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Design's Ontology: Emergent Properties and Affordance

Abstract:

This essay proposes a visualist ontological framework for understanding design, rooted fundamentally in the theories of emergent properties and affordances. Opposing functionalist and intentionalist paradigms, the framework underscores design's visuality and relational engagement as its core ontological elements. The concepts of emergent properties and affordances are presented as deeply interconnected, reflecting their philosophical and practical relationship within the ontology of design. Emergent properties are conceptualized as qualities that do not reside intrinsically within individual components but instead arise through the dynamic relational interactions among parts within a system, often exemplified in complex, non-linear systems. I demonstrate, however, that even singular, discrete design objects encapsulate complexity and exhibit emergent qualities. Design's ontological structure extends beyond its planned form to include these emergent qualities and open affordances rooted in visual surface configurations and relational engagement, because design inherently exists in relations – not only with users but also with other objects and environments. Relatedly, affordances elucidate how visual and material configurations invite specific actions, enabling meanings and functions to be continually redefined through ongoing interactions. The integration of these theories offers a comprehensive, non-reductionist account of design's ontology, emphasizing its inherently relational, dynamic, and open-ended nature as central to its identity and operative capacity.

1. Introduction: Ontology of Design

Design, which furnishes a substantive segment of our environment, deserves its own ontological discourse. While the ontology of the artwork is a wide and long-standing area of research, interestingly, the design piece – be it a car, a chair, a coffee machine, clothing or jewelry, a building or its interior, an interface or a graphic work – has yet to receive its due ontological attention within aesthetics. Motivated by this, I aim to prove design's open ontological structure, which is gained mainly through its visuality and our relations with it. This structure, I claim, is grounded in two main ontological elements of the design piece: its emergent properties and affordances. The essay delineates their definitions, their manifestation in design, and their internal connections.

By stressing emergent properties and affordances, which have much to do with design's sensuous surfaces, I propose a visualist ontology of design. This stance opposes functionalist and intentionalist descriptions of the ontological structure of design as possessing a stable proper function dwelling at its essential depth, with an adapted form that finalizes the object as complete. This approach is described by Ian Hodder in his seminal *Entangled: An Archaeology of the Relationships between Humans and Things*: "There is an often expressed assumption in anthropology and the social sciences that things, objects, are stable and fixed."[1] This assumption, I claim, is bound to meet an opposing reality, because design objects simply do not work this way. Thanks to their visuality and our visualist nature, as well as their location in our close-by active environments, design objects exist within external, ongoing perceptual and embodied relations.[2] The aesthetic layers of design objects, combined with our ontologically productive perception and engagements with their surfaces, make them generative of emergent properties and affordances – neither of which can often be pre-planned nor conceptualized. Therefore, adopting what he calls "behavioral archeology," Hodder stresses the "mixing of people with things" and reminds us that things depend on temporal and spatial networks, systems, and settings, as well as on "behavioral chains and throughout their use lives."

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1)   Hodder, *Entangled*, 64.

2)   Gal, "Everydayness, and the Illusion of Function."

Consequently, "from an archaeological perspective things seem transient, always changing, problematic, unbounded."[3]

Indeed, in reality, a drinking cup is often used for flowers, as a surface for somewhat tacky notes such as "the best father," to collect coins, as a makeshift tiny drum, to lean a book or cellphone against, or to store pencils. A pencil, in turn, is often used as a hair bun holder, plant support, makeshift drumstick, toothpaste roller, or a device for restless hands to practice balancing on one finger or between fingers. These are not peripheral relations – they are essential to the ontological structure of the design object, constituting a dialectic between the generative visual nature of design objects and our engagements with them. James Gibson, who coined the term "affordance" and developed an ecological theory of visual perception, calls this the complementary relations between us and the objects: "The environment of animals and men is what they perceive. The environment is not the same as the physical world, if one means by that the world described by physics. The observer and his environment are complementary. So are the set of observers and their common environment."[4] Gibson classifies as natural vision the kind exercised when the perceiver or user is not channeled towards specific actions: "When no constraints are put on the visual system, we look around, walk up to something interesting and move around it so as to see it from all sides, and go from one vista to another. That is natural vision."[5] I would like to add that it is natural for the visual form of the pencil to invite us for balance games; it affords it and results in acquiring emergent properties, such as the very classification as a balancing device, but also stability, a center of gravity, balance or equilibrium, sensitivity to movement, and expressive motion. True, the emergent property could be a passing one, such as when the pencil's visual and dynamic character changes: now it hangs, swings, and steadies itself, displaying behaviors more like a mobile than a writing tool; or setting a few cups and teaspoon for an impromptu concert, then store them back in their cabinets. But these properties could also be far more substantial, established, and stored in our visual memory than their allegedly stable intended function.

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3)   Hodder, *Entangled*, 18, 64–65.

4)   Gibson, *Ecological Approach to Visual Perception*, 11.

5)   Ibid., xii.

Ecological theories of visuality, perception, and objects, that acknowledge the productivity and richness of visuality and our relations with it, such as Gibson's, have been around for quite some time. Neo-Gibsonians nowadays even refer to higher embodied cognition "in terms of skillful activities in sociocultural practices and the material resources exploited in those practices."[6] However, intentionalist function-alist ontology practically ignores this and consequently overlooks the real essence of design ontology. The lack of current theories in philosophy of design, especially in aesthetics, which acknowledge the power of visuality and our relations with it is quite surprising. Donald Norman's prominent theory of design provides a good example. On the one hand, he admits the knowledge that dwells in the body and world beyond the mind. Speaking on our encounters with objects, he claims that "our knowledge is often quite incomplete, ambiguous, or even wrong, but that doesn't matter: we still get through the day just fine. How do we manage? We combine knowledge in the head with knowledge in the world. Why combine? Because neither alone will suffice."[7] On the other hand, he proposes an internalist-conceptualist definition of design that attributes privileged status to internal-conceptual mental content of the designer, which is supposed to be manifested in a design object that is transparent to its proper function, which in turn ought to direct the user toward specific, pre-planned, proper use. Accordingly, Norman offers a reductionist characterization of affordance, which trims down what Gibson sees as affordances' openness, to the object's imperative of a correct action of the user according to the planned proper function.

