

Rethinking Hybridity: From Hybrid Systems to Assemblages

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ABSTRACT

The term “system” in hybrid human–Artificial Intelligence (AI) systems evokes the idea of humans and AI coming together forming a fixed, structured entity with clear boundaries and pre-defined functions. But if we examine how hybridity unfolds in everyday life from the perspectives of cultural anthropology and science and technology studies, we do not see systems, but rather constantly changing assemblages of heterogeneous elements, relations, and practices. This opinion paper proposes that using an assemblage thinking approach to understanding hybridity better accounts for human–AI entanglements in their everyday unfolding, offering a deeper insight into the various elements and dynamics contributing to them. This perspective implies (at least) three arguments. First, hybridity is messy; second, hybridity comes into being through joint practices; third, hybridity is constantly transforming. By using the notion of assemblage to better understand hybridity, this paper seeks to contribute to interdisciplinary collaborations in the analysis and development of human–AI hybrids.

1. INTRODUCTION: THE QUESTION OF HYBRIDITY

A hybrid (from latin *hybrida*) first described a mixture, “[t]he offspring of two animals or plants of different species, or (less strictly) varieties; a half-breed, cross-breed, or mongrel” (Oxford English Dictionary, 2023).² Today, the term is widely used in various contexts, commonly defining a combination of certain elements, ideas, or characteristics, as in hybrid work and learning settings,

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² The notion of hybridity has a history of problematic use due to its roots in 19th-century racial taxonomies, which classified races as distinct species. This classification was often used to justify colonial and racial hierarchies, implying a threat to racial purity and reinforcing ideologies of racial superiority and inferiority (see Young, 1995).

events, vehicles, and technologies. In hybrid intelligence (HI), the “hybrid” is often defined loosely via the combination of human and machine intelligence (Kamar, 2016, p. 4070; Dellerman et al., 2019, p. 276; Akata et al., 2020, p. 19). Hybridity, then, is a form of “partnership” (Kamar, 2016, p. 4070) in which “human intelligence can be integrated into an [Artificial Intelligence (AI)] system to complement machine capabilities (i.e., to form hybrid intelligence) throughout its life cycle. Hybrid systems can offload computational tasks to humans on demand to overcome the deficits of AI systems” (Kamar, 2016, p. 4070). As in this quote, conceptualizations of HI often describe human–AI hybrids as “systems” (see also Dellerman et al., 2019; Lasecki, 2019; Akata et al., 2020; Prakash & Mathewson, 2020; Maletzki et al., 2024). The term suggests the idea of humans and AI coming together as a static unity with specific structures and boundaries. But if we examine how hybridity unfolds in everyday life from the perspectives of cultural anthropology and science and technology studies (STS), we do not see *systems*. Instead, we see constantly changing *assemblages* of heterogeneous elements, relations, and practices.

While other definitions, such as the one described in Dellerman et al. (2019), go beyond a static understanding of HI by stressing that HI systems are “socio-technical ensembles and [their] human and AI parts can co-evolve to improve over time” (Dellerman et al., 2019, p. 276), in this opinion paper³ we go one step further and suggest moving away from thinking about HI in terms of *systems* altogether. Rather, we propose an understanding of hybridity that emphasizes its contingency, multiplicity, and processuality. From this perspective, humans and AI are not independent, pre-existing components, but mutually shape each other in their relational becoming.

