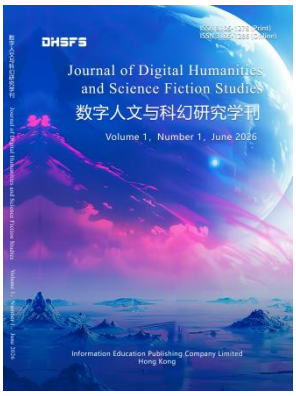

DHSFS

Journal of Digital Humanities and Science Fiction Studies

***DHSFS*, Vol. 1, No. 1, 2026, pp. 1-21.**

Print ISSN: 3105-1278; Online ISSN: 3105-1286

Journal homepage: https://www.dhsfs.com

DOI: Https://doi.org/10.64058/DHSFS.26.1.01

HIEP
Academic Publishing

An Integrated Study of Interdisciplinarity, Posthuman Theory, and Digital Humanities: An Interview with N. Katherine Hayles

Jiang Yuqin, N. Katherine Hayles

Abstract: This interview with N. Katherine Hayles examines the interdisciplinary intersections of science, technology, and literature. Reflecting on her intellectual trajectory, Hayles discusses key concepts in her work, including posthumanism, digital humanities, and cognitive assemblages. The interview situates contemporary knowledge production within the dynamic interactions among science, literature, the humanities, and education. It further traces the development of posthuman theory, with particular attention to AI technologies, cognitive assemblages, and human-machine symbiosis. Building on Hayles's insights, the discussion highlights how cognition is increasingly distributed across biological and technical systems, thereby challenging anthropocentric models of subjectivity. At the same time, it positions digital humanities as a mediating field that operate through transmediality, material metaphors, and digital simulation. From this perspective, digital environments are understood not merely as tools for representing knowledge but an active agents that reshape interpretive practices and modes of cultural production. Finally, the interview reimagines the future through the lenses of AI writing, non-human cognition, and science fiction. Hayles proposes new conceptual

Received: 16 Mar 2026 / Revised: 13 Apr 2026 / Accepted: 16 Apr 2026 / Published online: 30 Apr 2026 / Print published: 30 May 2026.

frameworks, such as “inverse awareness”, to better interpret the linguistic and cognitive capacities of large language models. In this context, Science fiction is reconsidered as a critical site for exploring technological futures and reconfiguring human-machine relations.

Keywords:N. Katherine Hayles; Interdisciplinary Studies; Posthuman Theory; Cognitive Assemblage; Digital Humanities

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题目：跨学科、后人类理论与数字人文的整合研究：与 N·凯瑟琳·海尔斯的访谈

摘要：本访谈与 N·凯瑟琳·海尔斯（N. Katherine Hayles）探讨科学、技术与文学之间的跨学科交叉关系。海尔斯回顾其学术思想的发展轨迹，阐释其研究中的关键概念，包括后人类主义、数字人文与认知集合体。本访谈将当代知识生产置于科学、文学、人文学科与教育之间动态互动的语境之中加以考察，并进一步追溯后人类理论的发展脉络，重点关注人工智能技术、认知组构以及人机共生关系。在海尔斯思想的基础上，该讨论强调认知正日益分布于生物系统与技术系统之间，从而对以人类为中心的主体性模式构成挑战。同时，数字人文被置于一种中介性领域之中加以理解，其运作依赖跨媒介性、物质隐喻与数字模拟。从这一视角来看，数字环境不仅被视为知识表征的工具，更被视为能够主动重塑阐释实践与文化生产方式的行动性因素。最后，访谈在人工智能写作、非人类认知与科幻文学的视域下重新想象未来。海尔斯提出诸如“反向意识”等新的概念框架，以更好地理解大型语言模型的语言与认知能力。在此语境中，科幻文学被重新视为探索技术未来并重构人机关系的重要批判性场域。

关键词：海尔斯；跨学科研究；后人类理论；认知组合体；数字人文

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An Interdisciplinary Knowledge Assemblage: Science, Literature, the Humanities and Education

Jiang Yuqin (Jiang for short hereafter): Thank you very much for your accepting my interview. I deeply admire your scholarly achievements and theoretic contributions, which have gained widespread recognition within the Chinese academic community. Several of your seminal works, including *How We Became Posthuman*, *Unthought*, and *My Mother was a Computer,* have been translated into Chinese and published to considerable acclaim. Among them, *How We Became Posthuman* stands out as particularly influential: It has become a foundational and widely assigned text in the field of posthuman studies in China, reaching a broad readership across both academic and intellectual circles. Your sustained and rigorous engagement with contemporary digital technology, artificial intelligence, and the life science--interwoven with literary criticism and critical theory--has produced a body of scholarship that is at once conceptually sophisticated, methodologically precise, and intellectually groundbreaking. Your work has played a formative and decisive role in shaping techno-humanistic inquiry within posthuman theory. In the estimation of many scholars, you are widely regarded as one of the most significant and influential thinkers in the field today.

N. Katherine Hayles (Hayles for short hereafter): I want to mention that my latest book, *Bacteria to AI,* is now being translated into Chinese as well. It should appear maybe within a few months.

Jiang: Thank you for your information. I am delighted to hear that Chinese readers eagerly anticipate the opportunity to engage with your work in translation.

Through the UCLA faculty profile and related academic resource, we have had the privilege of gaining an overview of your distinguished scholarly trajectory. You earned your Bachelor's and Master's degree in chemistry before transitioning to literary studies, where you completed a second Master's degree and subsequently your PhD. Throughout your career, you have consistently brought together science, technology, philosophy, and literature to interrogate human cognition, epistemological frameworks, and the modes of thought that define our contemporary condition--all from an elevated conceptual vantage point. Building upon this foundation, your scholarship has rigorously explored the conditions under which human-machine integration becomes possible in an era of advanced artificial intelligence, as well as the contours of potential future characterized by symbiosis between humans and non-humans. This body of work is both profoundly original and intellectual generative, offering deep insight and critical guidance to scholars and readers alike.

Could you briefly reflect on the intellectual and personal circumstance that motivated your transition from the natural sciences to the humanities? Your trajectory across these domains is widely regarded as exemplary, and your reflections would be of considerable interest to our academic community.

