Abstract

With the unprecedented development of large-model-based artificial intelligence (AI) and its rapid integration into creative and innovative industries, we are witnessing a paradigm shift in the creative and inventive process. If we adopt Margaret Boden's product-based definition of creativity—the ability to generate outputs that are novel, surprising, and valuable—then arguably, state-of-the-art (SOTA) AI has evolved into what may be called *artificial creativity* (AC). Unlike traditional tools such as paintbrushes or microscopes, AC now plays an active role in this new paradigm, particularly in the downstream stages of solution exploration and predictive synthesis.

Because of their distinctive strengths, human researchers and AI contribute differently to this new collaborative landscape. Humans excel at discovering and framing creative problems in complex, real-world contexts, drawing on lived experience and a rich understanding of causal relationships. AI, by contrast, excels at generating potential solutions within the problem space defined by human researchers, owing to its unprecedented capability to detect subtle correlations within vast datasets. In my opinion, it is precisely this division of "cognitive" labor that gives rise to *Centaur Inventing Synergies* (CIS), where human and AI collaborate by leveraging their respective advantages—often achieving results far greater than the sum of their parts.

Boden, a pioneer in both creativity research and AI studies, distinguishes three forms of creativity: *combinational*, *exploratory*, and *transformational*. While AC has demonstrated impressive capabilities in the first two—recombining ideas or exploring within pre-defined conceptual spaces—it remains remarkably limited in achieving *transformational creativity*. A defining feature of transformational creativity—embodied in human beings' remarkable capability to find and frame pathbreaking problems—is its intimate connection with the 'unknown unknown' territory of human knowledge. Unlike combinational or exploratory processes, transformational creativity ventures beyond existing ontologies, identifying problems that had not yet been articulated—often by disrupting core assumptions of a field. This capacity to perceive and formulate challenges that lie outside the current map of knowledge is a deep epistemological achievement. By contrast, even the most advanced AI models operate within closed-world assumptions derived from training data; they reveal (sometime novel) structures among the known, but cannot reach what is as yet unthinkable. If patent law fails to distinguish *post hoc* correlations made possible by AI from these *ex ante* human leaps, it risks penalizing the very form of creativity that drives scientific and technological breakthroughs.

Not surprisingly, this new inventing paradigm poses systematic challenges to long-standing patent law doctrines—from inventorship and disclosure to the "ultimate

condition of patentability," non-obviousness (or inventive-step, as it is termed in many European and Asian countires). In particular, CIS has the potential to elevate the skill level of the hypothetical "person having ordinary skill in the art" (PHOSITA), a central but underdevelped legal construct underpinning key judicial inquiries.[1] Some commentators have gone so far as to suggest that, in the AI age, "everything is obvious," or that we are witnessing "the end of the patent system as we know it."[2]

Respectfully, I disagree with these views. Rather than prematurely lamenting—or celebrating—the end of patent law, we must keep a clear vision of the real challenges posed by state-of-the-art ("SOTA") AI, rather than by the speculative, sci-fi version inflated by AI hype. These challenges may arise at the doctrinal level or implicate deeper theoretical foundations for justifying patents as a vital form of intellectual property. On a more philosophical plane, artificial creativity (AC) offers a timely opportunity to revisit—and, where necessary, reaffirm—the *telos* of intellectual property law: to promote human creativity not as a means to an end, but as an end in itself. That ideal, rooted in Renaissance humanism, has too often been overshadowed by fundamentalist utilitarian logics reinforced through successive industrial revolutions.[3]

As a key doctrinal pillar, the non-obviousness requirement should: (1) identify how the emerging division of labor between humans and SOTA AI alters the evaluative baseline; and (2) respond systematically, rather than through piecemeal doctrinal tweaks. In two articles, I try to examine these challenges and propose how non-obviousness doctrine might adapt to the "AI challenge." Specifically, I explore:

1. How CIS may affect the skill level attributed to PHOSITA, that "ubiquitous but vague" construct in patent law;
2. How CIS may challenge the current doctrine of analogous art; and, on the basis of 1. and 2.,
3. Whether "everything becomes obvious" in the AI age—and how the law might respond to preserve a meaningful threshold of invention.

This article focuses on the first and second inquiries. Specifically, it argues that the existing two-pronged test for "analogous art" has a major drawback, and if left unchecked, it may unduly penalize human creativity in the AI age—
especially *transformational creativity* rooted in groundbreaking problem finding and framing.

---

[1] Regarding the underdeveloped part, see Laura Pedraza-Farina, *The Ghost*
[2] See Ryan Abbott; Tom Dornis
[3] See Mark Lemley, *Faith-Based IP,*

Under U.S. patent law, prior art must be "analogous" to be considered in a non-obviousness inquiry. This limitation is perceived to be grounded in two concerns: (1) that a PHOSITA cannot be expected to know all teachings across all fields, and (2) that without such constraints, hindsight bias may distort the judgment. The Federal Circuit recognizes two categories of analogous art: (i) art within the same field of endeavor, and (ii) art "reasonably pertinent" to the problem "with which the inventor is involved." *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004)

Through two thought experiments—(1) how bicycle mechanics inspired the Wright brothers' breakthrough in human aviation by reframing the crucial challenge of three-dimensional control, and (2) how the ancient Chinese art of origami enabled novel surgical tools—this article shows that the if current doctrine remains unexamined, the positive error of a PHOSITA in the AI age (or CHOSITA – an ordinarily skilled Centaur inventing team) would be substantially increased. In doing so, it risks undermining patent protection for radical PFF inventions—those that likely would remain human researcher's stronghold in the foreseeable future. Once a human inventor identifies and frames a new problem, AI's unmatched capacity to draw correlations may retrospectively render even distant art "pertinent"—despite the fact that such art would have been invisible to the CHOSITA *before* the problem was so framed. The result is a systematic, under-recognized bias against human being's creative leaps at the frontiers of technological knowledge.

1. Introduction

As the "ultimate patentability requirement," the doctrine of non-obviousness reflects a deep rationale of patent law: to merit protection, an invention must be adequately creative in the legal sense—that is, it must represent a meaningful advance over the existing body of technological knowledge (the prior art). Yet, because there is no fixed threshold for what qualifies as "enough" of an advance, assessing non-obviousness is inherently complex and susceptible to both subjectivity and hindsight bias. For decades, courts and scholars have wrestled with the challenge of evaluating this requirement in a structured and consistent manner.

In *Graham v. John Deere*, the U.S. Supreme Court established a four-factor framework to guide non-obviousness assessments. The first three factors are factual inquiries: (1) the scope and content of the prior art, (2) the differences between the claimed invention and the prior art, and (3) the level of ordinary skill in the pertinent art (PHOSITA). The fourth factor—whether the claimed invention as a whole would have been obvious to a PHOSITA at the time of invention—is a question of law derived from the preceding factual determinations. The Court also acknowledged that "secondary considerations," such as commercial success, long-felt but unsolved needs, and the failure of others, may shed light on the overall inquiry.[4] In the years that followed, the Federal Circuit recharacterized these secondary considerations as "objective indicia" of non-obviousness—a deliberate effort to constrain judicial subjectivity and reinforce analytic discipline.[5]

With the rapid rise of state-of-the-art (SOTA) artificial intelligence—particularly large scale model based machine learning—we are witnessing the emergence of a new inventing paradigm.[6] In a previous article, I termed this paradigm *Centaur Inventing Synergies* (CIS), borrowing the metaphor from Garry Kasparov, the first human world chess champion defeated by a computer.[7] In CIS, human researchers and AI systems leverage their distinct comparative strengths, working toward a shared inventive goal as defined by the humans.[8] As Section II explains, compared with conventional research tools like microscope or lithography, SOTA AI may contribute significantly to the conception of the claimed invention.[9] On the other hand, human beings (still) possess several innate capabilities that even the most remarkable SOTA AI does not: the ability to reason about causality, draw on lived experience, and engage in ethical judgment.[10] These uniquely human faculties empower researchers to contribute meaningfully and often decisively in the form of creative *problem finding and framing* (PFF)—a stage particularly instrumental in transformational creativity that AI cannot automatically replicate.[11]

Three components of the *Graham* framework are especially likely to be impacted by the CIS model: two factual inquiries—(1) the scope and content of the prior art and (3) the level of ordinary skill in the art—and the ultimate legal determination of obviousness. This Article focuses on the first two. Its goal is to examine how SOTA AI may challenge the doctrine of *analogous art*, which defines the scope and content of prior art to be considered under *Graham* Step One, and in doing so, also discusses how SOTA AI impacts the level of PHOSITA. Section II briefly introduces the new CIS (Centaur Inventing Synergy) paradigm and explains why *transformational creativity*—defined as the crucial cability to identify paradigm-opening or paradigm-shifting problems—is likely to remain the human being's stronghold, at least in the foreseeable future. This section builds on my earlier work on human-AI inventing synergie.[12]

4

5

6 See *Infra*

7

8

9

10

11

12 See Yuan Hao, *The Rise of Centaur Inventors,* Journal of Patent and Trademark Law Office (2023).

Section III reviews the doctrine of analogous art and highlights its implicit assumption that the problem to be solved is already known or well-articulated. Drawing on this foundation, Section IV presents two thought experiments—(1) how the Wright brothers, informed by their experience as seasoned cyclists, reframed the challenge of flight by focusing on the overlooked problem of three-dimensional control of the flying appratus, and (2) how the ancient Chinese art of origami—originally a remarkably non-analogous domain—became functionally analogous to surgical design only after a novel medical problem had been identified and precisely framed. These examples illustrate that, if left unexamined, the current doctrine of analogous art could systematically reinterpret remarkably remote references as "reasonably pertinent" to a *Centaur PHOSITA*(CHOSITA)—i.e., a PHOSITA augmented by ordinarily accessible AI tools.[13] This shift risks undermining patent protection for highly innovative PFF inventions and inadvertently penalizing the most creative human contributions at the frontier of technologies. Section V concludes.