Similarly, other seminal design theories that are classified as user-centered[8] fail to grasp the *real* users. Possessing active-constructive perception, particular needs and habits, aesthetic passions, aspirations, creativity, humor, pleasures, emotional tendencies, poetic heights, preferences, and social contexts – all involved in engage-ments with design object – the real users are not fully taken into ontological account. For example, in the very recent "The Case for Design Affordances" an intentionalist, somewhat reductionist, approach to design is demonstrated: "as users and modifiers

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6) Rietveld and Kiverstein, "A Rich Landscape of Affordances," 326.

7) Norman, *The Design of Everyday Things*, 74.

8) Dreyfuss, *Designing for People*; Forsey, "Design and Beauty"; Flusser, *The Shape of Things*; see also Gal and Ventura, *Introduction to Design Theory*, chpt. 2.

of environments, as well as observers of others, designers should have enough capacities *to anticipate user affordances in a design.*"[9] This approach presumes what I see as a linearity running from the mental content of the designer, through an embodying object, to fitting proper use.[10]

The expectation that designers will both determine and predict users' engagements with the design object overlooks what the philosophy of art has addressed since antiquity: the generative power of visuality, forms, and compositions.[11] This power allows emergent, sometimes intricate diversity of engagements between users and design objects, which are the main operators in constituting design's ontology. The same obliviousness applies to the design objects themselves, even prior to our engagements with them, notwithstanding their own autonomous power of their visuality, their own compositions and those they form with relations to the environment and their surrounding objects, and their ability to invite users to various engagements. Design Historian Judith Attfield rightfully classifies design objects, as "things with attitude" which "derive their meaning from their obvious visual presence," in her *Wild Things: The Material Culture of Everyday Life.*[12] She accordingly demystifies the modernist ambition "to predict and control how the product will be put to use within certain parameters of space and place."[13] Indeed, design's ontological structure expands beyond its plan to emergent properties and open affordances. The essential location of design objects in our daily lives and environments where we are always active, their generative visuality, and our active perception continually reconstruct design objects. Simply put, given that one uses a mug daily – filling it, stirring, holding, drinking, washing, storing, even contemplating its shape and ornaments – how can this object NOT possess emergent properties and affordances? As we will shortly see, emergence is usually applied to complex systems, but design, even as a simple discrete design piece, is complex in nature because it essentially exists in engaging environments.

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9)   Koutamanis, "The Case for Design Affordances," 17, my italics.

10)   Gal, "Design and Rationalism," 79.

11)   Gal, "Generative AI in Aesthetics."

12)   Attfield, *Wild Things*, 32.

13)   Ibid., 77.

These elements lie at the core of a visualist approach to design, which conceives the design object as fundamentally visual and therefore relational and emergent. Its visual configuration affords particular ways of seeing, handling, and engaging, through which new meanings and functions come into being. The object's visual properties invite certain actions, while our perceptual activity – shaped by needs, desires, and what Arnheim calls our "visual storage" – responds to and completes these invitations. In this interplay, the object's affordances and our perception together generate emergent properties that define both its aesthetic presence and ontological status. Let us, then, present the idea and category of emergent properties.

2. Emergent Properties and Design

The notion of "emergent properties" usually designates those systemic qualities that do not reside in any single element but materialize only through the configuration and interplay of multiple components within a whole. Such properties are irreducible to the sum or analysis of isolated parts; they manifest when relational patterns, rather than intrinsic attributes, determine the system's behavior. In this sense, emergence exposes the generative dimension of structure itself: the way organization gives rise to new forms, functions, or meanings that transcend prediction from the level of individual constituents. But I would add that emergence also exposes the generative dimension of relationships between a thing and its surroundings.

As is known, the prominent philosopher of emergence C.D. Broad introduced the concept in 1925 as opposed to mechanism; these differ "according to the view that we take about the laws which connect the properties of the components with the characteristic behavior of the complex wholes which they make up." According to emergence theory, "characteristic behavior of the whole could not, even in theory, be deduced from the most complete knowledge of the behavior of its components, taken separately or in other combinations, and of their proportions and arrangements in this whole."[14] While emergence is naturally (even logically) endorsed by visualism, mechanism is quite similar to functionalism in design. In Broad's distinction, a mechanistic theory explains a system's behavior entirely through the arrangement

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14)   Broad, *The Mind and Its Place in Nature*, 59.

of its parts and the general physical laws that govern them. Mechanists often use the clock as a paradigmatic example, he informs: its regular movement can be deduced from the interaction of springs, gears, and pendulum. This contrasts with emergent phenomena where the properties of the whole cannot be predicted or deduced from the parts and their laws – something genuinely new arises, with behaviors and qualities not reducible to or implicit in the components themselves.