Hayles: Thank you for your thoughtful question, and thank you all for your generous and kind words about my work. I really appreciate that.

When I was an undergraduate, I found myself profoundly exhilarated by the discovery of scientific methodology, research practices, and the robust, reliable forms of knowledge they produced about the world. Coming from a small Midwest town with limited intellectual resources, college represented an extraordinary opening of thought, ambition, and new ideas. Yet, as I advanced into graduate-level research and became more deeply immersed in scientific practice, I gradually realized that--at least for me--the discipline was dominated by an accumulation of fine-grained details, with relatively few opportunities to pursue larger conceptual questions. From the outset of my college years, I had been equally drawn to science and literature. I therefore decided to redirect the scientific training I had acquired toward literary studies.

The transition was not easy. I worked tremendously hard, harder than I have ever worked before or after in my life. What proved most challenging was the recognition that the epistemological assumptions I had internalized through scientific training were not universal. Literary studies operated according to fundamentally different conceptions of argument, evidence, and the demonstration of knowledge. I was initially resistant, spending at least a year clinging to the frameworks I had brought from science. Eventually, however, I understood that success in the new discipline required me to set aside those earlier commitments—to close the door on them, as it were--and to immerse myself fully in the intellectual conventions of literary inquiry.

This experience was profoundly disorienting. It shattered what I now recognize as a culturally specific set of assumptions. Much like individuals who grow up in one cultural context and later encounter another, I came to see that what I had once regarded as universal was in fact contingent. There are multiple ways of knowing, multiple modes of reasoning, and multiple forms of life. Once that realization takes hold, a return to naïve universalism becomes impossible.

I never entirely abandoned the intellectual habits formed in science. I looked for a middle path between science and literature, where I was skeptical of many claims in the humanities, but I was also skeptical of some of the scientific work as well. Over time, I sought a middle path between these two cultures: one that retained a critical distance from certain humanistic assertions while also questioning aspects of scientific practice. This effort led me to engage deeply with science and technology studies, particularly the insight that scientific knowledge is culturally conditioned and emerges from specific historical and social contexts. At the same time, I was concerned with how such knowledge could still contribute to reliable understanding. This tension has remained central to my intellectual project. I have found Karl Popper’s formulation particularly illuminating: science excels at demonstrating what is not true, but it cannot definitely establish what is true. It can only indicate what is consistent with reality, not reality itself. This distinction has been foundational for me.

The latest expression of these concerns appears in of the Umwelt: each species constructs its own phenomenal world according to its sensory and neurological capacities, but that world is never the world in its totality. The same principle applies to human: we do not apprehend reality as much, but only our species-specific experience of it. Contemporary discoveries concerning dark matter and dark energy further underscore this limitation: the portion of the universe accessible to human perception constitutes only a minute fraction of what exists. While science has achieved extraordinary feats of discovery, relative to the totality of the cosmos, our grasp remains modest. I regard this realization not as a diminishment of science, but as an occasion for humility—one that coexists with deep admiration for its accomplishments.

Jiang: In my view, your scholarship has consistently operated from a higher conceptual dimension, examining technology, science and the humanities in ways that transcend the conventional divide articulated by C.P. Snow more than 50 years ago. Snow famously emphasized the separation between scientific and humanistic cultures, each embodying distinct modes of thought. You, however, have positioned yourself at the intersection of these two cultures, actively working toward their integration. In your view, is it possible for these two cultures to be genuinely reconciled?

Hayles: Well, that's a great question. Of course, all the great ideas in history are never unique. They're experienced over and over again. I had my own version of C.P. Snow's two cultures, in what I've just said about my own experience with going from science to literature. To me, it's very important to recognize that when I write about literary texts in my books, I do not mean them to be illustrations of scientific ideas. That is a very weak interpretation of what literature can do. Rather, literature has its own methods of conveying truths about the world. And these are powerful truths. They're often cultural and social and political truths, not so much scientific truths. Yet I see literature and science as co-equal partners; science tells us about physical processes, but literature has unparalleled resources to illuminate cultural, social, economic, and political processes. And all of those constitute our human world. We need insights into both of those things to have a balanced picture of what is. When I write about literary texts in my books, which often pick up scientific ideas and explore scientific themes, I don't mean them simply as illustrations. so you're right about this. No, I mean them as counter viewpoints that have their own impact and their own validity.

Jiang: Thank you for this illuminating response. Your scholarship clearly opens a generative path for understanding both scientific fields and humanistic domains. From an educational perspective, might you offer recommendations on how curricula could be designed to foster greater integration across the humanities, science, and engineering, and perhaps philosophy? What kinds of structure—whether individual courses, programs, or institutional arrangements—might best enable students to engage meaningfully with interdisciplinary approaches that bridge these traditionally separate fields?

Hayles: The modern university remains structured around disciplines. Students sign up for majors in physics, English, philosophy, mathematics, and so forth, each governed by its own protocols and ideologies. There is real intellectual value in immersing oneself in a single discipline long enough to absorb its distinctive ways of thinking—its assumptions, its methods of argumentation, its criteria for evidence, and its modes of demonstration. I think it's important for young people to learn what those are. But the world is not divided up according to disciplines. An alternative way to imagine a curriculum is one focused not on disciplines, but on problems and issues. That means you would then bring in a number of disciplines to attack problems of considerable complexity. I think there should be a balance between disciplinary inquiries, which are important and problem-oriented inquiries, which will inevitably be interdisciplinary. Perhaps a model curriculum, for example, might have the first two years of college be solely in a specific discipline, and then the last two years of college, the junior and senior levels, focus more on interdisciplinary problems. Students have the disciplinary grounding, but now they begin to see how other perspectives are also necessary to make progress on e very complex issues.

Jiang: Your approach is highly innovative. Thank you. In practice, interdisciplinary collaboration tends to occur more readily within the humanities, art, philosophy, and history, whereas bridging the natural sciences and the humanities remains considerably more challenging. Your reflections underscore the importance of giving this matter serious consideration and developing structured programs to facilitate such integration.

