Indeterminacy and Agonism: Deweyan Reflections on Design Progress in the Age of AI

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Abstract: This paper assesses the current state of professional design practice in light of the American pragmatist philosopher John Dewey's conception of inquiry as leading from a state of indeterminacy to a state of comparative resolution or determinacy. In the past several decades, design practice has made great progress in ways illuminated by the problematic of indeterminacy/determinacy. In particular, user-centered design, focused on making artifacts easy for individuals to use through the effective management of design affordances, epitomizes design practice pursued as a simple reduction of indeterminacy. Today, however, the program of user-centered design has reached a point at which costs stemming from the approach have begun to outweigh the benefits. In products such as the modern smart phone, the paradigm of user-centeredness is now contributing to the emergence of new problems like social isolation, viral misinformation, and political polarization. At the same time, rapidly emerging algorithmic technologies including artificial intelligence are already replacing human designers, based on the technologies' superior capacity to offer a progressively refined series of solutions aimed at individuals. Responding to these dynamics, recent design literature proposes that a more inclusive frame of reference for design practice, transcending the individualistic user-centered paradigm, is now needed. A renewed reflection on the Deweyan theory of inquiry can help illuminate a way forward for the design of communication devices, interfaces and networks, emphasizing the sense of possibility that forms the essential meaning of indeterminacy in Dewey's philosophy. The paper concludes with a call for designers to commit to a program of facilitating more robust social and political connections among users: a program that acknowledges the irreducible pluralism and conflict in human affairs, but seeks to replace the epistemic isolation and antagonism characterizing modern digital communications about public matters with more genuinely related forms of "agonistic" engagement.

Keywords: John Dewey; Design inquiry; Design and indeterminacy; User centered design; Artificial intelligence; Mechanized convergence; Agonistic design

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1. Design and Indeterminacy

In a famous and oft-quoted passage from his 1938 treatise *Logic: The Theory of Inquiry*, the American pragmatist philosopher John Dewey characterizes inquiry as "the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole" [1]. Dewey's definition has received a good deal of attention from design scholars seeking to illuminate the nature of rationality and of progress in a design context [2]. This paper too offers an assessment of the current state of professional design practice,

during a moment of rapid technological change, in light of Dewey's conception of inquiry as a transformation of indeterminacy that yields a state of relative resolution—a new situation that is more stable, coherent, or complete.

Dewey's theory of inquiry was part of a large and ambitious project of "reconstruction" of the main ideas of the Western philosophical tradition, in which he sought to redeem that tradition's tendency to prioritize stasis or invariability over time and change, treating the latter as less real, less knowable, and less valuable. To be sure, Dewey's philosophy does not boil down to the slogan that change is the only constant, a position he ascribed to certain "philosophies of flux" of the late 19th century that in his view ultimately committed the same error of seeking a permanent and unchanging truth [3]. Instead, he labored to develop a "naturalistic metaphysics" [4] centered around a conception of "existence as precarious *and* as stable" [5], insisting that these are not categories of merely subjective experience, but instead are "generic traits of existence" [6]. For Dewey, there is "something problematic, undecided, still going-on and as yet unfinished and indeterminate … *in nature*" [7]. Although not used by him as strict synonyms, precariousness and indeterminacy are closely related terms in Dewey's metaphysics, both pointing to a fundamental contingency or lack of fixity in the world. Indeterminacy specifically points to a constitutive plasticity of all situations, their irreducible openness to both risk and opportunity. Given this fundamental openness, it is in Dewey's view a mistake to believe that the indeterminate aspects of a particular problematic situation might be definitively "resolved," reduced or overcome in some total and permanent way. Although for Dewey, as for pragmatists generally, reality is "brimming with indeterminacy, pregnant with possibilities, waiting to be completed and rationalized," the condition of indeterminacy, being "endemic to reality" as such,

> cannot be terminated once and for all. It can be alleviated only partially, in concrete situations, and with the help of a thinking agent. The latter has the power to carve out an object, to convert an indeterminate situation into a determinate one, because he is an active being. The familiar world of color, sound and structure is his practical accomplishment, i.e., he hears because he listens to, he sees because he looks at, he discerns a pattern because he has a stake in it, and when his attention wavers, interest ceases, and action stops—the world around him sinks back into the state of indeterminacy [8].

Stability, regularity, and focal attention are never just given experiences, but exist only against a penumbra or background of the indeterminate and the precarious. Both risk and possibility are permanent, insuperable features of all existence, and thus of any human "experience" more narrowly and conventionally construed.

Like the other classical pragmatists of the late 19th and early 20th centuries, Dewey brought an evolutionary perspective to the traditional problems of philosophy. The emphasis of his thinking is always on continuity, transience and change—on verbs and adverbs as opposed to nouns and adjectives, as it were. Dewey's theory of inquiry, in other words, corresponds to an *ontology of process* that further clarifies the meaning of "existence as precarious and as stable." On this view, "structure is a character of *events*, not something intrinsic and *per*

se" [9]. Stability, in other words, is real, but relative, a matter of the comparative rates of change among different elements comprising a situation [10]. The process ontology that characterizes Dewey's naturalistic metaphysics has the effect of supplanting the traditional philosophical "quest for certainty" about an independent or "antecedent reality" [11] with a quest for guidelines for *navigating* an ever-shifting environment [12]. Knowledge is not to be understood as it has been for much of the tradition of Western philosophy, as an accumulation of definite facts about the world "out there"—facts which preceded their discovery, and which will remain, pristine and intact, after a particular investigation ends. Instead, as a response to the world's "endemic" indeterminacy, inquiry or

> reflective thinking transforms confusion, ambiguity and discrepancy into illumination, definiteness and consistency. But it also points to the contextual situation in which thinking occurs. It notes that the starting point is the actually *problematic*, and that the problematic phase resides in some actual and specifiable situation [13].

While indeterminacy is a ubiquitous trait of existence as such, not all discrete experiences are specifically attuned to their indeterminate aspects; in these cases, no problem is perceived and no inquiry seeking a transformation of indeterminacy is stimulated. But when human actors find themselves troubled or confused about a situation, unclear about how to proceed, and thereby moved to inquire into the conditions surrounding the problem with the aim of reducing the incoherence in the situation, they are exhibiting rational behavior. For Dewey, therefore,

> thought and reason are not specific powers. They consist of the procedures intentionally employed in the application to each other of the unsatisfactorily confused and indeterminate on one side and the regular and stable on the other [14].

This conception of reasoning reveals knowledge and human interests, thinking and practical concerns, as being inextricably intertwined. Reasoning is thus best understood as "intelligence": an adaptive and transformative capacity that responds in practical ways to the vagaries of events. In turn, this reconstructive understanding of rationality requires a modification in the understanding of truth, away from correspondence to an independent reality and toward effectiveness in meeting the needs of the moment, or what "works" in allowing us to continue making forward progress toward our goals. Dewey's name for this revisionary conception of truth is "warranted assertability" [15]. Although inquiry constitutes a movement from an indeterminate situation toward an increasingly determinate one, there is no definable end state of pure or perfect determinacy that could underpin conventional notions of truth as correspondence. As one commentator puts this crucial point,

> facts are not the ultimate test of a hypothesis …. The relationship is not a foundational one, and facts and hypotheses are symmetrical with regard to their revisability. What matters is that they "fit" with each other such that together they function to guide successful experimentation and eventual resolution of the underlying problematic situation. Instead, facts and ideas coevolve: sometimes facts suggest new ideas or revisions, and sometimes reasoning through ideas suggests further operations of observation, restatement of the facts,

or even rejection of some data as spurious. The ultimate test of both is the transformation of the situation to resolve its problematicity [16].

Together, these interrelated analyses—of "existence as precarious and as stable"; of the "unfinished and indeterminate" as irreducible aspects of reality set within a process ontology; of indeterminacy as constituting a penumbra of risk and of opportunity conditioning all definite thoughts and focal perceptions; of inquiry as the intentional effort to improve the coherency of problematic situations through a transformation of their indeterminate elements; and of provisional warrants, as opposed to permanent truth claims, as the outcome of intelligent inquiry—disclose an understanding of the human situation within the world of great relevance for design. On one hand, Dewey's naturalistic metaphysics reveals indeterminacy, the "endemic" contingency and constitutive plasticity of reality, as an index of permanent possibility, inasmuch as both risk and opportunity are part of the basic structure of every possible experience. On the other hand, Dewey's theory of inquiry, the intelligent adaptation to and transformation of indeterminacy, reveals the human being as a "thinking agent" [17] capable of exercising at least some control over its fate. We are neither the masters of our world nor the passive playthings of the gods, but something in between. The upshot is that, regardless of the current state of individual beliefs and of social and political arrangements, things might always become other and better than they are now—that we might improve on received ideas and hidebound traditions, changing them to meet new needs and necessities as they emerge. At the same time, improvement is never guaranteed. The status of precariousness as a "generic trait of existence" highlights the unavoidable vulnerability pervading every experience, arrangement and institution, the fact that the deterioration of current conditions, no less than the prospect of their improvement, remains a permanent possibility. Everything rests on the strength, vitality and flexibility—that is, on the intelligence—of our capacity for inquiry, as we attempt to manage ongoing challenges, to confront new emergencies, and to imagine, and strive to realize, new arrangements acknowledged to be better than what preceded them.

