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## 17 **Summary**

18 Neuroscientific discourse on consciousness often resorts to ‘collection of elements’,  
19 notwithstanding the Gestalt demonstrations against representing conscious experience as a  
20 collection of sensory elements. Here I show that defining conscious experience as an object of  
21 the category of conscious experiences, instead of as cohesion-less set of structure-less elements,  
22 provides the conceptual repertoire—basic shapes, figures, and incidence relations—needed to  
23 reason about the essence of conscious experiences and the essence-preserving transformations of  
24 conscious experiences. Viewed in light of the category of conscious experiences, designers of  
25 user experience—in designing pre-conceptualized user experiences—are well situated to  
26 contribute to the development of the science of consciousness.

27 What is consciousness? Consciousness, according to Koch, “is everything you experience. It is  
28 the tune stuck in your head, the sweetness of chocolate mousse, the throbbing pain of a  
29 toothache, the fierce love for your child and the bitter knowledge that eventually all feelings will  
30 end”<sup>1</sup> (p. S9). This raises two foundational questions:

31 1. What is the nature of conscious experiences?

32 2. What is the nature of consciousness?

33 How are we to think of the totality of conscious experiences i.e., consciousness? How are we to  
34 think of the constituents of consciousness i.e., conscious experiences? One obvious answer:  
35 Conscious experiences are objects of the category of all conscious experiences and  
36 consciousness is the category of conscious experiences. In other words, every conscious  
37 experience has the essence of the category of conscious experiences, whatever the essence(s)  
38 maybe. This characterization is in the spirit of asserting that a chair is an object of the category  
39 of chairs.

40 Let us consider a visual experience: a face. A first-order approximation would represent the  
41 experience as a feature list, as a point in a feature-space, or as a set of features: Face = {eyes,  
42 nose, mouth}<sup>2</sup>. Sensory features are obviously structured, unlike the structure-less elements of  
43 sets<sup>3</sup> (p. 1). Equally importantly, sensory features of a visual object are related to one another in  
44 specific ways resulting in a cohesive object, which cannot be modeled by a set with its zero  
45 internal cohesion<sup>4</sup> (p. 146). Elementism, notwithstanding the Gestalt demonstrations<sup>5</sup> (p. S34),  
46 continues to be the default terminology as in analyzing “perceptual experience into a collection  
47 of simple sensory elements”<sup>6</sup> (p. 19). Along similar lines, mind is defined as a set of brain  
48 functions (p. 68 in ref. <sup>7</sup>; p. 546 in ref. <sup>8</sup>). The claim that ‘mind is a set’ is repeatedly asserted in

49 the textbook *Principles of Neural Science*<sup>9</sup> (p. 5, 334, 384), which takes on added significance in  
50 light of its pedagogical value in training neuroscientists. Of course, this terminology does not  
51 reflect any failure to recognize that, in terms of the above example of face perception, the  
52 constituent eyes, nose, and mouth, unlike the structure-less elements of a set, are figures of  
53 various shapes; and that these figures constituting a face are related to one another in specific  
54 ways. Nevertheless, it does highlight the absence and the significance of having a conceptual  
55 repertoire that fits the reality of conscious experiences.

56 Here I put forward mathematical category<sup>4</sup> (p. 21, 135-148) as a construct suited for the study  
57 of consciousness. In line with the commonplace understanding of the notion of category, a  
58 mathematical category consists of objects all of which partake in the essence that is characteristic  
59 of the category; since every object of the category partakes in the essence, the transformations of  
60 objects preserve the essence (e.g. in the category of dogs, a transformation of an young dog into  
61 an old dog preserves the “dogness”).