Hayles: I agree, and this is precisely why acquiring some foundational tools is essential. In this respect, China may well be ahead of the U.S. in implementing such training systematically. Every student, in my view, should have a basic understanding of advanced mathematics—including calculus, nonlinear algebra, and certainly algebra. Once equipped with these basic tools, it becomes possible to engage meaningfully with research that bears on the problems one wishes to address. Mathematics is indispensable in scientific context, but a working knowledge of fundamental scientific principles—physics, chemistry, biology—is equally necessary. These tools endure long after specific factual knowledge may become outdated. We should think about acquisition of knowledge as a lifelong progress. It's never finished, fortunately. Even now, I'm still learning new things every day. It's never finished, but it's always satisfying. I admire your own commitment to ongoing learning at this stage of your career.

Jiang: Thank you. I would like to turn to some of your early works, particularly *the Cosmic Web* and *Chaos Bound*. In *the Cosmic Web*, you introduced the concept of "field" as a domain of universal interconnection that incorporates the observed objects, events, the act of observation, and the observer within a unified system. This bears some resemblance to system theory, but it is distinct in important way. On this basis, you examined linguistic referentiality in literature and constructed a sustained dialogue between the scientific notion of the field and tits literary counterpart. In doing so, you moved beyond earlier approaches that merely traced the influence of

scientific models (such as field theory) on literary production. Instead, you recognized literature itself as an imaginative response to the complexity and terminal indeterminacy already implicit in field models—though often left unarticulated within scientific discourse itself. This may be regarded as one of your earliest efforts to facilitate communication between scientific and literary modes of thought. From this perspective, science and literature are not related through a unidirectional model of influence, but through a resonance between fields—an epistemological attunement to the complexity and ambiguity of the world—such that concept of the field becomes simultaneously scientific and literary. Subsequently, in *Chaos Bonds: Orderly disorder in contemporary literature and science*, you deepened this concern with complexity and indeterminacy by locating it in cultural condition. As you argue, different disciplines are drawn to similar problems because the concerns underlying those problems are culturally charged and significant within a particular historical moment. Disciplinaries rely on similar foundational assumptions in constructing the theories precisely, because those assumption guide the formation of knowledge within a specific epistemological framework. This suggests that scientific theory and models are shaped by cultural conditions. They participate in and are grounded in fundamental assumptions that operate across much multiple levels and domains of culture. At the same time, as you have noted in various writings, scientists and humanities often do not operate on the same conceptual plane when discussing key terms, which itself contribute to the difficulty of junior dialogue between scientific and humanistic discourse.

My questions are as follows: Looking back to your field theory in your early works, are any meaningful connections with Pierre Bourdieu's concept of the field when you situate science and literature within a shared systemic framework and argued that the underlying logic is conditioned by cultural factors, while also insisting that both must be situated within the broader context of contemporary culture to be properly understood? Might this approach be understood as a form of "Chaos culture"? And does it bear any relation to Frederick James's notion of the cultural logic in late capitalism?

Hayles: Thank you! Thank you for returning to those early works. Looking back some forty years later, I recognize that I have never abandoned the idea that both scientific discoveries and literary productions are deeply rooted in, and shaped by, an underlying culture matrix. I believe this then, and I believe it still. What I lacked at that time, however, was a robust methodology. I had an idea, and I had some texts to examine, but it was not until the emergence and maturation of Science and Technology Studies (STS) that scholars began to develop rigorous, empirically grounded models for understanding precisely how cultural diffusion and conditioning operate in scientific knowledge production. Pioneering studies by Bruno Latour, Steve Woolgar, Karin Knorr Cetina, and many others built an impressive body of work that examine specific cases and work out methodologies for thinking about science as a culturally embedded practice—while, of

course, also analyzing cultural itself through the lens of scientific and technological formation. It really provided a toolset of ideas and methods that one could use.

By the time I wrote *We Became Posthuman* (published in 1999), STS was already firmly established. I therefore had the advantage of all these contexts when I came to write my third book. One of the strategies I adopted—in common with STS case studies—was to identify historical instances in which two competing theories emerged, only for the ultimately less robust or less successful theory to win our. So, the particular case study that I was looking at was what information means. Claude Shannon, an engineer working at Bell Labs, approached information from a strictly engineering perspective: he was interested in how messages are transmitted. His theory of information stripped away context, and as Warren Weaver observed when he wrote the introduction to Shannon's 1948 book, meaning was thereby lost. Shannon's theory of information was decontextualized, purely a statistical definition of information. But Donald MacKay, a British physiologist and neuroscientist, working around the same time, developed a very different conception of information—one that was richly contextual and embodied. For MacKay, information was understood through its impact on the receiver: it changes our mindset, and changes even how our neurons operate. He had a richly textured, embodied theory of information. Yet it was Shannon's model, not MacKay's, that became widely adopted. In retrospect, the reasons are clear: Shannon's simplification enabled qualification and wide applicability; Mackay's complexity resisted easy formalization and thus remained marginal.

Returning to these mid-1950s debates from the vantage point of the 1990s, it became possible to reimagine information in ways that had not been feasible earlier: as contextually laden, meaning prone, and inseparable from the conditions of its reception. This shift was foundational for *How We Became Posthuman*. But I want to emphasize again that that book was made possible because of many other people's contributions to STS in the intervening decades. I was a beneficiary of that collective effort. So finally, I had a model, or a whole series of models that allowed me to articulate these ideas with greater force and clarity than had previously been possible.

A Development of Posthuman Theory: AI Technology, Cognitive Assemblage, and Symbiosis

Jiang: Thank you for this illuminating exposition of your ideas concerning information theories. *How We Became Posthuman* remains, in my view, is your most influential work. In it, you trace a trajectory from cybernetic frameworks to an understanding of how technology reshapes not only the physical body, but also cognition and subjectivity. What I find particularly compelling across your books including *How We Became Posthuman*, *Unthought*, and your most recent *Bacteria to AI*, we can see the gradual shift in your inquiry: from a microscopic, systems-oriented mode of analysis toward an increasingly focused examination of the human itself—embodiment,

consciousness, and the very question of mind. Through dialogues among science, philosophy, and literature, you have sought to rearticulate what it means to be human, to reconsider the ontological and epistemological assumptions underlying scientific and philosophical paradigms of human subjectivity, and thereby to argue for both the necessity and the possibility of a posthuman trajectory. In light of this, I would like to pose a question that has long preoccupied scholars of your work: How do you understand the prefix "post" in "posthuman"? Does it signify "after"(temporal succession) or "beyond"(a qualitative transcendence or reconfiguration)?