2. The Significance of PFF in the New Inventing Paradigm of Centaur Inventing Synergies ("CIS")

2.1 The Rise of Centaur Inventors

We are living through a turning point in the history of invention. In my 2022 paper, *The Rise of Centaur Inventors*, I argued that we are indeed entering a new inventing paradigm in human history—what I termed Centaur Inventing Synergies (CIS)—where human researchers and state-of-the-art (SOTA) AI work in tandem, each leveraging their distinct comparative strengths. Because of human being's live experience and our superior faculty to understand causation, human researchers in the CIS would define the inventive goals (steer the research direction as the human being's upper body in the Centaur image), curate the training dataset and do the final value judgment of the inventive outputs, while the deep-learning based AI tools (or agents) would greatly help in predicting solutions within the carefully defined problem space, due to their unprecedented strength in correlation recognition in mass data. This new paradigm is likely to challenge several key doctrines of patent law, including inventorship, inventiveness/non-obviousness, and disclosure. Recent developments in AI-assisted scientific discovery—especially progress in materials science, drug design, and clean energy—reinforce the practical significance of the CIS concept.

The essence of CIS lies in recognizing the comparative strengths of both human beings and this super tool with unprecedented "horsepower": (1) while SOTA AI has

[13] See *Infra* Part III.

become a remarkable assistant for navigating vast solution spaces (essentially through sophisticated correlation-based inference), it remains inherently limited in its ability to formulate original problems; and (2) by contrast, human beings possess a deeply contextual, causally grounded, and experience-driven capacity for identifying unseen or unexpected problems—the very kind of creative insight that often forms the genesis of pioneering inventions. This division of creative labor reflects a fundamental asymmetry: AI can predict what is *likely*, but only human beings are capable of asking what is *possible*, and what is *valuable*. Invention, in its most profound sense, begins with a question no one else has thought—or dared—to ask.

This distinction was powerfully echoed in the co-founder of Hugging Face, Thomas Wolf's March 2025 response to Anthropic CEO Dario Amodei's highly influential essay one year before, "The Machine of Loving Grace," where Amodei asserted that AI systems might very soon ("in one or two years") become the next Einstein.[14] Wolf pushed back, arguing: "To create an Einstein in a data center, *we don't just need a system that knows all the answers, but rather someone that can ask questions nobody else has thought or dared to ask*—one that writes 'what if everyone was wrong about this,' when all textbooks and common knowledge suggest otherwise."[15] (Bravo!!) Similarly, Yann LeCun has long argued that intelligence must involve the capacity to build inherent world models and autonomously *originate* questions (note: not automatically *replicate*)—capabilities that current machine learning models based largely on large data do not yet possess.[16] In a similar vein, Judea Pearl (Turing prize winner and author of the seminal book, *the Book of* Why) lately said during a lecture …… These reflections align closely with my longstanding emphasis on problem finding and framing (PFF) as a curical defining feature of human creativity—one that SOTA AI, built essentially on statistical prediction, cannot easily replicate.[17]

2.2 Human Creativity in Problem Finding and Framing ("PFF")

One insight that IP law may draw from modern creativity research lies in its systematic study of the creative process itself**,** rather than focusing solely on the outcome. For example, drawing upon the decades of empirical consensus, Reith Sawyer organized the creative process around an integrated framework that consists of eight crucial stages:[18]

14

15

16

17 For curious minds of the "why" behind this emphasis, see, e.g. *the Book of Why* (2018). Also Prof. Pearl's recent intervew…

18 Another consensus from the second wave of creativity research is that creativity isn't a single, unitary mental process. Instead, it results from many distinctive mental processes, each associated with one of the eight identifiedstages.

1. *Find and frame the problem.*
2. *Acquire knowledge relevant to the problem.*
3. *Gather a broad range of potentially related information.*
4. *Take time off for incubation.*
5. *Generate a large variety of ideas.*
6. *Combine ideas in unexpected ways.*
7. *Select the best ideas, applying relevant criteria.*
8. *Externalize the idea using materials and representations.*

Similarly, [cite to the classic research of inventing process ...]

For this article's sake, the key point lies in the first stage: problem finding and framing ("PFF")—the capability to identify a potentially significant problem and formulate it in a way that opens the path to transformative, rather than incremental, solutions.[19] As John Dewey observed in 1933, "Often, the bottleneck step in a particular innovation is finding and framing a problem to be solved. Once a problem is defined, the steps to its solution frequently reveal themselves." Albert Einstein echoed a similar view when he famously remarked, "If I had an hour to solve a problem and my life depended on the solution, I would spend the first fifty-five minutes determining the proper question to ask, for once I know the proper question, I could solve the problem in less than five minutes."[20]

[Theory is all you need?...]

One reason PFF is such a significant step in the creative process, in addition to the fact that it largely dictates the research/creative direction, is that it often demands a higher level of creativity than problem solving itself. Generations of creativity researchers have consistently found that exceptional creativity more often emerges from the effort to formulate a meaningful generative problem, rather than from solving a superficially defined one, and this is not limited to the technological areana [cite Chicago experiments].[21] One reason that exceptional findings often follow a generative problem rather than a superficial one, is that the latter are mere symptoms of deeper, more complex issues. When one moves too quickly to address these surface-level symptoms, the underlying root problem may remain hidden—and the opportunity for a more fundamental and lasting solution is lost. An example given by Sawyer is that one might view poverty as a problem to be solved simply by giving poor people money – yet this approach addresses only the symptom, "no money", without grappling with deeper

[19] There are a variety of terms for problem finding and framing, most common of which are problem discovery, problem identification, problem posing, problem formulation, problem defining and problem construction (Abdulla et al., 2020).

[20]

[21] Beitttel & Burkhart, 1963; Getzels, 1964; Csikzentmihalyi, 1965; Mackwordth, 1965.

systemic causes. Is poverty rooted in disparities in educational access, in regressive taxation systems, or in transformations in the labor market? Only by carefully uncovering and articulating such foundational questions can one hope to meaningfully address the real complexity. [22]

Generations of creativity researchers found that solving well-defined problems typically calls for convergent thinking, whereas framing and addressing ill-defined problems from the messy complexity of real world requires a higher degree of divergent thinking. The effort invested in such divergent thinking can be profoundly generative. "With truly transformative creativity, you might even create an entirely new 'search space' with a radically new topography and geography."[23]

Another reason PFF is significant is that, in the real world—whether in the arts, science, or business—problems are rarely presented in neat, well-defined terms.[24] More often, the problems innovators confront are rather ill-structured: (1) the initial conditions are ambiguous; (2) the desired end state is unclear or contested; (3) there may be multiple possible outcomes; (4) the path forward cannot be determined by routine application of past knowledge; and (5) there may be several potentially viable approaches to a solution.[25]

[...]

In his illuminating book *Questions Are the Answer*, Hal Gregersen explores a particular class of "good problems" he calls *catalytic questions*—so named because, like catalysts in chemical reactions, they lower cognitive barriers and release creative energy.[26] Once articulated, such questions have the power to shift entrenched thinking and open entirely new pathways. Citing the work of Stanford creativity researcher Tina Seelig, Gregersen emphasizes that "all questions are the frame into which the solutions fall." [27] Consequently, breakthroughs often hinge not on finding answers to existing questions, but on asking the right questions in the first place.

Yet catalytic problems also share a *paradoxical trait*: they are often strikingly original in the moment they are posed, yet in retrospect, they seem almost self-evident.[28] This paradox makes them especially susceptible to *hindsight bias*—an issue

[22] See Sawyer, Chapter 5, *Explaining Creativity* (2023).
[23] *Id.*
[24] For PFF in art, see the Chicago experiment.
[25] (Mumford et al., 2003; Jay & Perkins, 1997)
[26] at 4. In fact, in another well-circulated book *The Innovator's DNA*, Gregersen together with his co-authors Clay Christensen and Jeff Dyer concluded that one of five key skills that distinguished outstanding innovators from ordinary people is their questioning behavior. See
[27] At 22. In his book, Gregersen gave many examples of such catalytic problems. One example is the Kodak
[28] *Id.*

of particular concern when evaluating the non-obviousness of inventions rooted in creative PFF, as later Sections will demonstrate.[29]

[...]