62

### 63 **Theory of Conscious Experiences**

64 What is the essence of conscious experiences? Continuing with our example of face perception,  
65 an experience of a face can be said to consist of figures of various shapes: two eye-shaped  
66 figures, one nosed-shaped figure, and one mouth-shaped figure. Of these shapes, we can say that  
67 eye, nose, and mouth are the basic shapes, and their incidence relations determine the mutual  
68 relations between various basic-shaped figures constituting the face<sup>4</sup> (pp. 82-83, 250-253). When  
69 considering conscious experience in general, we may treat sensory features (e.g. color, shape),  
70 modalities (visual, tactile, etc.), and emotion, among others, as basic shapes. For example, anger

71 (in conscious experience) can be considered as an emotion-shaped figure (in the experience) just  
72 as redness can be thought of as a color-shaped figure. The mutual relations between basic shapes,  
73 say, emotion and color, determine the mutual relations between figures of the corresponding  
74 shapes (anger and redness).

75 Basic shapes along with their incidence relations constitute the abstract essence or theory of the  
76 category of conscious experiences (pp. 154-155, 235-236 in ref. <sup>3</sup>; pp. 149-151, 369-370 in ref. <sup>4</sup>;  
77 p. 215, 217 in ref. <sup>10</sup>; pp. 10-12 in ref. <sup>11</sup>). First, every experience has the essence [of  
78 experiences] given by the basic shapes and their incidence relations. Next, every experience can  
79 be represented as a structure formed of the basic-shaped figures and their mutual relations  
80 induced by the incidences of basic shapes (Fig. 4 in ref. <sup>12</sup>). Since every experience has the  
81 essence of experiences, transformations of experiences are required to preserve the essence of  
82 experiences, and as such are natural transformations. Geometrically speaking, natural  
83 transformations ‘do not tear’ the structure transformed<sup>4</sup> (p. 210). Philosophically, a natural  
84 transformation is: Becoming consistent with Being<sup>13</sup> (e.g. biological growth).

85 What are we to make of the totality of all conscious experiences along with their essence-  
86 preserving transformations? Objects along with essence-preserving morphisms of objects form a  
87 category. With conscious experiences as objects and essence-preserving transformations of  
88 experiences as structure-preserving morphisms of objects, consciousness—the totality of  
89 conscious experiences—can be construed as a category of conscious experiences<sup>4</sup> (p. 21, 152-  
90 154, 321-322). Note that any experience can remain the same (identity transformation). If I went  
91 from sad to happy and from happy to detached, then I went from sad to detached (composition of  
92 transformations of experiences). Along these lines, the other axioms and laws, which are  
93 required to be satisfied in order for us to talk about a category of conscious experiences, can be

94 verified. Within this categorical framework, the structure of consciousness is an external  
 95 reflection of the structural essence of conscious experiences<sup>14</sup> (p. 10). More immediately, a  
 96 category embodies a mode of cohesion<sup>4</sup> (p. 146), which is the most basic attribute of conscious  
 97 experience. For example, parts (hands, legs, etc.) of a body have a mode of cohesion, which is  
 98 different from the mode of cohesion of parts (color, shape) of a visual object. Note that ‘part’ is  
 99 both itself and its relationship to the whole<sup>15</sup> (pp. 53-55).

100 As an illustration of theory of a category and its basic shapes, I present simple theories  
 101 (abstract essences) of conscious experiences. More explicitly, the mathematical method,  
 102 according to F. William Lawvere, “consists of taking the main structure [of an object] by itself as  
 103 a first approximation to a theory of the object, i.e. mentally operating as though all further  
 104 structure of the object simply did not exist”<sup>14</sup> (pp. 9-10). With ‘interpretation of sensation’ as a  
 105 theory of conscious experiences, we obtain a category of two-sequential processes as the  
 106 category of conscious experiences. Here, the basic shapes are physical stimuli, neural sensation  
 107 of stimuli, and conscious interpretation of sensation. With conscious experience as an object of  
 108 the category of two sequential functions, we find that the objective logic intrinsic to  
 109 consciousness is non-Boolean; for example, it has four truth values<sup>12</sup> (pp. 172-174).  
 110 Alternatively, we can take ‘action of memory on sensation’ as a theory of conscious experiences.  
 111 Yet another example of an abstract theory of conscious experiences: ‘particular as an exemplar  
 112 of a general’<sup>9</sup> (pp. 628-630), which gives the category of idempotents as the category of  
 113 conscious experiences<sup>4</sup> (p. 106).

