influence the design of algorithms, its inputs, and measurement of bias.
- Human-in-the-loop: Should humans be allowed to override model-based recommendations (i.e., what is the right degree of automation)?
- Interplay between managerial insights and algorithms: Methods that combine human judgement with algorithms.
- Strategic reaction of humans to algorithms, e.g., “gaming” of an algorithm.
- Algorithms and market design: the impact of algorithms on how markets and institutions are designed.

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:

- 03 October – 07 October: Study from home preparation, Flipped Classroom ILIAS course on Scientific Work
- 10 October 2022 09:00 – 11:30: Seminar Kick-off & Q&A Scientific Work (Room S310)
- 15 October 2022, 12:00, Submission of topic proposals in ILIAS
- 17 October 2022, Study from home:
 - Online materials on literature reviews
 - Developing a draft study protocol
- 24 October 2022, 08:30 – 11:30: Workshop on literature reviews and developing a study protocol (Room S310)
- 14 November 2022, 09:00 – 17:00, Review and discussion of the study protocols (Room Seminarraum 1.31, Building 810 ; 810/01/1.31)
- 18 January 2023, Final presentation (Room Seminarraum 1.31, Building 810 ; 810/01/1.31)
- 30 January 2023, Submission of seminar paper

Our seminar takes place in room S310 in Pohlighaus (Building 411) and in Room Seminarraum 1.31 in Universitätsstraße 91 (Building 810).

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, Hind, 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. 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>
- 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*.
- 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>
- Dietvorst, B. J., Simmons, J. P., & Massey, C. (2015). Algorithm aversion: People erroneously avoid algorithms after seeing them err. *Journal of Experimental Psychology: General*, 144(1), 114–126. <https://doi.org/10.1037/xge0000033>
- Dietvorst, B. J., Simmons, J. P., & Massey, C. (2018). Overcoming Algorithm Aversion: People Will Use Algorithms If They Can (Even Slightly) Modify Them. *Management Science*, 64(3), 1155–1170. <https://doi.org/10.1287/mnsc.2016.2643>
- Gulshan, V., Peng, L., Coram, M., Stumpe, M. C., Wu, D., Narayanaswamy, A., Venugopalan, S., Widner, K., Madams, T., Cuadros, J., Kim, R., Raman, R., Nelson, P. C., Mega, J. L., & Webster, D. R. (2016). Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs. *JAMA*, 316(22), 2402. <https://doi.org/10.1001/jama.2016.17216>
- 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>
- 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), 304–324. <https://doi.org/10.17705/1jais.00663>
- Tao, F., Cheng, J., Qi, Q., Zhang, M., Zhang, H., & Sui, F. (2018). Digital twin-driven product design, manufacturing and service with big data. *International Journal of Advanced Manufacturing Technology*, 94(9–12), 3563–3576.

<https://doi.org/10.1007/s00170-017-0233-1>

Ting, D. S. W., Cheung, C. Y.-L., Lim, G., Tan, G. S. W., Quang, N. D., Gan, A., Hamzah, H., Garcia-Franco, R., San Yeo, I. Y., Lee, S. Y., Wong, E. Y. M., Sabanayagam, C., Baskaran, M., Ibrahim, F., Tan, N. C., Finkelstein, E. A., Lamoureux, E. L., Wong, I. Y., Bressler, N. M., ... Wong, T. Y. (2017). Development and Validation of a Deep Learning System for Diabetic Retinopathy and Related Eye Diseases Using Retinal Images From Multiethnic Populations With Diabetes. *JAMA*, *318*(22), 2211. <https://doi.org/10.1001/jama.2017.18152>

Werder, K., Ramesh, B., & Zhang, R. (2021). Establish Data Provenance for Responsible Artificial Intelligence Systems. *ACM Transactions on Management Information Systems*, *13*(2), 23. <https://doi.org/10.1145/3503488>

Wong, A., Otles, E., Donnelly, J. P., Krumm, A., McCullough, J., DeTroyer-Cooley, O., Pestrue, J., Phillips, M., Konye, J., Penozza, C., Ghous, M., & Singh, K. (2021). External validation of a widely implemented proprietary sepsis prediction model in hospitalized patients. *JAMA Internal Medicine*, *181*(8), 1065–1070. <https://doi.org/10.1001/jamainternmed.2021.2626>