

# EXPERIENCE AND DESIGNING EXPERIENCES

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## Abstract

Neuroscientific discourse on consciousness often resorts to ‘collection of elements’, notwithstanding the Gestalt demonstrations against representing conscious experience as a collection of sensory elements. Here the author shows that defining experience as an object of the category of experiences, instead of as a cohesion-less set of structure-less elements, provides the conceptual repertoire---basic shapes, figures and incidences---needed to think about the essence of experiences and the essence-preserving transformations of experiences. In light of the category of experiences, designers of user experience---in designing pre-conceptualized desired experiences---are well situated to contribute to the development of the theory of consciousness.

What is consciousness? Consciousness, according to Koch, “is everything you experience. It is the tune stuck in your head, the sweetness of chocolate mousse, the throbbing pain of a toothache, the fierce love for your child and the bitter knowledge that eventually all feelings will end” [1]. This immediately raises two questions: 1. What is the nature of conscious experiences? 2. What is the nature of consciousness? How are we to think of the experiences listed? An obvious description: They all are experiences, and hence each one of the experience has the essence of experiences, whatever the essence(s) maybe.

Let us consider a visual experience: a face. A first-order approximation would represent an experience as a feature list or as a point in a feature-space or as a set of features i.e., Face = {eyes, nose, mouth} [2]. Sensory features are obviously structured unlike the structure-less elements of sets [3]. Equally importantly, features of a visual object are related to one another resulting in a cohesive object, which cannot be captured by a set with its zero internal cohesion [4]. Elementism, notwithstanding the Gestalt demonstrations [5], continues to be the default terminology for analyzing “perceptual experience into a collection of simple sensory elements” [6]. This state-of-affairs does not reflect any failure to recognize that, in terms of the above example of face perception, the constituent eyes, nose and mouth, unlike the structure-less elements of a set, are figures of various shapes; these figures constituting a face are related to one another in specific ways. Nevertheless, it does highlight the absence and the significance of having a conceptual repertoire that fits the reality of experiences. Here I put forward mathematical category [7] as a framework suited for the study of consciousness. In line with the commonplace understanding of the notion of category, a mathematical category consists of objects all of which partake in the essence that is characteristic of the category; since every object of the category partakes in the essence, the transformations of objects preserve the essence.

## THEORY OF CONSCIOUS EXPERIENCE

What is the essence of experience? Continuing with our example of face perception, an experience of a face can be said to consist of figures of various shapes: two eye-shaped figures, one nosed-shaped figure and one mouth-shaped figure. Of these shapes, we can say that eye, nose and mouth are the basic shapes, and their incidence relations determine the mutual relations between various basic-shaped figures constituting the face [8]. When considering conscious experience in general, we may consider sensory features (e.g. color, shape), modalities

(visual, tactile, etc.), intuition, memory and emotion, among others, as basic shapes. For illustration, anger (in an experience) can be considered as an emotion-shaped figure (in the experience) just as redness can be thought of as a color-shaped figure. The mutual relations between basic shapes, say, emotion and color, determine the mutual relations between figures of the corresponding shapes (anger and redness).

Basic shapes along with their incidence relations constitute the abstract essence or theory of the category of experiences [9--11]. First, every experience has the structural essence [of experiences] given by the basic shapes and their incidence relations. Next, every experience can be represented as a structure formed of basic-shaped figures and their mutual relations induced by the incidences of basic shapes [12]. Since every experience has the essence of experiences, transformations of experiences are required to preserve the essence of experiences, and as such are natural transformations [13]. Geometrically speaking, natural transformations ‘do not tear’ the structure transformed [14]. Philosophically, a natural transformation is: Becoming consistent with Being (e.g. biological growth) [15].

What are we to make of the totality of all conscious experiences along with their essence-preserving transformations? Objects along with structural essence-preserving morphisms of objects form a category. With experiences as objects [with a given structural essence] and essence-preserving transformations of experiences as structure-preserving morphisms of objects, consciousness---the totality of conscious experiences---can be construed as a category of experiences [16]. Within this categorical framework, the structure of consciousness is an external reflection of the structural essence of conscious experiences [17]. More immediately, a category embodies a mode of cohesion [18], which is the most basic attribute of conscious experience.