Among design theorists and scholars, Dewey's theory of inquiry focused on practical problems, his process ontology resolving stability into precarity, and his attempt to replace the philosophical tradition's quest for certainty with a more dynamic and provisional search for warranted assertability, have in recent years been topics of particular interest. In Richard Buchanan's influential writings on design, Deweyan pragmatism, in particular his account of inquiry as a transformation of indeterminacy, represents a model for design practice in a period of social and epistemological fragmentation. Against an accelerating "specialization in the … subject matter" of different fields and professions, Dewey's philosophy points to the possible "use of new disciplines of integrative thinking," of which design can be understood as an exemplary or paradigmatic case [18]. For Buchanan, moreover, the increasing prevalence of "wicked" problems, whose extraordinary complexity defies resolution within the terms of any one special discipline alone, is making design a particularly salient model of constructive practical reasoning as such [19]. Thus, reflection on the resonance between Deweyan inquiry and what Buchanan called design thinking highlights commonalities between designers and nondesigners [20].

The procedures that designers follow in resolving particular design challenges are, in Buchanan's view, broadly similar to those everyone follows when they are acting effectively—procedures illuminated by Dewey's account of intelligent inquiry. Professional designers and ordinary people alike can become aware of indeterminacies in the situations they confront, often experienced as a sense of maladaptation, poor fit, or incompleteness. Both can respond intelligently—that is, opportunistically and experimentally, exploring a wide range of possible ways forward and not limiting themselves to a pre-established recipe of steps to follow. In particular, both can transform problematic situations in ways that may involve changing the external environment, changing themselves (that is, their attitudes or expectations, and hence their very understanding of what the problem is), or, most often, changing both, through the process of inquiry, a process by which "facts and ideas coevolve" [21]. Indeed, "ordinary" people—all of us at one time or another—who try to resolve their felt challenges through inquiry as Dewey described it are behaving in substantially analogous ways to professional designers. In addition to design's integrative potential in the face of complex problems, this overlap between problem-solving in design and non-design contexts is a main reason Buchanan urged the recognition of design as "a liberal art of technological culture" [22]: a method of practice that all can and should learn at a basic level, while some people go on to achieve special mastery in specific techniques such as visualization or prototyping.

Tying these various points together, some design scholars influenced by philosophical pragmatism have begun to speak of "sensemaking" as the outcome of inquiry in a design context, a term encompassing the diverse range of connotations, both adaptive and interventionist, inherent in Dewey's understanding of intelligent inquiry as it applies both to designers and to ordinary people, including the users of designed artifacts. Peter Dalsgaard's general comment is instructive in this connection:

> The pragmatist conceptualization of inquiry can offer insights concerning both *how designers approach and explore design challenges*, and *how users make sense of and employ the products of design*. The pragmatist perspective implies a systemic understanding of situations and prompts us to consider users as resourceful actors who, just as designers, draw on interactive artifacts and systems to make sense of and transform their situation [23].

More recently, "sensemaking" has started to appear in the literature as a way of understanding the outcome of design inquiry in a manner that escapes the cognitivist connotations which have sometimes attended the language of "problem-solving" within design theory. For Anna Rylander Eklund, Ulises Navarro Aguiar and Ariana Amacker, for example, a Deweyan framing of design thinking can help the discipline move past the dualisms of mind and body, thinking and feeling, theory and practice implicated in earlier conceptions of design as a "science," including Herbert Simon's canonical account [24]:

> "sense" allows the integration of both cognitive and emotional aspects of the human experience in interaction with the environment [25].

Whether initiated by a professional designer or an ordinary individual, an act of sensemaking, as Rylander Eklund and colleagues represent it, is an "inherently creative and imaginative" response to "ambiguity and uncertainty" [26]. It brings an improvisatory

and experimental attitude to a situation perceived as indeterminate. Whereas for Simon, "problem-solving" follows a convergent logic, seeking in principle to minimize indeterminacy through a process of elimination and refinement revealing an optimal [27], ideally permanent, solution, acts of sensemaking remain inherently open to the new and inchoate—open, that is, to possibility and the anticipation of future change. "Sensemaking," as this term has been used in recent design-theoretical literature, names an attempt to establish a practical, temporary transformation or ad hoc resolution, but not a sheer and permanent reduction, of indeterminacy.

The following sections of this paper consider the state of contemporary professional design in light of the foregoing framing, based on Dewey's philosophy, of indeterminacy as the *context*, intelligent inquiry as the *procedure*, and sensemaking as the *outcome* of design.

2. Design in the Age of AI

The historian John Heskett has described how, as a consequence of the industrialization process that began in Great Britain during the late 18th century, "users were *deskilled*. People adapted to products and processes that treated them as a mass, and rarely in terms of unique individual or social entities" [28]. One of the great accomplishments of the design professions over the past several decades has been the achievement of a more balanced perspective on the relationship between users and artifacts. In particular, the careful analysis of design affordances [29] has led to great progress in creating products that *do* adapt to people, and not the other way around. In the familiar jargon of the field, design practice has become *human-* or *user-centered*, predicated on an empathetic identification with the perspective, needs and interests of the individual end user of the designed artifact. Supplemented by the combination of experience and interface design (UX/UI) as new subdisciplines within the domain, user-centered design has made great strides in developing products that are easy to use—that are "user-friendly."

The user-centered approach is well exemplified in the paradigmatic product of the digital age: the "smart" (i.e. internet-connected) mobile phone, a triumph of user-friendliness with its sensitivity to ergonomics, intuitive screens and interfaces, and overall ease of use. Indeed the extraordinary adaptability of these devices, with their numerous settings and downloadable apps allowing for an almost infinite degree of customization, would appear to have completely overcome the deskilling effects of early mass production that Heskett pointed out. Mobile phones empower their owners in a variety of obvious ways, as evidenced by the devices' ability to integrate a vast and heterogeneous range of user activities: communicating with friends and colleagues; receiving news and weather updates; taking pictures and videos and subsequently editing, organizing and sharing them; maintaining networks of connections through social media; and so on. In more abstract terms, we can interpret the success of these artifacts in the marketplace in terms of their amazing ability to solve problems—that is to reduce indeterminacy—for the individual consumer. Mobile phones, and the world of digital media they afford access to, are both products of, and powerful tools for, inquiry: they help their owners address many challenges of everyday living within contemporary societies. Especially in their current

instantiation as product-service systems, incorporating both hardware and highly configurable software applications, modern mobile phones epitomize "the unity of a balanced and functioning whole" [30] that Buchanan predicted design would be able to deliver in an increasingly complex world.

Yet for all of the impressive capabilities of these devices, it has long been obvious that smart phones, and the so-called "digital transition" to a world of internet-mediated communications more generally, has not been an unalloyed good for modern people or societies. An air of paradox has come to surround networked computational devices like mobile phones. Designed to connect, they frequently isolate; intended for communication, they instead often facilitate a self-segregating epistemic tribalism; built to inform, they have become major vectors of misinformation and of algorithmically-driven confirmation bias. It is a deep irony of contemporary design that modern digital communication devices and networks, an apotheosis of design's integrative potential, are now contributing to various forms of social *dis*integration, within families, communities and societies as well as between nations.

The disciplines of contemporary industrial design are of course not solely, or even primarily, responsible for our current predicaments, which have varied and complex origins (climate change, large-scale migration, the recent global pandemic, and of course the rapid development and commercialization of internet-based technologies themselves, to name just a few of the most obvious). But the growing recognition that the screens and "feeds" now colonizing so much of people's time and attention have become an increasingly salient source of personal, social and political problems is forcing a reconsideration of design practice in relation to contemporary needs. Today, it appears that the program of user-centered design and its offshoots such as UX/UI may be reaching a point at which the costs stemming from the problem-solving approach to design that they have more or less perfected are outweighing the benefits of further developments along the same trajectory. In products such as the modern smart phone in particular, the goal of user-friendliness has in some ways become a victim of its own success. The result is that design today is contributing to a dynamic reminiscent of the philosopher Herbert Marcuse's analysis of the foundational ideas underpinning modern liberalism:

> The rights and liberties which were such vital factors in the origins and earlier stages of industrial society yield to a higher stage of this society: they are losing their traditional rationale and content. Freedom of thought, speech, and conscience were—just as free enterprise, which they served to promote and protect—essentially *critical* ideas, designed to replace an obsolescent material and intellectual culture by a more productive and rational one. Once institutionalized, these rights and liberties shared the fate of the society of which they had become an integral part. The achievement cancels the premises [31].