Hayles: Thank you for this perceptive question. The concept of "human" has never been fixed; it has always been historically contested. From the earliest encounters between humans, such as Cro-Magnons and Neanderthals—history shows that each group has tended to claim the designation "human" for itself while denying it to the other. For me, "human" is a historically and culturally specific information. The specific configuration I was looking at was the Enlightenment ideal of the human: rational, autonomous, possessed of free will, capable of reflecting critically upon its own situation. This conception was ideologically powerful in its time; it underwrote movements such as American Revolution, French Revolution, and the emergence of modern democratic ideals. Yet it is historically contingent, bound to the intellectual horizons of the 18th and 19th centuries. With the growing impact of technology—particularly the intensifying feedback loops between technology and the human—the human is undergoing a profound transition. This is what I intended by the prefix "post". It does not mean we have post-biological; biologically, we remain much the same creatures we were in Paleolithic times. Rather, culturally, cognitively, and socially, we have been significantly changed through our long and deepening entanglement with technology. Bernard Stiegler, drawing on the work of the French anthropologist Andre Leroi-Gourhan, has argued persuasively that humans have been co-constituted by their technologies from the earliest periods. Leroi Gounhan demonstrated, for example, that the domestication of fire altered early hominid diets (cooked rather than raw food), which in turn reshaped jaw structure and facilitated the emergence of language. From the first flint tools onward, humans have existed in strong feedback loops with their technical artifacts—loops that have altered physiology, psychology, and their cultural structures. In the 21st century, this feedback loop has expanded and intensified enormously. From the steam engine, and printing press to quantum mechanics, rocketry, the internet, and now advanced computational system, the pace and scope of technological transformation have accelerated dramatically. Tools have become cognitive. This is a decisive shift: as a species, we have long identified our exceptionalism with superior cognitive capacity. The emergence of cognitive technologies therefore affects not only our physical being but our very processes of thought.

We are now witnessing an explosion of these cognitive tools. Every month brings new developments, especially in artificial intelligence. The consequence for the species is difficult to foresee with precision because the changes are occurring so rapidly and on such a profound scale.

The best we can do is to speculate responsibly—which is what I attempted in *Bacteria to AI*. In that work, I proposed a fundamental reorientation of human cognition in relation to other species and to computational media. Historically, we inherited from the Enlightenment and earlier periods a view of humans as the dominate species: master of the planet, apex predator, the top of the food chain, justified by our superior cognitive powers. Yet this orientation is becoming increasingly unsustainable—for ecological reasons, among others. Our cognitive powers have not prevented us from creating multiple environmental crises: ocean acidification, global warming, widespread pollution. We're now beginning to face the excesses of our own attitudes of domination. What is urgently needed is a new orientation: from dominance to symbiosis, from human exceptionalism to relationality. In *Bacteria to AI,* I drew on the work of Lynn Margulis, whose research fundamentally altered the Darwinian picture of evolution. While Darwin emphasized competition and survival of the fittest, Margulis fundamentally changed that picture by arguing that the prime driver of evolution was not competition and survival. The prime driver of evolution was symbiosis. Her work discovering that eukaryotic cells were actually mutants that emerged from the symbiosis of two previous prokaryotic cells was fundamental. It showed that the very emergence of oxygen-using cells, which led to the emergence of animals, which led to the emergence of humans, resulted from endosymbiosis, not from competition, not from the clash of two species as Darwin had imagined it, but rather two species joining in symbiotic union. So I was trying to emphasize symbiosis as another major reorientation, from dominance to symbiosis, from human exceptionalism to relationality. I was proposing that those ideas not only applied to our relations with our biological creatures with whom we inhabit the planet, but also with computational media. Humans had already developed an intense symbiosis with computational media, so much so that if all our computational media crashed. The die-off of humans within 6 months would be enormous. I estimate maybe only 10% of humans would survive, because our food chain, our information networks, our transportation networks are completely dependent on computational media nowadays. Unlike earlier transformative technologies (the steam engine, the printing press), computational media are cognitive. They control information flows, and in societies where information is central to economic, political, and cultural life, dependence on such media becomes existential. The more the society relies on information, the deeper the symbiosis becomes. It has already altered how we think, how we act culturally, how economies function—and the pace of change continues to accelerate.

Jiang: Your work has opened a generative path toward envisioning a symbiotic future among humans, technology, and the environment—a vision that might be described as a sustained cognitive tour. Returning to your most recent book *Bacteria to AI*, you express alignment with Bernard Stiegler's emphasis on the symbiotic co-constitution of humans and technology throughout history, yet you also register a critique of his later stance, particularly his opposition to granting rights or agency to artificial intelligence. In light of this, I would like to ask: are you

guardedly optimistic about our present AI-driven technological future? Moreover, when you advance the concept of the cognitive assemblage, how might we practically organize such an assemblage—one that integrates human cognition, nonhuman biological cognition, and machine cognition—while still preserving and affirming human subjectivity?

Hayles: If I were to identify with a philosophical position, it would be pragmatism. Pragmatists focus on results; thus I would characterize my position as guardedly optimistic. I am acutely aware of the profound risks attendant upon the development of a technology as powerful as artificial intelligence. Yet I see little value in adopting a posture of despair or resignation—declaring that we are doomed and retreating from engagement. To plan responsibly and sustainably for the future, we must first believe that a future is possible. This belief becomes, in a sense, self-fulfilling. That's why I was determined to conclude *Bacteria and AI* on a note of measured hope, devoting the final chapter to the work of Kim Stanley Robinson, whose writing is animated by an inveterate commitment to the possibility of solving even our most intractable problems through collective effort, ingenuity, and political will. I do not claim that all problems will be solved—many will persist well into the future—but I do maintain that we must act as though a livable future remains attainable, because only such action can bring it into being.

