Chapter five: Transposing isomorphism to communication design for neuroscience

5.0 – Introduction to chapter five

5.1 – A historical tendency toward fusion images

5.2 – Defusion in contemporary neuroimaging

5.3 – Fusion images and isomorphism

5.4 – Isomorphic of what?

5.5 – Conclusion to chapter five

5.0 – Introduction to chapter five

This final chapter interrogates communication design, and the fidelity of images in particular, differently construed in contemporary art and neuroscience.[1] In my general introduction, I demonstrate that, in the context of communication design for contemporary art, the photographic image can be deployed not only as a mimetic document, but also to express meaning *isomorphically* through its technical, material, and distributive aspects, appealing to culturally specific — often conceptual or poetic — notions of fidelity to the artistic sensibilities it represents. Such expressions depend on a shared visual literacy fostered by the relatively adjacent educational and professional contexts of communication design and contemporary art. Here, I transpose this model of communication design practice onto a dissimilar culture of imaging and visualisation in neuroscience.[2] With the exception of two self-initiated, practice-based projects — discussed in 5.4, below — this transdisciplinary move takes the discussion beyond the immediate scope of my communication design practice, drawing on concerns formulated in two published texts (Langdon, 2020, 2021[3]).

Neuroscience is a visual science. Our historical understanding of brain anatomy is indebted to the intricate and beautiful drawings of nineteenth century pioneers such as Santiago Ramón y Cajal and Camillo Golgi. Their methods for displaying the brain were audacious and unbelievably dextrous. They dissected brains, slicing them into thin sections for inspection under the microscope. Confronted there with an impossibly dense tangle of cells and connections — barely visible against the dull ambience of grey matter — they developed chemical staining techniques to graphically isolate anatomical structures. Recent developments in technological instrumentation, in particular the use of functional magnetic resonance imaging (fMRI) to visualise localised responses to experimental stimulation in living human brains, maintain the primacy of the visual in neuroscience:

---

1 As I have exemplified in chapters two and three, imaging — the origination, technical specification, layout, and output in print or on screen — is an integral aspect of communication design practice.

2 Twentieth century designers, such as Will Burtin and Jerry Karo, engaged extensively with science communication. Their work is not gone into in this chapter, however, because I consider it to conform to *reasonable* modernist tendencies towards didactic, reductive visual presentations.

3 James Langdon, *"HUMAN" "BRAIN" "NEURON" "SPACE" "GALAXY"*, *Dear Friend* no. 14 (EKA, 2020). James Langdon, *The visual communication of neuroscience* (working title), *Revue Faire* no. 39 (Syndicat, 2021).

> "Neuroimaging technologies have played a pivotal role in the boom of neuroscience research we have witnessed in the last three decades."[4]

There are significant knowledge gaps in the field of communication design as it relates to neuroscience. Neuroscience research laboratories typically produce communication design for conference presentations and publications in-house. Original visual material derived from experimental work, where available, might be combined with data displays and images sourced from stock photography providers and the internet at large, and formatted for presentation using institutional templates in software such as PowerPoint and Google Docs. In publishing contexts, cooperation with designers and illustrators at popular science journals tends to follow the graphic identities and serial formats prescribed by those publications. Sustained collaborative engagement between a neuroscientist and a communication designer (specifically, a designer whose practice resonates with the approaches outlined in my general introduction in relation to communication design for contemporary art) seems not to exist. Reasons for this are numerous. Indeed the typical communication designer could not be expected, simply by means of their formal education, to share the same level of familiarity with a neuroscientist's field as they might with an artist's. This disconnection is compounded by a culture of scepticism towards communication design in neuroscientific research laboratories. Communication design is perceived as a practice that may potentially distort data, posing an unnecessary risk to credibility in the context of professional presentations that primarily address a peer group of researchers.

