What Counts as 'Creative' Work? Articulating Four Epistemic Positions in Creativity-Oriented HCI Research

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ABSTRACT

This paper examines prevailing understandings of creativity in creative computing research through the lens of feminist epistemology. We analyze "creativity support" as a construct that encodes different definitions of *creative work*. Drawing on existing literature and practices, the paper surfaces four views about creative work that underpin current creative technologies and HCI research: *problem-solving*, *cognitive emergence*, *embodied action*, and *tool-mediated expert activity*. Each view makes different claims about the role of computing in creative work and the creative subject assumed. We articulate the attendant politics of each view and illustrate how critical feminist epistemology can serve as an analytical tool to reason about the trade-offs of various creativity definitions. The paper concludes with recommendations for integrating feminist values into creativity-oriented HCI research.

CCS CONCEPTS

• **Human-centered computing → HCI theory, concepts and models**; **Interaction design theory, concepts and paradigms**.

KEYWORDS

creative work, creativity definitions, epistemic positions

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1 INTRODUCTION

A major direction for HCI research has been examining the potential of incorporating technology into creative work, whether it is harnessing digital technologies to support the process of creation [107] or enabling new forms of creative expression via emerging computational techniques (see e.g. Anna Ridler and David Pfau's *Bloemenveiling*). This research area is often associated with different keywords – computer-aided design, creativity-support tools (CST), creative AI, creative computing, and more. While the nomenclature may differ, these strands of research share similar goals of leveraging computing to enhance and advance creative work.

Across these contexts, understandings of what constitutes creative work are sprawling and diverse. HCI researchers have noted the dearth of and the need for more precision around definitions. Frich et al. [54] for example, discuss the absence of consensus regarding goals for CST, attributing it to insufficiently bounded creativity definitions. Remy et al. [112] also highlight the lack of theoretical grounding in evaluations of CST, which further contributes to the conceptual vagueness around the roles of computing in creative work. As these studies suggest, the term "creativity" is doing much conceptual heavy-lifting in HCI research, and yet there are surprisingly few resources available for delineating its diversity and making sense of the impact various definitions have on computing research and design.

Definitions are hardly innocent – they encapsulate distinct notions about *where* creativity occurs, *what* constitutes creative activity, *who* the creative subject is, and the *role* technology plays in the process. And these distinctions can manifest in creative technologies. For example, both Rhino Grasshopper and AutoCAD can be used to design a chair, but the workflow implied by each tool differs, so does the language of interaction. What distinct construals of creative process do they reflect? Each definition conceptualizes creative work differently by welcoming some characterizations and de-emphasizing others. While creativity definitions may seem diverse, they do not exist in the vacuum. They are socially, culturally, and historically constructed, which means underlying patterns can be found.

We argue that adopting a pluralistic and contextual perspective on epistemology, as advanced by feminist theorists can provide clarity in understanding these patterns. Our goal is to bring into relief the political dimension of creative technologies. Feminist epistemology frameworks contend that technologies are "part of larger sociotechnical entanglements and thus give rise to knowledge and practices that are partial, situated, embedded and embodied,

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as well as implicated in a broader nexus of power relations" [89]. Creative technologies embody the values and assumptions of the practices that produce them. This calls for an examination of the normative questions they entail. Doing so will allow us to discuss trade-offs among different notions of creativity.

We make three contributions in this paper. First, we articulate four *epistemic positions* underpinning creative computing research by disentangling diverse conceptions of creativity from psychology, cognitive science, sociology, and AI literature. We look at how these fields understand and study creativity, attending to connections between them and foregrounding shared methodologies. We show how these concepts inform HCI research and design practices at large. This provides conceptual levers for a comparative analysis of the assumptions and commitments that are reflected in the epistemic positions. By linking theory to practice, this work contributes toward articulating the "goals" [112] and roles for computing in creative work. Second, we sketch a set of *provocations* about the value-laden questions implicated by each epistemic position. This serves as a starting point for reasoning about the trade-offs and politics in creative computing and research. Finally, we discuss strategies for integrating more feminist values into creativity-oriented HCI research.

A note on epistemic positions

Our deployment of the term *epistemic position* is rooted in feminist epistemology. Feminist theorists have argued that rather than being neutral and objective (the universal "view from nowhere"), knowledge is necessarily partial and incomplete [67]. The feminist epistemology frameworks reject "disembodied report of value-free, context-independent facts", recognizing instead that knowledge is shaped by "social desires, interests, and values" [6]. As argued by Harding [68], every concept has a "subject" and that subject has a standpoint, or "a perspective involving assumptions and values based on the kinds of activities [the subject] engages in" [6]. To improve objectivity is to examine the standpoint and make legible pluralistic ways of knowing across different contextual factors. As noted by [89], feminist epistemology has close alliances with other related critical concepts, such as and "figuration" [23], "diffraction" [14], and "critical fabulation" [116].

Inheriting from this intellectual tradition, our use of epistemic positions is close to the notion of "logic" in Mol's book *The Logic of Care* [102]:

> I am after...the rationale, of the practices we are studying. Here the term 'logic' helps. It asks for something that one might also call a style. *It invites the exploration of what it is appropriate or logical to do in some site or situation, and what is not. It seeks a local, fragile and yet pertinent coherence.* This coherence is not necessarily obvious to the people involved. It needs not even be verbally available to them. It may be implicit: embedded in practices, buildings, habits and machines. And yet, if we want to talk about it, we need to translate a logic into language. This, then, is what I am after. (also cited in [113]; emphasis mine)

Therefore, similar to Ribes et al. in their study of domain [113], the epistemic positions we propose aim to provide conceptual tools for reasoning about different styles of *organizing* creativity-oriented research practices in HCI. These epistemic positions, while presented as separate categories, are not meant to be mutually exclusive nor do they necessarily map chronologically forward. In fact, some of the positions share overlaps in methods and intellectual influences, as well as practices. Our goal is not to draw hard boundaries but to gather together research with similar values and epistemological commitments as a way to draw attention to similarities between approaches and the different lenses they adopt.

We analyze the historical conditions under which these epistemological styles develop and how they shape and inform ideas about the role technology plays in supporting creativity. Therefore, what counts as creative work depends on the particular concepts through which we use to interpret it. Phil Agre argues that being able to see our own "glasses" is the first step to a critical practice [1]. We contribute toward a critical practice of creative computing by making explicit existing glasses HCI researchers have used to conceptualize creative work.

2 CREATIVITY DEFINITIONS AND THEIR DISCONTENTS

We situate this work within existing creativity frameworks in HCI research. Given the elusive nature of creativity and its ubiquity in computing research and rhetoric, HCI researchers have conducted literature reviews of creativity support tools [54] and creativity-oriented HCI research more broadly [55]. In their surveys, Frich et al. [54, 55] map out dominant trends and their characteristics, sampling literature from the fields of computing and information technology as well as psychology that have creativity as their central research focus. They show that these works vary across methodologies adopted, creative settings (individual, collaborative, mixed, etc.), and domains studied. While not explicitly delineated, it can be gleaned from their literature review that different notions of creativity serve to encapsulate different epistemological commitments, which in turn influence the researchers' analytical stance, objects of inquiry, methodological affinities, and design practices.