More recent theories of emergent properties reject the possibility of complete explanations, while stressing the substantial ontological status. In his brilliant *Darwin among the Machines: The Evolution of Global Intelligence*, George B. Dyson claims that "emergent behavior is that which cannot be predicted through analysis at any level simpler than that of the system as a whole. Explanations of emergence, like simplifications of complexity, are inherently illusory and can only be achieved by sleight of hand. This does not mean that emergence is not real. Emergent behavior, by definition, is what's left after everything else has been explained."[15] Still, some emergence theories do not exclude explainability from this phenomenon. Looking at an emergent property, a complete explanation of it is impossible by breaking it down into simpler parts. But, in his comprehensive *Emergence: A Philosophical Account* Paul Humphreys argues that complete exclusion of explainability would render the theory of emergence too mythical, whereas sometimes "we do have credible explanations of why those candidates have their emergent features" and "understand how and why emergent entities emerge."[16]

Humphreys defines ontological emergence, which applies both to properties and objects, as unpredictable, relational, and holistic. He contrasts theories of emergent properties with generative atomism, which applies in exact sciences but also social and ecological sciences, and assumes that everything about a composite entity is already implicit in two sources: the intrinsic properties of its atomic components and the rules governing their combination. Under the atomistic view, the whole contains nothing that is not already contained in its parts and their modes of composition: "generative atomism leads to the in-principle predictability, the explainability, and the lack of novel

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15)   Dyson, *Darwin Among the Machines*, 9.
16)   Humphreys, *Emergence*, 42, 27.

features of the whole system with respect to the properties of its parts."[17] In contrast, ontological emergence, or emergent properties, come to being outside the domain of what can be derived from atoms and compositional rules alone. Humphreys thus identifies two defining features of this phenomenon: first, the emergent features result from something else, and involve a novel aspect not reducible to component behavior; and second, this emergent feature entails at least one fact that is not implicit in the parts or their rules, making it an irreducibly holistic and relational property.[18] I will elaborate shortly about this relevance to design. But we can already see how well the distinction between emergent theories and mechanism or generative atomism applies to the that between visualism and functionalism, which operates under the spell or illusion of the stability of proper function of the design object, and the ability to predict and control its use. Humphreys calls the inability to predict a property from atomic elements and composition rules "failure of determination," or "breakdown of predictability."[19] The failure is oftentimes positive, Humphryes believes. Surely, by opening ourselves to the ontology of the design object, we gain much from what it can offer. This holds true both the designer's and user's perspectives. From the designers' side, I was amazed to find out how reluctant the students of design in the philosophy of design seminar were to think about the chair they designed as coat hangers. From the side of the user, I can easily distinguish between my grandmother's severe restrictions on couch use and the way my daughter used to stack our couch pillows into a mountain to jump from. But we are sliding into normativity, which is a separate topic.

Emergence is also deemed opposed to reductionism, given that emergent properties are usually classified as non-predicted and reductionism supplies causal explanations.[20] At the same time, it can support a realist and externalist stance. As argued by the new emergentist Danny Hillis in his "Intelligence as Emergent Behavior," emergence "offers a way to believe in physical causality while simultaneously maintaining the impossibility of a reductionist explanation of thought."[21]

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17) Humphreys, *Emergence*, 12.

18) Ibid., 26, 28.

19) Ibid., 26.

20) Kistler, "New Perspectives on Reduction and Emergence," 311.

21) Hillis, "Intelligence as an Emergent Behavior," 176.

For example, according to Hillis, as Dyson describes it, music leads to the mind's emergence rather than the other way around. What is called "inferential emergentism" began with the idea that the mind, or mental contents, emerge from the matter, rather than the reverse, and therefore is closely aligned to physicalism or materialism and its sister theory – externalism. Applied to design objects, we can push this idea even further to point to ontological, material properties which emerge from elements composition.

Further substantiation of the link between emergent properties theory and design is found in the eye-opening introduction of the theory and examples supplied by Jerome H. Saltzer and M. Frans Kaashoek, who understand the omnipresence of compositions' unpredictable power, or the fact that they gain lives of their own. The claim that:

> Emergent properties are properties that are not evident in the individual components of a system, but show up when combining those components, so they might also be called surprises. Emergent properties abound in most systems, although there can always be a (fruitless) argument about whether or not careful enough prior analysis of the components might have allowed prediction of the surprise. It is wise to avoid this argument and instead focus on an unalterable fact of life: some things turn up only when a system is built.[22]

Saltzer and Frans Kaashoer supply paradigmatic examples taken from group behaviors: "The behavior of a committee or a jury often surprises outside observers. The group develops a way of thinking that could not have been predicted from knowledge about the individuals."[23] Another informative example relates the group behavior designers' inability to predict some of their objects' resultant properties, even objects that are designed with utmost rational care, such as an important bridge: "When the Millennium Bridge for pedestrians over the River Thames in London opened, its designers had to close it after only a few days. They were surprised to discover that

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22) Saltzer and Kaashoek, *Principles of Computer System Design*, 4.

23) Ibid.

pedestrians synchronize their footsteps when the bridge sways, causing it to sway even more."[24] This leads us directly to design and unpredictability.

The application of the concept of "emergent properties" to design is almost obvious. Design consists of function given in a composition, which stretches beyond its ontological origin to the environment it inhabits and close engagement with users. When a pencil is casually balanced on or between fingers, it reveals emergent properties arising through the shifting relation between object, hand, and motion: from its material form and the hand's micro-adjustments. Its weight, symmetry, and smooth surface afford delicate tactile and visual feedback, turning a habitual object into a miniature kinetic system. What is ordinarily a static tool for writing becomes momentarily dynamic – responsive, rhythmic, and self-adjusting. Its slender shape and even distribution of weight allow it to teeter, pivot, or spin, displaying delicate equilibria and micro-movements that depend on touch and attention. In such playful engagement, the pencil's affordances for balance, rotation, and motion come to the fore, transforming it from an instrument of utility into a perceptual and kinetic object whose expressive behavior emerges only through interaction. Therefore, emergent properties in design arise both from unforeseen relations between the elements of the object and environment affordances, enabled by the relations between the objects and the engagers. The lion's share of these is dependent on the objects' visuality, their surfaces, because "the surface is where most of the action is," as Gibson formulates it, under what he names "ecological laws of surfaces."[25] These relate emergent properties with affordances, as will be argued in the next chapter.

The emergent properties concept is generally used today regarding complex, non-linear systems occurring in both natural and human-made domains, such as environments and ecologies, as well as complex structures, such as software, societies and economies – sometimes under "system behavior."[26] When applied to artifacts, one needs to address both the relations between different elements, yielding new properties, and the relations between the entities and human practices, systems of meanings, and creativity. Humphryes presents a bird flock and a traffic jam example, in

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24) Ibid.