This analysis of modern freedoms is itself a manifestation of Marcuse's general dialectical account of history: a broader intellectual context which is not invoked here. The current point is simply that, having emancipated design from its initial, deskilling phase, the program of user-centeredness is now, paradoxically, creating new forms of deskilling in its

own right, by undermining people's capacities for stable relationships and for mature citizenship within modern, pluralistic societies [32].

The growing awareness that problems ranging from screen addiction to political polarization can be exacerbated by the very qualities of seamless utility and intuitive usability that have served as primary goals of the design fields has led an increasing number of observers to question the appropriateness of professional design practice focused entirely on the satisfaction of individual consumers. The increasing untenability of the user-centered paradigm of design has thus become a prevalent theme among design scholars in recent years, with the excessively narrow focus of conventional industrial design practice emerging as a consistent point of criticism. Jodi Forlizzi, for example, has questioned the individualistic orientation of UX/UI design, at a time when the online platforms and networked devices that designers help to create can support the interactions of thousands of users at once. In Forlizzi's view, the "framing" of interface design, still focused on the individual user, has failed to keep up with contemporary technical developments; accordingly, human-computer interaction design now requires a renovation, which would "add a service framing to the framings of [user-centered design] and UX that have preceded us in the discipline" [33].

A "service framing," in this context, would lead to interfaces being "designed with multiple stakeholders in mind, rather than one user" [34], thus helping to counteract the ways in which user-centered product and interface design are growing increasingly out of step with contemporary social exigencies. Summing up her diagnostic assessment of contemporary UX/UI, Forlizzi calls for a more self-consciously *stakeholder-centered* design, which takes into account the notion of different entities interacting with and through products, services, and systems" [35]. Such an expansion in the framing of interface design would entail a radical revision in the professional expectations pertaining to design practice [36]. Implicit in this assessment is the idea that accounting for the interests of stakeholders other than the individual user would necessitate the reintroduction of certain types of *friction* in the use of digital communication devices and networks, disrupting the seamless user-friendliness that currently facilitates flows of misinformation and a pattern of mindless provocation online.

An even more radical challenge to contemporary design is emerging from the rapidly developing capabilities of networked devices themselves, capabilities now increasingly driven by algorithmic decision systems, especially those incorporating artificial intelligence (AI) and machine learning. As Elisa Giaccardi and Johan Reström observe in a prescient 2020 article that concretizes and extends Forlizzi's allusion to "different entities interacting with and through products, services, and systems," in the case of modern products like smart phones, we are really dealing with "autonomous or semiautonomous entities that increasingly do business with humans and with each other, across previously separate spheres of life" [37]. This observation leads the coauthors to make an important prediction: as these types of networked computational devices

> become increasingly sensitive to context … their design begins to evolve based on what they "learn" through their encounters with the world (us and each other), [and] they will begin to express agency and become active in a way we have never seen before [38].

While Forlizzi's call for design to become more "stakeholder-centered" foregrounds human beings who might be negatively affected in a collateral way by user-centered design (for example, as recipients of misinformation), Giaccardi and Redström point out that networked devices like chatbots, powered by AI and machine learning, are themselves rapidly acquiring some of the characteristics attributed to human stakeholders, becoming "agents in a design space where they actually participate" [39]. Although the emerging powers of such "agentic AI" do not, in the authors' view, warrant ascribing to these technologies the kinds of interests commonly considered essential to (human) "stakeholders" as such, they do require a serious revision in the conceptual model underpinning contemporary design practice. Drawing on Martin Heidegger's classic analysis [40], Giaccardi and Redström suggest that this conceptual model is ultimately an expression of the modern understanding of technology in general, which interprets the designed artifact as a passive tool, indifferently available for incorporation into various human purposes but in itself inert and incapable of initiating purposive action. This conventional understanding of artifacts, and of design's role in the specification and production of artifacts, argue Giaccardi and Redström, is becoming increasingly irrelevant to the realities of product development in the context of the digital transition, since "if things 'learn,' 'act,' 'change,' and more, then relating to them as passive tools more or less hides what they are actually capable of" [41].

Today, the design-relevant capabilities of agentic AI systems are coming into focus, revealing the total inadequacy of the traditional understanding of technological artifacts as neutral instruments awaiting deployment in service of a human intention. In general terms, algorithmic decision systems, especially those incorporating AI, are assuming a role as "partners in a more-than-human design practice" [42].

More specifically, agentic decision systems are taking over the problem-solving role that has animated user-centered design for the last 40 years. As noted above [43], problem-solving in design instantiates a convergent logic, "narrowing down" to an optimal solution through an iterative series of prototypes in order to realize "an outstanding synthesis worthy of mass production" [44]. AI-based systems are able to enact this type of convergent prototyping process much more efficiently than human designers, especially in the domain of digital products where the time lag between design and implementation is reduced to virtually nothing and large numbers of iterations or alternatives can therefore be introduced in rapid succession. Indeed, as Roberto Verganti, Luca Vendraminelli, and Marco Iansiti have pointed out, contemporary commercial applications of AI and other algorithmic decision systems, for example in firms such as Netflix, have already achieved the full automation of this problem-solving role, a fact exemplified in the unique user-specific programming recommendations—including even the visual art used to represent each suggested program—that Netflix's algorithms now produce [45]. For the design fields, the significance of this development is that AI-driven businesses (which Verganti and colleagues call "AI factories") have effectively already reached the conceptual telos of

user-centered design: the literal individualization of product delivery. It's not that further improvements won't continue to emerge, especially in the area of platform integration, but that AIs will be able to appropriate most of this ongoing refinement work by means of the recursive, self-training loops at the heart of machine learning systems.

It may be fairly asked whether the convergent logic seeking to satisfy a customer, pioneered by human-led user-centered design and now increasingly taken over by algorithmic decision systems, is something to uncritically celebrate. Even in the comparatively innocuous arena of TV programming, is a scheme to suggest, for a given customer, only programs "relevantly" similar to ones the customer has already selected—or "liked" by other viewers who also "liked" the last program the customer chose—truly in that person's best interest, all things considered? It seems obvious that no one should be encouraged to consider programs they are likely to hate. But it is less obvious that devoting much or all of one's TV watching to algorithmically pre-filtered content, progressively reducing over time the chance of exposure to the new, the serendipitous, and the unexpected, is actually the best arrangement. At the same time and from another perspective, there are emerging concerns about ways that reliance on AI-based systems may "narrow down" individual users' *own* agency, including capacities for creativity and for critical reasoning.

Human-computer interaction researcher Advait Sarkar, for example, has found evidence of a "mechanized convergence" effect among users of AI tools, in which "the automation or mechanization of work leads to a convergence in the space of outputs" [46], evidenced in a reduction in the variety of text-based responses to prompts for both creative and nonfiction writing. These effects may be very subtle, and "the nudge towards standardized, centralized, averaged, generic, and statistically optimized answers … barely perceptible [to the user]. Yet the data demonstrates that these nudges in fact have a measurable cumulative effect on knowledge work" [47]. Another recent research project found that the use of ChatGPT among 50 undergraduate MIT students assigned a writing task encouraged cognitive offloading and what Sarkar calls the delegation of intent [48], and reduced neural activity overall [49]. Summarizing these distressing developments, Sarkar observes that "mechanized convergence, as a tendency of automation more broadly, creates a crisis of intentionality: a culture that has lost the capacity to intend, does not realize, and does not care" [50].

In the context of the digital transition, user-centered design has helped create a media environment in which the content each user sees has been algorithmically optimized to produce maximum "engagement" as measured by screen time, click-through rates, and sales conversions. The "problem-solving" dynamic structuring digital media feeds is now driving individuals into ever-narrower and more precisely defined content channels, each new item being determined mainly by the user's own previous clicks, likes, and re-postings, enhanced by sophisticated collaborative filtering mechanisms. Users are becoming more and more completely enclosed within tribal epistemologies that are partial at best, and thus more and more susceptible to self-reinforcing biases, manipulative lies, and conspiracy theories. The upshot is that the convergent logic at the heart of the user-centered paradigm of design is now helping to make people more isolated, more distracted, more polarized, and less able to focus on—let alone to thoughtfully address—problems of shared concern.

More abstractly put, user-centered design today enacts a *sheer reduction of indeterminacy* that is becoming increasingly dysfunctional and socially toxic. In many contemporary digital communication contexts, an approach to design narrowly focused on problem-solving for individual users now contributes to the systematic leveraging of confirmation bias in the service of profit maximization or the accumulation of political power. Views alternative to the users' own, or to those of their ideological, partisan or ethnic group, are represented, if at all, as being less accurate, less valid, irrational, the product of disingenuous bad faith. The narrowing, individualizing logic of user-centered design, pursued in recent decades under the rubric of user-friendliness, has today curdled into something a lot less friendly. In its conventional meaning within industrial design practice, problem-solving has itself become a problem. And algorithmic systems employing AI and machine learning promise to vastly accelerate the narrowing, homogenizing logic of user-centered design, locking individuals and groups into ever more separate, mutually inaccessible silos of conviction, while simultaneously weakening their capacities for developing independent, critical perspectives on their own beliefs, requisite both for their articulate defense and for envisioning alternatives and new possibilities.

