Computational Reification of Creativity: How Generative AI Reshapes Creative Cognition

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1 Introduction

Cognition is the foundation of how we think, learn, and approach problems. Creativity is a function of cognition that involves generating novel ideas, driving innovation in everything from art to science. The rise of generative AI has sparked concerns about eroding human cognition, particularly in regard to creativity [1, 6, 7, 10].

Creativity involves generating novel ideas, naturally making it the most crucial aspect of human cognition to attend to as generative AI explodes onto the scene. Researchers have identified shifts in creative workflows impacting practitioners in domains ranging from writing [21], to design [8], to software engineering [12] and beyond [4]. These shifts are due to the emergence of cognition-like capabilities of generative AI previously exhibited only by humans [20]. We argue that humans should be primary drivers of creativity and not delegate abstract tasks like ideation and decision-making to generative AI. Instead, AI should be given well-defined, concrete tasks where it does not have to make abstract decisions on its own.

We ground this work in our recent study on the perceptions of different design stakeholders on generative AI tools. While designers were optimistic about generative AI's potential to increase efficiency and democratize design skills, they also expressed concerns about generative AI overtaking their creative workflows. They believe that the design workflow needs human intervention and control.

To explain the impact of generative AI on creative workflows, we describe Sawyer's model of creativity [19] as a historical reference point before contrasting it with workflows transformed by generative AI. Given that context, we distinguish between aspects of Sawyer's model that describe well-defined concrete tasks as opposed to those that center decision-making. Those in the latter class should not be offloaded to generative AI so that humans may maintain control as creators rather than curators, while generative AI fulfills the role of an assistive tool.

Generative AI is reshaping cognitive processes by changing how we engage in creativity—an essential function of human thought. This computational reification of creativity demands we choose which aspects of creative workflows should continue to center human thought as the rest are offloaded to or fundamentally altered by AI. We make the following contributions:

(1) Describe how characteristics of creativity in Sawyer's model are evolving given the proliferation of generative AI.
(2) Distinguish between the characteristics that should continue to center human thought as opposed to those that may be offloaded to or augmented by generative AI tools.
(3) Highlight design paradigms for generative AI that support the goal of provoking creativity rather than eroding it.

2 Creativity as a function of Cognition

Cognition is the foundation of how we think, learn and approach problems [2, 17]. Creativity is a function of cognition that involves generating novel and important ideas, driving innovation in everything from art to science. Because creativity enables the generation of new knowledge—capacities that AI struggles to replicate—it is the fundamental aspect of cognition to maintain in a landscape where AI-based technology is slowly reshaping human tasks and thinking.

Scholars have long studied the creative process, outlining it as a series of discrete stages [3, 5, 18, 19, 22]. Early models like Wallas' four-stage framework [23] from 1962 and later expansions such as Mumford's model [14] describe creativity as thus: it begins with problem identification followed by knowledge acquisition, information gathering, idea incubation, generation, refinement, and ultimately, the expression of a final concept.

Keith Sawyer challenges traditional stage-based models of creativity, instead describing it as a nonlinear, iterative, and improvisational process. Sawyer's model is the most relevant to our work because it breaks the creative process into characteristics relevant to our study results. The eight characteristics are as follows:

(1) *Iteration*: Creativity is not a linear path; it involves continuous refinement and unpredictable shifts in direction as ideas evolve through repeated cycles of development.
(2) *Ambiguity*: Defining problems via open-ended trial and error is crucial to creativity, keeping the process from becoming procedural. This element of uncertainty is an essential part of discovery.

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Figure 1: Sawyer's characteristics of creativity [19] re-imagined with generative AI in the loop. Characteristics with a shared color are impacted similarly by generative AI use[15].