A defining characteristic of transformational creativity in human problem finding and framing (PFF) is its intimate connection with the "unknown unknowns" of human knowledge. Whereas routine or exploratory creativity operates within known conceptual spaces, transformational creativity ventures beyond the current map—identifying problems that had not yet been formulated, often by reframing or disrupting foundational assumptions or conjecture (think of classical mechanics v quantum mechanics...). This capacity to perceive and articulate challenges that lie outside the existing human knowledge infantry is a superbly creative act - it involves seeing gaps in understanding that are not even recognized as gaps, a feat no statistical model, no matter how powerful, can autonomously perform.[30] By contrast, SOTA AI systems operate within a closed world of known data distributions and training paradigms. Their power lies largely in sophisticated interpolation, rather than boundary-crossing extrapolation; they reveal (very cleverly) latent structures among the known – and true it's very useful (see Section 2.3),[31] yet do not extend the boundaries of what is knowable. This innate asymmetry suggests that human PFF will likely remain indispensable in initiating genuine leaps in invention in the foreseeable future.[32] **And if patent law fails to recognize and reward these unique human feats, i.e. by conflating *post hoc* AI-assisted correlations with *ex ante* human insight, it risks penalizing the form of creativity most vital to long-term technological progress.**[33]

Breif Illustrations: *How Creative PFF Catalyzed Paradigm – Shifting Research in History of Inventions*

2.2.1 *From Bicycles to Airplane: How Wright Brothers' Transformative Problem Finding and Framing Catalyzed Human Flight*

[29] See *Infra*

[30]

[31] Prof. Pedra-Farina identified three kinds of barriers due to social network failures: 1) lack of social-cognitive ties; 2) cognitive distance; and 3) different (or clashing) evaluative frames - How would AI impact them? ...... Arguably, AI may help address some of these innovation failures, but importantly, not much on social dimension – much relying on human researchers' tacit knowledge + problem driven

[32]

[33] Although such utilitarian risk is not the sole reason.

The Wright brothers' invention of the first successful heavier-than-air flying machine in 1903 offers a quintessential illustration of creative problem finding and framing (PFF) in action. Their success in Kitty Hawk did not arise from incremental improvements on known designs, but from a profound reframing of what the bottleneck problem of flight actually was.[34] At the turn of the twentieth century, most researchers in the aviation art focused on increasing lift and power. Samuel Langley, for example, invested substantial public funds in developing ever stronger propulsion systems, assuming that success depended primarily on overcoming gravity.[35] Wilbur and Orville Wright, by contrast, had a hunch that an equally crucial challenge of heavier-than-air flight lies in adequate control—how to maintain dynamic equilibrium in three-dimensional motion once the machine is airborne.[36]

This reframing was neither explicit nor logically deducible from the prevailing state of the art. It emerged from the brothers' lived experience as both avid cyclists and expert bicycle mechanics. As Philip Johnson-Laird (2005) observed, the Wright brothers' mental models of balance and steering—honed through years of repairing and riding inherently unstable bicycles—enabled them to perceive an underlying structural analogy between two then-seemingly-unrelated domains: cycling and flying. In both, stability is not achieved through rigidity but through continuous, responsive adjustment to dynamic forces. Through this intuitive and embodied understanding, the Wrights reconceptualized flight as a problem of dynamic control rather than one of static lift. In fact, their 1903 "Flying Machine" patent explicitly stated the object of the invention as "maintaining or restoring the equilibrium or lateral balance of the apparatus," a formulation that directly reflected this newly defined problem space. This problem shift paved the path to human being's first success in heavier-than-air flight.

From this new framing flowed a sequence of inventive leaps. Most notably, they devised a method of wing warping that allowed differential control of an aircraft's lateral balance—an insight inspired by the rider's subtle counter-steering on a bicycle. They coupled this mechanism with coordinated control of pitch and yaw, creating the world's first effective three-axis control system. In terms of creativity theory, this work exemplifies transformational rather than exploratory creativity: the Wright brothers did not merely navigate a known problem space; they expanded it by posing a catalytic new question—*How can a pilot control an inherently unstable body in the air?*—thus opening an entirely new path for invention.

For our discussion, what is remarkable of the Wright brothers' story is how analogy, guided by causal reasoning, facilitated this transformation. The Wrights'

34

35

36

cognitive model of the bicycle served as a bridge between intuition and abstraction, enabling them to import causal intuitions of balance, feedback, and movement into an unfamiliar domain. As Johnson-Laird explains, they reasoned abductively and diagnostically—constructing and refining mental models of aerodynamic interaction through iterative testing, including extensive experimentation in their self-built wind tunnel. In doing so, they enacted precisely the iterative, co-constitutive process of problem finding and solution development that modern creativity research (Dewey 1933; Sawyer 2012; Gregersen 2018) identifies as the hallmark of paradigm-shifting innovation. Their work stands as a historic exemplar of how creative problem finding and framing—rooted in lived experience, analogical reasoning, and intuitive understanding—can catalyze breakthroughs that redefine what is possible.

2.2.2 Origami-inspired surgical tools

Among a series of pathbreaking innovations of the past century, one recent development in surgical design offers another vivid illustration of creative problem finding and framing: the application of origami principles to minimally invasive medical tools. The medical challenge was long-standing—how to design surgical instruments small enough to enter the human body through tiny incisions, yet large and strong enough to function effectively once inside. For decades, researchers focused on pushing the boundaries of miniaturization within the traditional paradigm of rigid-link mechanisms. But despte incremental advances over the past decades, a core dilemma remained: the tool could not be too large to insert, nor too small to operate.

This bottleneck began to break when a team of researchers at Brigham Young University, led by Professors Larry Howell and Spencer Magleby, reframed the problem. Rather than asking conventionally how to make surgical tools ever smaller, they posed a catalytic new question: *How to design a surgical tool that could be inserted in a compact, folded form and then deploy into a functional shape once inside the body?* This new frame essentially transformed a mechanical impasse into a geometric design opportunity—one made possible by borrowing from a seemingly unlikely domain: the ancient Asian art of origami.[37]

[37] The ancient art of origami was firstly invented in China in the 2th Century AD. It was afterwards learned and further developed by the Japanese artists in the 6th Century AD. See

Howell credited his team's crucial insight to a doctoral student who pointed them toward the mathematical precision and spatial logic of origami artists. "We realized there were a lot of things we could learn from these origami artists that could help us doing engineering in ways we would not have discovered using our traditional approaches," he later reflected.[38] Magleby also mentioned, one reason the medical industry became interested in origami is to create smaller devices, but they wanted a new concept – not just a smaller device, but a new way to think about the devices.[39]

The connection was reinforced by the work of Robert Lang, a Caltech-trained physicist and origami master whose folding algorithms had already gained attention at NASA and the Lawrence Livermore National Laboratory.[40] Lang's designs—such as deployable telescope lenses and light-blocking "starshades"—demonstrated how intricate crease patterns could fold large structures into compact forms and then re-expand with precision.[41] His work bridged cognitive distance between cultural art and advanced engineering—providing not only technical inspiration but also a compelling example of how problems in one domain can be reimagined through the lens of another.

Inspired by this cross-domain analogy, the BYU team began building surgical tools based on compliant mechanisms—structures that bend at flexure points rather than rotate at joints.[42] These single piece devices, modeled on origami folds, eliminated the need for hinges or pins and made it possible to construct tools that were both small in insertion and expansive in deployment.[43] Among their innovations were the Oriceps, a grasping tool that fits through a 3-millimeter incision and unfolds like a chomper, and the D-Core, a spinal disc replacement that begins flat and expands into two curved, rolling surfaces to simulate vertebral movement.[44]

Importantly, none of these inventions would have been possible but for the pathbreak problem reframing. Before the reframing, no PHOSITA (Person Having Ordinary Skill in the Art) of surgical instrumentation would have reasonably considered origami to be a relevant field of reference. Only after the problem was redefined—when size became a variable rather than a rigid constraint—did origami become functionally pertinent.

From the perspective of modern creativity research, the reframing in cases such as the Wright brothers' pioneer work in aviation and the origami-inspired surgical tools

---

38

39

40

41

42

43

44

exemplifies transformational problem finding and framing**:** it changed not just the approach to a solution, but the ontology of the problem itself.[45] In each case, the inventive leap began not with a technical solution, but with a catalytic shift in problem framing—one that opened up entirely new conceptual and design spaces. Such breakthroughs highlight a crucial but oft-undervalued defining feature of human creativity: the capacity to identify generative problems that had not yet been recognized, often by drawing on lived experience, analogical reasoning, and insights from seemingly distant domains. In history of inventions, such transformational PFF has long served as the generative engine behind some of the most consequential innovations in science and technology.