In 5.1, I establish a specific historical context for the relation of neuroscience and communication design. I qualify my focus on the image with reference to the science and technology studies (STS) tradition, and the recent influence of art historical approaches in social studies of scientific imaging and visualisation (SIV). Specifically, I adapt concepts and metaphor from Lorraine Daston and Peter Galison's histories of scientific images to establish a subgenre of technical image — the *fusion image*, exemplified in contemporary neuroscience by fMRI — that serves as the primary agent of the chapter's transposition.[5]

---

4 Irja Marije de Jong, Frank Kupper, Marlous Arentshorst, and Jacqueline Broerse, 'Responsible Reporting: Neuroimaging News in the Age of Responsible Research and Innovation', *Science and Engineering Ethics* no.22 (2016), 1108.

5 As will be clear from the vocabulary in 5.1, while the verb "fuse" is used by Galison, I am coining the specific term 'fusion image'.

5.2 consists of case studies of visual presentations by four neuroscientists. I have previously initiated transdisciplinary collaborations with two of these scientists in formal teaching contexts, a third was interviewed in the preparation of the chapter, and the fourth is a bibliographical account of the first appearance of an fMRI on the cover of a mainstream science journal in 1991. I consider these examples to be representative of a broad range of approaches to communication design, and, specifically, the use of images, in public presentations of neuroscience. The case studies are organised so as to acknowledge the general division of the field of neuroscience into two distinct areas, according to the so-called "easy" and "hard" problems of studying the human brain, and are addressed specifically with respect to their use, or rejection, of fusion images.[6]

5.3 is the crux of the chapter's transdisciplinary move. Taking an example from my practice — the graphic identity for the contemporary art space Eastside Projects — I elaborate on the poetics of isomorphic communication design beyond the examples given in my general introduction, where communicative fidelity is reasoned in relation to singular artistic sensibilities, and toward fidelity construed in response to unpredictable, extended duration, and collectively-authored curatorial and artistic propositions.[7] The discussion here is pointed: I posit this approach as a critique of the fusion image and its common alternatives, such as those shown in 5.2.

In 5.4, I introduce a second, self-initiated, practice-based project. Neurovague is an image generation service speculatively directed at neuroscientists. I discuss its implementation in relation to another genre of defused scientific image, 'molecular graphics', as exemplified in James D. Watson's 1965 book, *The Molecular Biology of the Gene*.[8] The abstract, anti-mimetic approach to images evident in this book suggests a basis for the reconciliation of apparently incompatible notions of fidelity in communication design for contemporary art and neuroscience, while expressly avoiding recourse to *reasonable*, problem-solving tactics.

---

6 David Chalmers, 'Facing Up to the Problem of Consciousness', *Journal of Consciousness Studies*, no. 2, vol. 3 (1995). This dichotomy is not universally accepted. Anil Seth, whose work is discussed below, disputes the "hard" problem, preferring to address the "real" problem. Anil Seth, *Being You: A New Science of Consciousness* (Faber & Faber, 2021).

7 This chapter's transposition requires some general disambiguation of the word isomorph. In the philosophy of science, isomorphism has an existing relation to representation that is not metaphorical, but operates according to scientific modelling practices.

8 James D. Watson, *Molecular Biology of the Gene* (W. A. Benjamin, 1965).

5.1 – A historical tendency toward fusion images

There is an extensive recent literature applying art historical methods to the analysis of scientific images (Crary, 1990; Daston and Galison, 2007; Elkins, 1995; Galison, 1997; Knorr Cetina, 1999; Stafford, 1999, 2007). Collections such as *The Technical Image* (Bredekamp, Dünkel, and Schneider (eds.), 2010), *Picturing Science, Producing Art* (Galison and Jones (eds.), 1998), and *Representation in Scientific Practice Revisited* (Coopmans, Lynch, Vertesi, and Woolgar (eds.), 2014), situate this analysis as part of a larger field of enquiry, sometimes termed 'social studies of scientific imaging and visualisation' (SIV). SIV, in turn, considers the image within the broader field of science and technology studies (STS).