This perspective builds on an established body of cultural anthropology and STS literature that has already explicitly or implicitly discussed the notion of hybridity in the context of human–technology relations. Bruno Latour (1993 [1991]), in his book *We Have Never Been Modern*, famously argued that nature and culture—and similarly, humans and non-humans (e.g. technology)—have always been hybrids. Latour proposed the idea that the divide between nature and culture was constructed to create the illusion of such separations but is doomed to fail because hybrids are constantly (re)created. In this sense, we have always been hybrids with technology and other more-than-human beings. Another influential concept is the figure of the cyborg, developed by Donna Haraway (1985). This figure further challenges the dualism of human and machine, emphasizing their entanglements and interdependencies: “we are all chimeras, theorized and fabricated hybrids of machine and organism; in short, we are cyborgs. The cyborg is our ontology” (Haraway, 1991, p. 150). Physicist and feminist theorist Karen Barad (1996) has offered another take on hybridity that has become influential in anthropological and STS thinking through the concept of intra-action (e.g. between human actors and more-than-human entities). Barad states that while the term interaction “assumes that there are separate individual agencies that precede their interaction, the notion of intra-action recognizes that distinct agencies do not precede, but rather emerge through, their intra-action” (Barad, 2007, p. 33). Agency, so the argument goes, is

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not possessed by entities as such, but emerges through their ongoing intra-actions. The anthropologist Lucy Suchman has taken a related approach, critically questioning the dichotomies between human and non-human entities in the study of digital technologies. She proposes shifting the question “from one of whether humans and machines are the same or different to how and when the categories of human or machine become relevant, how relations of sameness or difference between them are enacted on particular occasions, and with what discursive and material consequences” (Suchman 2007).

What these perspectives have in common is that they ask us to think less about the “systematic“ compositions of humans and technologies, and to remain open to the messiness, relationality, and unexpected transformations that characterize the human–technology hybridity in everyday life. A helpful concept for capturing this epistemological reorientation, particularly for inter- and transdisciplinary endeavors in HI research, is the notion of *assemblage*. Originally developed by Gilles Deleuze and Félix Guattari (Deleuze & Guattari, 2013), the concept has evolved into a specific style of thinking and analysis known as “assemblage thinking” (Anderson et al., 2012).

In contrast to systems, the concept of assemblage fundamentally builds on the understanding of “heterogeneous, contingent, unstable, partial, and situated” (Ong & Collier, 2005, p. 12) compositions of both human and more-than-human elements and their relations that form, and are shaped by, the assemblage (Welz, 2021; Hansen & Koch, 2023). Elsewhere, Libuše Hannah Vepřek (2024a) and Christoph Bareither (2024) have already discussed how assemblage thinking can contribute to anthropological studies of AI. In this paper, we will build on this work to show how assemblage thinking can help us think about the notion of hybridity in ways that hold potential for creating synergies between different perspectives on and approaches to HI.

Assemblage thinking has much in common with the above approaches to hybridity, and shares several assumptions with actor-network theory (ANT), which was developed by Bruno Latour, Michel Callon, John Law, and others. Law, for instance, argues that “there is little difference between Deleuze’s agencement (awkwardly translated as “assemblage” in English) and the term ‘actor-network’...[b]oth refer[ring] to the provisional assembly of productive, heterogeneous, and (this is the crucial point) quite limited forms of ordering located in no larger overall order” (Law, 2009, 146). Some scholars even understand ANT to be “an empirical sister-in-arms of the more philosophical assemblage thinking” (Müller 2015, 30) and work with combinations of both ANT and assemblage theory. However, different approaches emphasize different aspects (see Müller and Schurr, 2016), some better placed to study specific phenomena. While a detailed discussion of the differences goes beyond the scope of this piece, one general distinction is that ANT often focuses on describing how hybrids become stable and made durable through processes of translation and mobilization, while assemblage thinking focuses on ongoing recompositions (Schwertl, 2013, 117) and the continuous dynamic between stabilizing and destabilizing processes. In the rapidly evolving

field of HI, attention on change is especially important. That said, our understanding of “assemblage” is inspired by each strand of theoretical thinking—one derived from the work of Deleuze and Guattari, the other from ANT—and incorporates elements of both. Addressing hybridity through the lens of assemblages allows us to analyze and comprehend hybridity 1) as messy, 2) as emerging through joint practices, and 3) as constantly transforming.