As an illustration of theory of a category and its basic shapes, I present a simple theory (abstract essence) of conscious experiences. With ‘interpretation of sensation’ as a theory of conscious experiences, we obtain a category of two-sequential processes as the category of conscious experiences [19]. Here, the basic shapes are physical stimuli, neural sensation of stimuli, and conscious interpretation of sensation.

Given a category of experiences, how do we abstract the theory (essence) of experiences? Theorization begins with measurements of properties of the objects of the given category. Oftentimes, we find that there is small subcategory of properties (and their determinations) within the category of all properties that constitutes the abstract essence shared by all objects of the given category. This abstract essence in which every object of a given category partakes is the theory of the given category [20,21]. In geometric terminology, we consider a subcategory of basic shapes and their incidence relations and examine if figures with objects in the subcategory as shapes are adequate to completely characterize every object of the category and tell apart morphisms [22].

## DESIGNING USER EXPERIENCE

Let’s say you were to design an artifact that elicits a specific experience, say, religious experience [23]. You imagine a category of artifacts (along with their mutual relations). Next, you measure the values of their properties and examine their mutual determination. On further examination, you find within this category of properties (and determinations), there is a subcategory of properties, which is essential for the elicitation of the specific experience (cf. raised gaze for religious experience).

This essence is the theory of the category of artifacts (eliciting the desired experience). Let us say you have the essence ('the raising of the gaze') of the category of religious buildings. You then interpret your theory into a background category of, say, brick and mortar to obtain a model of the theory of your imagined category of religious buildings [24]. Within this broad categorical framework, we can accommodate distinct experiences elicited by different architectural designs [25].

In the context of developing a scientific theory of conscious experience, it is important to recognize change-of-experience as intrinsic to the practice of design. Designers of user experience, by way of changing the basic shapes (sensory features and modalities) and their incidence relations constituting the essence or theory of desired experiences, are designing experiences ranging from ordinary experiences with the usual subject-object divide and all the way to aesthetic and spiritual experiences variously described as 'figure-sans-background', 'disappearing into appearance' or 'losing oneself' (cf. music) [26]. Here, material objects are designed to elicit a specific (pre-conceptualized) experience. In practice, design is design of experience, with design subsuming specification of the experience (in terms of basic figures and their incidences) and its essence-preserving transformations from and to experiences of the category of experiences. Since theory is the essence of practices extracted from a conscious participation in the practice [27], a theory of experience can be abstracted from conscious participation in the practice of designing user experiences. Furthermore, changing theories and the induced changes in experiences are integral to designing user experiences. Equally importantly, the wealth of empirical data accumulated in designing user experiences is a valuable resource to draw upon in testing for the adequacy of theories of experience. In closing, I defined conscious experience as an object of the category of conscious experiences, which provided the conceptual repertoire needed to abstract an ever more refined declarative understanding of consciousness from the procedural knowledge of designing user experiences.