Galison (1997) puts the history of experimental physics into two "competing traditions". The *image* tradition:

> "has had as its goal the representation of natural processes in all their fullness and complexity — the production of images of such clarity that a single picture can serve as evidence for a new entity or effect. These images are presented, and defended, as *mimetic* — they purport to preserve the form of things as they occur in the world."

Against the image tradition's "physics-as-observation", Galison casts the *logic* tradition, or "physics-as-theory":

> "which has used electronic counters coupled in electronic logic circuits. These counting (rather than picturing) machines aggregate masses of data to make statistical arguments for the existence of a particle or effect."[9]

It is clear from the outset of Galison's historical account that the image and logic traditions are destined to be unified:

> "logic had statistics and experimental control and wanted persuasive detail; image had the virtues of being fine-grained,

[9] Peter Galison, *Image and Logic: A Material Culture of Microphysics* (Chicago: University of Chicago Press, 1997).

> visible, and inclusive but wanted force of statistics and control over experimentation".[10]

The perceived virtues of the two traditions — characterised as *persuasive detail* and *statistical control* — are synthesised in the ultimate project of twentieth century instrumental physics, the particle collider:

> "The *fusion* of the image and logic traditions occurred on several levels simultaneously. For the first time, the output of an electronic detector was recognised as 'pictorial', with a detail previously available only in the image tradition. But to achieve that refinement of representation, the electronics and the accompanying computer processing introduced automatic statistical inference into the identification of particles."[11]

In the particle collider, conceptualised as a singular imaging instrument, "the controllable image came to supplant the century-old ideal of objectivity that the chemical photograph had embodied. Knowing through the passive registration of the eye no longer stood apart from knowing through manipulation."[12] The fusion of the two traditions occurs by the subsumption of *logic* into *image*. The fusion image does not merely support statistical data or theoretical statements, it *embodies* them.

Daston and Galison (2007) survey a broader range of images, arguing that, historically, and across scientific disciplines, modes of representation have followed paths of divergence, reconciliation, and, ultimately, fusion. They identify three distinct eras in which the notion of representational fidelity, or "objectivity" was differently understood. The first of these, the era of "truth-to-nature", they exemplify with illustrations prepared for Carolus Linnaeus's 1737 botanical atlas, *Horus Cliffortianus* (FIG. 5.1.1). These illustrations were made from detailed observation, but "aimed to portray the underlying type of the plant species, rather than any individual specimen."[13]

The subsequent era of "mechanical objectivity" is roughly contemporaneous and consistent with the defining features of Galison's image tradition in physics. Mechanical objectivity breaks radically with truth-to-nature, such as in Daston

---

10 Galison, *Image and Logic*, 807.
11 My emphasis. Galison, *Image and Logic*, 570.
12 Galison, *Image and Logic*, 810.
13 Lorraine Daston and Peter Galison, *Objectivity*, (Zone Books, 2007), 20.



5.1.1. Carl Linnaeus, *Hortus Cliffortianus*, illustration by Jan Wandelaar.

and Galison's example of Gustav Hellmann's 1893 atlas of snowflakes. Each individual snowflake, microphotographed by Richard Neuhauss, is "shown with all its peculiarities and asymmetries in an attempt to capture nature with as little human intervention as possible".

The twentieth century reconciliation of these two modes Daston and Galison term "trained judgment". They show an image from Howard, Bumba, and Smith's 1967 *Atlas of Solar Magnetic Fields* that "mixed the output of sophisticated equipment with a 'subjective' smoothing of the data — the authors deemed this intervention necessary to remove instrumental artifacts". Trained judgment favours the dispassionate aesthetic of mechanical objectivity, but expertly adjusts its raw, instrumental image, in order to selectively reintroduce elements of truth-to-nature. The image is manipulated to ensure that it supports insights, gleaned concurrently, from data.