In HCI research, ideas of creativity support select what types of work are rendered visible as well as which cultures of practice get recognized. Creativity support has two implied referents: the person (*who*) and the activity (*what*). When evaluating computer-mediated creative work, should we ask if technology is enhancing the creative person(s) –*perhaps pointing toward an adoption of CST definitions such as "[computational techniques that] mak[e] people more creative more often" [124]*– or should we examine how technology is facilitating the creative activity –*thus suggesting the need to develop evaluation metrics for CST that are comparable to usability principles [112]*. In addition to the ambiguous referents, there also seems to be an ontological inconsistency in the usage of the term. Creativity support is a value judgment (invoked to answer the question, "What counts as creative?") often obscured as an umbrella signifier for a set of stable, widely recognized forms of work (e.g. practices of graphic design, brainstorming processes, etc.). Simply put, creativity is a noun performing the work of an adjective. Identifying this vagueness, Remy et al. [112] point out that creativity can simultaneously refer to the "creativity of the outcome", "the usability of the tool itself”, or “the productivity of the process [as mediated through] CST”.

In current HCI literature, researchers seek definitions of creativity to effectively describe the quality of creative work. The premise is that a precise definition will adequately circumscribe creative work, marking out the part(s) of creative process or levels of expertise technology should support [54]. This will in turn inform the appropriate evaluation strategy to adopt [112]. An example of such relationship between creativity definition and evaluation metrics can be seen in Cherry and Latulipe’s [30] work on the creativity support index (CSI). CSI is a set of quantitative measures meant to evaluate how well a tool supports creativity, developed according to Boden’s conception of creativity as “exploration and play” [18], Csikszentmihalyi’s characterization of creativity as *flow* [36], and Shneiderman’s design principles for creativity support tools [125].

All these studies [30, 54, 112] have cautioned against a one-size-fits all approach to defining creativity, noting instead the need for situated definitions. However, not many analytical resources exist for understanding the broader historical and theoretical underpinnings of creative computing. Researchers have notably emphasized the importance for creativity theoretical research to join efforts with creative computing research [53]. From this perspective, our progress has been limited. While creativity research in psychology has generated different concepts of creativity, from convergent and divergent thinking [65] to domain expertise [37], their direct impact on computing research remains ambiguous. Shneiderman’s articulation of the three perspectives on creativity [123] marks an initial effort to link theories with their influences on user interfaces. We build on this work and take stock of the advances creative computing research has made over the past 23 years. We explore the conceptual work that creativity theories (going beyond psychology to include also disciplines such as philosophy and sociology) are doing in creative computing, teasing out the politics of each view. Our approach is in line with recent efforts to critically examine digital creative tools, such as analyzing CST from the lens of “power” [94]. In our work, we draw attention to the diversity of understandings of creativity support, and we provide a framework for further examination and evaluation of digital creativity rhetoric and practice.

In the following sections, we first introduce our method and approach, followed by each epistemic position. We will then synthesize theoretical threads from each position into key themes, noting the impact they have on HCI research and practice. From there, we will interrogate the politics of each position.

Table 1 summarizes the epistemic positions. The three dimensions (characteristics of work, unit of analysis, creative site) are developed to capture the key distinctions among the positions. Table 2 summarizes how these positions shape creativity support practices along two dimensions: role of computing and creative subject.

3 INVESTIGATING EPISTEMIC POSITIONS

We take a critical-interpretive approach to distilling the epistemic positions [110]. Following this approach, we first drew on HCI literature concerning creativity. We also took stock of the various conceptions of creativity present in theoretical scholarship, tracing back to their historical roots in diverse disciplines spanning psychology, social sciences, anthropology, and philosophy. We subsequently explored various clustering of these conceptions based on a range of variables (such as view on process, methodology, and value). Over time, distinct groupings started to coalesce around three primary analytical dimensions that we considered were key to articulating the differences across them: characteristics of work, unit of analysis, and creative site.

We reconstructed the four epistemic positions from a combination of HCI literature, academic research, and creative practice. We blurred the distinction between what is considered theoretical or practical material, viewing them as inherently intertwined: “practices embody systems of ideas, and such systems are not only themselves a form of practice but draw from practical experience” [38]. Similar to [38], we did not subscribe to the notion of “representative” sampling [99] considering the heterogeneous nature of this material. Rather, in line with a critical-interpretative approach, we drew on our knowledge and previous research in the field to select texts and practices that we deemed noteworthy. As such, the chosen exemplars are inherently shaded by our interpretations and judgment. While we do not assume full coverage of all creativity notions out there, we consider the ones we highlight to be integral to any discussion of “what qualifies as creative work?” [73].

This paper is not a systematic review of creativity research in HCI (see e.g. [54, 123]) or in adjacent fields (see e.g. [55]). It is an essay that serves to spark reflection, discussion, and debate around the complex interplay of epistemology and technology in creative practices. Adopting an argumentative approach with supporting examples to draw conclusions, we analyze creative work as encountered in computing contexts in a “discursive fashion” [95]. In other words, we draw our examples from interaction design and computing research as well as artistic and other forms of creative practice. We use “practice” as the unit of analysis, which describe the “intelligible background” for actions [10].

Overall, we provide a “problematization” [10] of creative work in HCI. According to Bacchi, problematization is a “strategy for developing a critical consciousness”: it disrupts “taken-for-granted ‘truths”’ and articulates the “process” through which values are formed, thus making politics of creative computing visible. In accordance to Bacchi, the primary goal of the paper is to dismantle creative work as a fixed notion and show how it emerges in a historical process; doing so “puts [its] presumed natural status in question” and allows us to draw alternative relations.

Positionality

The research team is composed of researchers based in Western institutions. Collectively, we have decades of experience working in computing research for creativity support. Our educational backgrounds span psychology, cognitive science, computer science, and interaction design. Much of our research has focused on understanding how technology and computing shape the practices of creative practitioners. Moreover, we contribute to computing research and design that seek to empower artists and designers. Part of the research team also has extensive artistic practices of their own mediated by technology. Informed by these experiences of being both active users and researchers of technology in creative practices, we pay particular attention to the complex interplay between practice and technology, and we focus on examining the values and politics that shape this relationship. As such, we gravitate toward pluralistic accounts of creative practice, acknowledging the long-standing tension between technology's dual roles: its capacity to both transform and integrate into existing practices. We aim to create a path between solutionist and critical perspectives [4] by examining how technology can support plural ways of knowing and expression. We take creative computing as starting point for an investigation of epistemic positions. Reflecting on this approach, we recognize that our scope is limited to practices that involve computing and digital tools. This omits forms of creative work that do not leverage computing such as traditional painting, sculpture, and other analog artistic expressions (though we note that HCI researchers such as [29] have examined how computation gets embedded into these traditionally analog practices). We hope others will build on and adapt our framework, teasing out other possible relationships between creativity theory and practice in ways that highlight the distinct configurations of their settings [46, 98]. In this paper, we define creativity as socially constructed. This rejects a monolithic treatment of the term and acknowledges instead that it can take on different meanings depending on one's epistemic position. We also note that the scholarship and history we draw from reflect a US-centric perspective. Our intention is for our work to serve as a first step towards embracing a more diverse and contextualized perspective in creative computing.