25) Gibson, *Ecological Approach to Visual Perception*, 19.

26) Mogul, "Emergent (Mis)Behavior," 293.

which the birds' coordinated movement in a flock and the cars' emergent clustering in a traffic jam both exemplify how simple local interactions generate novel, holistic structures at the collective level. A traffic jam is not reducible to any single car, just as a flock is not reducible to any individual bird; both are autonomous formations with properties – shape, density, cohesion – that arise only at the group level.

I think we can seamlessly apply these paradigmatic examples to sets of design pieces, and note that even when design objects are made as individual pieces (not as part of sets), they always inhabit environments containing other objects serving as some sort of set. A single dish is a functional and aesthetic object, but when dishes are arranged together as a service set, new properties emerge: relations of pattern, rhythm, scale, and use. The set possesses affordances that no single dish has alone – for instance, the capacity to host a shared meal, to structure social interaction, or to produce a visual composition. Like a flock or a jam, the emergent character of a dish set is independent of its specific members – one plate can be replaced without altering the overall pattern. In this way, designed tool sets demonstrate design-based emergence: local material and visual relations give rise to higher-order functions and meanings that are irreducible to the individual objects themselves. Victor Margolin's holistic concept of "product milieu," referring to the sphere in which design objects "are drawn together in situations through human action," helpfully indicates that atomistic, and accordingly intention-alist-functionalist, characterization of the design's ontology is often barren.[27] Though he is not explicit about it, given that Margolin characterizes the design object's sphere of existence, his theory could be classified as ontological, and more specifically, exter-nalist-materialist. The concept of "product milieu" serves as a platform for analyzing our experiential relations with products, and Margolin accordingly argues that "to pursue the question of how products contribute to human experience, it is necessary to consider the larger social sphere in which they exist. I have coined the term *product milieu* to characterize the aggregate of material and immaterial products, including objects, images, systems, and services, that fill the lifeworld."[28]

Moreover, mere object arrangement impacts how we see them. Barbara Tversky analyzes space perception in her comprehensive research on what she

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27)   Margolin, *The Politics of the Artificial*, 44.

28)   Ibid.

names "perspective-taking." A person's presence near objects changes our perspective on describing a space and the spatial relations between objects. We can apply this to design, where we may change our perspective from egocentric to allographic (looking from others' point of view). This happens, for example, when looking at a space with a person standing near an object. According to Tversky, viewers then tend to describe the structure of the space according to the person engaging with the object. User-centered approaches did not account for this. Tversky explains why many viewers take another person's perspective, and that an action by this person even augments that effect: "When a scene has objects and no person, answering the question is simply a matter of determining the spatial relations between the objects, and the most prominent referent is one's own body. However, when the scene includes a person, even though the question is only about the spatial relations between the objects, it may be preceded by an attempt to make sense of the entire scene, especially the role of the person in the scene."[29] She adds that perspective-taking affects social interactions because they involve responding to the actions of others, where considering others' actions from their viewpoint, or what the world looks like to them, is required. If we consider that design objects' location in spaces is often critical, as well as seeing others using them, we may better understand how design objects are actually almost always given within complex systems. Given that these systems inhabit our action-filled daily lives, they are dynamic and repeatedly modified. Following Gibson, Tversky points to various spatial transformations:

> Object-based spatial transformations and perspective transformations. Object-based transformations and perspective transformations both involve updating the relationship between three spatial reference frames: an *egocentric reference frame*, which codes objects' locations relative to the observer; one or more *object-centered* (or "intrinsic") reference frames, which code locations relative to an object; and an *environmental* (or "allocentric") reference frame, which codes things relative to the local environment.[30]

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29) Tversky and Hard, "Embodied and Disembodied Cognition," 128.
30) Zacks and Tversky "Multiple Systems for Spatial Imagery," 273.

My thought is, therefore, that the link between emergent properties to affordances renders the design object a complex system. Even when deemed simple, such as a glass, a fence, or a bench, the design object joins a complex system merely due to its affordances – the relations between its surfaces and the user. It cannot be otherwise given that design is meant for, actually calls for, a close engagement with it. When it comes to design, object individuation is entangled with human practices from the outset. Consequently, even simple objects, necessarily entangled with their surroundings and engagers, become complex systems. The object affords different relations with it, even invites us to various actions (think of the cases where we cannot help but lay our feet on a coffee table or grasp a door handle), and receive our projections onto it. Look at our aforementioned cup. In addition to various uses of it, when a cup is lifted, tilted, or held, new properties emerge that are absent in its static form. Its affordances for grasping, containing, and pouring activate perceptual and sensory dimensions: the weight shifts, warmth is felt through the material, and the rim meets the lips with a particular contour. These qualities – of balance, temperature, texture, and intimacy – are not intrinsic to a simple object but emerge in use, as if the object is given in a system, through the coordination of hand, body, and object. The cup thus becomes expressive not only of function but of gesture, revealing how meaning and form unfold in interaction.

We should note that I do not promote an anti-realist stance here. Design objects and our relations with them are out there – a very substantial part of reality. "The ontological approach considers emergent entities to be genuinely novel features of the world," as Humphryes explains in his *Emergence: A Philosophical Account*.[31] I do endorse an externalist view, which also acknowledges the power of the external in constituting us and our relations with it. This is an ontological emergence, as Humphreys classifies it, saying that "this asserts that genuinely novel objects and properties emerge even within the domain of physics, and it rejects the idea that only the level of fundamental physics is real."[32] Emergence theories are ontological, but they go beyond generative atomism, or compositional ontology, which sees the world as consisting of things as generating solely "from combinations of elementary physical

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31) Humphreys *Emergence*, 41.
32) Ibid., xvi–xvii.

objects and their properties." Namely, that "The world is nothing but spatiotemporal arrangements of fundamental physical objects and properties… arranged in different configurations and account[ing] for all the astonishing variety that we encounter in our day-to-day and scientific lives. "[33] A more realist vision is offered by Gibson's theory of affordance, which attributes a power to the object itself to invite us to form relations with it, but this invitation is due to its depth. "The object offers what it does because it is what it is. To be sure, we define *what it is* in terms of ecological physics instead of physical physics, and it therefore possesses meaning and value to begin with. But this is meaning and value of a new sort."[34] Visual perception, according to Gibson, is ecological.

