On the Relationship Between the Conscious and the Senses

A Preprint

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1 Introduction

This colloquial research paper concerns observations I made from several psychedelic experiences, specifically Lysergic acid diethylamide (LSD). I detail the conditions, what I experienced, and source concepts from several academic fields to put forth a theory for sensory processing by the conscious that potentially explains these experiences.

2 Conditions

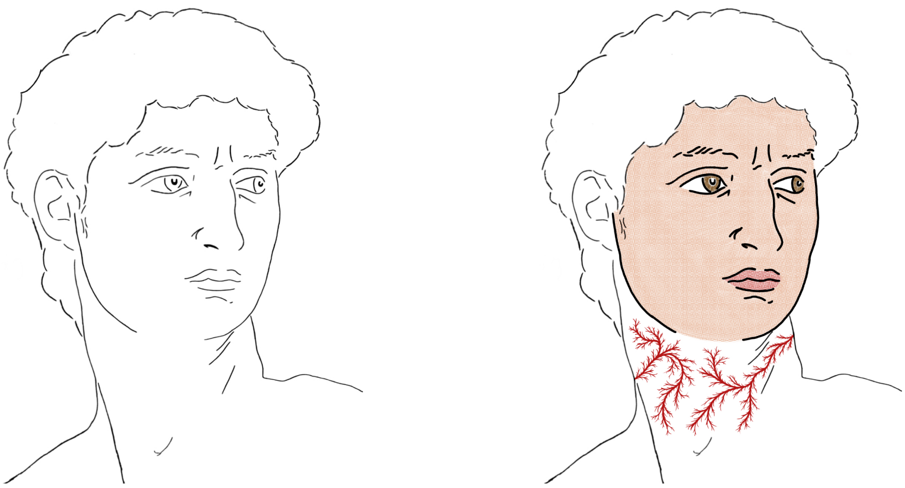
These experiences took place several times over the span of a few years. Subject (me): male, 27-29 years old, approximately 150-160 lbs, approximately 9%-15% body fat, half asian / half caucasian. Substance ingestion: absorption of LSD tabs via placement on the tongue, 150-300 μg.

3 Observations

It is clear humans sense more of their surrounding than is recognized by the conscious:

1. see blood vessel vibrations underneath skin
2. feel gut movement otherwise ignored
3. feel ear pain from listening to loud music all the time
4. when looking at faces, detail is scrutinized much more closely

Observations 1. and 4. are depicted in Figure 1.



(a) **Normal** (b) **LSD**

Figure 1: **Schematic depicting exaggerated differences of visual perception between the two states.** In the **Normal** state, the conscious concludes this is a depiction of the face of Michelangelo's statue of David. In the **LSD** state, the conscious has access to greater detail as well as lower level features, such as tesselating geometric patterns on the face (zoom in). Facial features are more prominent, shown here by thicker ridge lines outlining the nose, for instance. Pulsating skin blood vessels are visible in this state, such as depicted on the neck. In general, colors are more vivid.

4 Exposition

Some of these observations are corroborated by the literature, such as observation 4. Under LSD conditions, Carhart-Harris et al. 2016 measured increased visual cortex cerebral blood flow and Pizzi et al. 2023 measured increased functional connectivity within the thalamus, responsible for relaying signals from the senses. In line with this, the fusiform face area (FFA) is explicitly devoted to this task (Kanwisher, McDermott, and Chun 1997). Therefore LSD-induced changes in blood flow and functional connectivity, or "rewiring", apportions more conscious to recognizing such facial details.

Likewise for observation 1. Under LSD conditions I witnessed my skin blood vessels pulsating at the frequency of my heart rate. In normal conditions these blood vessels are not recognized by the conscious. They are, however, visible in certain unusual situations. When unfortunate victims are hit by lightning strikes, some are left with temporary finely branching skin marks, known as Lichtenberg figures, that are believed to be the result of these vessels bursting upon electrical current impact (Ritenour et al. 2008). What I witnessed, then, was the unburst and unbruised form of these vessels - which are not visible to the conscious in a normal state.