In their detailed explication of truth-to-nature, Daston and Galison offer the metaphor of "four-eyed sight" to describe the cooperation between naturalists and illustrators in the preparation of eighteenth century botanical atlases:

> "In four-eyed sight, epistemology and ethos *merged* along with the vision of naturalist and artist. For naturalists who sought truth-to-nature, a faithful image was emphatically not one that depicted exactly what was seen. Rather, it was a reasoned image, achieved by the imposition of reason upon sensation and imagination and by the imposition of the naturalist's will upon the eyes and hands of the artist."[14]

The two innocent eyes of the illustrator maintain a believable, mimetic resemblance to the particular specimen, while the two expert eyes of the natural scientist introduce the nuanced signals that assert the scientific credibility of the resulting image and its accordance with an appropriate formal typology. Trained judgement technologically upgrades these two roles. The illustrator becomes the operator of an imaging *device*, and the scientist's expertise is quantified with statistical data, itself derived from other kinds of device, but in any case, calculated in accordance with a given scientific paradigm. The archetypal image of trained judgement — the fusion image — should at once *look like* the thing it represents, and, in an expertly-determined sense, *be like* it, by signalling implicit relations between the specific phenomena pictured and its

---

[14] My emphasis. Daston and Galison, *Objectivity*, 98.

categorisation — to maintain the botanical vocabulary — in a family, a genus, and a paradigm.

Daston and Galison's eras of objectivity are historically contingent, and thus, driven by technological progression, they are shown to proceed *toward* syntheses of observation and categorisation. Just as the image and logic traditions in physics ultimately *fuse*, so the practices of truth-to-nature and mechanical objectivity *merge* in trained judgement. Delehanty (2010) describes contemporary biological images that seem consistent with this progressive narrative toward the fusion image:

> "Given that many imaging technologies in biology and medicine are non-optical and generate data that is essentially numerical, it is a striking feature of these technologies that the data generated using them are most frequently displayed in the form of semi-naturalistic, photograph-like images."[15]

Functional magnetic resonance imaging (fMRI) is one of the preeminent technologies in the recent history of neuroimaging. It constitutes a significant breakthrough in that it "provides a noninvasive window into human brain function, allowing us to associate the performance of particular cognitive tasks with measurements reflecting brain activity."[16] As such, fMRI produces exemplary fusion images:

> "Functional images are hybrid epistemic objects. They combine features of two distinct types of representation: pictures (photographs, naturalistic illustrations) and graphical displays of statistical information." (FIG. 5.1.2.)

In the case of fMRI, however, the combination of the pictorial and the statistical has potentially problematic consequences for the perceived fidelity of the resulting images. The fusion image clearly constitutes a form of image *manipulation*, which might contravene scientific imperatives to (ideally) refrain from such practices, or (where manipulation is deemed necessary) to clearly label them: "When images are 'the' experimental result, photo editing opens up the distinct possibility of overmanipulation and misrepresentation."[17]

---

15 Megan Delehanty, 'Why Images?', *Medicine Studies*, vol. 2 (2010).

16 Adina L. Roskies, 'Are Neuroimages Like Photographs of the Brain?', *Philosophy of Science*, no. 74 (2007), 860.

17 Julio M. Ottino, 'Is a picture worth 1,000 words?', *Nature* (2003). I am specifically referring to



5.1.2. *Science*, fMRI visualisation, cover.

For Daston and Galison, trained judgement and its fusion image conclude a historical arc. The fusion they theorise is *productive*. By formulating their metaphorical four-eyed sight as "the imposition of the naturalist's will upon the eyes and hands of the artist", they constitute the fusion image as an innocent document rendered *persuasive*. To fuse is to persuade. The scientist confers credibility and theoretical expertise on the otherwise merely passive, mechanical, work of the illustrator (and later, in trained judgement, the imaging device). In this formulation, "expertise" is historically qualified (in the sense that Daston and Galison's canonical examples, *Horus Cliffortianus* and *Atlas of Solar Magnetic Fields* remain stable in their scientific credibility), but in a typical fMRI presentation, the sublimation of novel statistical data into an image might implicitly assume, or even potentially *exaggerate* the authority of the scientific results that inform the statistical element of the image. By fusing the pictorial and the statistical, their respective characteristics, fallibilities, and ultimate sources of credibility are dissolved, becoming potentially inscrutable.