Theories of emergent properties acknowledge the irreducibility of behaviors and new properties of different configurations – irreducible to the original elements – and therefore completely applicable to design. Surely, Humphrys rightfully returns Broad's formulation of the concept of emergence in the philosophy of science, suggesting that the behavior of a whole system cannot be predicted from its individual parts' behavior, even with complete knowledge of those parts, either separate or given in other combinations, as well as their proportions and arrangements in this whole.

Therefore, in endorsing a (moderate) realism, we need not apply the idea of objects' "sameness" as Ian Hodder puts it. Calling readers to think about things differently, Ian Hodder opposes attributing sameness to things, claiming that they are "not inert": "Even what we call inanimate things have charges, weights. They are attracted to each other or repulse each other. They have force and velocity, heat and viscosity. They fall down, rise up."[35] Moreover, Hodder proposes that things are not isolated but possess intricate spatial and temporal links to other things. What appears to us to be a discrete, self-contained object – like a car or a wristwatch – is in fact embedded within vast material and historical networks. "A car appears to us as a car. We are taken in by the fact that the car has a perceptual boundary we can see or feel. It appears isolated, an object that is stable."[36] But in fact, Hodder rightfully claims, a car

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33) Ibid., 1.

34) Gibson, *Ecological Approach to Visual Perception*, 130.

35) Hodder, *Entangled*, 4.

36) Ibid., 6.

is connected "to a whole network of roads and road management systems that make the car possible."[37] A car also depends on mines, factories, and oil fields sustaining its existence. Hodder's argument, therefore, is that our perception of objects as stable and self-contained is a form of "spatial and temporal forgetting." Things are active participants in extended relational systems – historical, material, and infrastructural – that continuously shape human life, even when we do not acknowledge it.

We see, then, that in design, emergent properties refer to those perceptual and functional qualities arising neither from the designer's intention nor from the intrinsic attributes of individual elements, but from the relational interplay among forms, materials, and users. These properties surface in the encounter, where an object's visual and tactile affordances activate unanticipated uses, meanings, or aesthetic responses. Emergence thus marks the moment when design exceeds its plan: when the organization of components and their affordances generates effects irreducible to either function or form alone. In this sense, the designed artifact becomes a dynamic field of potential rather than a fixed solution – a site where visual and material relations continually reconfigure what the object can do and signify. In other words, an open system of affordances.

Therefore, I find that emergence and affordance are closely linked concepts and features, and it is time to move to the affordance part of the essay.

3. Affordance and Design

"Affordance" is a central and widely adopted concept for describing visually driven creative relations with objects, famously introduced by James Gibson. The original term refers to the reciprocal relations between observers and their environment, shaped by the visual configuration of surfaces – by what they allow, invite, or enable us to do. As mentioned above, for Gibson, "natural vision" takes place when perception and actions unfold without restrictions or controls, enabling us to approach, examine, and interact with objects from multiple perspectives and for different purposes.[38] In this view, the environment's values and meanings are directly perceivable, emerging through inter-

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37)   Ibid.

38)   Gibson, *Ecological Approach to Visual Perception*, 115.

play between perceiver and the visible world. Almost needless to say, then, how closely related the concept of "affordance" is with that of "emergent properties." Especially, they should be co-used in the philosophy of design. This may be clarified in Gibson's explanation of his ontological shift to the ecological description of objects:

> The theory of affordances is a radical departure from existing theories of value and meaning. It begins with a new definition of what value and meaning *are.* The perceiving of an affordance is not a process of perceiving a value-free physical object to which meaning is somehow added in a way that no one has been able to agree upon; it is a process of perceiving a value-rich ecological object. Any substance, any surface, any layout has some affordance for benefit or injury to someone. Physics may be value-free, but ecology is not.[39]

The subsequent affordance theories are divided into those not fully adopting Gibson's pluralist-visualist ontology and those aiming to prove affordances' richness even further. While Gibson's idea of affordance implies openness of objects or environments and our relations with them, the influence of intentionalist functionalism brings about reductionist views of affordances among design theorists. For Gibson, affordance is saturated in surfaces and our complementary relations with them. Our natural relations with surfaces, for him, are exercised when no constraints are set and people are allowed or inclined to do various things with objects and environments. In contrast, Norman, aligned with functionalism, aims at what the designer "can control" regarding the users' engagements with objects. He declares in "Design, Conventions, and Affordance," that "the most important part of a successful design is the underlying conceptual model… and then assuring that everything else be consistent with it," and accordingly draws a distinction between what he names "real affordance," which is built in the design object and sometimes invisible, and the "perceived," perhaps less real, affordance.[40] Norman promotes employing logical and conventional constraints by designers to guide the users' behaviors, and concludes that "the art of the designer is to ensure that the

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39) Ibid., 131–32.
40) Norman, "Affordance, Conventions, and Design," 39.

desired, relevant actions are readily perceivable" in order to "help people understand how to use our designs."[41] Similarly, Auke Pols describes affordance as "opportunities for action" which are the designer's plan-based, rather than the user's particular needs or creative engagements, even if the plan is in the social realm, such as a phone affording calling a friend.[42] While Pol's account on affordance is more complex than Norman's, it still reduces the variety of relations arising between us and design objects, including temporary and particular or local engagement. In the same vein, You and Chen apply affordance and semantics to product design, claiming the design object's semantics uses graphic elements to link affordances to their intended functions.[43] These anti-Gibsonian reductionist views of affordance actually present a categorical imperative for design to be as transparent as possible to its pre-conceptualized function, and thereby to ensure the design object's stability.