4 CREATIVE WORK AS PROBLEM-SOLVING

4.1 Overview

A major category of creativity theories focuses on problem-solving processes [47, 126]. This perspective suggests that creative work follows rational and systematic processes, much like a computer searching all possible combinations [118]. It emphasizes how concepts like *problem representations* and *heuristic search through problem spaces* fundamentally explain the ways people generate creative solutions to problems [84].

The problem-solving view of creativity holds that "practitioners are instrumental problem solvers, who select technical means best suited to particular purposes" [120]. These practitioners solve "well-formed" problems by "applying theory and technique derived from systematic...knowledge" [120]. In other words, creative work is about "devis[ing] courses of action aimed at changing existing situations into preferred ones" [128]. The creative process begins "when a problem has occured" [50]. This requires formulating creative process as a procedure that follows a series of steps that go from pre-determined objectives to final solution. Alexander [7] for example describes the creative process as following a general shape of divergence and convergence, where *divergence* involves decomposing an initially ill-defined problem into a set of sub-problems. And in the *convergence* step, these smaller problems get analyzed, solved, and eventually synthesized into a solution to the overall design problem [49].

As such, creative work is simply a "special class of problem-solving" characterized by "difficulty in problem formulation" [104]. From this perspective, systems thinking is central to the practice of design. The creative person here is someone who is "able to follow prescribed action" as well as "effectively and efficiently traverse the design space" [49]. This view, with its emphasis on "structured methods" and "externalized guidelines" [49], tends to render the role of individuals invisible: so long as the steps are followed, anyone can achieve an outcome that is deemed creative.

In this view, the creative person does the same work as that of an engineer. Cybernetician Gordon Pask captured this sentiment, stating, "Architects are first and foremost system designers" [108]. Therefore, the kinds of problems they work with can be broken down into a set of "invariants" that can be "programmed into the system" [108].

Historical roots: cybernetics

Herbert Simon's work is influential in shaping this set of ideas. He can be credited for making design a scientific pursuit: "a process that could be thoughtfully achieved, building connections between fields of urban planning, engineering and cognitive science that went on to have an enormous influence on design scholars" [116].

Table 1: Overview of the epistemic positions on creative work reconstructed from theoretical literature. The columns summarize the characteristics of the work (i.e. the goal of the creative process), the unit of analysis (i.e. the core object of study), and the primary site in which the creative work is found.

Creative work as	Characteristics	Unit of analysis	Site
Problem-solving	To develop heuristics to navigate solution space	Systems models	Structured activities: e.g. engineering, architecture
Cognitive emergence	To generate new ideas, make associations, combine concepts	Phases of a process	Ideation activities
Embodied action	To engage with embodied knowledge and the dynamic material world	Relations between body and world	"Alt" sites: e.g. everyday resourcefulness, craftwork
Tool-mediated expert activity	To perform creative tasks as mediated by tools	Common tasks	Creative practices in which one can develop expertise: e.g. graphic design

Proponents of this movement stood on the spectrum with regards to how close they placed design next to science. On the looser end, design is viewed simply as "systematic design", or, "the procedures of designing organized in a systematic way" [34]. Meanwhile, others adopted a narrower view, seeing design as *wholly* rational, where it is a "scientific activity itself" [34]. This was challenged by many design theorists like Grant [63] who wrote, "Most opinion among design methodologists and among designers holds that the act of designing itself is not and will not ever be a scientific activity; that is, that designing is itself a nonscientific or a-scientific activity". Nevertheless, these design methodologists employed science as a guiding lens to demonstrate the formalizability of the design process, making it both tractable and transferable.

The historical backdrop to these ideas of "scientizing" the design process can be traced to the period following World War II in the United States. This ostensibly narrow focal point paved way for various intellectual interventions later. The post-war era was dominated by rhetorics of rapid technological development, power of systems thinking, and promise of science. Creativity is connected to discourses of industrial capitalism and political power. In 1954, psychologist Carl Rogers appealed to US geopolitical interests in the Cold War by making creativity a military asset, essential to the "leaps and bounds" of "scientific discovery and invention", which would help the US gain a competitive advantage in the nuclear arms race [114]. The instrumental value of creativity is popularly depicted in Richard Florida's book, *The Rise of the Creative Class* [52] in which Florida writes that creativity is the "defining feature of economic life" and that it is the "font from which new technologies, new industries, new wealth, and all other good economic things flow". This sentiment is echoed by Ben Schneiderman [123] who espouses creativity as the key ingredient to innovation and argues for the need to create technologies that "allow more people to be more creative more of the time". Creativity, as a symbol of cultural and economic strength, became a subject of great interest to computer scientists and psychologists alike.

It was in this intellectual climate that Herbert Simon's *The Sciences of the Artificial* [128] was published. Simon applied the same ambition to "unifying the social sciences (e.g. design) with problem-solving as the glue" [75]. In seeing design as a "scientific problem solving" activity [75], he was able to establish legitimacy in a still nascent field of design in scientific communities.

Simon was part of a community of researchers invested in representing the creative process in computational terms. He believed that creativity can be simulated computationally. In doing so, he hoped to show that creativity is not "mysterious" nor an act of "divine intervention": simple processes can make novel discoveries. He rejected the claim that "discovering a [scientific] theory requires a 'creative' step and that creativity is inherently unexplainable in terms of natural processes" [129]. Using the game of chess a fundamental example, Simon pointed to computers successfully arriving at a solution as evidence that "the processes of scientific discovery is cooperation between pattern recognition and selective search" [127]. He used those examples to demonstrate how scientific discoveries can be made using simulations, turning creativity into a proper field of study.

4.2 Creativity support as a representational problem

In formulating creative work as a problem-solving process, AI scientists and design methodologists invested in developing heuristics to arrive at the solution. The problem-solving view advances the notion that "complex design problems can be algorithmically solved if decomposed in the right way" [106]. This set of ideas has inspired HCI research that defines creativity support as one of problem representation. For example, the view has produced tools that use computational models to help search the design space in structured design tasks such as layout design.

The intellectual foundation of formalizable steps further gives way to design practices such as computational design. Oulasvirta [106] describes computational design as an "emerging form of design activities that are enabled by computational techniques". Specifically, it frames design activities as a "mathematical optimization problem" in which design criteria are seen as "objective functions", design space as "search space", and design exploration as "the process of searching for solutions" [106]. Computational design leverages mathematical models and computational processing power to augment a design workflow, making it more efficient.

These computational methods are often applied to structured design activities. For example, August Dvorak [44] "used principles of statistics and experimental findings on typing performance to explore alternative layouts for an improved typewriter design, inventing the Dvorak Simplified Keyboard (DSK)" [106]. Another historical example can be found in the practice of Karl Gerstner, who, in his 1963 book, *Designing Programmes* [59], wrote about the use of programs to create variations to the typographic grid. He

Table 2: Overview of creativity support through the lens of the epistemic positions. It summarizes how each position renders creativity support differently, both in terms of the assumed role of computing and creative subject.