114 Given a category of conscious experiences, how do we abstract the theory (essence) of  
 115 experiences? Theorization begins with measurements of properties of the objects of the given  
 116 category. Oftentimes, we find that there is small subcategory of properties (and their

117 determinations) within the category of all properties that constitutes the abstract essence shared  
118 by all objects of the given category. This abstract essence in which every object of a given  
119 category partakes is the theory of the given category (pp. 154-155 in ref. <sup>3</sup>; pp. 149-150 in ref. <sup>4</sup>;  
120 Fig. 5 in ref. <sup>12</sup>; pp. 44-47 in ref. <sup>14</sup>). In geometric terminology, we consider a subcategory of  
121 basic shapes and their incidence relations, and examine if figures with objects in the subcategory  
122 as shapes are adequate to completely characterize every object of the category and tell apart  
123 transformations between objects (pp. 370-371 in ref. <sup>4</sup>; p. 49 in ref. <sup>15</sup>).

124

## 125 **Designing User Experiences**

126 We now view user experience design in light of the category of conscious experiences. Let us  
127 say you were to design an artifact that elicits a specific experience, say, religious experience<sup>16</sup>.  
128 You imagine a category of artifacts (along with their mutual relations). Next, you measure the  
129 values of their properties and examine their mutual determination. On further examination, you  
130 find within this category of properties (and determinations), there is a subcategory of properties,  
131 which is essential for the elicitation of the specific experience (cf. raised gaze for religious  
132 experience). This essence is the theory of the category of artifacts (eliciting the desired  
133 experience). Now that you have the essence ('raising the gaze') of the category of religious  
134 buildings, you interpret the essence (theory) into a background category of, say, brick and mortar  
135 to obtain a model of the theory of your imagined category of religious buildings<sup>15</sup> (pp. 44-47).  
136 Within this broad categorical framework, we can accommodate distinct experiences elicited by  
137 different architectural designs<sup>17</sup> (p. 201).

138 In the context of developing a scientific theory of conscious experience, it is important to  
139 recognize change-of-experience as intrinsic to the practice of design. Neuroscientists vary stimuli  
140 and examine the corresponding changes in conscious experience. So do designers of user  
141 experience. Designers of user experience, by way of changing the basic shapes (e.g. sensory  
142 features, modalities) and their incidence relations constituting the essence or theory of desired  
143 experiences, are designing experiences ranging from ordinary experiences with the usual subject-  
144 object divide and all the way to aesthetic and spiritual experiences variously described as ‘figure-  
145 sans-background’, ‘disappearing into appearance’, or ‘losing oneself’ (cf. music<sup>18</sup>). Here,  
146 material objects are designed to elicit a pre-conceptualized experience. In designing experience,  
147 design subsumes specification of the experience (in terms of figures of various basic shapes and  
148 their incidences) and its essence-preserving transformations from and to experiences of the  
149 category of experiences. Since theory is the essence of practices extracted from a conscious  
150 participation in the practice<sup>10</sup> (p. 215), a theory of experiences can be abstracted from conscious  
151 participation in the practice of designing user experiences. Furthermore, changing theories and  
152 the induced changes in experiences are integral to designing user experiences. Equally  
153 importantly, the wealth of empirical data accumulated in designing user experiences is a valuable  
154 resource to draw upon in testing for the adequacy of theories of consciousness.

155

## 156 **Conclusions**

157 I defined conscious experience as an object of the category of conscious experiences, which  
158 aligns with the intuitions engendered by our everyday experience with things and thoughts (cf.  
159 an idea is an object of a category of ideas). It is fascinating to note that the most advanced

160 scientific understanding of object (as an object of a category of objects) is in accord with our  
161 ordinary experience. The category of conscious experiences provides the conceptual repertoire—  
162 basic shapes, figures, and incidences—needed to develop an adequately explicit theory of  
163 conscious experiences. In doing so, it brings into focus the significance of user experience design  
164 in the development of a comprehensive theory of consciousness.

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