One possible explanation for this narrative can be sourced from the Computer Vision (CV) machine learning field, which in turn was sourced from the biological vision field (Hubel and Wiesel 1962). Therein, convolutional neural network (CNN) models operate by extracting features, initially linear and then progressively nonlinear with each layer, culminating in an object category (Lecun et al. 1998, Zeiler and Fergus 2014). Akin to how the final connections of a CV model only consider higher level features - and not lower level features - for object categorization, the conscious in a normal state may be precluded from perceiving the aforementioned skin blood vessels and detailed facial features. In other words, under LSD conditions the conscious diffuses past the boundary that typically confines it, allowing access to the unconscious sensory periphery. Figure 2 furthers this theory. I propose this phenomenon be termed ***terminus inter conscios et sensus***, the boundary between the conscious and the senses, or ***TICES*** for short.

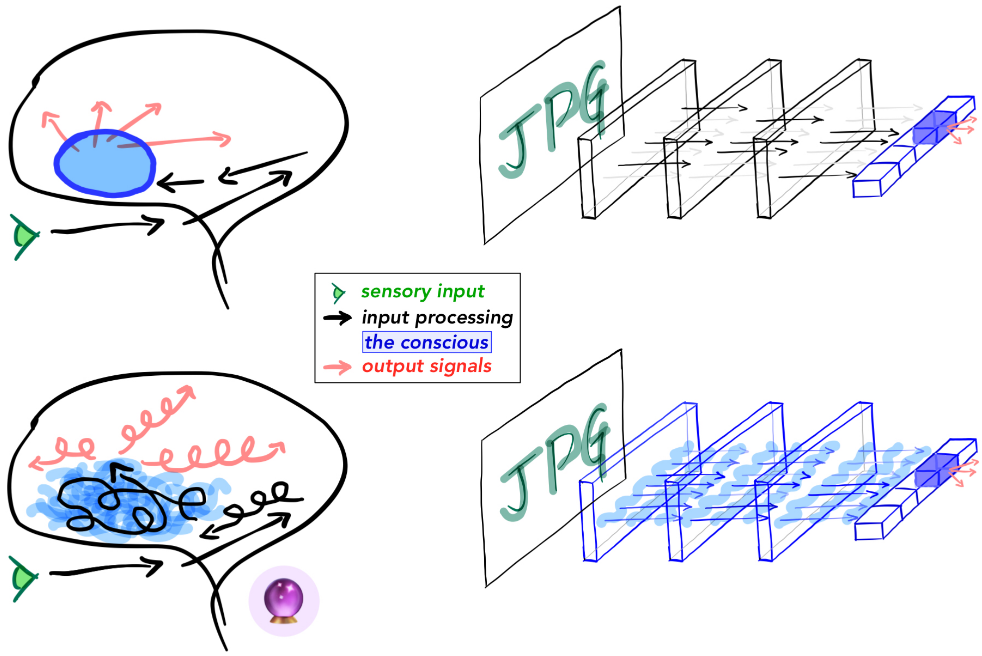


Figure 2: **A proposed theory of sensory processing by the conscious analogized by a generic computer vision (CV) model.** ***Top*** is the **Normal** state. The brain, left, in this state processes "sensory input" in discrete steps, processively, through to efferent "output signals". A well-trained CV model, right, depicts the conscious, in blue, sitting at the end of the object detection (sensory processing) pathway. The conscious in this state does not have access to lower level features. ***Bottom*** is the **LSD** state, indicated by the crystal ball emoji. The brain's conscious in this state is more diffuse. It is obfuscated such that the full span of the "input processing" step of the sensory processing pathway is accessible. An untrained CV model, right, depicts this obfuscated access by distributing the conscious across the layers of the model - as opposed to sitting at the end of the pathway. In other words, lower level features are accessible to the conscious in this state.