These properties of hybridity are supported by insights from two recent research projects conducted by the authors. The first focuses on hybrid epistemic practices related to generative AI in the qualitative social sciences and humanities (project reference), and the second examines human computation systems in the field of citizen science (Vepřek 1, 2024b). In this piece, we also draw on other, more general examples. The various human–AI entanglements we use are characterized by different degrees of openness and closure. While some are initially designed as closed structures with a well-defined purpose (such as HI in citizen science), others are open to multiple purposes (such as generative AI in academic research and teaching). Importantly, not all examples we discuss were originally conceived or developed as strictly hybrid systems. By adopting a rather broad understanding of *hybrid intelligence* and by using examples with varying degrees of openness and closure, we hope to demonstrate that our approach can be useful for thinking about a wide range of hybrid human–AI assemblages.

2. HYBRIDITY THROUGH THE LENS OF ASSEMBLAGE THINKING

2.1 Hybridity is messy

As we have already noted earlier, much of the work on HI systems assumes that they are integrated frameworks combining human and artificial intelligence to create a cohesive and stable unit with predefined functions and goals. By contrast, if we understand hybridity through the lens of assemblage thinking, we can account for the fact that new elements continuously join and leave the hybrid assemblage, that things often do not work out as planned, and that humans and AI systems do not always follow the intended prefigured path. In short: hybridity is messy.

Unlike the system perspective, the concept of assemblage encourages us to think about how its elements assume different functions and roles over time, and contribute to different assemblages simultaneously. Consider large language models (LLMs), which continuously form multiple hybrids with different users. These individual hybrids contribute to the creation of much larger hybrids in which countless users and their data drive the evolution of the model. These assemblages are never closed. They constantly interact with other relations, elements, and assemblages in myriad ways.

Second, the assemblage approach to hybridity’s messiness assumes that hybridity is shaped by the histories of its many elements. Human–AI hybrids—like computer systems in general—often draw on existing code libraries and models, which introduce path dependencies in the design that, to a

certain extent, prescribe how new practices will unfold (Vepřek and Carlson, 2025). Consider Stall Catchers, a citizen science game designed to speed up Alzheimer’s research. It was inspired by and initially built on the basis of another human computation game whose interface and design choices defined how data could be analyzed by the participants and algorithms (Vepřek, 2024b; Vepřek and Carlson, 2025), both enabling and restricting potentials for new hybrid formations. Hybridity is also shaped by established social and cultural routines and by the experiences, embodied knowledge, and values of the assemblage’s human actors. In the example of Stall Catchers, different human actors shaped the human computation game based on their experiences and motivations. For instance, some participants rejected the project’s design as a game and instead created their own meanings. For many, contributing was not just a fun activity but a way of coping with the effects of Alzheimer’s disease in a family member (Vepřek, 2023, 2024b). The different meanings attributed to Stall Catchers affected how its human–technology entanglements unfolded. Participants with a personal connection to Alzheimer’s disease focused more on avoiding mistakes while others focused more on the game and aimed to maximize their rewards.

Third, hybridity is messy because technological elements and human actors in the assemblage often fail to fulfill or resist what designers or users of HI systems imagine to be the intended role. As we observed in our study of LLM-based chatbots for academic research, tools designed to augment and simplify certain research tasks often add to the complexity of the task itself. Many students and researchers reported rarely using the output of generative AI tools because they did not meet the standards they expected. Some researchers observed that certain cultures of researching and publishing make tools problematic or less effective. One historian realized while experimenting with AI-based literature search tools that they are designed to find academic papers, whereas in the field of history research typically relies on monographs. The discrepancy between the intended ease and simplification promised by the technology and the actual user experience exemplifies the messiness of such hybrid relations. Similarly, human actors can “fail” to use technology in the “right” way, either by making mistakes or by intentionally resisting its intended purpose. One example is when scholars use LLM-based chatbots to write parts of their papers but fail to cover its tracks. Text passages such as “[c]ertainly, here is a possible introduction for your topic” or “I’m very sorry, but I don’t have access to real time information” (Zhang et al., 2024) appear erroneously in the published work, reducing the value of the academic product. A famous example is a now retracted article in the journal *Physica Scripta* (Bader et al., 2024) in which a ChatGPT “regenerate response” label in the text went unnoticed during peer review and typesetting (see also Conroy, 2023). What makes these situations “messy” is not the limitations of the LLM-based chatbot, but the failure of human actors to collaborate with the tool in a way that serves its intended purpose.