In the following section, 5.2, I document, through four case studies, an apparent *defusion* of images in public presentations of contemporary neuroscience. To preface these case studies, I identify here two general problems with fMRI-as-fusion image that might anticipate and explain this tendency toward defusion.

The first is a problem of differences in visual literacy producing differing interpretations of images in scientific and non-scientific contexts. Daston and Galison's trained judgement must be understood not only in terms of the encoding of reason into images, but equally in terms of the consequent decoding, interpretation and evaluation of those images. Roskies (2007) identifies the potential for confusion when fMRI are interpreted in a straightforward, imagistic, register:

> "What is being *directly* measured in functional MR is the timescale of the dephasing of water molecules in the brain, not neural activity. *The visual properties of the image are not visual properties of the object being measured.* Moreover, fMRI is not sensitive to brain activity, but to some of its causal effects."[18]

---

fusion of fMRI data into pictorial presentations.

18 Adina L. Roskies, 'Are Neuroimages Like Photographs of the Brain?', *Philosophy of Science*, no. 74 (2007), 864. Original emphasis.

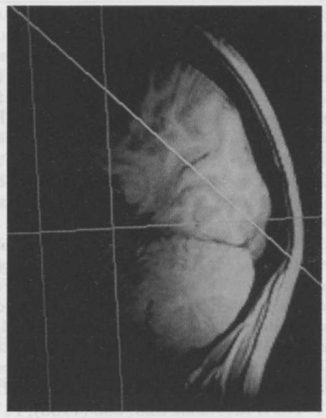
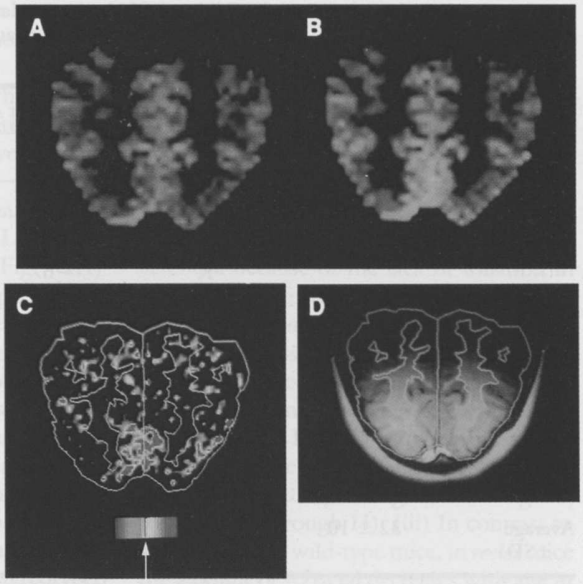


Fig. 1. Magnetic resonance surface coil image of the occipital pole. 3-D (T1-weighted) images were acquired for anatomical correlation with the functional CBV images (Fig. 3). The two vertical lines bisect the anterior and posterior commissures. A horizontal line is drawn between them (AC-PC or bicommissural line). The oblique line defines the plane of the CBV images, located along the bank of the calcarine fissure.

5.2.1. *Science*, fMRI figure from Jack Belliveau paper.