Statistical analysis of a widely used CV model, ResNet50, provides parallel support to this theory (He et al. 2016). A well-trained, or post, model can be thought of as the normal state; an untrained, or prior, model as the LSD state. As seen in Figure 3, weight magnitude is pruned as well as shifted to important connections from prior to post. The conscious in the LSD state, having diffuse access to earlier sensory processing layers, is also able to perceive otherwise unimportant parameters - those, that in a normal state, have negligible magnitude. Code made use of several python based scientific computing packages (Harris et al. 2020, Hunter 2007, Virtanen et al. 2020, Abadi et al. 2016).

Observation 3 is mildly supported by recent work which showed that very low frequency sounds, imperceptible to the conscious, can influence dancing activity (Cameron et al. 2022). Observations 2 and 3 lack further support or modeling analogy.

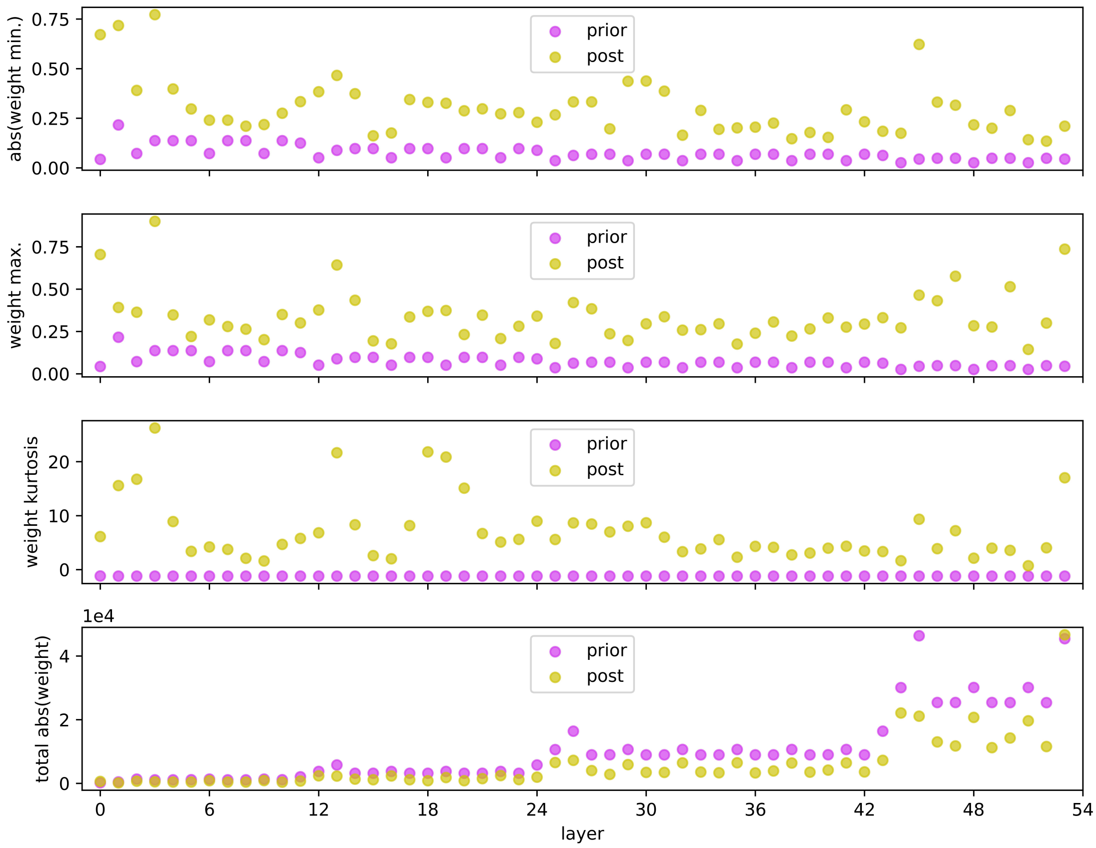


Figure 3: **Statistics of a popular CV model, ResNet50**, suggests weights are reapportioned to a select subset of important connections from prior (untrained) to post (well-trained). When comparing the prior weights to the post weights, with only a few exceptions: maximum magnitude increases, kurtosis increases, and total absolute weight decreases.