## References and Notes

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2. J. Fodor, "When is a dog a DOG?" *Nature* **396** (1998) p. 325.
3. F. William Lawvere and R. Rosebrugh, *Sets for Mathematics* (Cambridge, U.K.: Cambridge University Press, 2003) p. 1.
4. F. William Lawvere and S. H. Schanuel, *Conceptual Mathematics: A First Introduction to Categories* (Cambridge, U.K.: Cambridge University Press, 2009) p. 146.
5. T. D. Albright, T. M. Jessell, E. R. Kandel and M. I. Posner, "Neural Science: A Century of Progress and the Mysteries that Remain." *Neuron* **25** (2000) p. S34.
6. T. D. Albright, "The Veiled Christ of Cappella Sansevero: On Art, Vision and Reality." *Leonardo* **46** (2013) p. 19. In a similar spirit, mind is conceptualized as a set of brain functions. See M. Bunge, *Scientific Materialism* (Boston: D. Reidel Publishing Company, 1981) p. 68; E. R. Kandel, "The New Science of Mind and the Future of Knowledge." *Neuron* **80** (2013) p. 546.
7. See Lawvere and Schanuel [4] p. 21, 135-148.
8. See Lawvere and Schanuel [4] pp. 82-83, 250-253.
9. See Lawvere and Rosebrugh [3] pp. 154-155, 235-236; Lawvere and Schanuel [4] pp. 149-151, 369-370.
10. F. William Lawvere, "Foundations and Applications: Axiomatization and Education." *The Bulletin of Symbolic Logic* **9** (2003) p. 215, 217.
11. F. William Lawvere, "Functorial Semantics of Algebraic Theories and Some Algebraic Problems in the Context of Functorial Semantics of Algebraic Theories." *Reprints in Theory and Applications of Categories* **5** (2004) pp. 10-12.
12. V. R. Posina, D. N. Ghista and S. Roy, "Functorial Semantics for the Advancement of the Science of Cognition." *Mind & Matter* **15** (2017) pp. 161-184.
13. See Lawvere and Schanuel [4] p. 378.
14. See Lawvere and Schanuel [4] p. 210.
15. V. R. Posina, "Truth through Nonviolence." *GITAM Journal of Gandhian Studies* **5** (2016) pp. 143-150.
16. See Lawvere and Schanuel [4] p. 21, 152-154, 321-322. Note that any experience can remain the same (identity transformation). If I went from sad to happy and from happy to detached, then I went from sad to detached (composition of transformations of experiences). Along these lines, other axioms and laws, which are required to be satisfied in order for us to talk about a category of experiences, can be verified.
17. F. William Lawvere, *Perugia Notes: Theory of Categories over a Base Topos* (Perugia: Universita' di Perugia, 1972) p. 10.
18. See Lawvere and Schanuel [4] p. 146.
19. See Posina, Roy and Ghista [12] pp. 172-174.
20. See Lawvere and Rosebrugh [3] pp. 154-155; Lawvere and Schanuel [4] pp. 149-150; Lawvere [11]; Posina, Ghista and Roy [12].
21. F. William Lawvere, "Tools for the Advancement of Objective Logic: Closed Categories and Toposes," in J. Macnamara and G. E. Reyes, eds., *The Logical Foundations of Cognition* (New York, NY: Oxford University Press, 1994) pp. 44-47.
22. See Lawvere and Schanuel [4] p. 215, 370-371; Lawvere [21] p. 49.
23. M. A. Arbib, "When Brains Design/Experience Buildings: Architectural Patterns for a Good Life," in J. W. Vasbinder and B. Gulyas, eds., *Cultural Patterns and Neurocognitive Circuits* (Singapore: World Scientific Publishers, 2016) pp. 111-140.
24. See Posina, Roy and Ghista [11]; Lawvere [21] pp. 44-47.
25. Albright, T. D. (2015) "Neuroscience for architecture," in S. Robinson and J. Pallasmaa, eds., *Mind in Architecture: Neuroscience, Embodiment, and the Future of Design* (Cambridge, MA: The MIT Press, 2015) p. 201.
26. V. R. Posina, "Symbolic Conscious Experience." *Tattva - Journal of Philosophy* **9** (2017) pp. 1-12.
27. See Lawvere [10] p. 215.

## REVIEW 1

### Should this paper be published?

Maybe — Leonardo editors will have to decide whether this author from outside the field is able simplify the language, populate the article with robust design examples, and reframe it under a less lofty claim than a model of human consciousness that can define the practice of experience design. These are not just content issues to be fixed. I am not sure he understands your reader.

## GENERAL EVALUATION

### Review Comments

(see attached pages)

**Title:** Does the title sufficiently describe the subject matter? Can you suggest an alternative?

No. I think this is really about a framework for describing semantic relationships between form and experience. It has almost nothing to do with experience design.

**Illustrations:** It needs examples from design that illustrate the concepts.

**References:** Comment on the author's use of references to provide readers with a sufficient context for the manuscript.