In sum, in "the age of AI," it would appear that we have succeeded in creating algorithmic "thinking agents" [51] of the kind anticipated by the process ontology of Dewey, with its corresponding account of inquiry as the navigation of indeterminacy. But the agency thus far developed is of a strongly one-sided or truncated character, aiming in principle for an absolute reduction of indeterminacy, as opposed to a sense-making approach to problem resolution that would preserve a healthy awareness of the contingency, hence revisability, of all solutions. After all, Dewey saw his naturalistic metaphysics as calling for "the application *to each other* of the unsatisfactorily confused and indeterminate on one side and the regular and stable on the other" [52]. Algorithmic decision systems, at least as currently conceived and configured, seem unable to encourage an attitude of sensemaking on the part of their users.

Commenting on a much earlier stage of design development, Victor Papanek caustically denounced "the myth that design solves problems," observing that

> it does, but only problems that are self-generated. A graphic designer "solves the problem" of advertising rail-travel as ecologically saner than automobile-travel, but at the cost of neglecting walking or bicycling, *and in so doing diminishes the choices people can make* [53].

Today, both the hardware and software of communication devices, especially internet-connected mobile phones, drive people apart as much as they draw them together, training them to expect a new experience of outrage every time they check their newsfeeds and social media apps, and priming them to "like" and repost such items mindlessly and in the heat of the moment. These devices also increase people's susceptibility to misinformation, by facilitating the misleading presentation of ideas while at the same time obscuring the provenance and original authorship of those ideas. The overall outcome is that *the very smoothness and seamlessness of contemporary product and interface design is now having a debilitating effect on many personal relationships and on public discourse*. When combined with the commercial imperatives of the firms that run the major digital media platforms,

and the opportunities these systems create for unscrupulous political figures and their supporters, it is hardly surprising that we are witnessing the suspicious factionalization and blind antagonism currently disfiguring social life within, and between, countries. It is safe to assume that these negative consequences were not intended by the great majority of design professionals who have contributed to the perfection of user-centered design and helped usher agentic AI into the design of networked communication systems. Nevertheless, an urgent question now confronts the professional design fields: having contributed to these serious contemporary problems, can the profession now contribute to their correction or amelioration?

3. Design for Agonism

In the context of the digital transition, user-centered design, the primary paradigm of contemporary professional design practice, is introducing new challenges. The goal of serving an individual consumer under the convergent logic of an increasingly refined series of product iterations, especially since the introduction of AI and machine learning into the digital design space, is now contributing to adverse effects ranging from individual isolation to political polarization to a general decline in critical and creative capacities. Meanwhile, in strictly economic terms, AI threatens the livelihoods of professional designers working to make products "friendly." In effect, the emergence of algorithmic decision systems has raised the prospect of the de facto exhaustion of human-led user-centered design as a general program for professional designers, a topic of increasing concern within the field [54].

Do the toxic, albeit unintended, consequences of the user-centered paradigm in digital design practice, which is already causing damage to social and political life and is now being colonized and supercharged by AI, portend the end of the design professions? No. Taking as its starting point the imperative of reorienting design to address the multifaceted challenges posed by the digital transition, this concluding section of the paper sketches a programmatic direction for design in the coming years, drawing on the pragmatist conceptual framing outlined at the outset for help in clarifying a viable path for professional design practitioners going forward.

The new opportunities for the repositioning of design practice being created (and necessitated) by the impending end of the human-led program of user-centered design is already a focus for many thoughtful observers of the design fields. For Marzia Mortati, for example, the technological transformation of design means that henceforth, design expertise and creativity can be applied further upstream in the development process. In an important programmatic article that draws explicitly on Forlizzi, on Giaccardi and Redström, and on Verganti and colleagues, Mortati calls for the recognition of an emerging "fifth order" of design "characterized by the centrality of mixed types of data both as input to and output from a design process"– a new era of design practice in which AI and other algorithmic decision systems will play an increasingly prominent role [55].

Mortati agrees with Forlizzi that the digital transition in particular has created a new context for design, centered on "different entities interacting with and through products, services,

and systems" [56], adding that these entities are increasingly taking the specific form of "socio-technical systems materialized through data feedback loops, data conceptualizations, and wider pathways to transformation" [57]. With Giaccardi and Redström, Mortati observes that "design is currently moving beyond the development of systems and environments where people relate to each other," and is instead "devising learning systems in which new and different types of *agents* act … outside the control of humans" [58]. These agents include networked computational devices driven by algorithmic decision systems, both customer-facing and internal to organizations, as Giaccardi and Redström predicted. Finally, Mortati acknowledges Verganti and colleagues' claim that "algorithms increasingly will become more efficient than humans at implementing and tailoring solutions" [59], agreeing that from this point forward, human designers must focus less on product refinement through iterative prototyping and more on the broader social environment in which products and services are to be introduced. Indeed, under the conditions of fifth-order design, incorporating AI and its recursive machine learning cycles,

> the near-perfection attribute of artifacts no longer is a relevant value. Instead, the digital world pushes toward the notion of the *good enough, for now*, coming to terms with the fact that millions of alternative versions can be proposed in a short time [60].

Mortati's analysis thus culminates in a call for design to transcend altogether the convergent logic of the user-centered paradigm that has governed design practice in recent decades, acknowledging the reality that "problem-solving no longer is the most relevant activity for design. In an uncertain world, establishing what problems are worth exploring is a priority interest" [61].

Of course, there is a long history of writers urging design practitioners to take greater account of social needs in the face of technological changes and constant commercial pressures [62]. But Mortati claims that for design, the challenges and opportunities posed by algorithmic decision systems are qualitatively new, and that they call for

> the renovation of the role of designers complementing a technical endeavor—the more traditional one linked to designing shape and function—with a sociological role, where a project starts from problem setting (or the understanding of the most pressing challenges) to provide hands-on support for transformation to communities and organizations [63].

In the wake of the digital transition, *problem setting* in design will involve a renewed responsiveness to the broader context in which design shapes the contours of risk and of opportunity. More concretely, it must involve a search for ways to support users in *thinking about*, and not of merely in *reacting to*, algorithmically generated prompts encountered online. Today, understanding "the most pressing challenges" requires not only the recognition, familiar to design theorists, that "artifacts have politics" [64], but more specifically that "convergence is the politics of AI, the artifact" [65].

The distinction between problem setting and problem-solving is echoed by Verganti and colleagues' discussion of "AI factories"—the AI-driven businesses, like Netflix, in which

> problem-solving is now increasingly embedded into … automated learning loops …. If problem-solving is performed by machines, what kind of thinking is left to humans in

innovation? The role of humans in AI factories … becomes to understand what problems should be addressed and to drive the continuous evolution of algorithms toward a meaningful direction. The core of this activity is not problem-solving, but problem finding [66].

Although Verganti and colleagues are here more focused on the role of design specifically in the context of product innovation, their identification of this role as pointing to "what problems should be addressed" i.e., to problem *finding*, makes essentially the same claim as Mortati's more general call for designers to reposition their practice away from problem-solving and toward problem setting. And both of these discussions recall the distinction discussed by Rylander Eklund and colleagues, between problem-solving as a predominantly cognitive activity and "sensemaking" as a term, informed by Deweyan pragmatism and incorporating emotional as well as intellectual factors, that in their view better captures the meaning of design thinking than the more conventional idea that it is a generic method for developing optimal solutions to complex problems. It is noteworthy in this context that Verganti and colleagues' article itself concludes with a call for design to embrace "sensemaking" as a new modus operandi for human designers, focused on "understanding which problems should or could be addressed" [67].

Problem setting, *problem finding*, *sensemaking*: these various expressions represent ways that sophisticated contemporary observers of design practice are attempting to articulate a role for professional human designers in the age of AI, an age in which algorithmic decision systems are taking over user-centered design, bringing advantages as well as serious psychological, social and political problems in their wake. In their intended contrasts with *problem-solving* understood in more conventional cognitivist, positivist, linear, or "tame" [68] terms, these expressions also resonate with the distinction between "technical" and "adaptive" problems discussed in the literature on organizational leadership [69], and with design theorist Donald Schön's highly influential dichotomy between the *setting* and the *solving* of problems [70]. But the contemporary authors addressed in this paper share a commitment to advocating for design as a privileged or paradigmatic approach to the challenges posed specifically by the digital transition. Notwithstanding their slight terminological differences, these authors, moreover, can be seen to share a similar interest—an interest in re-situating or re-contextualizing both the development and the use of designed artifacts, interfaces, and systems, so as to promote the outcome that "thinking occurs" [71] in modern contexts of digitally mediated communications.