Creativity support as	Role of computing	Creative subject assumed
Representational problem (per problem solving view)	Performing simulations	Systems thinker
Divergence problem (per cognitive emergence view)	Facilitating knowledge discovery	Sensemaker
Problem of continuous negotiation (per embodied action view)	Enabling direct physical interaction	Bricoleur
Problem of "fit" (per tool-mediated expert activity view)	Augmenting the user	Cyborg

sees designers as taking a curatorial role of selecting the "solutions" generated by the computer [101].

In HCI, optimization techniques have also been applied to the design of layouts in web pages and mobile apps, as well as forms and dialogues. In these projects, design problems are seen as having "exponential design spaces" and "contradictory objectives" [106]. And computational approaches offer both high probability of finding the "best design" [106]. For example, in MenuOptimizer [13], the system aims to predict "good design" when designing interface menus. "Good" is determined by the objective function which consists of constraints editable by the user such as "relative weight of user performance", "consistency" of item locations, and "edit distance to present design" [106].

Another descendent of the problem-solving tradition is generative design. According to Michael Hansmeyer in his 2011 TED talk, generative design allows designers to think about "designing not the object but the process to generate objects". This echoes computational design in that the designer's position is one of distance, where they curate the numerous generative outputs of a computational model. Generative design has been widely adopted in architecture and industrial design, where efficiency and scalability of a process are often prioritized. Like computational design, they allow designers to explore wide range of design possibilities at a glance.

5 CREATIVE WORK AS COGNITIVE EMERGENCE

5.1 Overview

Cognitive emergence rests on the notion that creative insights emerge from complex underlying cognitive processes [51]. Whereas the problem-solving view sees creative work as a structured problem to solve through models and methods, the cognitive emergence view sees it as a cognitive activity. Creative work, in this view, is characterized by the alternating *generative* divergent processes and the *analytic* convergent processes. Methods such as brainstorming [105] and collaborative sketching [121] are meant to support the joint development of those processes.

This view was propelled by Guilford's noteworthy address to the American Psychological Association in 1950 [64] who noted that there was "considerable agreement that the complete creative act involves four important steps". The four steps have been previously identified by Wallas [141] as: (1) preparation, (2) incubation, (3) illumination, and (4) verification. This has given rise to rich scholarship in psychology on the methods behind processes of "idea generation". For example, psychological studies of creative process suggest that divergent and evaluative thinking form the basis for the generation of creative ideas [12]. This is also in line with the view that there are two distinct forms of thought: "an *associative* mode of perceiving metaphoric connections between correlating items in memory, and an *analytic* mode that is conducive to understanding cause and effect relationships" [33]. According to Gabora [57], the associative mode "provides us with the ability to associate loosely related concepts and create novel thoughts", while "the second gives us the necessary focus to assess ideas and make selections" [33]. Coughlan et al. [33] have also made the observation that the stages in Wallas' model "can be roughly mapped to these modes of thought: *Preparation* and *Verification* phases correspond to the analytic mode, whereas *Incubation* and *Illumination* correspond to the associative mode".

5.2 Historical roots: creative cognition

The cognitive emergence view shares many similar intellectual roots as the AI scientists and design methodologists in the 1960s. Similar to them, cognitive scientists held that "generative cognitive processes are commonplace and normative" [84], reacting against the personality psychologists up until then who devised tests to pick out creative individuals. They do not subscribe to the thinking that "geniuses use cognitive processes that are radically different from those employed by most individuals and that may not be accessible to the methods of cognitive science" [84]. From this view, a common set of processes underlie creativity in all forms, from those seen in everyday problem solving (also referred to as "little-c creativity" such as solving puzzles) to those seen in expert practices (also known as "big-C creativity" such as a career physicist devising experiments). By noting that all observable aspects of creativity are generalizable, the cognitive psychologists believe that individual differences in creativity can be understood as variations in common cognitive principles such as "combinations of processes" or "the richness or flexibility of stored cognitive structures to which the processes are applied" [51].

Cognitive emergence is closely tied to research in creative cognition which focuses on studying novel combinations of elements [143]. The creative cognition approach explains creativity by examining how concepts are combined by the mind [51]. Studies have shown that novel properties can emerge from conceptual combination of existing ideas [48]. These psychological studies have primarily examined "the cognitive processes that are involved when people comprehend combinations of concepts (such as computer dog), or when people imagine creative interpretations of ideas randomly combined by [" [86].

An example result of the creative cognition approach is a cognitive model called Geneplore. It frames the creative process as alternating between concept generation and subsequent exploration and interpretation. The key contribution of the Geneplore model hinges on the idea of *preinventive structures*. One can understand preinventive structures as the prequel to creative ideas. Some examples are visual patterns, mental blends, and verbal combinations. Conceptual combination as a preinventive structure, in particular, is heavily studied by creative cognition researchers. Wisniewski [143], for example, investigated how people combine nouns to make novel concepts (e.g. "boomerang flu" is a type of flu that goes away then comes back). As a explained by Sawyer, these conceptual combinations are "not simply additive"; they are a "case of emergence" [119]: "In such cases, the two component concepts themselves change when they are combined (the "car" that is a "car boat" is not exactly like any other kind of car); and this conceptual change is itself a form of creativity, as each concept guides the creative modification of the other".

5.3 Creativity support as a divergence problem

HCI research that can find its intellectual roots in this view focus on augmenting and supporting ideation. They set divergence as a goal for design exploration, and they promote techniques for brainstorming, free association, and lateral thinking.

combinFormation [85] is one such example of a tool directly inspired by ideas from creative cognition such as conceptual blending. It is a tool that "integrates processes of searching, browsing, collecting, mixing, organizing, and thinking about information" in order to support creative idea generation [85]. *combinFormation* enables associations between collections of information resources such as texts and images. It includes a *generative agent* that composes space based on elements already on the canvas. The generative agent is a web crawler that finds web pages that might be of interest to the user according to inferences made based on what is already collected by the user. The system also operationalizes the principle of conceptual combination: "When elements are next to each other, new meanings are suggested through combination...The researchers call this effect of generating new meanings through remix juxtaposition *recombinant information*" [85].

Along similar lines of novel ideation methods, HCI researchers have also developed strategies for crowd-based ideation [9], interaction techniques for organizing visual artifacts [8], an AI-driven system for ideation on digital moodboard [90], and a prototype for contextual query suggestions [107]. These studies contribute to insights about how technology can support and enable co-creative processes, often leveraging ideas of human-AI partnership. The goal of these tools is to help people discover useful ideas quicker and more abundantly than standard search tools as well as to facilitate sensemaking activities.