(3) *Exploration*: The creative process involves experimentation, trial and error, and testing different approaches to uncover meaningful solutions. This process helps individuals find and refine problems rather than simply solving predefined ones.
(4) *Emergence*: Ideas develop through active engagement rather than being fully formed from the start. Creative work often begins without a clear vision, and through an iterative process, meaningful ideas take shape.
(5) *Failure and Dead Ends*: Setbacks are a natural part of creativity. Rather than being a step backward, failure can redirect the creative process, offering valuable learning opportunities and guiding work in more innovative directions.
(6) *Deliberate and Intentional*: Creativity is not a mysterious or unconscious process but rather a structured and methodical one. It requires critical engagement, rigorous effort, and intentional refinement to produce high-quality work.
(7) *Conscious Reflection*: Reflection plays a central role in creativity, helping individuals analyze their work, refine their approach, and make intentional decisions.
(8) *The Importance of Constraints*: Constraints provide structure and direction, preventing creative paralysis. Limitations push individuals to think more deeply, stretch beyond their comfort zones, and generate more innovative solutions.

This elaboration of the creative process further illustrates how entangled creativity is with cognition, and why it is relevant to consider theories of creativity in understanding human cognition with generative AI. Having defined these characteristics, we next explain how they are being evolved by generative AI based on results from a recent study.

3 Creativity in the Age of Generative AI

Creative workflows that integrate generative AI are diverging from Sawyer's model of creativity in significant ways. Creative practitioners across industries have expressed concern about how generative AI has the potential to "skip" parts of the creative process [11], with ideation also being relegated to generative AI [24] given its ability to produce a large number of concepts to build upon. This leads the user into more of a curatorial or managerial role [9], where they perform the work to tie together the various concepts produced by generative AI [21], at times from an assembly of generative AI applications [16]. These changes have led researchers to consider new creative frameworks [13] to capture how generative AI impacts the creative process.

Insights from our recent qualitative study [15] with designers who use generative AI tools reveal that AI is evolving the creative workflow of designers. The characteristics of creativity as defined by Sawyer are no longer characteristics of human creativity but characteristics of AI-assisted human creativity. With AI, *iteration*, *deliberate intentionality*, and *conscious reflection* shift from refining, creating, and reflecting on one's own ideas to tweaking prompts and evaluating AI outputs. Instead of being shaped by problem *constraints*, *ambiguity*, and lessons from *failure*, creative workflow is now shaped by AI's limitations and lack of explainability. While AI can pigeonhole users into specific ideas, it also accelerates *exploration* by quickly generating style variations, refining abstract ideas, and enabling quick customizations. Generative AI has the potential to transform creative workflows—it is our responsibility to reflect on the process and be mindful of the characteristics of creativity should maintain human control so that we can avoid the threat of eroding human cognition.

4 Balancing Automation and Human Control in Creative Cognitive Workflows

We describe characteristics of the creative workflow that can be completely offloaded to AI (as they relate to actualizing decisions) as opposed to those that must retain human control (as they relate to decision-making).

4.1 Characteristics of Creative Cognition that can be Augmented by Generative AI

Several characteristics of Sawyer's creative thinking process—*iteration*, *failure*, *emergence*, and *constraints*—are suitable for offloading to AI, much like how we offload the repetitive manual task of calculations to calculators. These characteristics involve repetitive, data-driven processes where generative AI can assist without threatening to replace human cognition. For example, generative AI can automate the refining process during *Iteration* or assist in generating a variety of ideas, styles, and even outputs from different tools to help *Emergence* of ideas without dictating the final creative direction. Similarly, *Failure* can be used as a learning tool where generative AI can suggest alternative ways and perspectives to navigate through the challenge that is leading to the failure or dead end. Finally, *Constraints* can be imposed by generative AI to help frame the problem or limit options, but humans would still dictate these boundaries. In all of these cases, it is important to note that generative AI serves as a support tool in the workflow, leaving the higher level decision-making to humans.

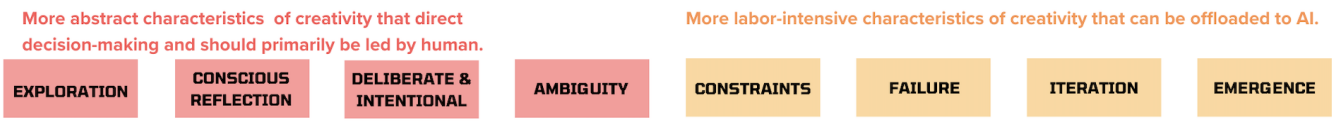

Figure 2: Proposed abstract (in red) and procedural (in yellow) characteristics of creativity.