Following Dewey, this would mean cultivating a renewed sensitivity, on the part of makers and users alike, to the "actually problematic" [72] quality of contexts of thinking, choosing, and acting—a sensitivity that is weakened by the convergent logic that algorithmic decision systems instantiate in generating new content whose "relevance" is determined by past user behavior. Put differently, these contemporary design theorists all point toward a new program for design, as seeking to encourage "creative and imaginative" responses to "ambiguity and uncertainty" [73]—not a definitive and permanent reduction or eclipse, but practical, temporary and tactical resolutions, of indeterminacy: resolutions that are "*good enough, for now*" [74]. These authors, in effect, recommend that design practice be reconfigured to encourage users in adopting an attitude toward perceived problems that respects "existence as precarious and as stable": a mode of orientation in the world that

remains attuned and open to novelty and to possibility. By definition, sensemaking, as a practice of "embodied beings with emotions and concerns in complex situations which render it not obvious how to proceed" [75], is such a mode of orientation to the constitutive risk and opportunity that pervades every situation. Thus, sensemaking (or alternatively, problem setting or finding), understood as the outcome of design, deviates dramatically from the prevailing design program of user-centeredness, a program which advocates convergence toward an ideal or perfect prototype through problem-*solving*—a program now best left to automated systems.

Indeed, AI systems are proving to be very effective at certain kinds of problem-solving, and will likely grow more so over time. But they cannot themselves navigate or maintain a sense of *indeterminacy*, of *open-ended possibility*—at least not at present. Algorithmic decision systems can progressively refine a product to serve an individual; but as currently configured, they tend to ignore the wider social and political context, and thus to suppress the user's awareness that things might always be otherwise, that all current arrangements are provisional, contingent and temporary, that there may be alternative and better ways of framing or understanding an issue. This is a main dynamic underlying the unsettling sense of social and political dissolution that is paradoxically attending the triumph of user-centered design in digital communication contexts: The more modern technology exploits each user's capacity for distraction, or reinforces each user's sense that *of course* their opinions are correct, their attitudes valid, the less able the user becomes to consider alternative views, ways or ideas. Meanwhile, the more we allow AIs to think for us, the less able we will become of even recognizing, let alone entertaining, alternatives to our settled convictions even when they are presented in clear and compelling ways.

What might design as sensemaking or problem setting—design conducted as a practice of re-situation and oriented to possibility, not just to the ever-more-refined satisfaction of the consumer—look like? More particularly, what might an approach to fifth-order design, taking into account the dynamic and self-actuating features of algorithmic decision systems supported by recursive machine learning processes, do to counteract the pernicious trends of epistemic isolation, identity-based tribalization and mutual incomprehension afflicting modern societies? First and foremost, design practice in the wake of the digital transition must prioritize users' agency, not their convenience [76]. Therefore, following Forlizzi, UX/UI design should at a minimum make it more difficult (or less easy) to thoughtlessly repost provocative content—intentionally reintroducing some friction back into the user experience of interfaces, and thereby taking into account the potential human recipients of (for example) harmful misinformation as stakeholders of the design process.

Following Giaccardi and Reström, design must consider the role that agentic AI systems will increasingly play in the design of new products and services, a rapidly emerging participatory role that requires an expanded frame of reference anticipating the incorporation of new algorithmic decision systems as "partners in a more-than-human design practice" [77], and a proactive, anticipatory posture on the part of designers in relation to these strange new partners. In particular, and following Mortati, design today needs to devote its resources to, and to understand itself primarily in terms of, activities of problem *setting*, not of problem-*solving*. In the context of public debate about contentious

issues, "problem setting" will mean affording intellectual access to a range of perspectives, while requiring that the perspectives be grounded in evidence whose authenticity can in some way be verified by the users of digital devices and platforms, or alternatively in an authority whose legitimacy is recognized, even if the authorities' policy pronouncements are ultimately not accepted by all. Crucially, it will also necessitate cultivating a sense of the contingencies involved in the development of AI-based systems themselves, countering the aura of inevitability that so often attends the emergence of new technologies, and making clear that the current, mainstream media representation of AI as an unstoppable juggernaut is itself a product—one that reflects the interests of a very small group of developers and investors who have the most to gain by representing the personal and social indispensability of algorithmic decision systems as a foregone conclusion.

Put more succinctly, design as problem setting will involve promoting the *intelligence* of the users of these new technologies, as Dewey understood this critical term. And this means that design practice in the fifth-order context of recursive machine learning loops and agentic AI will need to renounce design's traditional role of gratifying an individual customer through progressive improvement in product delivery, in favor of promoting genuine engagement—that is, confrontation—with otherness, with diverse perspectives. Design must now reject the attractive but increasingly problematic ideal of (for example) the "perfectly intuitive interface" yielding frictionless, transparent communication throughout an extensive social network, encouraging instead an understanding that accounts for the unavoidability—and in fact, the desirability, within appropriate limits—of friction, ambiguity and conflict in social life. Today, any new program or paradigm for human-led design practice, any worthy successor to the program of user-centered design, must not suppress disagreement by offering each user only what they want to see and hear, but must try instead to make disagreement more productive.

Design for the AI-powered fifth order, in other words, must reconfigure itself around an *agonistic* role: facilitating constructive confrontation among people and groups, and no longer trying just to satisfy isolated consumers in ways that only deepen their isolation. A way that design might contribute to rehabilitating more robust and related communities, more genuinely participatory democratic societies, and more functional international affairs, would be to establish opportunities for people to disagree in reasoned, structured, and thoughtful ways—not, as at present, to offer additional modalities for agreeing only with themselves and with other members of their ideological or identity tribes, while flattening, stereotyping and demonizing those they think of as outsiders.

Political agonism has primarily been developed as a critique of certain assumptions underpinning modern liberal democracy, in particular the assumption that rational consensus regarding public policies and procedures of governance is, if not achievable under current historical conditions, at least a coherent ideal that can, and should, regulate political speech and action [78]. Against this assumption, the theory of "agonistic pluralism" advances an understanding of conflict as an irreducible feature of all societies, and not something that can be simply wished or willed away—but which can be channeled into productive contests within an agreed-upon framework of rules. Over the past 20 years, the theme of agonism has been taken up by writers interested in exploring the specific potential

of design for supporting constructive forms of social conflict, while discouraging destructive forms [79]. By bringing political disagreements into sharper relief and highlighting inequities of political power, the structuring of conflict through design, it is hoped, may promote wider political participation, convert blind polarization into a more constructive confrontation with those who disagree with one's own commitments, and, ideally, help to catalyze creative experiments and innovative resolutions to intractable social problems. The discourse on agonistic design is robust and diverse; nevertheless in the current context the following example may suffice to suggest the kind of contribution design might make to the contemporary challenge of web-based distraction, misinformation and epistemic self-segregation.

Although not focused specifically on digital communication environments, relevant work by the participatory design pioneers Erling Bjögvinsson, Pelle Ehn, and Per-Anders Hillgren sheds light on the potential political role of agonism in design, and will accordingly serve as an indicator of the approach's potential in the context of the digital transition and its many adverse effects on public life. Turning from earlier applications of participatory design in workplace contexts, the authors explore the potential of design as a resource for facilitating greater participation in discussions bearing on matters of public concern. A main source of the authors' interest in this framing of "political design" [80] is their dissatisfaction with conventional understandings of design and of design expertise, which focus overwhelmingly on the production of artifacts for sale: an understanding of design whose political meaning has therefore generally been limited to "the idea that a market economy—[which] increasingly thrives on the speed of producing novelty products—is a precondition for democracy" [81]. The authors propose an altogether more ambitious role for design in support of democratic societies, arguing that the "diversity of perspectives, concerns, and interests" characterizing such societies requires that design focus on the creation of "socio-material assemblies" which establish "a common place where conflicts can be negotiated" [82].

Opening up a temporal perspective on the design process in a way that anticipates Forlizzi's later call for design to account more fully for human stakeholders, the authors distinguish two discrete phases: "design before design," the shaping of artifacts and services more traditionally associated with design as such; and "design after design," the latter phrase reflecting a recognition that "there are stakeholders other than immediate users and that people appropriate designs in unforeseen ways. Envisioned use is hardly the same as actual use" [83]. The recognition of "design after design" as a real and irreducible phase of the overall design process, in other words, puts a premium on openness and unfinishedness, on "unanticipated events and performances yet to be" [84]. In general, Bjögvinsson and colleagues' two-part recommendation—leveraging the special expertise of designers in the phase of "design before design," while ensuring that they "deliberately design indeterminacy and incompleteness into the infrastructure" [85] in anticipation of future appropriations and changes—represents a balanced and sensible understanding of how designers can understand their role in the context of modern technological developments.