However, as I see it, this wish for predictability and control is both caught in illusion and misses design's positive essence.[44] Design's emergent properties and affordances, while endowing the design object with substantiality and effective power, also allow its dynamic introductions to various new groups. This is why Humphreys stresses the significance of the inclusivity of the theories of ontological emergence – because together they cover rich ontology. Humphreys claims that "the three approaches – ontological, inferential, and conceptual – are not mutually exclusive. For example, conceptual novelty is often forced upon us when predictability fails or is required when a new type of collective entity ontologically emerges. Fail in cases where the states involve an ontologically new type of entity."[45] See how well linked they are to the ecological ontology that grounds theories of design's affordance: beyond the unpredictability of the object's properties, emergence emphasizes the sphere and relations in which the object exists, which fits exactly with the ideas of ecological ontology as affordance's basic foundation. Humphreys stresses about relational ontology and emergence: "The fact that elements falling into each of these categories are relational

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41) Ibid., 41.

42) Pols, "Characterising Affordances," 116.

43) You and Chen, "Applications of Affordance and Semantics."

44) Gal, "Design and Rationalism."

45) Humphreys, *Emergence*, 38–39.

is logically important, for rather than the criteria for emergence being applicable to an entity E in isolation, one must consider a domain D or framework F with respect to which E emerges, in the sense that it is the relevant relations between E and D or F that determines the emergent status of E."[46]

This ontology serves the second kind of affordance theories, which promote an open definition of affordance, namely, "understanding affordances as relations between aspects of the material environment and abilities available in a form of life."[47] Rietveld and Kiverstein widen the extension of affordance theory by considering the internal link between affordances and way of life, also referred to by Gibson, as the starting point of describing affordance's richness. They claim that material objects and environments are joined by social practices in opening the possibilities for human action, and therefore the concept of affordance "as applied to humans should be able to straddle differences within the human way of life and accommodate the rich variety of socio-cultural practices that are found in the human ecological niche."[48] This definition is relevant to design's open ontology. It surely applies to a living room sitting set, which one can take a nap on, several can happily squeeze, or sit on one piece and stretch legs on another, pile laundry on, use as a device for placing feet for a sophisticated plank exercise, or kids may playfully crawl underneath time and again. Indeed, "defining affordances relative to a form of life turns the materiality of affordances into sociomateriality in the human case."[49] A recent experiment on doors' affordances as assembly spots rather than portals in offices testifies to affordance's sociomaterial elements. This is eye-opening given Norman's well-known claim that a door is aimed solely at opening or closing: "Informal interactions were situated in the doorways of the cell offices. The employees were standing with their back and backside to the common circulation area leaning against the door frame talking to one or two colleagues sitting in a cell office. Walking around in the environment, it was inevitable not to see what we could a phenomenon of 'backsides in doorways.'"[50]

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46) Ibid., 42–43.

47) Rietveld and Kiverstein, "A Rich Landscape of Affordances," 335.

48) Ibid., 328.

49) van Dijk and Rietveld, "The Skilled Intentionality Framework," 5.

50) Øien, Grangaard, and Lygum. "Architecture with the Concept of Affordance," 1865.

Bruno Latour's action network theory is helpful here. In his discussion of agency in *Reassembling the Social*, Latour rejects the anthropocentric assumption that only intentional human subjects act, arguing instead that any entity capable of altering a state of affairs must be recognized as an actor.[51] The presence of a hammer, a basket, a speed bump, or a list, transforms the nature of the action itself: driving a nail with or without a hammer, carrying goods with or without a basket, slowing down with or without a speed bump, or organizing tasks with or without a written list are not equivalent activities.[52] These objects do not merely support human action; they *reconfigure* it, shaping its temporal, spatial, and social contours. In Latour's terms, their capacity to "make a difference" grants them agency as concrete participants in networks of action. This conception is crucial for design ontology because it foregrounds *the power of objects themselves – their affordances, their capacity to direct and redistribute action, and their role in constituting emergent configurations and properties.* Objects are thus not neutral intermediaries but active mediators: they generate effects, reorganize relations, and contribute to the becoming of the social world. Latour's view invites us to rethink design ontology through emergence and affordance: objects possess an operative power that exceeds intentionality, enabling new configurations to arise through their material and visual affordances. Far from passive instruments, designed artifacts act as mediators that redirect, generate, and stabilize relations within the social field.

Design may even have performative *properties*, which are a key source of aesthetic value in design, as Matilde Carrasco Barranco recently classified them. These qualities emerge through the user's active engagement with the artifact – through movement, bodily response, and action. She contends that the aesthetic pleasure of using an elliptical machine, for example, lies not in its static appearance but in the experience of motion it enables. Although these properties arise in activity rather than in the object itself, they are grounded in the object's affordances, which shape and guide users' actions. Namely, the performative property of being used in motion belongs to the object, she stresses, "as in the case of the elliptical machine, the object is designed to afford certain (performative) aesthetic experience."[53] Design structures promote

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51) Latour, *Reassembling the Social.*
52) Ibid., 71.
53) Carrasco Barranco, "Aesthetic Appreciation of Design Objects," 79.

these experiences through their functional and social framing, making them more than private sensations. Performative properties thus reveal the agency of artifacts: their capacity to configure aesthetic experiences through use.