6 CREATIVE WORK AS EMBODIED ACTION

6.1 Overview

The unifying feature that cuts across the previous two epistemic positions on creative work is that they group around the implicit belief that it is the individual mind that is doing the creating. That view of creativity neglects the role the body and the physical world play during the creative process as well as the social context in which creativity takes place. Creative work as embodied action thus casts attention on the embodied, situated and ineffable nature of creativity and creative work. Schon shows that creative work happens *in action* [120]. This stands in stark contrast with the *problem-solving* view that creative actions are fully transparent and hence can be verbalized and subsequently codified. It also differs from the *cognitive emergence* view where there exists clear separation between processes of *thinking* (e.g. idea generation in the Geneplore model) and *acting/making* (e.g. exploring structures in the same model).

One of the implications of an embodied view on creative work is that it relies much on tacit knowledge, where "we can know more than we can tell" [109]. Polanyi gives an example of such knowledge by observing that we can recognize a person's face among a sea of faces, yet we cannot usually put into words how we recognize a face we know. Schon [120] notes this tacit knowledge is akin to the sort of *know-how* seen in musicians playing a musical instrument. In other words, a practitioner's (such as the skilled violinist) know-how is revealed through movement of the body, as the fingers' muscle memory help them remember a complex concerto, instead of invoking an intellectual operation. According to Schon, these unconscious processes are central to creative practices, as practitioners' knowledge unfolds through "spontaneous, skillful performance" [87].

Creative work as reflective practice focuses on the "importance of physical and artifact-centered action in the world to aid thought" [88]. From this perspective, the practitioner engages in a "conversation with the materials of the situation" [120]. For example, designers work through ideas by sketching on paper or making prototypes. These interactions with physical objects often introduce "uncertainty" and "surprise" into the process, "furthering understanding of the problem as well as contributing to the envisioning of a solution" [88].

In addition to the primacy of interacting with the physical world through our bodies, the embodied view of creative work also highlights the role of the body in partnership with the dynamic situation, i.e. the moment-to-moment *actions* people take in response to different contingencies. This is echoed by Lucy Suchman in her book *Plans and Situated Actions* [134], where she describes how people respond to dynamic situations by deviating from preset plans. She shows how people use the "resources and constraints afforded by physical and social circumstances" to "achieve intelligent action" [134]. These examples are used to challenge the procedural logic that dominated technologists in the late 80s who saw "deviations as noise" to do away with [115, 116]. Accounts of situated action in creative contexts can be observed in jazz improvisation where the musician pulls from pre-existing repertoire of musical ideas to respond spontaneously to a highly dynamic environment. In other words, moment-to-moment creative actions draw from a large pool of embodied resources, relying on tacit analysis of the fit between the resource and the situation at any given moment.

Gibson's [60] theory of affordances also takes a similarly situated and contextual view of creative action, with specific focus on objects rather than situations. Affordance refers to the interrelationship between properties of the object and the capabilities of the individual. Because of the inherently dynamic nature of this relationship, the use of an object can change as the person or the object changes, as well as from one context to another. For example, stairs afford walking, but if the person uses a wheelchair, stairs can no longer afford the same action. To discuss affordances in creative contexts means to notice the possibility in any object to be used differently from its canonical, culturally normative uses. For instance, using a self-adhesive wall-hook to hang clothes may not be terribly creative but a quadriplegic person using it to open a jar can be [1].

This body of research is inspired by the situated nature of creativity and highlights the everyday creativity of people, by the way they appropriate objects and by how design unfolds through everyday use of objects. The notion of an "everyday designer", conceptualized by researchers like [39], shows that design continues after the deployment of the product, "long after the products have left the hands of professional designers" [140]. Through repair and reuse [77], end-user customization [26], and appropriation [41], users constantly "re-design" the objects they use [39, 97, 139]. This research program "moves beyond a task-oriented perspective of the user in order to encompass users' creativity and resourcefulness"

[1] https://sarahendren.com/projects-lab/engineering-at-home/

[39]. Instead of casting users as passive recipients of somebody else's design, this view highlights them as active designers who are experts of the unique dynamics of their living spaces, constantly adapting the object to fit better with their own lives.

Locating creativity in everyday resourcefulness allows us to see creative action beyond traditional ideals of "engineering" [117] or making "structurally sound designs" [130]. A rich body of design works have highlighted the alternative forms of creative work that arise from unsettling entrenched metaphors and values. For example, [130] have developed the notion of unmaking to challenge the traditional life cycle of an designed artifact; [82] builds on the generative concept of *failure* to characterize an "error-engaged studio" for artists; [25] develops sewable micrcontroller that "provides a case for shifting metaphors of engineering development from brittle and mechanical solutions toward open-ended possibilities" [117]; and finally, *Engineering at Home* [3], a project by designer and professor Sara Hendren, constructs alternative narratives of engineering innovation using examples of everyday adaptations by a disabled person. These works attune us to how dominant narratives of creative work have been about disembodied cognitive processes. By embracing values such as manual labor, sustainability, and failure, they open up possibilities for new forms of creative work.

6.2 Historical roots: sociocultural turn to creativity

Since the 1980s, creativity research in psychology has moved away from "univariate, positivist research paradigms" to "more complex, constructivistic, systems-oriented research models" [56]. These models emphasize the distributed nature of creativity, highlighting the role of social relations and interaction with artifacts over time in creative expression [62]. As a result, creativity research, which had previously been taken up by psychologists and AI researchers begin to attract the attention of sociologists.

As we have seen in the previous problem-solving and cognitive emergence views of creativity, researchers are primarily answering the questions of "What is creativity?" and "Who is creative?". Csikszentmihalyi [35] redresses the essentialist overtones of those questions to ask instead, "Where is creativity?": "Rather than regarding creativity as an intrinsic attribute of particular artifacts or capabilities of a person, Csikszentmihalyi argued that creativity judgments emerge via three interacting components: 1) the domain...2) the individual...and 3) the field...Each has a say in what counts as creative" [84].

By reframing the basic questions about creativity, this view "deemphasizes internal processes and individual contributions and instead places much more emphasis on collaborative creativity" [84]. What this socially-distributed view of creativity does is to recognize "that a creator does not create in isolation but amidst other people (e.g. audience, collaborators, or other stakeholders). The interaction and communication with other people are crucial in shaping the final outcome" [62]. Howard Becker [16] illustrates how this web of complex social relations play out in artistic productions. Instead of seeing an artwork as the work of an isolated genius, he sees it as the result of interactions between the artist and the world. Not only does every piece of art rely on "extensive division of labor", it has a "social origin", and all these forces play a critical role in shaping the final work.

One of the key implications of seeing creativity as a social process is to recognize that people "create their world, at least in part, by anticipating how other people will respond, emotionally and cognitively, to what they do" [16, 61]. This dynamic relationship between the creator and the world is captured by philosopher John Dewey in his book *Art as Experience* [40], where he gives the example of a painter shifting between standing back and drawing as a demonstration of the painter shifting between the view of the audience and the maker. Even in a classically solitude activity such as painting, the painter is never working fully alone – they "embody in [themselves] the attitude of the perceiver while [they] work" ([40, p. 50]).