4.2 Characteristics of Creative Cognition that Require Human Control

We argue that certain fundamental characteristics should remain primarily under human control rather than being totally offloaded to generative AI. *Conscious Reflection* is necessary for evaluating and refining decisions. If all decision-making is conducted by generative AI, humans risk their role in decision-making to be mere approval rather than active involvement. *Ambiguity* means engaging with uncertainty through open-ended trial and error rather than following set procedures. Generative AI may suggest solutions, but without open-endedness, the process risks becoming shallow and predictable. *Reflection* is about understanding why certain choices were made, how they fit into the larger creative process, and whether they should be refined. Generative AI can provide feedback or pattern recognition, but humans should critically assess their own work. *Reflection* being completely offloaded to generative AI will strip the human of too much creative control. *Exploration* drives conceptual breakthroughs. If generative AI conducts all exploration, humans may lose the ability to explore undiscovered territory as such models only iterate on existing wisdom which can lead to intellectual stagnation. *Deliberate and Intentional Engagement* ensures that creativity remains an active, thoughtful process rather than a passive, automated one. Over-reliance on AI risks turning creators into curators, accepting AI-generated outputs without refining them. Without intentionality, creative workflows will become overly formulaic.

5 Design Paradigms Supporting Tools for Thought

We provide suggestions in the form of design paradigms to protect the active and intentional role of humans in creative thought. Generative AI should be designed in a manner that stimulates human creativity so we may utilize human problem-solving capabilities and avoid the risk of eroding human cognition.

We should use generative AI to bring forth provocations in the form of questions, counterarguments, and alternate perspectives. This is not a proposal to expel users from the role of curator; rather, it's more of a "balancing of the scales" that makes better use of both generative AI and people's abilities to ideate. If we build generative AI that asks questions, presents alternative perspectives, and promotes independent thinking, we can prevent offloading the characteristics of creativity that relate to decision-making and critical thinking.

We provide concrete examples of design paradigms that supports the primary role of human cognition in creative workflows. For instance, **Socratic AI** that asks counter questions to provoke critical thinking instead of providing solutions will ensure humans are reflecting on ideas generated by human-AI collaboration. Moreover, it will ensure that the creative direction and exploration is driven by human intent rather than humans taking dictations from AI. A **Scaffolding AI** will discourage dependence of human cognition on AI by gradually reducing support and instead help humans learn and build independence. Building AI more responsibly is the way forward to prevent the threat of erosion of human cognition and creativity due to the misuse of generative AI.

6 Conclusion

In this work, we described how characteristics of creativity are being reified by generative AI, identifying characteristics that cannot be offloaded to the technology if we hope to protect human cognition. We suggest design paradigms for generative AI that serve to protect the active and intentional role of humans in creative thought, inculcating critical thinking while embracing the positive potential of generative AI to support workflows. While generative AI has the potential to completely transform workflows, it is our responsibility to establish boundaries so that the technology does not erode human cognition.

References

[1] Nantheera Anantrasirichai and David Bull. 2022. Artificial intelligence in the creative industries: a review. *Artificial intelligence review* 55, 1 (2022), 589–656.
[2] Tim Bayne, David Brainard, Richard W Byrne, Lars Chittka, Nicky Clayton, Cecilia Heyes, Jennifer Mather, Bence Ölveczky, Michael Shadlen, Thomas Suddendorf, et al. 2019. What is cognition? *Current Biology* 29, 13 (2019), R608–R615.
[3] Marion Botella and Todd Lubart. 2019. From dynamic processes to a dynamic creative process. *Dynamic perspectives on creativity: New directions for theory, research, and practice in education* (2019), 261–278.
[4] Josiah D Boucher, Gillian Smith, and Yunus Doğan Telliel. 2024. Is Resistance Futile?: Early Career Game Developers, Generative AI, and Ethical Skepticism. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*. 1–13.
[5] John D Bransford and Barry S Stein. 1993. The IDEAL problem solver. (1993).
[6] Nicholas Caporusso et al. 2023. Generative artificial intelligence and the emergence of creative displacement anxiety. *Research Directs in Psychology and Behavior* 3, 1 (2023).
[7] Adalberto Fernandes. 2024. The Replacement of What? Artificial Intelligence, Creativity and (More-than-) Humanness. *Journal of Creative Communications* (2024), 09732586241275955.
[8] Frederic Gmeiner, Humphrey Yang, Lining Yao, Kenneth Holstein, and Nikolas Martelaro. 2023. Exploring challenges and opportunities to support designers in learning to co-create with AI-based manufacturing design tools. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–20.
[9] Matthew Guzdial, Nicholas Liao, Jonathan Chen, Shao-Yu Chen, Shukan Shah, Vishwa Shah, Joshua Reno, Gillian Smith, and Mark O Riedl. 2019. Friend, collaborator, student, manager: How design of an ai-driven game level editor affects creators. In *Proceedings of the 2019 CHI conference on human factors in computing systems*. 1–13.
[10] Dewi Lanjar Ibana Hutagalung, Laili Khoirul Nisa, and Dian Marlina Verawati. 2024. Artificial Intelligence And Human Creativity: Collaboration Or Replacement?. In *Bengkulu International Conference on Economics, Management, Business and Accounting (BICEMBA)*, Vol. 2. 965–972.
[11] Nanna Inie, Jeanette Falk, and Steve Tanimoto. 2023. Designing participatory ai: Creative professionals' worries and expectations about generative ai. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–8.