2.3 SOTA AI's Unprecedented "Horsepower" in Problem Solving

Yet despite this limitation in PFF, SOTA AI has begun to demonstrate extraordinary capabilities in *problem-solving*—once the original problem has been well-formulated by human researchers.[46] As exemplified by the following case studies in materials science and drug design, we are indeed witnessing the rapid emergence of the CIS paradigm: a powerful synergy for scientific research and invention between human and SOTA AI.

2.3.1 *Centaur Inventing Synergies in Materials Research: The Inverse Materials Design*

Materials science research plays an indispensable role in a wide range of modern industrial sectors, e.g. renewable energy, energy storage, space technology, semiconductor devices, and AI. However, designing novel materials with precisely tailored properties has long been a daunting task, largely due to the vast uncharted design space and the difficulty of predicting the non-linear relationships between material structure, properties, and processing parameters.[47] The three conventional approaches to materials design—namely, Edisonian trial-and-error (TAE), theoretical

[45] I think this story of origami-inspired surgical design also exemplifies a broader pattern identified by Professor Laura Pedraza-Fariña in her seminal 2017 article, *The Social Origins of Innovation Failures*. Drawing on sociology of science, she observes that "breakthrough ideas arise from the work of teams that bring together knowledge from cognitively-distant communities to find and frame new problems at their intersection." These insights do not emerge from the routine application of existing expertise, but from boundary-crossing collaborations that make unfamiliar connections visible. In fact, Pedraza-Farina argues, "breakthrough ideas are rare precisely because of social network failures." This framing aligns precisely with the origami-surgery case, where inspiration from paper folding—an art form far afield from biomedicine—enabled a redefinition of the problem space and thus a reordering of what prior knowledge became pertinent. See Laura Pedraza-Farina, *The Social Origins of Innovation Failure* (2017)

[46] Often it's "researchers" rather than "researcher" in modern R&D teams, and this may have implications…

[47] Pyzer-Knapp, E.O., Pitera, J.W., Staar, P.W.J. et al. *Accelerating Materials Discovery Using Artificial Intelligence, High Performance Computing and Robotics*. Npj Comput Mater 8, 84 (2022). https://doi.org/10.1038/s41524-022-00765-z

models governed by physical and chemical rules, and traditional computer screening—are all by nature forward screening, in that they begin with some candidate materials and proceed toward the goal of desired properties.[48] Among these, the TAE method - often amplified with some form of computer screening- is the most commonly used. It relies heavily on serendipitous discovery and is often exorbitantly time-consuming and expensive—taking years or even decades to develop a material that meets the target performance criteria.[49]

A typical TAE process involves the following iterative steps:[50]

1. **Literature Review & Conjecture Formulation**: Researchers begin by carefully reviewing existing influential literature and, based on prior knowledge and intuition, formulating conjectures about potential candidate materials for experimentation.
2. **Trial-and-Error Experimentation**: A few candidate materials based on the initial conjecture are designed and often selected manually. This step is usually both slow and uncertain, as there is no guarantee that the chosen compositions will succeed.
3. **Prototype Synthesis & Lab Testing**: Prototypes of the designed materials are synthesized in the lab and subjected to performance testing. Many materials fail to meet expectations, requiring multiple rounds of refinement.

This process is repeated by adjusting compositions and re-testing, until a satisfactory result is eventually achieved. This trial-and-error cycle can span months to decades, and the probability of successful commercialization remains low. Overall, while these forward screening approaches have led to incremental advances, they are inherently limited by the challenges of navigating vast chemical design spaces.

To address these limitations, researchers have increasingly explored *inverse design* (ID), which reverses the pipeline by beginning with desired material properties and then computationally predicting candidate structures to match them.[51] This shift is not merely technical: it reassigns the human researcher's role from near-random exploration—not a particularly strong human trait—to strategic *problem finding, framing, and constraint setting*, which alights with human researcher's comparative advantage in posing meaningful scientific questions and delineating the relevant design space, then activating AI's comparative advantage in navigating a vast but well-defined problem space.

[48] *Id.*
[49]
[50]
[51]

Early efforts in ID involved computational methods such as genetic algorithms (GAs) and Monte Carlo tree search (MCTS), which laid the groundwork for further development.[52] However, these early approaches often fell short in performance and efficiency when scaled to complex design landscapes, as they essentially relied on rigid pre-defined exploration paths with limited flexibility.[53] Over the past decade, deep learning-based generative models have emerged as a transformative tool in ID, e.g., deep reinforcement learning with human feedback (RLHF), variational autoencoders (VAE), generative adversarial networks (GAN), deep autoregressive models, and most recently, diffusion models.[54] The strength of these deep generative models lies in their robust capability to map the intricate relationships between material structure and properties, and to directly perform materials generation conditioned on target properties.[55] Materials scientists suggest that this reflects a paradigm shift from conventional forward screening to AI-driven inverse design methodologies.[56]

Microsoft's diffusion-model-based generative AI, MatterGen, has been recently publicized as a leading development in such inverse design.[57] Rather than screening known candidates, MatterGen enables goal-conditioned generation of novel inorganic crystal structures—guided by human-specified property targets such as magnetization, bulk modulus, and supply-chain safety. According to the publicized materials, its diffusion model based architecture "makes it possible to explore multi-objective optimization across the entire periodic table with unprecedented flexibility."[58] Crucially for our discussion, this generative capacity (assuming it's accurate) is not spontaneous; it is activated by creative human framing of the specific scientific objective, including the careful selection of constraints, trade-offs, and desired use cases.

Cases like MatterGen offers a vivid illustration of the Centaur Inventing Synergy (CIS) model in action: scientists do not merely provide data for AI to analyze; they create the design space itself. The researchers determine what problems matter—for example, designing thermally stable and supply-chain-resilient materials for energy infrastructure—and fine-tune the AI model accordingly. The AI tool then generates candidates across an expansive space of possible compositions, simulates their predicted properties, and ranks them by fitness.[59] Notably, this process can identify

52

53

54

55 From Fig. 1 (in the longer version of the anlogous art paper), we can see a clear trend toward inverse design, now accounting for approximately 8% of the materials design literature.

56

57

58

59 To realize the full potential of Centaur Inventing Synergies though, it is essential to form multidisciplinary teams *from* the very beginning of the research process. A well-functioning CIS team should not treat AI experts as downstream toolmakers, but as co-framers of scientific inquiry. The early integration of diverse expertise—across domains such as biology, chemistry, engineering, materials science, and machine learning—enables richer problem formulation, better

viable materials that would likely have been missed by traditional intuition or computer screening, e.g., a newly generated compound that was successfully synthesized with a bulk modulus nearly identical to the AI's prediction.[60] In this context, the inventive act lies not only in computationally predicting a structure, but perhaps more importantly, in properly *defining the specific problem worth solving*— it is this creative human framing that transforms a system rooted in statistical pattern recognition into a tool for genuine scientific discovery. In other words, it is the human intellect that decides what kind of material is worth designing, why a specific property matters, and how different trade-offs should be navigated.

An oft-overlooked yet equally important point is that *material representation in the latent space of generative models is itself an act of problem framing*. In inverse design, AI searches for candidate materials within a mathematically constructed space shaped by the model's encoding of known materials. When this representation fails to capture fundamental properties—such as periodicity and symmetry in inorganic solids—the model cannot meaningfully generate or evaluate viable new candidates, even though it is technically powerful. This highlights a deeper truth: the design of the latent space defines the structure of the inquiry itself. In this sense, the human researchers' role extends beyond posing the target properties—they must also thoughtfully choose or design the representational scheme that defines what is visible and tractable to the AI. This act of landscaping of possible discovery is an implicit, yet equally important form of creative problem framing. In other words, within the Centaur Inventing Synergy (CIS) paradigm, the human contribution thus lies not only in asking the right question / specific problem, but in constructing the very language and geometry in which the AI seeks answers. Indeed, MatterGen specifically allows fine-tuning of the model, enabling human researchers in different sub-fields to precisely guide the generative process. According to Microsoft's technical briefing, MatterGen supports user-specified property conditioning and architecture-level control mechanisms, including constraints on elemental composition and physical parameters, to align output structures with human-framed scientific objectives by inputting pre-determined properties of the target materials, and representing the desired properties in the latent space. Once again, this underscores the essential role of human creativity in the CIS: AI has become a powerful engine of solution exploration and structural optimization, but the very spark that ignited the invention—the precise articulation of a specific problem worth solving—

---

data stewardship, and the design of AI systems that are scientifically grounded, interpretable, and relevant. Such integration ensures that problems are found and framed in ways that are both computationally feasible and scientifically meaningful. It also promotes a shared language and culture of creative trust, in which rapid iteration, cross-pollination of ideas, and feedback across disciplines are routine. In contrast, compartmentalized teams often struggle to harness the full potential of multimodal data and fall into the trap of optimizing ill-posed problems. The CIS paradigm therefore demands a shift not only in tools, but in how scientific collaboration is structured: with early, sustained, and intentional dialogue across disciplinary boundaries as a foundational design principle.

