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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”¹ (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}². Sensory features are obviously structured, unlike the structure-less elements of
43 sets³ (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 cohesion⁴ (p. 146). Elementism, notwithstanding the Gestalt demonstrations⁵ (p. S34),
46 continues to be the default terminology as in analyzing “perceptual experience into a collection
47 of simple sensory elements”⁶ (p. 19). Along similar lines, mind is defined as a set of brain
48 functions (p. 68 in ref. ⁷; p. 546 in ref. ⁸). The claim that ‘mind is a set’ is repeatedly asserted in

49 the textbook *Principles of Neural Science*⁹ (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 category⁴ (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 face⁴ (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. ³; pp. 149-151, 369-370 in ref. ⁴;
77 p. 215, 217 in ref. ¹⁰; pp. 10-12 in ref. ¹¹). 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. ¹²). 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 transformed⁴ (p. 210). Philosophically, a natural
84 transformation is: Becoming consistent with Being¹³ (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 experiences⁴ (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 experiences¹⁴ (p. 10). More immediately, a
96 category embodies a mode of cohesion⁴ (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 whole¹⁵ (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”¹⁴ (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 values¹² (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’⁹ (pp. 628-630), which gives the category of idempotents as the category of
113 conscious experiences⁴ (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. ³; pp. 149-150 in ref. ⁴;
120 Fig. 5 in ref. ¹²; pp. 44-47 in ref. ¹⁴). 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. ⁴; p. 49 in ref. ¹⁵).

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 experience¹⁶.
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 buildings¹⁵ (pp. 44-47).
136 Within this broad categorical framework, we can accommodate distinct experiences elicited by
137 different architectural designs¹⁷ (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. music¹⁸). 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 practice¹⁰ (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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