All of the references are from outside of design, despite a number of cognitive scientists working within the field on these issues. None of the references indicate that design already considers these issues (just not under the author's terminology in all cases) and that there are more robust explanations in design and related fields. And if one purpose of the article is to provide a view from neuroscience (which appears in the abstract), then more than the bibliography should indicate that viewpoint — there is no explanation in the article how neuroscience contributes to this thesis as a discipline.

**Do you wish to remain anonymous to author?** Doesn't matter to me – share if you think it helps

### Comments on manuscript 1021-1: Experience and Designing Experience

There is a strong history of design relying on scholarship generated from outside the field. This is especially important in today's interdisciplinary practices. In recent decades, neuroscience and cognitive science have contributed much to designers' understanding of how people construct meaning and experience design. However, a problem in knowledge transfer, especially when it offers a paradigm for thinking about design practice, is a tendency to oversimplify the design task and its effects. I think this is the case with the author's argument. It is not that I disagree with what he describes, but that it ignores so many things in how design mediates experience.

Another class of concerns addresses the degree to which the author's ideas represent new insights for design. Overly complicated language and abstraction don't make something new. Much of what he describes is inherent in existing theories of design, whether validated by science or not. Curiously, the actual writing offers no biological support from neuroscience for his theories (only footnotes to articles), so I'm not sure what the added value is for readers. And none of the author's sources are from design, or apparently from scientists who work in design, which further suggests he may lack deep understanding of the discipline and practice.

In this review I ignore particular influences in the current context for practice; the economic, social, technological, political, and environmental systems that shape designer and user responses. These are significant aspects of any design problem and increasingly relevant to the motives and values that influence interpretation and behavior well beyond the categorization of concepts. And even under the categorization paradigm, they play a role — this is the premise of linguist George Lakoff's take on the political underpinnings of metaphor and post-structuralist notions of power relationships embedded in form. But for the most part, they fall outside the scope of the author's interests.

A caveat in this review is that I may have misunderstood the author's thesis. This is possible, given the writing style and overly layered definitions. I am not a naïve reader on this subject, but I struggled through sentences like this:

*"Since every experience has the essence of experiences, transformations of experiences are required to preserve the essence of experiences, and as such are natural transformations."* Perhaps logically consistent within his model, but readers should not have to parse every word to understand what he is saying.

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**The role of syntax** — The contribution of syntax to experience is not adequately represented in this article. The author focuses more on semantics in the categorical associations among of elements, attributes, and emotion (redness and anger, for example) than on the meaning created by their organization in space and time. Yes, designers make choices about elements and their qualities, but a disproportionate number of decisions in design are about order. The author hints at syntax in his discussion of human features forming a face but goes no further.

For example, the Kuleshov effect – the construction of meaning through image sequences – informs the experience of film. In Kuleshov's experiment, a shot of an actor's face is followed by second image: a plate of soup, a girl in a coffin, or a woman on divan. The image of the actor doesn't change but viewers experience his expression as hunger, grief, and desire, respectively in the pairings. In other words, the "experience" of the film, and even of the first image, depends on what follows the first image. It cannot be described by the formal and emotional content of the first image alone. This is the basis of the "jump cut" or what Eisenstein called the "collision montage."

The experience of architecture is similar. An attribute of buildings in the category of "home" is an intimacy gradient. Rooms serve more private functions as we move inward from the entrance. That emotional aspect of the experience is syntactic. Yes, bedrooms and bathrooms contain attributes that suggest privacy but we would have a different experience of those very same "basic shapes" if these rooms were directly inside the front door.

Another example addresses the author's concept of a raised gaze as defining the spiritual experience of religious architecture. A seventeenth-century church in Isle of Wight, Virginia has a door that is too small for the average man to pass through upright. In stooping, he humbles himself as he enters the house of God and then raises his gaze as he straightens his posture in the sanctuary. The sequence of two bodily positions defines the experience.

This is a very different experience than one resulting from a high element or peaked wall that raises the gaze.

