

- Awad distinguishes between different “types” of AI. What classification scheme does the paper use and why do these types matter for scientific research?

Awad identifies several types of AI and paradigms. This includes foundational paradigms such as descriptive AI, predictive AI, and generative AI, decision-oriented paradigms such as optimization AI and prescriptive AI, and cross-cutting principles such as privacy-aware AI, causal AI, and explainable AI. These types of AI are classified by their unique features and goals. Understanding this classification is important because different types of AI have different levels of scientific reliability. For example, AI systems used for optimization and pattern recognition mainly affect the speed and scale of research. However, systems involved in hypothesis generation challenge traditional scientific reasoning and understanding. Not acknowledging these differences can lead to misleading conclusions.

- Does Awad make a clear distinction between AI as a tool and AI as a scientific collaborator? If so, what are the differences and what are some examples given to support the differences? Do these examples suggest a real shift in how science is conducted, or mostly an extension of existing methods?

Awad does make a distinction between AI as a tool and as a scientific collaborator. However, she also argues that it is shifting from just being a tool to epistemic agent or collaborator. AI as a tool is characterized as instrumental. It helps scientists and researchers by executing defined tasks under human direction. In this role, AI does not meaningfully create or shape research questions and is mainly used to increase efficiency. One example she gave of this is AlphaFlow which she explains is a robotic system that helps create nanoparticles with less human involvement. AI as a collaborator contributes more directly to scientific reasoning through generation of hypotheses and identifying unseen correlations. An example of this is ChemVLM which has advanced chemical recognition and understanding. The use of AI as a collaborator appears to be more of an extension of existing methods. Although AI is growing to have a new level of autonomy and influence, scientists control the issues being studied, evaluate the outputs, and integrate results into previous research.

- What are some limitations or risks of using AI in science? How do these relate to issues such as interpretability, bias, reproducibility, or theory formation?

Awad identifies several limitations and risks of using AI in science. She mentions that some AI systems are like black boxes that hide their reasoning. This makes it difficult to verify their results or identify potential biases. Due to bias prevalent in training data and past research, AI systems can have skewed results that appear objective but are systematically distorted. This problem is especially serious in fields where data collection itself is uneven or socially

influenced. This black box issue also affects reproducibility. With complex pipelines and proprietary models, other scientists cannot replicate the tests or results.

- According to Awad's arguments, is AI more likely to accelerate scientific discovery or to reshape the scientific method itself? Do you agree or disagree?

Awad states that AI is both accelerating scientific discovery and reshaping the scientific method. It is speeding up data analysis, larger-scale simulations, and more comprehensive exploration of complex systems. On the other hand, she also mentions the shift toward abductive inference where explanations are formed from data patterns rather than starting from theoretical premises.

From reading this paper, I agree with this. We have already seen how AI can speed up scientific discovery and as newer AI systems emerge and older ones undergo more improvements, I can see how it will begin to shift how we approach science as a whole. Since AI leads to new challenges with interpretability, hypothesis formulation, reproducibility, the scientific method may need to adapt in more fundamental ways to deal with this. For now, however, AI is mainly an accelerator of science and not yet a replacement for its underlying principles.