2.2 Hybridity emerges through joint practices

While in the system view human–AI hybrids are fixed combinations of pre-existing components, in assemblage thinking hybridity continuously comes into being through human–AI *joint practices*. Classical conceptualizations of the term in social theory (e.g., Bourdieu, 1977; Schatzki, 1996)

understand human practice “as a temporally unfolding and spatially dispersed nexus of doings and sayings” (Schatzki, 1996, p. 89). In STS, this view has been broadened due to the influence of ANT and related approaches, and is now often used to refer to the practices of more-than-human actors such as technologies. This position does not assume that technologies are subjects capable of intentional action. Rather, it sees them as agents that can enact doings and (quite literally in the case of LLM-based chatbots) sayings. In human–AI hybrids, human or non-human agents enact practices *jointly*. It is this joint process in which boundaries are dissolved through doing that constitutes the “hybridity” in human–AI relations. Our approach to hybridity focuses on *how* humans and AI are molded together in and through practice in various ways (Beck et al., 2012, p. 33).

In the Stall Catchers example, our practice-focused perspective reveals how the problem the game aimed to tackle—the analysis of large Alzheimer’s disease research datasets—only became possible in the joint practices of humans and technology. Neither machine learning models and other computer algorithms nor human analysts were able to solve this problem independently. The former were too inaccurate; the latter were unable to handle the enormous quantity of data. Together as human-technology hybrids, however, they accelerated the speed of data analysis in Alzheimer’s disease research. Here, hybridity did not simply emerge from the sum of the individual components—such as humans, algorithms, and machine-learning models—but from their specific ways of acting collaboratively. In their joint practices, analytical results were calculated based on individual human annotations of research data, which were then reviewed, evaluated, and rated by algorithms, and finally combined into a weighted crowd answer. Participants received feedback on their performance, so that they could improve and adapt their annotation skills. In this example, the practice of analyzing data arose neither from humans nor from technology. It relied on a joint human–AI practice consisting of annotating-evaluating-weighting-feedback cycles. This example also illustrates how our approach to hybridity is not content to merely discuss the predefined roles of individual elements. We examine their interactions in practice and how they give rise to hybridity.

Similarly, hybridity emerges in joint practices of writing texts between researchers and chatbots. In our work on hybrid epistemic practices, one researcher reported using LLM-based chatbots to generate text suggestions, but instead of using these texts as his “own,” he used them as inspiration. The researcher explained: “I would say: No, we’ll take out these adjectives here that seem kind of dull but, according to the training data, are apparently supposed to be here or are likely to fit here. I remove the adjectives, change this and that, take this fragment and that one to shape it into my own text.” This, he points out, is not “an independent productive achievement of the system, but rather a collaboration.” The example demonstrates once more that the hybridity of human–AI relations is not simply the sum of pre-existing components, but something that emerges through their ongoing collaboration.

2.3 Hybridity is constantly transforming

The hybridity of human–AI relations not only emerges in practice but is also constantly transforming. As technological capabilities advance, and AI models and approaches improve through new research, feedback-loops, and intra-actions, human actors adapt their practices and self-conceptions. This evolving aspect of hybrid systems has already been described by Dellerman et al. (2019, see above). But to understand *how* “human and AI parts can co-evolve to improve over time” (Dellerman et al., 2019, p. 276), the notion of *system* falls short, for it implies that hybridity is, to some extent, temporally stable.