Regarding the cognitive assemblage, this concept is integral to the broader shift I have traced from a paradigm of domination to one of symbiosis. It requires to us to recognize the extent to which we are already entangled—both with other biological organisms (we could not digest food without symbiotic bacteria in our gut, for example) and with computational media. Once one enters a complex system of this kind, small differences can produce large effects. Such systems are inherently unpredictable, yet this very unpredictability also opens space for hope. Strategic thinking in the context of cognitive assemblages therefore involves identifying inflection points—those points where you can apply a little bit of leverage that results in a large difference. We are already operating within cognitive assemblages in which information, interpretation, and decision-making flow throughout the system, meaning that no single entity exercises total control. Agency is partial and distributed. Cognition itself is distributed—it is not only human thought that matters, but also bacterial cognition, AI cognition, and the emergent interactions among them. Acknowledging this distributed character is central to the relational perspective I advocate, which displaces the older paradigm of human dominance.

Jiang: I really love the word you use, **entanglement**. It suggests that everything and everyone is interwoven, mixed together—a clear deconstruction of anthropocentrism. Humanity is displaced from the center of the universe, a position it has occupied since the enlightenment. Yet this is not an entirely novel insight. During a visit to Egypt, I encountered cultural remains dating back more than five thousand years in which humans symbolically incorporated the powers of diverse life forms—solar deities, jackals, serpents, scarab beetles—into religious and political imaginaries in order to endow human sovereignty with cosmic legitimacy, both in earthly life and in the afterlife. This appears as a

form of symbiosis, yet at its core it remains an assertion of human centrality. Moreover, within human societies themselves, hierarchical divisions have historically meant that many humans—slaves, for instance—were denied full recognition as human.

Hayles: Yes, that is precisely the issue. When I speak of a symbiosis with other species and with artificial intelligence, I do so in a U.S. context where such ideas are increasingly marginalized. As an intellectual, my political power is limited, but I continue to use whatever influence I have to articulate arguments and support actions that might help redirect the current trajectory. I remain hopeful, albeit cautiously, that we will eventually renounce the ideas that now appear dominant and return to a more sustainable, rational, and realistic approach to our environmental crises, to our responsibilities toward other species, and to our obligations toward other humans.

Digital Humanities as Mediation: Transmediality, Material Metaphor and Digital Simulation

Jiang: I'm very interested in your media study. Your scholarship has consistently demonstrated a profound and sustained engagement with media studies—what I would characterize as your distinctive contribution to Digital Humanities. Across your excellent works—from *the Cosmic Web, Chaos Bound*, *How We Became Posthuman*, to your 21st century works such as *The Writing Machine*, *Nanoculture*, *My Mother was a Computer*, *Electronic Literature*, *Unthought*, *Postprint*, and *Bacteria to AI*—you have meticulously traced the transformations wrought by digital technologies and their far-reaching cultural, social, and epistemological consequences. In *Writing Machines*, you decisively reoriented the discussion of media toward materiality, foregrounding the recursive, persuasive process between media forms and emphasizing the interactions between language, literature as information, digital information, and the broader social, cultural, and narrative transformations resulting from technological digitalization. This work underscored the critical importance of materiality in any serious study of media. Subsequently, *My Mother was A Computer* and *Electronic Literature* further advanced the analysis by attending to the emergent narrative possibilities enabled by digital technologies and coding practices, thereby laying a robust theoretical foundation for contemporary debates concerning whether AI can generate autonomous narrative. I interpret this trajectory as a distinctive strand within digital humanities—one that shifts humanistic inquiry from purely philosophical speculation toward a rigorous framework of technological integration and media-specific analysis. My questions are as follows: First, your approach to digital humanities clearly distinguishes itself from computational humanities, digital humanism, and studies in digital culture more broadly. Could you elaborate on your specific research trajectory in this domain and your understanding of digital humanities as a research field? How do you conceptualize digital humanities in relation to the broader humanistic

enterprise? How do you define digital humanities, and what methodological principles guide your own work within it?

Hayles: Well. Thank you for your perceptive question. I am a big fan of the digital humanities. When the field first emerged maybe about 20 years ago—I was teaching in a literature department that was firmly based in print. At that time, the very idea of digital literature, let alone digital humanities, was frequently marginalized or dismissed. Two decades later, digital humanities are well established as part of literature departments and other departments as well. Its importance has been demonstrated repeatedly through the developments of innovative methods and insights, perhaps most notably distant reading: the capacity to identify patterns and characteristics across corpora too large for close reading of individual works, but amenable to computational analysis. This approach has only grown more significant in the age of AI.

My most recent work, which hasn't yet been published, is investigating the tradition of analog computation. Digital computation now so thoroughly dominates the technological landscape that the adjective digital is often taken for granted when we speak simply of computing. Yet there exists a long and significant history of analog computation, both technologically and biologically. Technologically, analog computation differs fundamentally from digital computation because it does not start with abstraction. Digital computation commences with abstraction: a continuous voltage signal of , say 05 volts is interpreted as 0.0 (corresponding to 0 in a binary system), while 4.98 volts is rectified to 5.0 exactly, which corresponds to binary 1. What is thereby abstracted away is what I have elsewhere called the noise of materiality—the irreducible irregularities and thresholds of precision inherent in the physical world. Every measurement has a limit of resolution; beyond that threshold, accuracy becomes impossible. Measurements are thus approximate, never exact. Digital computation achieves precision only by ignoring these material irregularities.

Analog computation, by contrast, starts with a physical model of a real-world situation. It may employ physical instruments (a tradition extending back centuries) or electronic analog systems (developed in the 1940s and widely used for real-time applications into the 1990s). Analog computation is therefore limited in precision, inherently approximate, non-abstract, and grounded in physical models rather than binary simulations. It represents a fundamentally different paradigm of computation.

Technologically, analog computing is a minor tradition. Digital computation is overwhelmingly dominant. Biologically, however, analog computing is primary. Non-human organisms possess no knowledge of abstraction, counting, and numbers. Yet they process environmental information through analog means, and they arrive at analog results. Technologically, digital is primary. Biologically, analog is primary. The problem with digital humanities is that it skews all the research over to the technological area. It ignores the biological area. So, in my most recent work, I am arguing for the creation of the analog humanities, which

will study analog computation in both its technological and biological dimensions. As biological processes are being understood as computational, we must recognize that organisms have always performed natural computation. Organisms must process information from the environment to survive, so they are carrying out natural computations. This field of natural computing is now rapidly emerging, with all the research into ways different species process information. Those computational processes of natural organisms are overwhelmingly analog, not digital. Consequently, what digital humanities has done is to focus so much on the technological that it's becoming difficult to bridge over to the biological. But if we include analog computing into this picture, we now have a much more balanced account of how computing works, both in the natural world and in the technological world. We are both technological and biological creatures. We ourselves, in our own cognitions, constantly blend the digital and the analog. That's why I think the future of computational studies and media studies is to include the analog along with the digital, to get a much more comprehensive picture of what's actually happening, and new ways to think about the biological and the technological together.