In other words, the task of design is more complicated than simply choosing the right basic shape for the desired response. And the sense of an experience is more nuanced than calling up a semantic category to which signs belong. John Dewey, in *Art as Experience*, draws a distinction between "an experience" and "experience." He says we can name an experience by its qualities (that is, we can categorize it and differentiate it from ordinary experience). It has a beginning and an end, and is constructed of episodes that flow seamlessly from one to another (that is, it has a syntax). These episodes have a distinctive pattern of "doing" and "undergoing" (that is, engaging through the senses, and making sense of the engagement). And it has a sense of fulfillment (that is, it reaches a satisfying conclusion or sense of resolution). This is the way designers think about designing the conditions that shape someone's experience.

Intentionally disrupting the expected syntax of perceptual elements is a frequent strategy used by artists and designers throughout history. For example, Futurist typographers intentionally subverted the syntax of language and diacritical marks to slow down the reading experience in a stated effort to make it "more conscious." They were addressing what they thought to be public lack of criticality in reading political texts. In this case, there is meaning in undermining the diachronic organization through which we normally experience text; one word at a time, according to the grammatical rules of language. You can debate whether they were successful, but they understood syntax matters in interpretation.

Other reading that may be helpful is cognitive scientist Jean Mandler's in *Stories, Scripts, and Scenes*. She analyzes the syntactical structures that differentiate our experiences of these forms, regardless of their specific content. And there is a good bit of literature in cognitive science on schema theory (role schemas, place schemas, event schemas, etc.)

**The concepts of affordance and embodiment** — Neurologist Frank Wilson links mind and body, tracing the development of the human brain in his book, *The Hand*. The brain imagines the hand reaching out and lifting a cup. The experience of a cup depends not just on its parts (rim, bowl, handle), but also on the perceived action it takes to use it and what it might be good for. This potential for a particular kind of action is part of its categorical qualification. And that potential allows us to see other objects that don't share all the same sensory properties as members of the same category (for example, drinking from a cupped hand).

This is also psychologist J.J. Gibson's notion of affordance; that the world is experienced not only in terms of object shapes and spatial relationships, but also in terms of possibilities for action. Design often fails by not considering this. Think about the number of times we're confused by the design of a door that

offers no cues among its parts for how it operates. And software manuals fail by simply describing features rather than describing possible tasks.

Neuroscientist Stephen Kosslyn, in *Image and Mind*, demonstrates that the time it takes to identify an inverted and tilted letterform is actually a factor of the number of mental rotations required to restore it to its natural position on a baseline. Our experience of two-dimensional stimuli, therefore, comes not only through the visual properties of stimulus itself, but also through our ability to mentally manipulate its state. This explains how we experience concepts such as balance, direction, and rhythm through static elements on a printed page. There is no actual “weight” to a black square versus a white one, or greater instability in a square resting on its corner rather than on its side, but we make that association from our experiences in the physical world and we assign meaning to those characteristics. We can imagine the square resting on its corner falling into the surrounding space.

Because we can identify embodied alternate states, we are able to identify the affordances of objects (potential for action and use) through their design. Children, for example, can accurately describe the purpose and action of no-longer-used tools in museums. They can tell you how they were held and the gestures involved in their use.

Designers acknowledge this capacity in achieving “user-friendly” experiences, often using categorical analogs of use (for example, the desktop metaphor for interfaces) to signify appropriate actions.

Presumably affordance and embodied concepts are “among other basic shapes” to which the author refers, but in many ways they are greater contributions to conscious user experience than some of the sensory attributes he itemizes. The yellow grip in the hammer above is far less significant than our ability to match its shape to action.

**Categorization and processing** — I also point the author to UC/Berkeley cognitive psychologist Eleanor Rosch’s work in categorization. It seems an oversight to ignore her studies in this article. Rosch describes a hierarchy of cognitive categorization. She says we sort perceptual stimuli into groups with graded levels (superordinate, basic, and subordinate) — “chair” is a subset of “furniture.” And members that are greater and lesser representatives of the category — “prototypes” are best examples of the category. She deconstructs the concept of “red,” saying that we make judgments regarding the “redness” of something by comparing it to our “best example” of red. Saying something is “too pink” means it is far from our best example of “red.”