An interesting element in our relations with objects, testifying to the rich and open character of affordances, is what Gibson names "education of attention."[54] Following Gibson, Rietveld and Kiverstein point out that "education of attention is a foundational operator in acquiring a skill to detect "in which places in the environment to find the affordances relevant to our concerns and what aspects of environment to attend to." In this process oftentimes experienced practitioners "electively introduce the novice to the right aspects of the environment and their affordances."[55] They rightfully classify this conduct as "sociomaterial scaffolding in skill acquisition." This approach is further developed to point to sociomaterial constitutive entanglement between practice and affordances, or social coordination and affordance perception which characterize concrete situations in real life. It is justly claimed that "despite the fact that in such real-life situations affordances and social coordination are situationally intertwined, the contextually situated nature of both is easily overlooked."[56]

Under the framework of the philosophy of the particular van Dijk and Rietveld claim that affordances are always situated within a specific context. For example, while sitting on a train, one may notice the possibility of drinking from a bottle of water, talking to a fellow traveler, or returning to writing. Yet these possibilities are shaped by the surrounding circumstances: the seat is in a designated "silence area," making conversation inappropriate, and the bottle belongs to someone else, so drinking from it is not an option. In this way, the perceived affordances depend not only on the physical environment but also on social and cultural conditions. Social coordination and affordances are always context-dependent. For instance, climbing old squeaking stairs is experienced differently when trying not to wake anyone, and stopping at a red light feels different when driving alone, with an elderly mother-in-law, or with a newborn in the backseat. Likewise, judging whether something can be carried together changes if the task involves carrying a coffin at a funeral, where the coordination among people

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54) Gibson, "Pictures, Perspective, and Perception," 226.
55) van Dijk and Rietveld, "The Skilled Intentionality Framework," 4.
56) Ibid., 2.

also shifts. These examples highlight that our responses to affordances – both material and social – are shaped by the practical situation in which they occur. Margolin claims that different people experience different levels of "fullness" with relations to objects, according to their own particular lives – for example, his and his wife's specific relations with his grandmother's dinnerware. He thus emphasizes the ontological openness of design with regard to the object's milieu:

> It is evident from this example that an engagement with a product will have different degrees of fullness, depending on how an individual's interaction with it resonates with his or her own sensibilities and past experience…. Product milieu… is vast and diffuse, fluid rather than fixed. It is always physically and psychically present and consists of all the resources that individuals make use of in order to live their lives.[57]

The philosophy of the particular and its relations to affordances gains further attention as well, because, as Ianniello and Habets have recently claimed, it redirects the emphasis from abstract, universal accounts of imagination and cognition to the concrete, dynamic, and specific nature of situations: "the indeterminacy of affordances, described as a 'friction' between different temporal scales, allows individuals to experience activities as imaginative, opening spaces for novel configurations."[58] Certainly, the connection between emergent properties and affordances here is clear. Emergent properties turn the design object into what Gibson names "value-rich ecological object."[59] In their "Rich Landscape of Affordances" Rietveld and Kiverstein explain that the ecological niche we inhabit is far more diverse and rich than often assumed, owning "to the variety in its physical structures (e.g., the variety of buildings from different epochs and cultures)" and "to the diverse repertoire of human abilities."[60] Aiming to push Gibson's theory of affordance to refer to broader extension, such as contexts of forms of life, they claim that particular contexts provides

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57) Margolin, *The Politics of the Artificial*, 42–43.
58) Ianniello and Habets, "Seeing Differently," 163.
59) Gibson, *Ecological Approach to Visual Perception*, 131.
60) Rietveld and Kiverstein, "A Rich Landscape of Affordances," 349.

numerous valuable opportunities for action, many of which have historically moti-
vated human activity, like social interactions around hearths or the use of pigments.
This ongoing openness and curiosity to explore affordances is meaningful because
these possibilities continue to hold potential value for human engagement. Materialist
social ontology shows us how substantial a part of the external world social institu-
tions, hierarchies, or regulations are, though they are not made of quartz. Rietveld
and Kiverstein "develop an account of affordances for humans that foregrounds their
embedding in sociocultural practices."[61]

A similar step of focusing the particularity of affordances, or the philosophy
of the particular, is taken by Anthony Chemero who following Gibson tries to bridge
the gap between the agents and their environment by proposing a fitting ontology of
affordances as "relations between particular aspects of animals and particular aspects
of situations," or better yet "relations between the abilities of organisms and features
of the environment."[62] Chemero's emphasis on affordance perceivability, by shifting
the word "subject" to perception in the formulation of affordance, is significant and
brings us back to design objects' visuality, and hence to our visualist definition of
design.[63] His claim is that in affordances we perceive properties of objects, but also
features of environments, such as "it is raining," and mostly the relations between
us and the either objects or environments.[64] This is helpful in understanding the
visual foundation as well as the intricacy of our relationships with design objects,
whose surfaces are essential to design ontology, given its membership in the realm
of aesthetic objects.

Certainly, ontology should note that the idea that environments contain meanings,
as held by externalist theories of direct perception, may acquire too heavy a burden. On
the other hand, reductionist physicalism cannot cover the affordances phenomenon.
Chemero takes it upon themselves to overcome the "ghostly entities" which may be
pointed to by Gibson's famous saying that "an affordance cuts across the dichotomy of
subjective-objective and helps us to understand its inadequacy." Chemero thinks it is

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61) Rietveld and Kiverstein, "A Rich Landscape of Affordances," 326.

62) Chemero, "An Outline of a Theory of Affordances," 184, 189.

63) Chemero, "What We Perceive When We Perceive Affordances."

64) Ibid., 114.