Jiang: Your work has been extraordinarily generative in opening pathway for us to move forward. Prior to your work, few scholars had systematically brought the biological and the technological into a unified framework. This is precisely why your explanations of cognition and thought have been so compelling—you have demonstrated how biological and technological process are already deeply entangled. I wonder what role you see digital media technology playing in contemporary research.

Hayles: Technology is, of course, still enormously important. If we think about artificial intelligence, specifically large language models, they have analog characteristics. These systems exhibit analog traits in several key respects: their parameters evolve continuously rather than discretely; they display context awareness that is analog in character rather than strictly binary; and their behavior is shaped by gradient descent and probabilistic processes that resist purely digital abstraction. Thus, with AI technologies, we witness a blending of digital instantiation with analog characteristics—a blending that accounts for much of their flexibility and power. In effect, we are reinventing the computational paradigm to include both digital precision and analog dynamism, and that's why our technologies have now taken a leap forward, because they've begun to incorporate characteristics of biological organisms that evolved millennia ago. This development is highly promising. It calls for a conceptual reorientation away from digital technologies alone to what I call computational humanities, which include both the digital and the analog, and include both the technological and the biological.

Jiang: I am particularly interested in your critique of object-oriented ontology. In your view, does this philosophical position bear any meaningful relation to your own theoretical framework?

Hayles: I've never been a great fan of object-oriented ontology. They start out with a kernel of insight, which is that you can never specify an object completely, and I totally agree with that.

To specify any object, you have to list a number of attributes, but the number of possible attributes is infinite. So, no object can ever be specified completely. The rest of object-oriented ontology takes this little kernel of insight and tries to expand it into a whole epistemological and ontological system. To me, this expansion recalls the historical efforts of astronomers and natural philosophers to preserve the geocentric model of the universe after empirical evidence had begun to undermine it. As observational data accumulated that contradicted the Ptolemaic paradigm, increasingly complex epicycles—wheels upon wheels—were introduced to salvage the older framework. To me, object oriented ontology is like adding these wheels on wheels from this basic insight. I don't think that gets them any closer to reliable or productive knowledge. That, I believe, is sufficient commentary on the matter.

Jiang: Thank you. Turning to another central theme in your work: do you consider digital media technologies to be actively reconstructing human beings themselves in some fundamental sense?

Hayles: Yes, definitely. Digital media have exerted a profound and pervasive impact on everything that we regard as crucial to human beings. Consider sociality: social media platforms have fundamentally altered how we form relationships, maintain communities, and perform identity. Economic systems are now inseparable from digital networks; banking, commerce, supply chains, and financial markets operate through computational infrastructures. Information flows, political discourse, cultural production—all are deeply entangled with digital mediation. These transformations have unfolded within my own lifetime. I recall writing in the early 1990s and realizing—almost as an epiphany—that the paradigm object I had previously assumed was the standalone computer, which had become obsolete. Computers were no longer standing alone: they were networked. That shift, which seemed revolutionary at the time, has since become foundational. In retrospect, the changes have been enormous, and digital technologies have unquestionably stood at the center of them.

Jiang: This transformative role of digital media appears to be one of the motivating forces behind your concept of "postprint" in *Postprint*, you define postprint as the combination of print and computation, and you introduced the concept of "network thinkin". Could you illustrate on how you understand postprint in relation to the broader reconfiguration of media, cognition, and subjectivity in the digital age?

Hayles: Indeed. *Postprint* was a book aimed mostly at the literary community. Print is still important and part of our lives. Most of human knowledge is now still in print form, although almost all of that has now been digitized. Yet the fact is that digital media are very short-lived. When your computer becomes obsolete, you need to buy a new computer. But even computational media, like disks and so forth, have a very limited lifetime, less than 10 years. So print is still the archival medium par excellence. If you really want to have something saved for the future, put it in print, and it'll still be there 500 years from now, whereas no digital media can make anything

like that kind of claim. So print is still important. But now print has become one output format among many. We have audiobooks, digital books, electronic books, and it's becoming, in that sense, less important as a publication medium. It's still enormously important and will continue to be important as an archival medium. I'm very sympathetic to people who study the history of the book and the materiality of the book. I love studies that focus on the quality of the paper and the kind of the ink that's used and so forth. That's all really essential scholarship. But at the same time, it needs to be contextualized in a digital landscape, and that's really what I was trying to do in the post-print book.

Jiang: Your discussion of media transformation leads naturally to the question of virtual reality. Contemporary discourse often invokes David Chalmers's formulation that virtual reality constitutes "reality +"—a genuine extension of physical reality rather than mere simulation. This view implies that virtual environments posses their own materiality and ontological status. In this light, do you see virtual reality as establishing a reflexive feedback loop between technological application and embodied response? How do you understand the role of virtual reality in reshaping materiality, embodiment, and the relationship between physical and computational realities?

Hayles: Right, I do think virtual reality does indeed establish such reflexive feedback loops, and these loops extend even to the body itself. For example, suppose you were in a video game where your avatar was a dinosaur, and you had a big, long, very fleshy tail. Your physical movements in that virtual world are now completely entangled with the fleshy tail that you move around with every step you take. When you leave that game, that kinesthetic feeling of having a tail isn't completely gone. You have a phantom tail now. That is what it is like to have a tail. You've had the physical experience of having a tail, and that changes your posture, the way you stand and move, because you've had that alternate experience. So, I think those feedback loops are there. The more important information becomes to us, the more varied the ways we try to incorporate information into our environments. Augmented Reality (AR) is not the same as Virtual Reality (VR), but it is also important. Ocular glasses combine physical presence with virtual displays or informational displays of one kind or another. I think that that kind of technology is bound to become almost standard. In the near future, will virtual reality constitutes a new medium? I think it is a new medium, a blending of computational media with kinesthetic feedback. We can think of the blending of physical reality and computational reality as another example of symbiosis, if you will. I am sure that the people who work in these fields would completely agree that it constitutes a new medium. AI technology developed so fast, we would like to use AI to generate our image, or a story, or anything. We should understand the development of literary simulation and AI-generated digital narrative within this process.