60

remains distinctively human. In other words, it is the human intellect that conceives of "*what matters*" and "*why* it matters," while AI expedites the search for "*how*."

2.3.2 *Centaur Inventing Synergies in Drug Design*

2.4 US Patent Law's Inadequate Attention to the Significance of PFF in the Inventing Process (Transition to Part III).

… US patent law's narrow focus on solution conception and reduction to practice must be re-examined in light of this new inventing regime, where human creativity increasingly lies upstream of machine-generated solutions… [Citing the case law on inventorship and non-obviousness to show that US patent law hasn't paid adequate attention to the significance of creative PFF in the inventing process]…

Comment on the 2024 USPTO Guidance on AI Inventorship…

[…]

3. The Current Analogous Art Doctrine: Rationales and Drawback

Unlike the Section 102 novelty doctrine, which treats any prior reference as potentially anticipating a patent claim, U.S. patent law imposes an additional filter for Section 103 non-obviousness: any prior art reference must be pertinent—or "analogous"—to the claimed invention to even be considered.[61] This requirement rests on two interrelated rationales. First, it reflects a judicial recognition of epistemic reality: a person having ordinary skill in the art (PHOSITA) "could not possibly be aware of every teaching in every art."[62] Second, it embodies a longstanding judicial concern about hindsight bias by limiting the pool of prior art to references a PHOSITA would have reasonably consulted at the time of invention.[63]

[61] The Federal Circuit ruled that petitioner is not required to anticipate and raise analogous art arguments in its petition; instead a petitioner can use its reply" to respond to, for example, arguments raised in a patent owner response. *Sanofi-Aventis v. Mylan,* 66 F.4th at 1379 (citing 37 C.F.R. § 42.23).

[62] Art that is "too remote" from the patents being attacked cannot be treated as prior art. *In re Sovish*, 769 F.2d 738, 741 (Fed. Cir. 1985); *see also In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992) ("The combination of elements from non-analogous sources, in a manner that reconstructs the applicant's invention only with the benefit of hindsight, is insufficient to present a *prima facie* case of obviousness.").

[63]

As a key aspect of fact-finders' subjective bias, hindsight bias refers to their unconscious tendency to overestimate the predictability of a past event based on current knowledge that it has occurred.[64] Legal scholars broadly agree that hindsight bias poses a persistent and non-trivial risk in non-obviousness determinations, largely due to the temporal gap between invention and legal assessment. As Mandel and others have observed, *ex post* evaluations are inherently vulnerable to distortion: individuals routinely overestimate the *ex ante* predictability of events once outcomes are known.[65] This is not merely a matter of poor judgment—it reflects a difficult-to-avoid cognitive limitation: even when explicitly instructed to ignore post hoc knowledge, people struggle to fully suppress its influence.[66]

Empirical studies reinforce this concern. A meta-review of experimental research on hindsight bias and patentability found that up to 27 percent of participants changed their answers to binary-choice questions after learning the correct outcomes—within experimental contexts most analogous to non-obviousness inquiries.[67] Moreover, individuals tend to overestimate not only the likelihood of a known outcome occurring, but also its foreseeability.[68] A particularly relevant insight is that, compared with "solution inventions," problem inventions—those whose creativity lies primarily in finding and framing the problem rather than the solution—are especially vulnerable to hindsight bias.[69]

This phenomenon is vividly captured in Hal Gregersen's concept of "catalytic questions," as developed in his illuminating book *Questions Are the Answer*. Gregersen defines catalytic questions as those that, like catalysts in chemical reactions, can knock down cognitive barriers and redirect energy toward more productive thinking. When properly framed, these questions can dramatically shorten the path to a breakthrough solution. Yet catalytic questions also have an inherently paradoxical nature: while surprising when first posed, they often seem rather obvious in retrospect, once properly delineated. This quality—the illusion of inevitability—renders them particularly susceptible to hindsight distortion.

These findings in cognitive psychology are instructive for patent law. They suggest that problem inventions, especially those groundbreaking ones based on catalytic reframing, are more likely to be undervalued during non-obviousness evaluations. Because such inventions initially appear unexpected but later seem

[64] See Mandel, *Another Missed Opportunity: The Supreme Court's Failure to Define Nonobviousness or Combat Hindsight Bias in* KSR v. Teleflex, 12 Lewis & Clark L Rev 323, 324 (2008) at 336–37.
[65]
[66]
[67]
[68]
[69]

inevitable, the creative leap involved in their formulation is easily overlooked. As later sections explore, this has profound implications for how courts apply the doctrine of analogous art.

3.1 The Doctrine of Analogous Art

Judicial concern about hindsight bias in patentability assessments dates back at least to the late 19th century. In *Potts v. Creager*, 155 U.S. 597 (1895), Justice Brown—writing for the Supreme Court—articulated a clear rationale for evaluating the remoteness of a prior art reference. Though the phrase "analogous art" was not yet in use, the case laid its doctrinal foundation. The plaintiffs in this ccase, Clayton and Albert Potts, held patents for machines designed to disintegrate clay more efficiently. The defendants challenged the patents based on a prior art reference: the Creager wood-polishing cylinder, drawn from a distant technological field.

The Court upheld the patents, recognizing the inventive significance of adapting a wood-polishing mechanism to clay processing. Emphasizing the danger of hindsight distortion – especially in the face of successful interdisciplinary adaptation – the Court noted:

> "Indeed, it often requires as acute a perception of the relations between cause and effect, and as much of the peculiar intuitive genius which is characteristic of great inventors, to grasp the idea that a device used in one art may be made available in another as would be necessary to create the device de novo… The apparent simplicity of a new device often leads an inexperienced person to think that it would have occurred to anyone familiar with the subject, but the decisive answer is that… it had never occurred to anyone before… Now that it has succeeded, it may seem very plain to anyone that he could have done it as well. This is often the case with inventions of the greatest merit." (*Potts*, 155 U.S. at 608–09)

This incisive passage clearly reflects an early judicial intuition that great inventive insight can be misjudged as "obvious" once success is known. Yet despite the clarity of *Potts*, courts have often paid only lip service to its warning, while largely ignoring the need to operationalize its wisdom. As the following review of modern Federal Circuit case law shows, a crucial part of *Potts*'s wisdom—how to protect the recognition of creative leaps in inventions of the "greatest merit"—remains severely underdeveloped.

Under current Federal Circuit precedent, a reference qualifies as analogous art if it meets one of two criteria: (1) it is from the same field of endeavor as the claimed invention, regardless of the problem addressed; or (2) even if from a different field, it is "reasonably pertinent to the particular problem with which the inventor is involved."

See *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004); *In re Deminski*, 796 F.2d 436, 442 (Fed. Cir. 1986); *In re Wood*, 599 F.2d 1032, 1036 (CCPA 1979). Whether a reference is analogous art is a question of fact. *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1378 (Fed. Cir. 2007).

Admittedly, the Federal Circuit has made commendable efforts to clarify this test—particularly prong one. For instance, *Bigio* emphasized that determining the field of endeavor should rely on objective indicators like the structure, function, and embodiment of the invention, as explained in the patent specification, not merely the "point of novelty" or "narrowest possible conception" or "particular focus within a given field." (Citing Gartside, 203 F.3d at 1315). Yet despite these efforts, not much concrete guidance on the methodology has been provided, and up until today, the ananolgous art tests remain largely vague and subjective.[70] Such vagueness is especially problematic with with prong two, which is not only more commonly litigated,[71] but its malleability also invites judicial inconsistency. Scholars argued that since *KSR v. Teleflex*, courts have sometimes used prong two to significantly and randomly broaden the scope of analogous art.[72] One practitioner further observed that this doctrinal looseness can allow skilled advocates "enough wiggle room in which a powerfully persuasive argument can sway a fact finder even in a seemingly hopeless situation."[73]

These concerns set the stage for Section 3.2, which explores the deeper drawbacks of this doctrinal uncertainty—particularly for recognizing and protecting inventions rooted in creative problem finding and framing.