By understanding design as contributing to "a common place where conflicts can be negotiated," the authors seek to assign to design the goal of keeping difficult or political

conversations going, opening people to perspectives other than their own. In the context of political discourse especially within modern democracies, then, a key goal for professional design can be understood as helping to "transform antagonism into agonism, from conflict between enemies to constructive controversies among adversaries who have opposing matters of concern but also accept other views as legitimate" [86]. In such a context, novelty or innovation may take the form of new policy proposals or ideas about how to resolve existing challenges. For design practitioners, supporting novelty in this sense requires recognizing that

> political communities are characterized by heterogeneity and difference … They are in need of platforms or infrastructures, "agonistic" public spaces—not necessarily to solve conflict, but to constructively deal with disagreements [87].

Although it was published more than a decade before Mortati's article, Bjögvinsson and colleagues' argument very well captures the challenge and the opportunity for design practice under the conditions of the AI-driven fifth order design that Mortati outlines. Despite the collapse of the design-implementation distinction in the age of AI, the authors' emphasis on "design before design" as opposed to "design after design" highlights the ongoing role that human designers may continue to play in the structuring of conflict. That role is not obviated, but on the contrary made all the more urgent, in our increasingly technology-mediated world.

On a more concrete level, there are many possible avenues for design to explore in promoting a greater capacity for agonistic engagement by users of digital media. The sort of friction Forlizzi's article implicitly calls for could be introduced through "accuracy prompts," pop-up screen messages that invite social media users to check the validity of their posts before uploading or reposting them [88]. News items or other content flagged for problematic keywords, phrases, or provenance could be subjected to similar pop-up warnings before the users even read them, a "prebunking" strategy drawing on the large body of research known as inoculation theory [89]. Gamified or narrative strategies of engagement, making use of pop-up screens, skins, or freestanding apps or sites, could lay out the stakes of controversial issues in relatively neutral ways, inviting users to challenge their own assumptions while exploring other perspectives. Interventions like these, opening up additional possible modalities for an agonistic design practice addressed to public affairs and policy disputes, would seek to counteract the seamless character of digital communications that has formed the main goal of contemporary design under the user-centered paradigm, in hopes of helping people become at once more skeptical about what they encounter online, more sympathetic or understanding of a wider range of views, and better able to defend their own deepest convictions in reasoned, effective ways.

"Design for agonism," in line with the general theory of agonistic pluralism on which it rests, in no way depends on or implies a utopian agenda of replacing a society of mutually suspicious individuals with a society whose members work happily through all their disagreements on the way to achieving a universal consensus. In modern, pluralistic societies, total consensus on any given issue is neither possible nor necessary—not a valid goal even in principle. But neither does agonism in public life necessarily augur a dystopian

state of zero-sum tribal conflict that can only end with the total domination by one group over all the others. Instead, an agonistic paradigm of public discourse would orient design practice toward helping people to put in context—that is, to *make sense of*—their social and political differences in ways that could help support constructive conflict leading ultimately to reasonable decisions, policies and laws. As a programmatic focus for digital design, therefore, agonism would be one critical way for the discipline to answer Mortati's call for design to complement its traditional, form-giving role with "a sociological role, where a project starts from problem setting (or the understanding of the most pressing challenges) to provide hands-on support for transformation to communities and organizations" [90].

Conclusion

Responding to the challenges that American society was facing a century ago, John Dewey admitted that in much of the country, intelligent discourse about public affairs was effectively "dormant … broken, inarticulate and faint" [91]. Despite being written many decades before the advent of digital media, the comment seems as relevant today as ever. As we do today, Dewey confronted a world of mounting risks but little corresponding sense of opportunities. Then as now, "existence as precarious," the "endemic" contingency and constitutive plasticity of reality, was a source of fear rather than of hope—a fear that was driving families, neighbors and citizens apart. Written shortly before the stock market crash of 1929 and the economic depression that followed it, Dewey's observation reflected the rigid class divisions, the widening inequality, and a grim sense of inevitability characterizing American social and political life at the time. Today, a similar sense of inexorable polarization forms one of the world's gravest challenges. On all levels, the tendency, natural enough but ultimately unhelpful, is to react and retrench, to focus inward, to rationalize and pursue one's own immediate prerogatives at the expense of all others. In a word, today we lack a sense of possibility, of "ambiguity and uncertainty" as occasions for the "creative and imaginative" responses that Rylander Eklund and colleagues thematize as sensemaking [92]. Design is not the ultimate, or even the most important, source of the sense of closure currently stultifying creative action to address our shared problems; but as discussed in this paper, recent design practice, focused on satisfying an individual customer, has contributed to that sense of closure.

Today, therefore, design has a role to play in restoring a sense of the world as "brimming with indeterminacy" and therefore as "pregnant with possibilities" [93]. In place of the unthinking pursuit of seamless functionality and user-friendliness for their own sake, which have degraded people's ability for genuine engagement with one another, restoring a sense of possibility must involve encouraging healthy types of intellectual and social friction: substituting agonistic engagement for tribal antagonism, and reasoned, albeit passionate, disagreement about what is to be done for smug suspicion and the anticipation of outrage. Design today must focus on actively discouraging the atomistic isolation frequently decried in our screen-addicted modern cultures, and the blind antipathy, often fueled by misinformation, which looks like engagement but is really just the same kind of isolation operating at the level of groups. Design can help us to address these psychological, social

and political dysfunctions wrought by the digital transition, exacerbated by the user centered paradigm in design, and now being rapidly amplified by algorithmic decision systems: dysfunctions that Mortati would surely agree rank among our "most pressing challenges." But there is no time to lose.

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References and Notes

1   John Dewey, *Logic: The Theory of Inquiry*, in *John Dewey, The Later Works Vol 12: 1938* (Carbondale: Southern Illinois University Press, 1984), 108.

2   A preliminary list would include: Donald A. Schön, *The Reflective Practitioner: How Professionals Think in Action* (New York: Routledge, 1983/2016); Richard Buchanan, "Wicked Problems in Design Thinking," *Design Issues* 8, no. 2 (Spring 1992): 5–21 [CrossRef]; John McCarthy and Peter Wright, *Technology as Experience* (Cambridge: MIT Press, 2004) [CrossRef]; Peter Dalsgaard, "Pragmatism and Design Thinking," *International Journal of Design* 8, no. 1 (2014): 143–155; Peter Dalsgaard, "Instruments of Inquiry: Understanding the Nature and Role of Design Tools," *International Journal of Design* 11, no. 1 (2017): 21–33; Brian Dixon, "Experiments in Experience: Towards an Alignment of Research through Design and John Dewey's Pragmatism," *Design Issues* 35, no. 2 (Spring 2019): 5–16 [CrossRef]; Brian Dixon, *Dewey and Design: A Pragmatist Perspective for Design Research* (New York: Springer, 2020) [CrossRef]; Brian Dixon, Anna Rylander Eklund, and Frithjof Wegener, "Introduction: Pragmatism, Dewey, and Design Inquiry," *Design Issues* 39, no. 4 (October 2023): 3–8 [CrossRef]; Patrycja Kaszynska, "Social Design as Normative Inquiry," in *DRS2022: Bilbao*, ed. Dan Lockton, Sara Lenzi, Paul Hekkert, Arlene Oak, Juan Sádaba, and Peter Lloyd, *DRS Conference Proceedings*, 2022 [CrossRef].

3   "[These] philosophies of flux also indicate the intensity of the craving for the sure and fixed. They have deified change by making it universal, regular, sure." John Dewey, *Experience and Nature*, in *John Dewey, The Later Works Vol 1: 1925* (Carbondale: Southern Illinois University Press, 1981), 49.

4   Thomas M. Alexander, "Dewey's Naturalistic Metaphysics," in *The Oxford Handbook of Dewey*, ed. Steven Fesmire (Oxford: Oxford University Press, 2019), 25–52. [CrossRef]

5   Dewey, *Experience and Nature*, Chapter 2. Emphasis added.

6   Dewey, *Experience and Nature*, 50.

7   Dewey, *Experience and Nature*, 262. Emphasis added.

8   Dmitri N. Shalin, "Pragmatism and Social Interactionism," *American Sociological Review* 51 (Feb. 1986): 10. [CrossRef]

9   Dewey, *Experience and Nature*, 64.

10 For Dewey as for other pragmatists, "nothing is unmoving, though there is much that appears this way because it moves at an exceedingly slow rate of change. … Stillness is … that which shifts slowly. … Instability is just that which moves

quickly. … Declining a perspective that presupposes eternality, pragmatism sees everything in terms of varying rates of change. Everything becomes a matter of the fast and the slow—quickenings and lingerings." Colin Koopman and Darren Garside, "Transition, Action and Education: Redirecting Pragmatist Philosophy of Education," *Journal of Philosophy of Education* 53, no. 4 (2019): 741. [CrossRef]

11   John Dewey, *The Quest for Certainty*, in *John Dewey, The Later Works Vol 4: 1929* (Carbondale: Southern Illinois University Press, 1984), 196.