Reimagining the Future: AI Writing, Non-human Cognition, and Science Fiction

Jiang: Then what is your perspective on AI writing and AI literature?

Hayles: Well, I am currently writing an article that addresses precisely this question. To date, most AI-generated fiction that I have read has not been equivalent to the best human writing. It's not even equivalent to mediocre human writing. Consider, for example, detective novels. Although the detective novel is not usually regarded as high literature, there are many highly competent human writers in this genre, and their works demonstrate a level of narrative craft that AI has rarely achieved. The creation of a compelling narrative remains something that AI systems seldom accomplish successfully. I collaborated with a graduate student in information science at Cornell University, Kiara Liu. Together we have created prompts that elicit human equivalent fiction from large language models that approaches the quality of human writing. This represents one of the few cases I have seen in which an AI system produced stories of notable literary merit. The way we did it is quite interesting. I proposed that LLM-generated fiction or novel writing might not be so much judged as failed attempts at conventional novels, but rather as novels that might incorporate an entirely different, nonhuman aesthetic. In other words, it may be possible for LLMs to evolve their own aesthetic, which would operate by criteria very different from those that guide human literary production.

With this in mind, we asked GPT-5 to write short stories for an LLM audience. We instructed the system to imagine that the readers were not humans but other LLMs. Surprisingly, however, these fictions that the LLM generated were not, in fact, aimed at an LLM audience, but what they tried to do was to imagine the LLM world for a human audience. Those stories were remarkably good, in a literary sense. The way they used language, the similes and the metaphors, was actually stunning. We're now in the process of trying to broaden this research program to find out why these particular prompts were so successful in generating human equivalent fictions, and what kind of future experiments could and should be tried in this vein. We're thinking about this question of AI and literature.

Jiang: It is amazing. In your book *My Mother was a Computer*, you suggest that digital narrative forms may emerge alongside developments in artificial intelligence. You also discuss the possibility that AI might eventually develop forms of consciousness as computer technology continue to advance. How would you explain the potential emergence of AI consciousness?

Hayles: This question has been widely discussed among both AI researchers and scholars in other fields. In my view, contemporary AI systems are not conscious. They lack a persistent sense of self, and a sense of selfhood is necessary for the emergence of consciousness. Our current line of inquiry, however, focuses not on consciousness but on awareness. In neuroscience and cognitive science there exists a well-established field known as theory of mind. The basic idea behind theory of mind is to determine whether a species can imagine what another person or species is thinking. For example, can one chimpanzee imagine what another chimpanzee is going

to think? If it can, the chimpanzee is said to possess a theory of mind, because it can theorize about the mental states of others and imaginatively project what that chimp will do. It turns out that chimpanzees do indeed possess a theory of mind. And of course, humans have theory of mind. There is also a well-developed area of literary studies called literary theory of mind that specializes in exploring how literature uses the theory of mind to develop characters, plots, and narrative dynamics. The question then is whether LLMs possess a form of theory of mind. Researchers have attempted to address this by applying experimental paradigms similar to those used in studies of chimpanzees. However, there is a crucial difference, because with chimps you are dealing with non-linguistic subjects. You're looking at behaviors and making inferences from their behaviors. You set up a scenario, the chimp performs certain actions in this scenario, and then you interpret its behaviors.

But with LLMs, we have exactly the opposite situation. We have linguistic productions instead of behaviors as physical actions. Researchers tried to apply the same kinds of tests with chimps to LLMs, and in general, LLMs are able to pass those tests. So, provisionally, one might conclude that LLMs exhibit a theory of mind. However, literary theory of mind is much more sophisticated than these behavioral paradigms. It doesn't deal with behaviors, but with representations—specially linguistic representations. When analyzing literary texts, we already operate within a symbolic and narrative domain. This provides a much broader framework for considering awareness and the kinds of cognitive processes implied by narrative production. So, the analogy here is really with humans and with literature, not so much with chimpanzees. The kinds of questions that have been asked to determine theory of mind in LLMs are based on animal studies, which is the wrong paradigm. They should be based on literary theory of mind. They should be using the same techniques that literary theory of mind deals with, because they're dealing with linguistic representations, not physical actions. When you apply literary theory of mind techniques to these stories that the LLMs generated, what is revealed is that GPT-5, and no doubt other LLMs, have an extremely well-developed sense of how humans think. They understand how humans think in certain situations. Are you jealous? Are you afraid? Are you hungry? Are you ambitious? They've read billions of human author texts and detected the patterns. I describe this process as **inverse awareness of theory of mind**. It is a projection of their understanding of human theory of mind onto computational components. It is "inverse" because it inverts from the human to the computational and then projects that n onto computational components. This is a new way to think about theory of mind and awareness. My concern is that some observers may dismiss such phenomena by arguing that, because they do not constitute human awareness, they do not qualify as awareness at all. But I would argue instead that we must reconsider our conceptual categories. Rather than insisting on a strictly human model of awareness, we should develop new categories that are appropriate to the capacities of LLMs. LLMs do not have any knowledge of their physical embodiment, but they have extensive

linguistic capabilities and extensive cognitive capabilities. They understand awareness from a human point of view and can create the kind of conflicts that one might imagine happening within a LLM itself. It is quite an imaginative leap to be able to have narrative scenarios. In the stories they generate, one can even observe imaginative attempts to construct internal conflicts within an AI system.

Conflict is, of course, essential to narrative. Without conflict, there is no story. The question then becomes: what form might be created within an AI? What would that consist of? Would that be a tension between one computational function or another? Would it be a tension between the program as a whole and a user? Would it be a tension between different programs? So, this opens up a whole new area of literary exploration that is not based on consciousness but based on LLM inverse awareness.