---

[70] Jacob Sherkow, *Negativizing Patentability*

[71] *In re Bigio*

[72] Although the Supreme Court's KSR philosophy of flexibility in the non-obviousness assessment is legitimate, epseicially in view of the growing interdisciplinarity of modern inventions in the years leading to this landmark case, it didn't really provide enough concrete guidance in how to achieve the difficult balance of flexibility and the prevention of hindsight bias, and as a result, its application in later CAFC and district court cases was widely criticized as being random. See Gregory N. Mandel, *Another Missed Opportunity: The Supreme Court's Failure to Define Nonobviousness or Combat Hindsight Bias in* KSR v. Teleflex, 12 Lewis & Clark L Rev 323, 324 (2008) (arguing, following the Court's opinion in *KSR*, that an exclusive focus on "the factual underpinnings that help inform non-obvious analysis . . . has blinded many from the lapse that the quantum of ingenuity necessary to satisfy the non-obvious requirement has never been elaborated," and predicting that "[t]he failure to instruct on the legal question of nonobviousness means that non-obvious decisions will remain inconsistent and unpredictable". Scholars have even described the resulting jurisprudence as "schizophrenic" and "arbitrary." See, e.g., Sherkow, *Negativing Invention*, "This struggle to define 'the analogous art' lends credence to the notion that the analogous arts test is wholly subjective, contrary to the Federal Circuit's rebuke of the inventor's criticisms in *Bigio.* Systemically looking at the issue across district court opinions, even the most generous view of the test finds a schizophrenic approach to defining an analogous art. As in *Mykrolis,* other courts, including the Federal Circuit, have circumvented the analysis entirely. It is difficult to conclude that the analogous arts test, therefore, is anything other than a "subjective" inquiry, a matter of judicial discretion or juridical whim, inappropriate for the supposed "objective" intent of measuring obviousness against a person having ordinary skill in the art." See also Takenaka, "a serious flow inherent to the doctrine of analogous art is its arbitrary nature of defining the applicable scope."

[73] Jeffrey T. Burgess, *The Analogous Art Test,* 7 BUFF. INTELL. PROP. L.J. 63, 74 (2009).

3.2 Drawback

This Article argues that a core concern with the current analogous art doctrine lies in the application of prong two, which asks: if a prior art reference is not within the inventor's field of endeavor, is it nonetheless "reasonably pertinent to the particular problem with which the inventor is involved"? *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004). Courts often articulate this standard as whether the reference "logically would have commended itself to an inventor's attention in considering his problem."[74] Despite variations in wording, these formulations share a common—and problematic—assumption: that the "particular problem with which the inventor is involved" is already well-defined and clearly framed at the time of invention.[75]

While this assumption may often hold true for solution-driven incremental innovations, it falters when applied to some of the problem-driven breakthrough or pioneer inventions. In such cases, the inventor's most significant contribution may lie not in solving a preexisting problem that's recognized by all, but in creatively discovering and framing the groundbreaking problem itself. In such a formulating process, the inventor's cognitive act in defining the problem and identifying relevant prior art is often iterative and mutually constitutive, with problem-framing and art selection developing in tandem. The invention of the flying machine offers such a quintessential example. As later sections will explore, the Wright brothers' genius lay not only in engineering solutions, but in reframing the core problem of heavier-than-air flight—recognizing that three-dimensional dynaminc control by the pilot once the machine is in the air, not raw lift power, was the critical barrier.[76] By ignoring this iterative and constitutive relationship, i.e. between Wright brothers' formulating the 3D control problem and finding bicycle as relevant art to draw inspirations, courts applying prong two may inadvertently allow hindsight bias to expand the scope of analogous art: once the inventor has framed the problem, even distant references can retroactively

---

[74]

[75] This omission is not limited to the case law on analogous art only, but is prevalent in the case law of non-obviousness. As Prof. Laura Pedraza-Farina put it in her pathbreaking article, *The Social Origins of Innovation Failure,* "Relying on market failure models of innovation, which predict that the sum of human knowledge will be easily available to innovators to address technical problems once access costs decrease, *courts have systematically widened the amount of prior art that is considered accessible to a person having ordinary skill in the art* . And just as market failure analyses of innovation treat the origin of problems to be solved (and of those ideas that attempt to solve them) as exogenous to economic analyses of innovation, so does patent law, through its utility and obviousness doctrines, assume that problems to be solved are simply out there. As we have seen in the previous sections, however, in many breakthrough innovations, the bottleneck is actually problem-finding and problem-framing..."
treating problem-finding and framing as exogenous would disincentivize the type of breakthrough innovation that requires deep and frequent interaction between groups with different cognitive repertoires.

[76]

appear "reasonably pertinent" to the PHOSITA—thus risking undermining the very creative insight the patent system seeks to reward.

<u>Modern Case Law of the Federal Circuit and District Courts</u>

If we set aside the presumption that a clearly-defined problem always exists at the time of the invention and look closely at prong two, we may begin to see that there are, in fact, two inquiring lens embedded in the test: (1) From whose perspective is the *problem"*defined? and (2) From whose perspective is the *pertinence* determined? A careful review of modern Federal Circuit and district court opinions reveals that while the *pertinence* inquiry is often addressed explicity through the the perspective of a PHOSITA,[77] the *problem* inquiry remains largely implicit and underrecognized. That definitional step—i.e., what constitutes the specific "problem" to which a reference might be pertinent and from whose perspective it should be defined—is typically taken as given, or drawn directly from the patent specification, rather than thoughtfully constructed from the PHOSITA's lens. As will be illustrated in the later sections (the three thought experiments), this vagueness has significant consequences, especially in cases involving pioneering or groundbreaking inventions where problem defining is central to the inventor's creative contibution. But first, let's look at the doctrine itself as embodied in the case law of the Court of Appeals for the Federal Cicuit ("Federal Circuit").

A typical example of this oversight is *Wyers v. Master Lock Co.* Fed. Cir. 2010) *(*Dyk, Lourie, Lynn).[78] In this case, the Federal Circuit ultimately finds that prior art padlocks were "reasonably pertinent" to the problem addressed by the inventor's hitch lock patent. However, the court's analysis reveals a subtle yet crucial vulnerability: it relied directly on the inventor's own formulation of the problem—as articulated in the patent specification itself—rather than independently reconstructing how a PHOSITA, at the time of invention, would have framed the relevant problem. This approach risks conflating the *ex post* narrative of invention with the *ex ante* perspective required for a proper obviousness analysis. By treating the inventor's problem statement as a given, rather than interrogating whether a PHOSITA would have recognized that specific problem and sought guidance in the cited reference, the court potentially reintroduces hindsight through the back door.

Meanwhile, even in those cases where courts (the Federal Circuit and district courts) and the Board sometimes assert the authority to make independent findings of the "problem to be solved", they frequently fail to specify whose perspective indeed

[77] See, e.g. *Airbus S.A.S. v. Firepass* (2019), "Indeed, *the pertinence of the reference as a source of solution to the inventor's problem* must be recognizable with the foresight of a person of ordinary skill, not with the hindsight of the inventor's successful achievement," citing *Sci. Plastic Prods., Inc. v. Biotage AB*, 766 F.3d 1355, 1359 (Fed. Cir. 2014)
[78]

frames that inquiry. Again, this ambiguity risks collapsing the PHOSITA's average vantage point into the inventor's creative narrative, thereby reintroducing hindsight bias into the analysis—precisely what the analogous art test is meant to guard against in theory.[79]

Notably, the very text of prong two as repeatedly and faithfully cited by all courts dealing the analagous art prong two test—"if it's pertinent to the problem with which the inventor is involved" or "the problem the inventor is trying to solve," or "if it logically would have commended itself to an inventor's attention in considering *his problem*"—strongly implies that the inventor's perspective governs the identification of that problem. As a result, most courts continue to cite this phrasing, inherited from early Federal Circuit analogous art cases, without pausing to examine its deeper meaning and implications. [80] Nonetheless, a few decisions in the past decade or so have begun to grapple with the challenge of problem identification more explicitly. These contributions—and their implications—will be examined in the following paragraphs.

i. *In re Klein*, 647 F.3d 1343 (Fed. Cir. 2011)

This case vividly illustrates how the framing of "the problem with which the inventor is involved" can largely shape the determination of whether a prior art reference is "reasonably pertinent."

Mr. Klein appeals the final decision of the Board of Patent Appeals and Interferences ("Board") affirming the rejection of certain claims of the '747 application as obvious under 35 U.S.C. § 103. The Court reversed on the ground that the Board's finding that five references at issue are analogous art is not supported by substantial evidence. Specifically, the '747 application (titled "Convenience Nectar Mixing and Storage Devices") concerns a mixing device for use in prepration of sugar-water nectar for certain bird and butterfly feeders.[81]

The Board had relied on five prior art references—Roberts, O'Connor, Kirkman, Greenspan, and De Santo—each of which described a container with a movable divider

---

[79] See *infra*, Section 3.3 Thought Experiments.
[80] Cite five or six CAFC and district court cases that repeatedly citing to this language or its equivalent without giving more detailed instructions. There are so many.
[81] According to the patent specification, the device has a series of rails that, when engaged with a divider, allow for the creation of two compartments for separating sugar and water within the device. The rails are located to divide the device into proportionate volumes of one part sugar to four parts water (to make hummingbird nectar), one part sugar to six parts water (to make oriole nectar), and one part sugar to nine parts water (to make butterfly nectar). Once the respective compartments have been filled to the same level with sugar and water, the divider is removed, allowing the sugar and water to mix and be stirred.

used to separate contents. Drawing on the Klein specification's statement that sugar-water ratios were known, the Board concluded that someone skilled in the art would have had reason to use known ratios with these types of containers to mix nectar for different animals. It therefore held that the cited references were reasonably pertinent to Mr. Klein's problem, which it agreed to be defined as "making a nectar feeder with a movable divider to prepare different ratios of sugar and water for different animals"("multi-ratio mixing problem").