5 Next

An outstanding question of the human experience is: what is the conscious? Physically delineating ***TICES*** may help eventually answer this question. While there are some obvious next steps for empirically evaluating this theory further, such as identifying how consistent these observations are across a diverse sample of people, there are many more that are not as obvious and are left as an exercise for the reader. Choosing a good scientific problem has been famously analogized by "The Cloud" (Alon 2009). Here it is also an invitation (Figure 4).

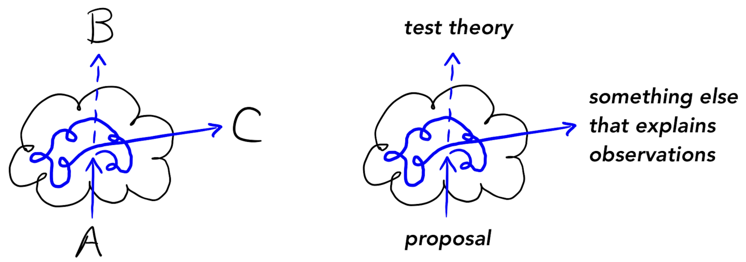


Figure 4: **The cloud is an invitation.** We collectively enter the proposal (A) to test the theory (B) which will either confirm it or deny it (C) leading us to something else that explains the observations.

References

Abadi, Martın et al. (Mar. 2016). “TensorFlow: Large-Scale Machine Learning on Heterogeneous Distributed Systems”. In.

Alon, Uri (Sept. 2009). “How to choose a good scientific problem”. en. In: *Mol. Cell* 35.6, pp. 726–728.

Cameron, Daniel J et al. (Nov. 2022). “Undetectable very-low frequency sound increases dancing at a live concert”. en. In: *Curr. Biol.* 32.21, R1222–R1223.

Carhart-Harris, Robin L et al. (Apr. 2016). “Neural correlates of the LSD experience revealed by multimodal neuroimaging”. en. In: *Proc. Natl. Acad. Sci. U. S. A.* 113.17, pp. 4853–4858.

Harris, Charles R et al. (Sept. 2020). “Array programming with NumPy”. In: *Nature* 585.7825, pp. 357–362.

He, Kaiming et al. (June 2016). “Deep Residual Learning for Image Recognition”. In: *2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*. IEEE, pp. 770–778.

Hubel, D H and T N Wiesel (Jan. 1962). “Receptive fields, binocular interaction and functional architecture in the cat’s visual cortex”. en. In: *J. Physiol.* 160.1, pp. 106–154.

Hunter, John D (2007). “Matplotlib: A 2D Graphics Environment”. In: *Comput. Sci. Eng.* 9.3, pp. 90–95.

Kanwisher, N, J McDermott, and M M Chun (June 1997). “The fusiform face area: a module in human extrastriate cortex specialized for face perception”. en. In: *J. Neurosci.* 17.11, pp. 4302–4311.

Lecun, Y et al. (Nov. 1998). “Gradient-based learning applied to document recognition”. In: *Proc. IEEE Inst. Electr. Electron. Eng.* 86.11, pp. 2278–2324.

Pizzi, Stefano Delli et al. (Oct. 2023). “LSD-induced changes in the functional connectivity of distinct thalamic nuclei”. en. In: *Neuroimage*, p. 120414.

Ritenour, Amber E et al. (Aug. 2008). “Lightning injury: a review”. en. In: *Burns* 34.5, pp. 585–594.

Virtanen, Pauli et al. (Mar. 2020). “SciPy 1.0: fundamental algorithms for scientific computing in Python”. en. In: *Nat. Methods* 17.3, pp. 261–272.

Zeiler, Matthew D and Rob Fergus (2014). “Visualizing and Understanding Convolutional Networks”. In: *Computer Vision – ECCV 2014*. Springer International Publishing, pp. 818–833.