But the status of these prototypes is built through individual life experiences and context. I use the example below to explain this concept to my design students. For some, the set of stimuli in Georgia O’Keeffe’s *Black Orchid* assigns the image to a category of stimuli we recognize as “flower.” It may be a less prototypical member than a rose (perhaps its color compromises its status as a prototype), but there are enough similarities to assign it to the category. For others who understand the history of O’Keeffe’s work, the image also belongs to the category of “female anatomy.” A designer seeking to use the image metaphorically is faced with determining the stronger categorical affiliation for a particular audience. The notion of a universally understood “essence” is insufficient in making that decision. Stimuli often have membership in more than one category, which the author doesn’t mention.

Designers use categorization in different ways. For example, one view of graphic design is that there should be a one-to-one correspondence between text and image in their categorical references — text should “label” image, and image should “illustrate” text. Another view is that asking people to resolve cognitive dissonance between text and image by constructing a “third meaning” produces a more conscious experience. Similar dissonance arises when the typographic form of a word evokes a category opposite of its anticipated verbal meaning> “Executive” set in pink script signifies women in management — not the usual male stereotype — and it becomes a political statement as well as a literal one. It is these issues that separate an aesthetic experience from ordinary experience in Dewey’s sense.

Christopher Alexander’s *Timeless Way of Building* and *Pattern Language* illustrate the role of “events” as social experiences that shape design. He says that architectural form must begin with an understanding that the experience of every place is given its character by the pattern of events that keep happening there. For example, the pattern of “watching the world go by” (a category of experience) tells architects that porches need to be raised above the level of the street. This isn’t just symbology (as in raising the gaze in churches = spirituality) but also the functional follow-through of design on categories of interactive behavior. These patterned relationships are determined by culture, transmitted by culture, and merely anchored in physical space. In some cultures, public space ends and private space begins at a high wall surrounding the house. In other cultures that transition happens at the front door. In other words, the sensory/emotional relationship in design is not universal in the same way that anger and redness of face

might be (it might help to read cognitive psychologist Donald Norman's *Emotional Design* for a taxonomy of emotion and what that means to form). Alexander's 253 patterns also constitute a language; the meaning of any one pattern depends partially on its interdependent relationship to other patterns. The pattern "a family of entrances," for example, depends on other patterns that address transitions. I think this is much more nuanced idea of the experience of architecture, than "churches are spiritual because their design makes us look up." All types of design can be viewed in terms of cultural pattern. There is a reason early software replicated the print reading experience and that product origins of computers were typewriters and televisions. We didn't have a pattern for touchscreens — that took developing a new language of interactive experience and it was a tough sell to cell phone companies until Apple established the pattern.

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My purpose in offering detail (which the author may see as relevant to his model or not) is to suggest that experience design is neither naïve with regard to the issues the author raises, nor as simple and deterministic a practice as his model seems to imply by its range of considerations. The absence of design examples and layered language don't help to dispel these impressions. I am not advocating the he expand scope as a model for experience design — that would take more disciplinary expertise in design than I suspect he has. And I understand he might argue that the issues I raise might already be subsumed in his model, just not explained in his text. But I think he could dial down the tacit claim as a comprehensive "theory of consciousness" that accounts for all variables in the relationship between design and user experience.

## **REVIEW 2**

I have read the paper and, to be honest, I cannot understand what it is about. This may be because it is beyond my capacity to understand.

## **REVIEW 3**

In its abstract, the manuscript defined "experience as an object of the category of experiences" therefore "designers of user experience are well situated to contribute to the development of the theory of consciousness." However, the intention was not supported by necessary case studies or argument in the body of the paper. The only example was analyzed on the surface so I was not convinced by the author's conclusion by reading the paper, even I totally agreed that user experience designer could "contribute the development of the theory of consciousness".