"confusing."[65] I disagree with Chemero's analysis of Gibson's ontology, because moderate externalism and even moderated materialism can easily acknowledge that objects and visual environments acquire conventional, symbolic, useful, and other properties. Some properties may be projected upon them, like sanctity of being a status symbol. But the very classification of material objects to categories, or any sort of labeling, while not made of pure matter, does not take us to idealist or internalist domains of thought, and is well accepted by moderate materialism and surely externalism. Arnheim reminds us that categories can be based on metaphorical grouping which happens in the everyday: "When we go by the perceived patterns of forces, some objects and events resemble each other; others do not. On the basis of their expressive appearance, our eye spontaneously creates a kind of Linnean classification of all existing things."[66]

This poetical tendency of grouping disparate objects by means of metaphors, extends beyond the "sophisticated invention of artist." It rather "derives from and relies on the universal and spontaneous way of approaching the world of experience."[67] Properties that are not absolutely material could still be external and visually perceivable, and can become very substantial, introducing objects to new categories. The visual is saturated with meanings, values, expressivity, and metaphorical loads.[68] Things look like other things, a car can have eyes and stare at us, a cup can look like a tiny drum when needed, a pencil like a balance game, and floor like a stretching surface. A kitchen gadget can look humorous or dignified. Thus, visual compositions and surfaces possess emergent properties and affordances that are visually perceivable. Some emerge from engagements with them, like Gibson puts it. Some rich visual properties emerge thanks to the power of composition, such as the "emotional elements of design" as classified by Roger Fry at the inauguration of the formalist-modernist discussion about design. For Fry, these elements follow the physical reality – they are absolutely properties of the composition, rather than mental content, but still emotional.[69] Arnheim similarly argues that "expression is an objective property of

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65)   Chemero, "An Outline of a Theory of Affordances," 182.

66)   Arnheim, *Art and Visual Perception*, 453.

67)   Ibid., 454.

68)   Gal, *Visual Metaphors and Aesthetics*.

69)   Fry, *Vision and Design*, 22–23.

all organized patterns of shape and color. It is an inherent aspect of every perceptual quality whatever, of size, space, movement, illumination, etc. It is found in the percept of every object or activity."[70]

The idea of the depth of visuality fits a closure of the essay and brings us back to the visualist ontology of the design object as primarily visual, which I propose. I think we realize now that the depth of visuality is in charge of a large segment of emergent properties and affordances. Thus, the application of both concepts to design seamlessly aligns with the theory of physiognomic expressive features of object – "smiling skies and menacing clouds, the caress of the wind and the soothing murmur of the brook" – which is formulated by the visualist Ernst Gombrich and Arnheim, both were Gibson's main conversers, both of whom were Gibson's main interlocutors.[71] Gibson reminds us that "the Gestalt psychologists recognized that the meaning or the value of a thing seems to be perceived just as immediately as its color. The value is clear on the face of it, as we say, and thus it has a physiognomic quality in the way that the emotions of a man appear on his face."[72] Like Gibson, Gombrich and Arnheim maintain that our relations with our objects and environments are greatly afforded by the fact that objects and visual phenomena are carriers of emergent significance through their visuality. Physiognomic emergent properties of design objects are fascinating elements in their affordances. Gombrich reminds us that "what we call the 'expressive' character of sounds, colors or shapes, is after all nothing else but this capacity to evoke 'physiognomic' reactions."[73] Arnheim goes even further to stress the "priority of expression" of objects, explaining that "the priority of physiognomic properties… have been developed by the organism as an aid in reacting to the environment, and the organism is primarily interested in the forces active around it – their place, strength, direction. Hostility and friendliness are attributes of forces. And the perceived impact of forces makes for what we call expression."[74]

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70) Arnheim, "From Function to Expression," 34–35.

71) Gombrich, "On Physiognomic Perception," 232.

72) Gibson, *Ecological Approach to Visual Perception*, 129.

73) Gombrich, "On Physiognomic Perception," 233.

74) Arnheim, *Art and Visual Perception*, 455.

Arnheim develops a visualist, anti-functionalist account of design that centers on the expressivity of objects and their physiognomic perception. Instead of treating function as a fixed determinant, Arnheim foregrounds the ways in which design objects visually and dynamically express what they afford. Their expressive properties, as he writes, "relate to the ways objects behave."[75] In this sense, expressivity is not a stable attribute but an emergent property – arising from shifting perceptual, cultural, and material forces rather than from predetermined functions.

Hence, design objects' expressivity is an instigator of affordances and emergent properties. This is exemplified by how "a blanket thrown over a chair is twisted, sad, tired."[76] These physiognomic properties are evident in the visuality of design objects and perceptions also through what I term "passing metaphors," such as the ordinary applying faces or bodily figures to objects.[77] According Arnheim, "Relevant here are the many instances in which an object is visually endowed with what it is to be used for… the look of a bottle of wine set near the fireplace to warm in preparation for a friend's visit changes "when the friend calls his visit off, the room seems quieter, the bottle looks forlorn."[78] Sometimes objects speak to us, call us, or seem inviting, with even less figurative properties. We just feel the need to relate to them: caress, touch, hold, push, shake. Such experiences reveal that function itself can emerge from the visual and material configuration of the object, rather than being conceptually imposed to lead to a "proper" use. Expressivity, even of function, enhances the ontological space of the object's emergent properties and affordances, and accordingly testifies to design object's ontology as open but substantial and present, productive of qualities, uses and engagements. I therefore join the next normative step of shifting the descriptive idea about design's open ontology, displayed by emergent properties and affordances' richness to educational action: "Given that all these value-rich affordances are publicly available, could we perhaps say that it is only our ignorance and lack of skill that limit our tapping into these potentially valuable resources for our practices? If so, such an insight might require us to rethink our educational practices… . Should we perhaps

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75)   Arnheim, "From Function to Expression," 38.

76)   Arnheim, *Art and Visual Perception*, 455.

77)   Gal, *Visual Metaphors and Aesthetics*, 23–31.

78)   Arnheim, *Visual Thinking*, 89.

pay more attention to the skill of being open to the detection of unconventional but relevant affordances?"[79] This applies, I think, both to designers and users. Thinking about sociomaterials and forms of life, we can understand how visualist externalism and moderate realism can contain the open ontology of design. Namely, design objects are unstable and powerful, but they are very real, and they are out there – in reality – waiting for our various engagements to reshape reality together time and again.

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79) Rietveld and Kiverstein, "A Rich Landscape of Affordances," 349–50.

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