On appeal, Mr. Klein argued that the Board erred by summarily concluding that the cited references were analogous art without properly analyzing their pertinence to the specific multi-ratio mixing problem. He emphasized that the Board's own findings showed that at least three of the references—Roberts, O'Connor, and Kirkman—were directed to containers for separating solids, not for mixing liquids, and thus would not logically have commended themselves to an inventor attempting to solve his problem.

The Federal Circuit agreed, finding that the Board's conclusory finding was unsupported by substantial evidence. As the Court explained, the cited references were all directed toward separation rather than mixing, and none was suitable for holding or combining liquids to achieve the ratios required by the invention. "An inventor considering the problem of 'making a nectar feeder with a movable divider to prepare different ratios of sugar and water for different animals,' would not have been motivated to consider any of these references," particularly given their incompatibility with the intended function. Importantly, the Court rejected the government's attempt on appeal to reframe the problem as a generic "compartment separation problem," citing the Chenery doctrine, which prohibits appellate courts from sustaining agency decisions on grounds not relied upon below. One can't help but think that if the Court accepted the Board's updated definition of the problem (compartment separation v. multi-ratio liquid mixing), the three references may very likeley have been found to be pertinent, as they all directed to compartment separation purposes.

In short, *Klein* demonstrates that the way a problem is initially defined—whether narrowly as "ratio mixing" or more broadly as "compartment separation"—may likely be outcome-determinative in prong two analysis. However, while the Federal Circuit recognized this definitional dispute, it did not specify from whose perspective—the inventor's or the PHOSITA's—the problem should be framed. This ambiguity continues to cloud the doctrinal clarity of prong two in later cases.

ii. *Circuit Check v. QXQ* (Fed. Cir. 2015)

This case clarifies that the question is not whether the disputed arts (e.g., rock carvings or Prussian Blue as argued by the infringer QXQ) are generally known to the PHOSITA, but whether "the inventor" would have reasonably looked to those specific arts to solve the specific problem at hand.[82]

The '796 patent concerned marking interface plates in circuit board testers. The accused infringer QXQ argued that references such as rock carvings, engraved signage, and the dye Prussian Blue were analogous. However, the patentee Circuit Check presented testimony that a PHOSITA would not have considered these references when addressing the marking problem in electronic test fixtures. The Federal Circuit upheld the jury's verdict, affirming that these references were not reasonably pertinent. The Court reiterated the standard that a reference must "logically have commended itself to an inventor's attention in considering his problem." Even though such techniques were familiar, the jury reasonably concluded that *the specific problem faced by the inventor—marking delicate, expensive electronics—would not have led a PHOSITA to consult these arts*.

The *Circuit Check* opinion unfortunately illustrates again the doctrinal ambiguity of prong two: while it likely purports to apply the pertinence inquiry from a PHOSITA's vantage point, the court repeatedly refers to "the inventor" or "an inventor" in its articulation of the inquiry.

iii. *Donner v. Pro Stage* (Fed. Cir. 2020)

Among CAFC opinions on analogous art, *Donner* stands out as a rare case that directly addresses the long-time oversight of the "problem" inquiry implicit in prong two jurisprudence.

The '023 patent addressed the challenge of easy positioning and organizing guitar effects pedals and their connecting cables. The allegedly analogous reference, Mullen, related to relay support structures and wiring channels in electrical systems. Crucially, the Federal Circuit clarified that under prong two, the pertinence of a reference must be judged by *identifying and comparing the specific problems addressed in both the patented invention and the prior art reference—explicitly from the vantage point of a PHOSITA*. This means that courts must not assume the problem was clearly framed at the outset or rely *solely* on the inventor's articulation in the specification. Rather, the analysis must firstly consider how a PHOSITA, would define the specific problem the patent addresses – in other words, fact finders must conduct an objective inquiry of the

82

"problem" through the perspective of a PHOSITA, before they get to the inquiry of "pertinence."

With this logic, the *Donner* court faulted the Board for failing to identify and meaningfully compare the problems addressed by Mullen and the '023 patent. It emphasized that without a clear articulation of those problems and without an analysis grounded in the PHOSITA's perspective, the analogousness determination could not stand. In doing so, the Court made the first key step in steering prong two toward a structured, evidence-based inquiry—requiring a problem-by-problem identification comparison informed by expert testimony and contextual understanding of the skilled artisan.

Nevertheless, the *Donner* decision does not appear to have been driven by the judges' recognition that inventors' creativity may lie in the act of problem finding and framing itself. Rather, its central concern appears to be a practical one: to prevent the PTAB or lower courts from uncritically adopting an overly narrow definition of the problem simply because the inventor (or petitioner) defined it that way—especially when such narrow framing could improperly exclude relevant references from the prior art pool. In this respect, *Donner* can be understood as a doctrinal safeguard against strategic framing by litigants, aimed at keeping the analogous art inquiry open to broader technical domains that may be reasonably relevant to a PHOSITA. Despite the unspecified rationale however, *Donner* begins to fill the doctrinal void that most other decisions leave open, thus providing a promising foundation for properly applying prong two in cases involving problem-driven inventions in the AI age (see more discussion in Section 3.3 of thought experiments, and Part IV).[83]

iv. *Corephotonics v. Apple* (Fed. Cir. 2023)

This recent opinion illustrates a procedural wrinkle in the identification of the relevant problem, namely that the PTAB may find the problem independantly based on the record before it, even if its conclusion differs from either party's proposed framing.

In this inter partes review (IPR), the Patent Trial and Appeal Board (PTAB) made its own findings regarding the problem "confronted by the inventors," even though Apple had advocated for a different framing. Apple argued that the relevant prior art—

---

[83] In particular, these doctrinal refinements take on heightened importance in the context of Centaur Inventing Synergies (CIS). As will be explored in Section IV, the collaboration between human researchers and AI systems may surface distant references that appear relevant only *after* a creative problem has been identified and framed by the human researcher(s) - the *Donner* decision's emphasis on problem alignment and the PHOSITA's perspective will therefore be critical in preserving the integrity of the analogous art inquiry in the AI-powered age.

Galan and Martin—was pertinent to the problem of a "jump" (discontinuous image change) when a dual-aperture camera switches output between sub-cameras or different viewpoints. The Board, however, identified a related but distinct problem: reducing image jump effects when switching between cameras with different fields of view. The Federal Circuit affirmed the Board's authority to make such independent findings, emphasizing that when the problem or field of endeavor is disputed, the Board may resolve the issue based on the record—even if its conclusion differs from either party's proposed framing, as long as the finding is grounded in substantial evidence.

In this case, although the Court did not explicitly address from whose cognitive point the "problem" should be framed in the first place, it seems to imply an adoption of the PHOSITA's perspective by authorizing the Board to independantly find the problem that "differs from either party's proposed framing."

v. *Netflix v. DivX* (Fed. Cir. 2023)

This case once again reinforces the Court's unreflected oversight of the problem inquiry lens, even when it makes the effort to conduct prong two test through the "foresight of a person of ordinary skill."

The '792 patent concerned facilitating "trick play" (e.g., skipping or fast-forwarding) in streamed multimedia. The Board determined that the cited reference, Kaku, which focused on image compression for long-term recording in digital cameras, addressed a different problem and was therefore not reasonably pertinent. The Court emphasized that analogousness must be assessed "with the foresight of a person of ordinary skill, not with the hindsight of the inventor's successful achievement," echoing prior holdings like *Scientific Plastic Products*and *Airbus*. The Board's meticulous attention to the problem statements in the specification and expert testimony helped it draw a clear distinction between the two references' purposes. The Federal Circuit affirmed, holding that a skilled artisan concerned with the trick-play problem would not have looked to Kaku.

Importantly, regardless of the Court's emphasize of assessing analogousness through "the foresight of a PHOSITA," the opinion continued to take the inventor's perspective by default – relying heavily on the problem statement in the patent specification - when defining the very problem to which the pertinence inquiry is conducted. By doing so, the court tacitly bypassed the deeper cognitive question: how was the problem framed, and by whom? This post-Donner omission again illustrates the under-recognized doctrinal void—the growing need to scrutinize not only the pertinence inquiry, but also the origin of the problem itself.

vi. *Daedalus v. Vidal* (Fed. Cir. 2024)

In the very recent case *Daedalus v. Vidal*, the Federal Circuit again took the default lens of the inventor in finding the problem "to be solved."