12   "That there is existence antecedent to search and discovery is of course admitted; but it is denied that as such, as other than the conclusion of the historical event of inquiry in its connection with other histories, it is already the object of knowledge. The Norsemen are said to have discovered America. But in what sense? …. Unless the newly found and seen object was used to modify old beliefs, to change the sense of the old map of the earth, there was no discovery in any pregnant intellectual sense …. Discovery of America involved insertion of the newly touched land in a map of the globe. This insertion, moreover, was not merely additive, but transformative of a prior picture of the world as to its surfaces and their arrangements." Dewey, *Experience and Nature*, 124–125.

13   Dewey, *Experience and Nature*, 61.

14   Dewey, *Experience and Nature*, 61.

15   Dewey, *Logic*, 15–18; 156–60.

16   Matthew J. Brown, "John Dewey's Logic of Science," *HOPOS: The Journal of the International Society for the History of Philosophy of Science* 2 (Fall 2012): 288. [CrossRef]

17   Shalin, "Pragmatism and Social Interactionism," 10.

18   Buchanan, "Wicked Problems," 6.

19   Buchanan, "Wicked Problems," 14–19. Buchanan's focus on design's capacity to constructively address complex or ill-defined problems was not entirely new, but extended earlier analyses such as that developed by Nigel Cross, which emphasized design's synthesizing and integrating capacities and consequent power for addressing problems in new ways. Cf. Nigel Cross, "Designerly Ways of Knowing," *Design Studies* 3, no. 4 (Oct. 1982): 221–227. [CrossRef]
On "wicked" problems, see the canonical discussion in Horst W. J. Rittel and Melvin M. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973): 155–169. [CrossRef]

20   Buchanan's conception of design's status as a general model of constructive and integrative reasoning is of course a main source of the popular idea of "design thinking," embraced within the mainstream business press as a general method of innovation in service of competitive advantage, but subsequently criticized as a simplistic reduction of what designers actually do and as a distortion of the specific value that design expertise can actually bring to an organization. Cf. Natasha Iskander, "Design Thinking Is Fundamentally Conservative and Preserves the Status Quo," *Harvard Business Review*, September 5, 2018; Tricia Wang, "Design thinking's most popular strategy is BS," Fast Company, June 28, 2021: https://www.fastcompany.com/90649969/the-most-popular-design-thinking-strategy-is-bs; Kipum Lee, "Critique of Design Thinking in Organizations: Strongholds and Shortcomings of the Making Paradigm," *she ji: The Journal of Design, Economics, and Innovation* 7, no. 4 (Winter 2021): 497–515 [CrossRef]; Rebecca Ackermann, "Design thinking was supposed to fix the world. Where did it go wrong?," *MIT Technology Review*, February 9, 2023.

21   Brown, "John Dewey's Logic of Science," 288. On "co-evolution" of facts and ideas (i.e. of problems and solutions) in a design context, see Kees Dorst and Nigel Cross, "Creativity in the Design Process: Co-evolution of Problem–Solution," *Design Studies* 22 no. 5 (September 2001). [CrossRef]

22   Buchanan, "Wicked Problems," 5.

23   Dalsgaard, "Pragmatism and Design Thinking," 149.

24   Herbert Simon, *The Sciences of the Artificial* (Cambridge: MIT, 1969).

25   Anna Rylander Eklund, Ulises Navarro Aguiar and Ariana Amacker, "Design Thinking as Sensemaking: Developing a Pragmatist Theory of Practice to (Re)Introduce Sensibility," *Journal of Product Innovation Management* 39 (2022): 32. [CrossRef]

26   Rylander Eklund et al., 32.

27   Notwithstanding Simon's famous critique of "substantive rationality" and defense of a "satisficing" approach to decision-making under conditions of "bounded rationality," a focus on real-world contexts of choice has shown that bounded (or "ecological") rationality regularly leads to outcomes that are the best possible, i.e. that are in fact optimal under the given circumstances: a finding that undermines the theoretical distinction between optimization (sometimes referred to as "maximization") and satisficing. See Peter M. Todd and Gerd Gigerenzer, "What Is Ecological Rationality?," *Ecological Rationality: Intelligence in the World* (Oxford: Oxford University Press, 2012), 2–30. Terminological issues aside, the key point here is that Simon's proposed "design science" is conceived as a *procedure for converging toward an optimal (i.e. best possible) solution to a design problem*, by means of a cognitive process that eliminates alternatives identified as suboptimal in some way. Such a procedure contrasts with the "sensemaking" approach advocated by Rylander Eklund and colleagues, which seeks adequate, ad hoc solutions to perceived problems, while remaining open to new alternatives and maintaining a sense of contingency and provisionality.

28   John Heskett, "Commerce or Culture: Industrialization and Design," in *A John Heskett Reader: Design, History, Economics* (London: Bloomsbury, 1991/2016), 27. Emphasis added.

29   James J. Gibson, *The Ecological Approach to Visual Perception* (New York: Routledge, 1979/2014); Donald Norman, *The Psychology of Everyday Things* (New York: Basic, 1988/2013). [CrossRef]

30   Buchanan, "Wicked Problems," 10.

31   Herbert Marcuse, *One-Dimensional Man* (Boston: Beacon, 1964/1991), 1.

32   See, e.g., the analysis of AI companions as a potential source of "social deskilling": Kim Malfacini, "The Impact of Companion AI on Human Relationships: Risks, Benefits, and Design Considerations," *AI & Society* (April 2025): https://doi.org/10.1007/s00146-025-02318-6. [CrossRef]

33   Jodi Forlizzi, "Moving Beyond User-Centered Design," *Interactions* (September-October 2018): 23. [CrossRef]

34   Forlizzi, "Moving Beyond User-Centered Design," 23.

35   Forlizzi, "Moving Beyond User-Centered Design," 22. Emphasis added. [CrossRef]

36   For one example of the complexities involved in adopting a stakeholder-centered approach to the design of a technical system, see Angie Zhang, et al., "Stakeholder-Centered AI Design: Co-Designing Worker Tools with Gig Workers through Data Probes," *2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*, 2023, Hamburg, Germany. [CrossRef]

37   Elisa Giaccardi and Johan Redström, "Technology and More-Than-Human Design," *Design Issues* 36, no. 4 (Autumn 2020): 34. [CrossRef]

38   Giaccardi and Reström, "Technology and More-Than-Human Design," 35.

39   Giaccardi and Reström, "Technology and More-Than-Human Design," 35.

40   Martin Heidegger, "The Question Concerning Technology," in *The Question Concerning Technology and Other Essays* (New York: Harper & Row, 1993).

41   Giaccardi and Reström, "Technology and More-Than-Human Design," 35.

42   Giaccardi and Reström, "Technology and More-Than-Human Design," 44.

43   See note 27.

44   Giaccardi and Reström, "Technology and More-Than-Human Design," 44.

45   Roberto Verganti, Luca Vendraminelli, and Marco Iansiti, "Innovation and Design in the Age of Artificial Intelligence," *Journal of Product Innovation Management* 37, no. 3 (2020): 218. [CrossRef]

46 Advait Sarkar, "Intention Is All You Need," *Proceedings of the 35th Annual Conference of the Psychology of Programming Interest Group (PPIG, 2024)*, 2024, 2–4.

47 Sarkar, "Intention Is All You Need," 3. A more recent research study appears to corroborate the risk that AI chatbots pose to critical reasoning in knowledge workers: Hao-Ping (Hank) Lee, Advait Sarkar, Lev Tankelevitch, et al., "The Impact of Generative AI on Critical Thinking: Self-Reported Reductions in Cognitive Effort and Confidence Effects From a Survey of Knowledge Workers," *CHI Conference on Human Factors in Computing Systems (CHI '25)*, 2025, Yokohama, Japan.

On more general risks that AI systems pose to human critical capacities, see Michael Gerlich, "AI Tools in Society: Impacts on Cognitive Offloading and the Future of Critical Thinking," *Societies* 15, no. 6 (2025): 6. [CrossRef]

48 Sarkar, "Intention Is All You Need," 3.

49 Nataliya Kosmyna, Eugene Hauptmann, Ye Tong Yuan, et al., "Your Brain on ChatGPT: Accumulation of Cognitive Debt when Using an AI Assistant for Essay Writing Task," https://arxiv.org/abs/2506.08872.

50 Sarkar, "Intention Is All You Need," 4.

51 See Shalin, "Pragmatism and Social Interactionism," 10.

52 Dewey, *Experience and Nature*, 61. Emphasis added.

53 Victor Papanek, "Ecographology—The Myths of Design and the Design of Myths," *Icographic* no. 9 (1975): 3.

54 Cf. John Maeda's "Design in Tech Report 2025: Autodesigners on Autopilot," which surveys the transition already underway whereby design expertise is increasingly deployed to "train AIs to automate daily work." https://www.youtube.com/watch?v=hWeVAX1LwII.