6.3 Creativity support as a problem of continuous negotiation

Research practices influenced by this view are informed by the notion of external representation of ideas in physical objects and its significance in the creative process. For example, FinalScratch cited in [88] is a DJ tool that "respects the primacy of physical practice". It lets DJs manipulate digital audio via traditional vinyl records and turntables. As argued by Klemmer et al., it "affords continuity of practice – skills acquired over years of practice still apply since the physical interface has not changed", providing the "sensory richness" and the "nuance of manipulation" DJs are used to with analog vinyl records.

Tools influenced by this view promote interaction styles that facilitate direct manipulation [122] of objects of interest, in a manner similar to Levi-Strauss' figure of *bricoleur* who takes a hands-on approach to creation [96]. For example, Jacobs et al. [78, 79] created tools that let people create procedural art (traditionally accessible via text-based programming languages such as Processing) through direct manipulation. This combines the expressive potential of procedural systems with the accessibility of direct manipulation [80]. Xia et al. [144] explores the other direction, imbuing traditional vector graphics interfaces with procedural power using object-oriented principles.

reacTable [81] is another example of using external representation to support music-making. It is a tabletop electronic musical instrument equipped with blocks that can be moved around to manipulate a modular synthesizer. By having the external representations to manipulate through embodied interaction, reacTable enables "reflection-in-action" and lets users develop a physical practice.

7 CREATIVITY WORK AS TOOL-MEDIATED EXPERT ACTIVITY

7.1 Overview

The *tool-mediated expert activity* view of creative work focuses on supporting (expert) creative practices through tools. Activity theory [19, 92] is based on the concept of tools mediating between people and the world. Computer, from an activity theoretical perspective, is not an object people act *on* but rather a mediating artifact people act *through*. In other words, "people are not interacting with computers: they interact with the world *through* computers" [83].

This epistemic position views creative work as mediated by tools. Tools support people in performing different creative tasks. Some of these tasks include exploration, execution, and sparking ideas. The computer, when viewed as a tool, is something manipulated by users to effect change and to extend themselves [73]. Creative work, then, is about the use of technology for creative aims to achieve expertise. This view understands the creative process in terms of the activities most commonly observed in real-world creative practices.

7.2 Historical roots: second and third wave in HCI

The *activity* view shares many of the historical roots with the *embodied action* view, but with greater emphasis on seeing creativity as interaction with the world through (digital) tools.

The shift in perspective toward the social in psychology covered in the previous *embodied action* view of creativity resembles an analogous trend in HCI's "second wave theories". Bodker [20] characterizes the second wave in HCI as concerned with group work across diverse physical spaces, as opposed to the first wave's concern with designing for individuals working at the desktop. Studies from the second wave are informed by the notion that human beings cannot be understood separately from the world in which they live, act, and think [83]. In other words, people's interaction with digital environments must be studied in tandem with the social and material contexts. A particular emphasis is also placed on how artifacts are used in various activities, as "equipment" or tool (drawing from phenomenology, e.g. [42]), as external representation (drawing from distributed cognition, e.g. [71]), or as mediation (drawing from activity theory, e.g. [83]). The third wave or the third paradigm [70] shares many of the same assumptions as the second wave – i.e. the centrality of the physical world in our construction of meaning – with a stronger focus on the various abilities of the human body. This paradigm explores the extent to which our physical capabilities and other senses open up design opportunities for new ways of interacting with technology in everyday settings [70].

7.3 Creativity support as a problem of 'fit'

This emphasis on "acting through the interface" [19] sees technology as acting as an extension of the artist or designer using the tool. This view consider tools as being integral to the creative practice itself, from graphic design to music production to digital illustration. On one end of the spectrum, artists can be seen as talking about computers as their instrument, with expressivity and power. Becoming an expert of the craft often means becoming an expert user of the tool. A "good" tool in this view is often evaluated based on its fluidity of use and power of expression. Examples range from widely-used commercial digital tools for various creative tasks (such as ProTools for music production or Fusion360 for 3D design) to more experimental ventures such as Tod Machover's hyperinstruments, which are technology-augmented guitars and violins that give extra "finesse to virtuosic performers" [135]. *Creativity support* in these contexts conveys a sense of "augmentation": the goal of technology is to seamlessly integrate with the user and to empower them, blurring the boundaries between human and machine.

Adopting an activity theoretical perspective suggests that the primary concern of designers of creative tools should be to support meaningful activities in creative contexts. Many HCI research developing creative tools align with this view. It includes a host of projects developing tools supporting specific design or artistic practices. A historical example is Ron Baecker's *Genesys*, built in 1969. It is often credited as the first digital system to support digital animation [101]. With *Genesys*, the user can sketch shapes, the paths in which the shapes follow, as well as the dynamics of the paths. Ron Baecker has said that the computer can be seen as "a powerful aid in the creation of beautiful visual phenomena" [11]. The idea that computer can serve as a tool in making art has continued to dominate current CST research in HCI.

Genesys can be seen as a precursor to HCI research in tools for wide-ranging creative disciplines, from music composition to graphic design to choreography. In the context of music composition, Garcia et al. [58] explore how interactive paper may be used to support contemporary composers in sketching musical ideas on paper as well as leveraging the power of digital composition software they already use. *Knotty Gestures* [136] supports contemporary composers in creating custom graphic scores with computation baked in. Using interactive paper, *Knotty Gestures* lets users add audio and video recordings onto hand-drawn sketches. Applying a similar idea, *Knotation* [32] lets choreographers and dancers draw floorplans on an iPad and make them interactive by embedding video clips that facilitate review and discussion during rehearsals.

To evaluate how well a tool supports a task, Mackay [142] has developed three principles, focusing on the details of interaction: Is the technology *discoverable*, *appropriable*, and *expressive*? *Discoverability* refers to how well the technology guides the user to discover its functionalities – "can the user easily and quickly learn what the technology is designed to do?" – either via visual cues or progressive guidance [142]. *Adaptability* refers to the extent to which users are able to appropriate the technology and adapt it to accomplish things outside of what it was originally designed to do. Finally, *expressivity* asks about the technology: "Can it capture human variation, both intentional and unintentional? Can users control it, but also be surprised by and work with it?" [142]. These principles, when used to look at technology-supported creative work, reveal common concerns people have when interacting with digital tools.

8 TENSIONS AND CHALLENGES ACROSS POSITIONS

We have articulated four epistemic positions that characterize dominant understandings of creative work in creativity-oriented research and practice. Each position casts light on different aspects of creative work and thus has different trade-offs when translated into design or technical knowledge. In what follows, we present four provocations in response to each position, each representing a specific tension or challenge associated with the view.

8.1 Problem-solving: deletion of essential, but often invisible work

How does a systems view change what gets counted as work? What forms of work are excluded?

The problem-solving view posits that creative work can be represented in terms of models and rational steps. This view has served as the basis for the "magical" [45] rhetoric around the ability of AI systems to perform traditionally human tasks, as exemplified by IBM's supercomputer-produced trailer for the film *Morgan*.