The patentee Daedalus Blue LLC challenged the PTAB's determination that Gelb—a reference outside the immediate field—was reasonably pertinent to the problems addressed in the '132 patent, which involved methods for handling files in a policy-based system across heterogeneous computing platforms, with functionality such as assigning service classes and performing operations accordingly. On appeal, Daedalus contended that Gelb did not address the same problem, and thus was not analogous art. The Court upheld the Board's finding that Gelb was analogous. Citing extensive passages from both the patent and Gelb's specifications, the Court concluded that both addressed the same high-level challenge: enabling automatic selection between storage options based on higher-level concepts or performance requirements. The Court emphasized that the Board's reliance on this alignment of purpose, rather than exact technical overlap, was supported by substantial evidence and satisfied prong two.

Similar to *Netflix*, in *Daedalus* the Board—and the Court—once again relied on problem statements from the patent's own specification to define the problem at issue.[84] This again suggests a subtle but persistent pattern in modern jurisprudence of prong two: courts tend to infer the relevant problem from the inventor's own articulation rather than independently and comprehensively reconstructing what a PHOSITA might have perceived *ex ante*. Although the *Daedalus* Court did not directly confront the issue of whose perspective governs the problem identification, the repeated invocation of specification-based problem statements once again reflects a default tilt toward the inventor's lens. As with other recent decisions, *Daedalus* illustrates the inertia of the existing doctrinal void, despite the progress made in *Donner*.

[Summarizing these cases, commenting on the consistent oversight of the problem lens in case law, despite some progress, particulary *Donner]*…

[84] Arguing on behalf of the USPTO, Michael Forman explained the USPTO's position as follows: *I think if you look at both the specification of the 132 patent and the prosecution history, you can see that the patentee was defining the problem as a data management problem, not as a network problem*.The Federal Circuit agreed with this perspective, that the problem stated was not focused on network issues. Judge Chen wrote:"We begin with Daedalus's not-reasonably-pertinent argument. The Board agreed with Daedalus that one problem identified in the '132 patent is "'not permit[ting] a user to automatically select between multiple storage options' and not addressing '[files] with varying storage or performance requirements or equipment with varying capacities and performance levels.'" Relying in part on Gelb's specification, the Board reasonably found that Gelb addresses the same problem: "namely that prior art storage access methods did not permit programmers to write code that would allow users to automatically select the appropriate storage devices based on 'high or logical level' concepts, such as 'data sets, data bases and the like.'" Substantial evidence therefore supports the Board's finding that Gelb would be reasonably pertinent to at least one problem identified in the '132 patent."

…

On the receiving end, patent practitioners' interpretation of these cases further supported the alleged doctrinal vagueness when it comes to whose perspective the fact finder shall use in defining the "problem the inventor tries to solve," even when the Federal Circuit went the extra step in holding that the specific probem should be identified before being compared with the prior art reference, not simply taken for granted. For example, after the *Circuit Check v. QXQ* judgment came out, one practitioner advised the prospective clients to "consider framing the particular problem the inventor was trying to solve in a field-based or otherwise narrow manner directly in the text of the application while drafting it. Doing so may prove helpful in establishing that the problem addressed by the inventors was not of the nature that would have led a person having ordinary skill in the art to look to a disparate field to arrive at the claimed solution."[85] Following the judgment of *Netflix, Inc. v. DivX, LLC*, an influential patent law blog similarly advised patent holders on the importance of explicitly articulating the problem, "Patentees also have tools at their disposal to potentially narrow the scope of analogous art. As seen in *Netflix*, explicitly articulating the problem solved by the invention (perhaps within the patent claims themselves) can limit the field of endeavor and pertinent prior art to references addressing that particular problem… This case raises this question: Should best practices for patent drafting include an explicit statement of the particular problem the invention seeks to involve? As the patent owner here demonstrated, doing so may limit the applicable scope of prior art during litigation. On the other hand, a narrow articulation in the patent itself may make the claims more vulnerable to workarounds."[86] The same author further observed after *Daedulus v. Vidal* (Fed. Cir. 2024) that, "[a]lthough the patentee lost this appeal, I believe that it adds to the body of evidence that applicants should consider filing narrower patent specifications when appropriate. In our post-AIA world, patents are more likely than ever to be invalidated post-issuance, and a carefully crafted problem statement can help limit the scope of analogous art. By explicitly identifying the specific problem solved by the invention, particularly in the broadest claims, applicants may be able to circumscribe the universe of prior art that can be relied upon for obviousness. While this approach requires striking a delicate balance to avoid unduly restricting claim scope, it is a strategy worth considering in light of the evolving analogous art doctrine."[87]

[……]

[85] https://www.nutter.com/ip-law-bulletin/federal-circuit-revisits-the-question-of-what-is-analogous-art?.
[86] www.patentlyo.com
[87] https://patentlyo.com/patent/2024/03/analogous-doctrine-insights.html?.

[……]

3.3 Two Thought Experiments - How the Current Analogous Art Framework May Unduly Punish Creative PFF (*highlighting how a careless application of the current analogous art framework – especially the second prong – can undervalue or mischaracterize the vastly creative aspect of a breakthrough invention: the initial act of problem finding and framing.*

To illuminate the doctrinal vulnerability, consider the following thought experiments…

3.3.1 *Was Bicycling Analogous Art to Human Aviation in 1903?*

At the intersection of the 19th and 20th Centuries, facing the dismal record of human beings' heavier-than-air flight experiments, the Wright brothers' pivotal insight in no way began with a clearly formulated problem of three-dimensional aircraft control followed by a detached survey of existing art to solve this problem; rather, it began with a *creative hunch* sparked by years of life experience as avid bicyclers —an intuitive sense that the seemingly remote art of bicycling might illuminate the obstacles to controlled flight. Their eventual problem framing, maintaining dynamic stability in three axes while the machine is propelling in the air, emerged from this lengthy iterative conversation between their intuition as seasoned bicyclers and mechanics, analogical thinking as experts straggling multiple technological fields, and causal thinking as diligent aerodynamics experimentalists….[needs a better expression/][88] Correspondingly, the act of choosing which prior art to engage closely with is not merely a retrospective matching of references to a predefined problem, but a *constitutive part of the problem-finding-framing process itself*. In other words, Wright brothers' act of selecting the bicycling art to follow and formulating the central challenge of controlled flight are not discrete steps, but a dynamic interplay where analogical thinking both shapes and is shaped by problem finding and framing.[89]

[88]

[89] As historian Philip Johnson-Laird explains, Wilbur and Orville "used analogy and their knowledge in diagnostic reasoning" to reconceive the obstacle from lift to dynamic—three-axis—control. Their epiphany—seeing flight through the lens of balance and steering on a bicycle—was not a post hoc alignment of a pre-defined problem to existing art, but a creative act that reframed the entire inquiry: only once they conceived of flight in terms of dynamic stability did prior knowledge of bicycles become both relevant and illuminating. See https://www.modeltheory.org/papers/2005flyingbicycles.pdf?utm_source.

At the time of the Wright brothers' breakthrough, many in the aviation community focused on getting enough lift and propulsion power. The Wrights reframed the problem however: they had a crucial insight that a three-dimensional dynamic control of the machine in air—not just lift or propulsion power—was the crux of the challenge.[90] …

[…]

[…]

3.3.2 *Was Origami "Analogous Art" to Surgical Tools in 2015?*

4. The *Donner* Teaching Should Be Vigorously Followed and Adequately Developed in the AI Age

Despite a (perhaps) different rationale, the Federal Circuit's *Donner v. Pro Stage* (2020) decision marked a pivotal clarification in the application of the second prong of the analogous art test. Departing from the widespread—and often unexamined—judicial tendency to rely on the inventor's own articulation of the problem (typically as found in the patent specification or prosecution history), *Donner* emphasized that the "problem to be solved" must instead be identified from the perspective of the hypothetical person having ordinary skill in the art (PHOSITA).[91]

This PHOSITA-centered inquiry, if faithfully applied, offers a powerful corrective to one of the doctrine's most persistent blind spots: the subtle but pervasive hindsight bias that arises when courts undervalue the inventive significance of unconventional problem finding and framing (PFF).

Yet *Donner*'s potential remains largely underrealized. While subsequent Federal Circuit and PTAB decisions frequently cited *Donner*, few have meaningfully engaged with its deeper insight. Courts continued to conflate the PHOSITA's vantage point with that of the inventor…

90

91 *Donner*, 979 F.3d at 1361.

[What follows - turn to the broader implications of Donner *in the AI age—where large-scale models increasingly serve as powerful solution generators, heightening the significance of the human role in upstream problem definition…]*

5. **Conclusion**