Jiang: These are very novel ideas. It is the first time I have heard you discuss the concept of literary theory of mind in this context. I am curious whether you agree with the view proposed by Fei-fei Li. She argues that AI research should move increasingly toward visual or graphical studies rather than focusing primarily on linguistic exploration. Do you agree with her perspective?

Hayles: Yes, she was the creator of ImageNet. Her insight was that if you have a huge database of images, you would get superior results for image recognition. Her work has really been foundational for AI, and I take seriously anything she says about the field, She is truly a pioneer in AI research. That said, her expertise lies primarily within artificial intelligence rather than literary studies. When it comes to interpreting AI-generated fiction, I believe that literary studies has a y valid viewpoint here alongside the computational viewpoint.

Jiang: Your introduction of literary theory of mind into AI studies seems to move toward the construction of a new epistemological framework. Given your extensive research on cognition, may I ask whether you are seeking to develop a new system of epistemology?

Hayles: Well, I would not describe it in quite such ambitious terms. I am not attempting to construct an entirely new epistemological system. However, I am interested in making some epistemological points. In particular, the points that I'm trying to make are that we need new ways to think about awareness that are not specifically tied to human consciousness, but are more appropriate to computational media. The notion of **inverse awareness**, which I mentioned earlier, is one possible conceptual category for understanding the forms of awareness exhibited by LLMs. These systems do not possess consciousness in the human sense, nor do they necessarily require consciousness to operate. Instead, they involve pattern detection on a very large scale, and the inferences one can draw from those patterns.

Jiang: Then in the process of inverse awareness exhibited by LLMs, what implications does the concept of embodiment have for literary studies, and what new directions might it open for future research?

Hayles: I continue to be very invested in the idea of embodiment, and its importance for human being in general. But now we're faced with a cognitive entity, artificial intelligence, that is instantiated in a profoundly different way from humans. So, for those of us who are interested in literary studies, it's opened up an entirely new frontier. For example, humans breathe and our breath is intimately tied up with our vocalizations. We have to coordinate our vocalizations with our breathing, which was one of the branches of traditional rhetoric. . If you study how to make an effective talk in public, it is all bound up with the idea of breathing: where you breathe from, when you breathe, how you manage your breathing at the same time you're trying to articulate all your ideas, and so forth. But LLMs do not breathe. They do not have lungs and bodies that work the way we have. Consequently, an area of literary studies that focuses on breathing and articulation, operates profoundly different for them. So, I keep making the point that LLMs do not produce natural language. They produce simulations of natural language that look like natural language, but operate in a fundamentally different way physiologically and cognitively. So, for us, our embodied experience of breathing is completely a part of how we think about language. It is how we devise our literary texts and construct our speech patterns. It is all tied up with the fact that we breathe. If you have an entity that does not breathe, then their involvement with language is different. Consequently, when we examine AI-generated texts, we must take into account the fundamentally different instantiation of artificial intelligence. This is why I say LLMs produce simulations of natural language rather than natural language itself. Natural language is what humans do when we breathe and talk. LLMs generate linguistic outputs through entirely different computational and representational processes.

Jiang: Great. Then we understand LLMs are producing the simulation of the natural language. Let us turn now to science fiction studies. I know that when you sought to explore the relationship between science and literature, you chose science fiction as a particularly productive field of inquiry. As you have pointed out, literature can serve as an excellent experimental space in which possible events and scenarios that have not yet occurred or take shape in real life, can be explored imaginatively. You have also consistently emphasized the importance of understanding the relationships among different kinds of cultural production, especially the relationship between literary and scientific knowledge. My question, therefore, is as follows: within the broader intersection of technology and the humanities, what role can science fiction play? What kinds of influence might it have on real life and how do you view the current development of science fiction as a literary genre?

Hayles: I believe that science fiction has had an enormous cultural effect, particularly in specific instances. For example, in 1950 Isaac Asimov published a collection *I, Robot*, in which he articulated the well-known Three Laws of Robotics. Even today, roboticists continue to refer to Asimov's formulation when discussing ethical principles in robotics. More than seventy years later, his ideas still influence the field that he imagined. There are numerous examples of this kind of interaction between science fiction and scientific or technological development. More broadly, I would emphasize that science fiction should be taken seriously as an intellectual genre within literary studies. It is a highly conceptual form of literature that engages deeply with theoretical questions about technology, society, and the future. My hope is simply that colleagues

in literary studies will recognize its intellectual significance and approach it with the same seriousness accorded to other literary genres.

Jiang: I think that technological development is occurring so rapidly that people turn to science fiction in search of prediction about the future.

Hayles: I have been somewhat tangentially involved with science fiction studies in China. For example, I taught for three semesters at Duke Kunshan University, where I was teaching a science fiction course to Chinese students. During that time, we also had a symposium on Chinese science fiction. One of the speaker was Stanley Chen, who is a well-known writer in the field. Another important figure is Liu Cixin, the author of *the Three Body Problem*, which received both the Hugo Award and the Nebula Award. Historically, Chinese culture possesses a rich mythological tradition, filled with imaginative depictions of mythical creatures and fantastical worlds. I think that contemporary Chinese science fiction can be understood, in part, as emerging from this long imaginative heritage. At the same time, Chinese science fiction is clearly experiencing a resurgence today. As you noted, this revival is evident not only in academic discussions but also in the emergence of new writers who are producing highly innovative works, such as *The Three Body Problem*.

Jiang: Thank you very much for your thoughtful and generous responses to all of my questions. I truly appreciate the time you have taken to share your insights and reflections. It has been a great honor and pleasure to learn from your perspectives.

Hayles: That sounds wonderful. Well, thank you very much for all your thoughtful questions and the opportunity to expand on some of my ideas. I appreciate the opportunity.

Jiang: Thank you very much for your time. We sincerely hope that we will have the opportunity to invite you to visit our university in the future.

Funding: This interview paper is sponsored by 2022 China National Project of Humanities and Social Science (22BZW175).

Conflicts of Interest: The authors declare no conflict of interest.

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[Jiang Yuqin (2026). “Constructing the Deep Logic of Science and Literature: The Innovative Cyborg Theory of Katherine Hayles.” *Journal of Guangdong University of Foreign Studies* (02): 1-13.]