55 Marzia Mortati, "New Design Knowledge and the Fifth Order of Design," *Design Issues* 39, no. 2 (Spring 2023): 23. In its assessment of the outlook for professional design practice, Mortati's article advocates for a comprehensive perspective oriented to dynamic "learning systems," to include nonhuman biological species such as microorganisms in addition to technological artifacts like digital communication networks; however, the current paper does not address her ideas about nonhuman biological species, limiting its focus to emerging technologies, especially the driving role that AI-based algorithmic decision systems are likely to play in shaping professional design practice in the coming years.

56 Forlizzi, "Moving Beyond User-Centered Design," 22. [CrossRef]

57 Mortati, "New Design Knowledge," 31.

58 Mortati, "New Design Knowledge," 27.

59 Mortati, "New Design Knowledge," 33.

60 Mortati, "New Design Knowledge," 34. Mortati's reference to "the good enough, for now" obviously recalls the concept of satisficing developed by Simon—a concept that has been very influential in conventional design practice (see e.g. "What is Satisficing?" Interaction Design Foundation, https://www.interaction-design.org/literature/topics/satisficing). However, it is important to note that whereas satisficing in Simon's original conception is a name for rational decision making under "bounded" conditions of limited time, information, budgetary resources, etc., in the context of digital design especially as supported by algorithmic decision mechanisms, some of these conditions are rapidly disappearing, as the temporal collapse of the design-implementation cycle reduces the effective cost of prototyping or modeling a new possible iteration to virtually nothing. Mortati's call for design today to focus on "the good enough, for now" thus has a different bearing than Simon's famous analysis of satisficing: her term calls for, i.e. prescribes, a renewed focus by designers on possibility, whereas his technical term offers a revisionary, but essentially descriptive, account of rationality under nonideal conditions.

61 Mortati, "New Design Knowledge," 34.

62 Cf. Ken Garland, "First Things First Manifesto," 1964; "Here Are Some Things We Must Do," 1967, in Elizabeth Resnick, ed., *The Social Design Reader* (New York: Bloomsbury, 2019), 47–55; Victor Papanek, *Design for the Real World: Human Ecology and Social Change* (New York: Pantheon, 1971). Even in more strictly commercial contexts,

Mortati acknowledges, the strategy of internet-based long-tail business models, built around selling a large variety of items in low volumes to diverse customers, is not new: Cf. Chris Anderson, *The Long Tail: Why the Future of Business is Selling Less of More* (New York: Hyperion, 2006).

63 Mortati, "New Design Knowledge," 31.

64 Langdon Winner, "Do Artifacts Have Politics?," *Daedalus* 109, no. 1 (Winter 1980): 121–136.

65 Sarkar, "Intention Is All You Need," 3. Emphasis added.

66 Verganti et al., "Innovation and Design in the Age of Artificial Intelligence," 224–225. [CrossRef]

67 Verganti et al., "Innovation and Design in the Age of Artificial Intelligence," 212. [CrossRef]

68 Rittel and Webber, "Dilemmas in a General Theory of Planning."

69 Ronald A. Heifetz, *Leadership Without Easy Answers* (Cambridge: Harvard University Press, 1994). [CrossRef]

70 "From the perspective of Technical Rationality, professional practice is a process of problem *solving*. Problems of choice or decision are solved through the selection, from available means, of the one best suited to established ends. But with this emphasis on problem solving, we ignore problem *setting*, the process by which we define the decision to be made, the ends to be achieved, the means that may be chosen. In real-world practice, problems do not present themselves to practitioners as givens. They must be constructed from the materials of problematic situations that are puzzling, troubling, and uncertain. In order to convert a problematic situation to a problem, a practitioner must do a certain kind of work. He must make sense of an uncertain situation that initially makes no sense." Schön, *The Reflective Practitioner*, 39–40.

71 Dewey, *Experience and Nature*, 61.

72 Dewey, *Experience and Nature*, 61.

73 Rylander Eklund et al., 32.

74 Mortati, "New Design Knowledge," 34.

75 Rylander Eklund et al., "Design Thinking as Sensemaking," 32.

76 Robert Collins, Anjuli Tushar Acharya, Tom van Wijland, Hanxiong Zhang, Johan Redström, and Marco C. Rozendaal, "Agonistic Design in Practice: Introducing Agonism to Interaction Design Pedagogy," in Andrew Morrison, Alma Culén, and Laurence Habib, eds., *Proceedings of Nordes 2025: Relational Design*, Oslo, Norway, 2025. [CrossRef]

77 Giaccardi and Restrom, "Technology and More-Than-Human Design," 44.

78 For agonistic pluralism as a theory of democratic society, see William E. Connolly, *Identity/Difference: Democratic Negotiations of Political Paradox* (Minneapolis: Univ. of Minnesota Press, 1991/2002); Bonnie Honig, *Political Theory and the Displacement of Politics* (Ithaca: Cornell Univ. Press, 1993/2023) [CrossRef]; Chantal Mouffe, "Deliberative Democracy or Agonistic Pluralism?," *Social Research*, 66 no. 3, (Fall 1999): 745–758; Mouffe, *The Democratic Paradox*, (London: Verso, 2000); Mouffe, "Some Reflections on an Agonistic Approach to the Public," in Bruno Latour and Peter Weibel, eds., *Making Things Public: Atmospheres of Democracy* (Cambridge: MIT Press, 2005), 804–807.

79 Cf. Carl DiSalvo, "Design, Democracy and Agonistic Pluralism," in David Durling, Lin-Lin Chen, Tiiu Poldma, Seymour Roworth-Stokes, and Erik Stolterman, eds., Design and Complexity—DRS International Conference 2010, Montreal, https://dl.designresearchsociety.org/drsconference-papers/drs2010/researchpapers/31 [CrossRef]; DiSalvo, *Adversarial Design*, (Cambridge: MIT Press, 2012); Erling Bjögvinsson, Pelle Ehn, and Per-Anders Hillgren, "Design Things and Design Thinking: Contemporary Participatory Design Challenges," *Design Issues* 28, no. 3 (Summer 2012) [CrossRef]; Erling Björgvinsson, Pelle Ehn, and Per-Anders Hillgren, "Agonistic Participatory Design: Working with Marginalised Social Movements, *CoDesign*, 8, nos. 2-3 (June-Sep. 2012): 127–144 [CrossRef]; Helena Kraff, "A Critical Exploration of Agonistic Participatory Design" *The Design Journal* 23, no. 1 (2019): 31–48 [CrossRef]; Akshita Sivakumar, "Agonistic Arrangements: Design for Dissensus in Environmental Governance," *International Journal of Design*, 18 no. 3 (2024): 105–117, https://doi.org/10.57698/v18i3.08. For an exploration of agonistic

approaches to digital technology development specifically, see Kate Crawford, "Can an Algorithm be Agonistic? Ten Scenes from Life in Calculated Publics," *Science, Technology, & Human Values* 41, no. 1 (January, 2016): 77–92 [CrossRef].

80 Björgvinsson et al., "Agonistic Participatory Design," 129. See also DiSalvo, *Adversarial Design*, 7–12.

81 Björgvinsson et al., "Agonistic Participatory Design," 128.

82 Bjögvinsson et al., "Design Things and Design Thinking," 102.

83 Bjögvinsson et al., "Design Things and Design Thinking," 107.

84 Bjögvinsson et al., "Design Things and Design Thinking," 108.

85 Bjögvinsson et al., "Design Things and Design Thinking," 108.

86 Bjögvinsson et al., "Agonistic Participatory Design," 129.

87 Bjögvinsson et al., "Design Things and Design Thinking," 116.

88 Gordon Pennycook, Ziv Epstein, Mohsen Mosleh, Antonio A. Arechar, Dean Eckles and David Rand, "Shifting Attention to Accuracy Can Reduce Misinformation Online," *Nature* 592 (2021): 590–595; [CrossRef]

Lucy Butler, Toby Prike and Ullrich K. H. Ecke, "Nudge-based Misinformation Interventions Are Effective in Information Environments with Low Misinformation Prevalence," *Scientific Reports* 14, no. 1 (2024): 11495. [CrossRef]

89 William J. McGuire, "Resistance to Persuasion Conferred by Active and Passive Prior Refutation of the Same and Alternative Counterarguments," *Journal of Abnormal and Social Psychology* 63, no. 2 (1961): 326–332; [CrossRef]

John A. Banas and Stephen A. Rains, "A Meta-Analysis of Research on Inoculation Theory," *Communication Monographs* 77, no. 3, (September 2010): 281-311, DOI:10.1080/03637751003758193; [CrossRef]

Sander van den Linden, *Foolproof: Why Misinformation Infects Our Minds and How to Build Immunity* (New York: Norton, 2023).

90 Mortati, "New Design Knowledge," 31.

91 John Dewey, *The Public and Its Problems*, in *John Dewey, The Later Works Vol 2: 1925-1927* (Carbondale: Southern Illinois University Press, 1927/1984): 372.

92 Rylander Eklund et al., 32.

93 Shalin, "Pragmatism and Social Interactionism," 10.