The movie trailer was made using the supercomputer Watson. To train Watson, over 100 horror film trailers were fed into its system. Watson then conducted a series of visual, sound and composition analyses on each scene in order to identify common dynamics of a trailer. Using that model, Watson processed 90 minutes of *Morgan* to select the scenes to include in the trailer. A human editor was subsequently brought in to assemble these scenes into the final trailer. The Wired article featuring this use of Watson emphasizes that "introducing the AI shortened the process down to only 24 hours when it typically takes around 10 to 30 days to complete a trailer" [2]. However, what exactly is lost in this account of creative work? Does this narrative represent an ideal depiction of future creative partnerships between humans and AI?

In *Art Worlds* [16], Becker discusses artistic production as relying on a network of support staff, in addition to the artist. From this collaborative view, the richness of knowledge emerges from close interactions with other individuals and the environment. In the AI-generated trailer example, the original model of collaboration based on communication, cooperation, and negotiation among staff members is replaced by a model of curation by a single film editor. Creative work here is no longer about navigating a complex web of social dynamics – it now consists of tweaking parameter values, selecting scenes and stitching them together. This perpetuates seeing the "support staff" as merely a resource (rather than central to the creative process), whose work can be replaced.

Star discusses these "deletions" of practices in the context of knowledge transfer in expert systems [131]. In her case study, engineers express that their personal interpretation of what goes into a knowledge base becomes obscured, thus "deleted". Similarly, in the case of *Morgan*, the human knowledge that is deemed relevant to the making of the trailer is limited narrowly to the ability to select scenes based on a formalizable set of parameters (such as "fast-paced", "dark", "length of the clips", etc.). Other situational and negotiated aspects of knowledge that are hard to computationally encode are omitted.

8.2 Cognitive emergence: risks of reinforcing mind-body dualism through the stage model

Can creative work be neatly compartmentalized? In what ways do digital tools stratify creative work and how might they introduce artificial divisions into the creative process?

The cognitive emergence view sees creative work in terms of cognitive processes. It rests on the idea that creative insights emerge from an interplay of processes that are often mapped to distinct stages of the creative process, such as Wallas' four stage model. Boundaries of software in HCI often correspond to the different stages of the creative process. For example, as shown by Frich's [54] review of CSTs, tools for ideation are frequently distinct from tools for implementation, often lacking the capability to seamlessly transfer data between them.

One consequence of such a framing is that the typically nonlinear creative process [74] gets structured treatment, separated out into distinct stages, with one stage handing off neatly into the next. In reality, stages in a creative process often blend into each other, overlap, or sometimes skipped over. The shape of each person's workflow is likely highly specific to personal habits, situational contexts, and work styles.

This point is echoed by creative practitioners interviewed by [107], the majority of whom mentions the importance of being able to switch between creative stages (e.g. between ideation and prototyping) and tools (e.g. between Premiere Pro and After Effects). Organizing the creative process in a linear temporal order can result in the loss of serendipitous encounters that often occur in between "phases" and "steps" [74]. Generativity, and indeed insights, often live in the uncertainty and unstructured unfolding of the creative process. When the temporal decomposition of a creative process is highly idiosyncratic, the flexibility of technological "seams" [28] becomes an important design quality and challenge. Designing for artful integration [133] forces us to "rethink the boundaries, purposes, and scope, of devices within a complex ecosystem" [24].

8.3 Embodied action: politics of translation

What are the pitfalls of repurposing concepts from one context to another?

To redress limits of universalism, the *embodied action* view provides descriptive accounts of different contexts and practices, painting a rich and nuanced picture of creative work. This has been translated into a set of sensitizing concepts such as tangible interaction and the primacy of physical practice in creative work. These concepts have been both generative and evaluative [88] and have been hugely influential in guiding the direction of HCI research with values and qualities to design for.

However, in the process of distilling operationalizable insights for design from thick descriptions, messiness gets tamed and the richness of a particular setting gets abstracted away. Irani et al. [76] refer to this as the politics of "translation": the process by which one representational scheme (e.g. ethnographic insights) get transformed into a different representational scheme (e.g. design insights). This is not a problem per se, as design knowledge is fundamentally distinct from insights derived for empirical understanding [15, 72]. It does, however, highlight the need for frameworks that will equip researchers with the tools to answer questions of *when* or *where* a concept is appropriate. Marshall et al. [100], for instance, exemplifies this orientation by posing the question, "are tangible interfaces really any better than other kinds of interfaces?". The goal of questioning the inherent value of tangible interaction is to invite researchers to better articulate the contexts for which tangible interaction might be useful. This recognizes that design concepts such as tangible interaction are not meant to be a *universal* feature of good interaction, irrespective of real sites of use. Its fitness and power depend on and vary with context.

The key strength of this view is its sensitizing power to less visible forms of work such as user adaptations. These stories of creative work feature bespoke designs that fit the particulars of a given situation. The challenge for designers in this case is figuring out how a "commitment to the one-off", the *particulars*, can offer generative lessons for future design [2].

8.4 Tool-mediated expert activity: lack of diversity and plurality within practices

Whose ways of knowing do the tools teach?

The *tool-mediated expert activity* view conceptualizes creative work as mediated by tools, with a focus on supporting people in their various modes of creative expression. These approaches often delineate a set of common activities (e.g. drawing, music composition, etc.) or a group of recognized creative practitioners (e.g. graphic designers, composers) to which the tool should address. When taken to its conceptual extreme in practice, this view tends to see creative activities as stable and uniform across individual practices. It lacks the analytical precision to grapple with diverse practices within pre-established categories.

Diversity of work practices can and does exist within a single creative activity. In "Epistemological Pluralism" [138], Turkle and Papert vividly illustrate a case where a computer science student, whose preferred strategy for organizing programming work is one where she stays close to objects (i.e. computer scripts in this case). Her strategy differs from the way that "programming and problem-solving in computer-related activities" are taught, which privilege "an analytic, rule- and plan-oriented style [of thinking]" that biases the construction of abstract struuctuures while "maintaining reason at a distance from the objects [of work]". Although perfectly capable of producing well-structured computer programs, the student's progress of getting there diverges from that of the norm taught in the classroom. Turkle and Papert use the case to reevaluate how programming is taught, but it can just as easily be applied to illustrate the need for tools to accommodate diverse work styles.

The main challenge for the *activity* view is finding a representative set of users for whom the tool is designed. This framing of creative work risks critiques of the Interaction paradigm, in which ideas about the activities to design for "focus on momentary and ahistorical HCI situations, that are not connected to a particular time and space; the focus is on the snapshot of the interaction at the moment, usually focused on an individual, centered on the human-machine dyadic relationship itself" [93].

9 SITUATING CREATIVITY-ORIENTED HCI RESEARCH

This essay calls on HCI researchers and creativity researchers to reflect on the role of computing in the emergence and transformation of creative practices. It also aims to capture the attention of critical scholars, inviting them to investigate creative technology as a sociotechnical phenomena. On the one hand, creative tools are praised for their potential to democratize creativity. On the other, automatic systems like generative AI pose threats of supplanting crucial creative practices. As noted by [22], the heady discourses of optimism and anxiety often "obscure the more nuanced and subtle shifts that are underway". This essay aims to articulate and elaborate on those nuances.