By contrast, analyzing hybridity from the perspective of assemblage thinking emphasizes the dynamic, procedural, and ever-changing nature of human–AI relations. As Deleuze and Guattari write, an assemblage “necessarily changes in nature as it expands its connections” (2013, p. 7). As such, it is not simply subject to change, but constituted by it. Transformations in human–AI hybrids can stem from new elements and relations introduced in the assemblage, or they can result from existing ones. In the latter case, human–AI relations become “intraverted” due to new computational capabilities, new creative engagements of human actors, and the potentials that they create (Vepřek, 2024a, p. 73).

To illustrate, we turn to a brief example: the development of ChatGPT and its underlying model. Though not developed as a hybrid human–AI system in the strict sense, ChatGPT shows how AI models are always hybrids whose individual elements continuously learn from each other. GPT models are based on the transformer architecture and unsupervised learning (a method in which a model is trained with data that has not been pre-labeled or annotated by humans). The models can be fine-tuned with supervised learning, where a smaller dataset is labeled by humans (most often by crowdworkers). InstructGPT, a successor to GPT-3.5, integrates reinforcement learning from human feedback, incorporating direct human input to enhance the model’s reliability. This process involves humans generating desired outputs or ranking various model outputs. In ChatGPT, which was built on the InstructGPT framework, a “safety system” was added. Here, as reported by *The Times*, crowdworkers from Kenya were paid very low wages to classify harmful content (Perrigo, 2023). Until ChatGPT’s public release, humans in the loop played a key role in model improvement. But once the chat interface was introduced, the crowdworker–AI relation now became intraverted. In a study of the use of LLM-based tools by crowdworkers, a Swiss research team found that between 33 and 36 % of the tasks they analyzed were completed with the help of an LLM-based tool such as ChatGPT (Veselovsky et al., 2023). That is to say, instead of simply providing input to improve such models, crowdworkers used LLM-based tools to improve the models that produced those very tools. The example clearly illustrates the constantly changing nature of crowdworker–AI relations.

3. CONCLUSION

In this paper, we proposed that assemblage thinking is better suited than a system framework for approaching the hybridity of human–AI relations. While system implies that hybrids are stable and predefined, assemblage thinking emphasizes their complexity, openness, and temporal stability. We argued that assemblage thinking better accounts for the development of human–AI entanglements in everyday life and can contribute to a clearer understanding of their elements and dynamics. Consequently, it can contribute to the advancement of HI by developing applications that are better tailored to actual scenarios.

This approach makes at least three assertions about the nature of hybridity. First, hybridity is messy: new elements continuously join and leave the assemblage, and humans or AI systems do not always follow intended and prefigured paths. Second, hybridity emerges through joint practices. Understanding hybridity rests less on identifying its individual elements and their roles than on examining *how* its elements come together in and through collaborative practices. Third, hybridity is constantly transforming. That is to say, the character of human–AI hybrids is processual and needs to be understood as it changes over time.

For all its advantages, the strength of the assemblage perspective—its attention to messiness and ongoing transformation—limits the approach’s capacity for broad generalization. To understand hybrid human–AI assemblages as constantly unfolding in ever-changing ways is to see every assemblage as unique. So what can the analysis of a unique assemblage tell us about any other unique assemblage, however similar? Our answer: the dynamics, constellations, and interrelations that characterize the elements of one assemblage can be observed across different assemblages despite their individual variations. Accordingly, assemblage thinking is more than an approach for examining highly specific cases. It provides insights that foster our understanding of human–AI relations on a more general level.

At the same time, assemblage thinking also establishes a valuable common ground and shared vocabulary for inter- and transdisciplinary research on human–AI entanglements. While the system approach has served some disciplines well—particularly when generalizability is desired and complexity reduction is acceptable—assemblage thinking invites engagement from the social sciences and humanities, enabling their perspectives to contribute meaningfully in collaboration with more established approaches in the field. By strengthening the notion of assemblage and its implications on the understanding of hybridity, we hope to contribute to facilitating such collaborations.

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