[12] Majeed Kazemitabaar, Justin Chow, Carl Ka To Ma, Barbara J Ericson, David Weintrop, and Tovi Grossman. 2023. Studying the effect of AI code generators on supporting novice learners in introductory programming. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–23.

[13] Michael Muller, Justin D Weisz, and Werner Geyer. 2020. Mixed initiative generative AI interfaces: An analytic framework for generative AI applications. In *Proceedings of the Workshop The Future of Co-Creative Systems-A Workshop on Human-Computer Co-Creativity of the 11th International Conference on Computational Creativity (ICCC 2020)*.

[14] Michael D. Mumford, Kelsey E. Medeiros, and Paul J. Partlow. 2012. Creative Thinking: Processes, Strategies, and Knowledge. *The Journal of Creative Behavior* 46, 1 (2012), 30–47.

[15] Syeda Masooma Naqvi, Ruichen He, and Harmanpreet Kaur. 2025. A Cross-Level Perspective on The Role of Generative AI in Design: Catalyst for Creativity or a Hollow Trend?: A Cross-Level Perspective on The Role of Generative AI in Design. *Proceedings of the ACM Conference on on Human Factors in Computing Systems (Forthcoming)* (2025).

[16] Srishti Palani and Gonzalo Ramos. 2024. Evolving roles and workflows of creative practitioners in the age of generative AI. In *Proceedings of the 16th Conference on Creativity & Cognition*. 170–184.

[17] Michael I Posner. 1973. Cognition: An introduction. (1973).

[18] Mark A Runco and Ivonne Chand. 1995. Cognition and creativity. *Educational psychology review* 7 (1995), 243–267.

[19] R Keith Sawyer. 2021. The iterative and improvisational nature of the creative process. *Journal of Creativity* 31 (2021), 100002.

[20] George Siemens, Fernando Marmolejo-Ramos, Florence Gabriel, Kelsey Medeiros, Rebecca Marrone, Srecko Joksimovic, and Maarten de Laat. 2022. Human and artificial cognition. *Computers and Education: Artificial Intelligence* 3 (2022), 100107.

[21] Nikhil Singh, Guillermo Bernal, Daria Savchenko, and Elena L Glassman. 2023. Where to hide a stolen elephant: Leaps in creative writing with multimodal machine intelligence. *ACM Transactions on Computer-Human Interaction* 30, 5 (2023), 1–57.

[22] Robert J Sternberg. 2020. Stalking the elusive creativity quark: Toward a comprehensive theory of creativity. In *New directions in aesthetics, creativity and the arts*. Routledge, 79–104.

[23] G Wallas. 1926. The art of thought. *Franklin Watts* (1926).

[24] Qian Wan, Siying Hu, Yu Zhang, Piaohong Wang, Bo Wen, and Zhicong Lu. 2024. " It Felt Like Having a Second Mind": Investigating Human-AI Co-creativity in Prewriting with Large Language Models. *Proceedings of the ACM on Human-Computer Interaction* 8, CSCW1 (2024), 1–26.