As we have shown, each epistemic position models a distinct worldview which produces a grammar that makes certain discourses and modes of thought easier. This paper addresses the feminist epistemological question, "What is the connection between knowledge and politics?" [6]. By elucidating these positions, we underscore the importance of explicitly contextualizing the values and politics that drive current creative computing research and design. We argue that our field can benefit from engaging critically with these worldviews at work. Grounded in feminist epistemology, we propose ways of operationalizing our framework below to situate creativity-oriented HCI research.

9.1 Develop reflexive practices in claims-making

A popular refrain in the marketing of creative AI goes something like, "technology X escalates and democratizes creativity, empowering everyone to [write like Shakespeare]". This rhetoric sees creativity as divorced from a practice, thus adopting a "magical language" [27] that spotlights the technical capabilities of the tool and obscures daily practices of creative work.

We argue that to counter magical language, we need to develop a reflexive practice in creativity-oriented research. To do so, we must first recognize creativity as a boundary-making mechanism. This then creates conditions of possibility for pluralistic views. The framework of epistemic positions we have articulated in this paper can be applied reflexively to examine the various ways in which creativity shows up in our own design and research practices. It reveals how differences in our knowledge systems can shape preferences for specific styles of inquiry and what meanings we associate with technology. One can see these knowledge systems as regimes that regulate practice through continuous engagement. We hope that our framework can be used to clarify our own points of view as researchers and technology designers, and also revealing opportunities to give space to other voices, enabling new discussions and debates and forms of collaboration across epistemological styles.

9.2 Interrogate institutional valorization of different views of creativity

The framework has also made it easier to see that some epistemic positions are being advanced or promoted more due to linkage with certain traditions. For example, the *problem-solving* view of creativity has been taken up by the most by the developers of creative applications of AI (see, e.g. [66]) , whereas the *cognitive emergence* view aligns with traditions of design thinking and has thus been absorbed into corporate settings [69] (see, e.g. [91]). The *embodied action* view has served as a guiding principle for creating tools that are rich and expressive in interaction. And, the *tool-mediated expert activity* view has dominated the creative technology market such as Adobe and Autodesk.

Each of these views holds significant epistemological implications: they demonstrate that different forms of creative work get valorized differently and that each view "generates epistemological fault lines" in the types of knowledge claims it is able to produce

[2] http://engineeringathome.org/manifesto

[45]. Becoming sensitized to these epistemological differences enables us to discern which aspects of creative work is emphasized more than others and see how hierarchies of knowledge get constructed.

Reading future technology developments through the epistemic lens, we can see that the *problem-solving* view has driven the dominant discourses around the active role of technology in democratizing creativity. This may further influence funding directions for creative technology projects, prioritizing those that apply emergent computational techniques to address creative challenges. These problems tend to yield results that translate to technological innovations. Projects that take a more reparative approach to technology development such as challenging and undoing dominant narratives (efforts most often associated with the *embodied action* view) often employ methodological tools that are required to understand cultural practices around technology, thus engaging with longer temporalities of scholarship. These efforts do not translate as readily to media discourses and as such may risk being sidelined or forced to align more explicitly with the language of innovation.

This points to an opportunity to engage with creativity-oriented HCI research or creative technology development as a critical technical practice [5], where awareness of what is in the "center" vs. "margins" serves as a methodology for value-centered design [21].

9.3 Stage encounters through counter methodologies

Our framework shows that each epistemic position comes with its blind spots when translated into specifications for design. Each trade-off points to opportunities for methodological remedies. We view knowledge as something to be captured rather than enacted in design [43], which suggests methodological approaches that stage encounters instead of measuring pre-determined outcomes.

By seeing the creative process as one that can be optimized, the *problem-solving* view can often abstract away crucial work that does not otherwise fit into the given model of a process. To address the challenge of work deletion in the *problem-solving* view, we could suggest considering computational ethnography [45] as a way for computer scientists to work with ethnography by collaborating with social scientists and anthropologists to study algorithms and other computational platforms that support machine-learning as a practice. By understanding creative AI technology as cultural practice, we are methodologically better equipped to capture a nuanced picture of creative work.

The *cognitive emergence* view, with its roots in psychology, tends to introduce Cartesian dualism into creative work, seeing cognitive activities (e.g. brainstorming) as temporally separate from manual activities (e.g. implementing the final product). To counter this, we suggest to seek opportunities for *artful integration* [133]. Artful integration, according to Suchman, recasts the designer's attention from discrete objects toward the spaces between them. Instead of designing standalone technologies, the designer's challenge is to design the *assembly* of heterogeneous devices, centering "analysis of specific environments of devices and working practices, finding a place for one's own technology within them". With this shift, rather than imposing a fixed temporal structure into one's workflow, the designer may attend to other ways of organizing work. For example, activity-centered computing [31] is a framework that prioritizes the dynamic interplay of user activities and interactions, offering flexibility in structuring work processes.

In the *embodied action* view, the rich insights about embodiment are often rendered in coarse ways when distilled into design concepts. To better engage with the politics of translation, one might want to engage in counter-storytelling practices that seek to complicate existing narratives of technology. For example, Bennett et al. [17] developed *biographical prototypes* that center "under-recognized" and "first-person accounts of design" from disabled people. Rather than seeking to transform thick descriptions into thin representations, the generated prototypes serve as a entry point for revealing complexities, taking a design stance that we could consider grounded in the value of *ultimate particulars* [103].

The *tool-mediated expert activity* view grapples with questions of "whose voices and whose knowledge are represented?" To meaningfully engage with diversity, we may look to methods for decolonizing design. For example, Elizabeth Tunstall [137] has suggested ways to "reprioritize existing resources" to put the margins in the center and to "stop seeking the supertoken and instead on addressing systemic exclusion", and to "change criteria of evaluation to include other ways" in which people can flourish outside of normative systems. Such a methodological orientation will guide resources and analytical gaze toward those that fall outside of the prototypical graphic designer or composer, for example.

10 CONCLUSION

Creativity is a notoriously slippery term, and our goal in this paper is not to fix it, but to show its seams. We have outlined four epistemic positions that underpin creativity-oriented research and rhetoric in HCI. Each position captures a *class* of creativity definitions. We show how these positions create epistemological *filters* that conceptualize creative work differently, thereby shaping the research questions a researcher asks as well as the methods chosen.

Furthermore, we show that what counts as creative work can be traced back to rich and diverse intellectual lineages, with different interests and value systems. This shows that defining the "nature of work" [132] is a nexus of politics. We seek to contribute toward a situated understanding of the creative definitions at work in HCI. This is the first step toward surfacing the plurality of epistemological commitments in existing creativity-oriented research. They represent parallel conversations that place weight on different themes, sites of inquiry, and analytical frameworks; considering these conversations alongside one another makes salient their strengths as well as their shortcomings.

Our goal is to attune HCI researchers to the underlying assumptions behind a term that carries much import (what is *creative* about creative work?), revealing their "boundaries" as well as "breaking points" [111]. By critically investigating and exploring the wide range of epistemic positions at work, we contribute toward a critical, reflexive, and situated foundation on which to build future research.

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