Fig. 3. Magnetic resonance CBV maps of the brain during darkness (**A**) and during 7.8-Hz photic stimulation (**B**). Image intensity is proportional to CBV. All images are aligned along the calcarine fissure (Fig. 1), with the occipital pole at the bottom. (**C**) Subtraction image of changes in CBV induced by photic stimulation (C = B − A). A linear color scale was used, with red equivalent to greatest activity. The arrow points to the +2 SD threshold. (**D**) An anatomic (T1-weighted) image was used to segment the gray and white matter (*20*). This outline was applied to the CBV subtraction image. A marked area (~600 mm^2) of increased blood volume (~24%) is localized in the anatomically defined primary visual cortex (C). We acquired these CBV images using a 3 by 3 by 10 mm voxel.



5.2.2. *Science*, fMRI figure from Jack Belliveau paper.

Other critical accounts of fMRI, such as Bealieu (2002), recast fMRI's characteristic presentational fusion as a *tension*:

> "At the heart of the paradoxical understanding of representations in this field is the dual appeal to the graphical and pictorial. Functional imaging makes use of the pictorial tradition of anatomical representations to provide spatial referents to the data it produces (activity in the brain) and convey the notion of control of the space of measurement (seeing the entire brain). Yet it also distantiates itself from the traditional visual understanding that accompanies these anatomical representations and invokes a graphical tradition where the correspondence of representation image to world is one of quantity and measurement, not one of depiction."[19]

The second problem with fMRI-as-fusion image considered in 5.2 is epistemological. The *persuasive* fusion image has the potential to exaggerate the scientific significance of the measurement data that it incorporates.[20] fMRI project data, with their attendant theoretical assumptions and methodological shortcomings, onto anatomical images to create fusions whose convincing and compelling digital aesthetics might cause non-scientists to overestimate the insightfulness and credibility of the scientific data that they represent. There are several layers of abstraction between the brain activity that fMRI records and the inferences that can reasonably follow from them:

> "The limitations of fMRI are not related to physics or poor engineering, and are unlikely to be resolved by increasing the sophistication and power of the scanners; they are instead due to the circuitry and functional organization of the brain, as well as to inappropriate experimental protocols that ignore this organization. The fMRI signal cannot easily differentiate between function-specific processing and neuromodulation, between bottom-up and top-down signals, and it may potentially confuse excitation and inhibition."[21]

---

19 Anne Beaulieu, 'Images Are Not the (Only) Truth: Brain Mapping, Visual Knowledge, and Iconoclasm', *Science, Technology, & Human Values*, no. 1, vol. 27 (2002), 77–78.

20 This phenomena is sometimes termed "neurohype".

21 Nikos K. Logothetis, 'What we can do and what we cannot do with fMRI', *Nature* no.12, vol. 453 (2018), 876.

The nature of the fusion that takes place in an fMRI is considerably more convoluted and transformative than Daston and Galison's historical examples. In 5.2, I scrutinise the origins of fMRI's complex presentational admixture of generic anatomical imagery, protocols of graphic processing in software that determine the appearance of incorporated data displays, and scientific assumptions about brain organisation and function whose status as speculative and inconclusive are impossible for non-scientific publics to comprehend from such fusion images.

5.2 – Defusion in contemporary neuroimaging

Classifying brain images

Burri and Dumit (2008) identify three contexts in which scientific images generally operate: *production* ("how and by whom images are constructed"), *engagement* ("how images are used in the course of scientific work"), and *deployment* ("how images diffuse into nonacademic environments").[22] These contexts are interdependent, and might readily encompass a single image as it proceeds through a workflow from technical origination to public presentation. My focus in this section is the contemporary neuroscientific image as it is ultimately deployed in contexts that involve communication design, such as conference presentations and publications. In 2021, despite the availability of an array of sophisticated fusion imaging technologies, of which fMRI, now thirty years after its introduction, is but one, neuroscience is often presented to its publics using images from non-scientific sources: corporate stock photography websites, clip art, and internet memes. A separation apparently occurs between notions of rigour applied to scientific images in production and engagement contexts, and deployed images, emptied of their strictly scientific content, and sometimes regarded by scientists as merely "pretty pictures".[23]

Chalmers (1995) classifies neuroscientific research according to two high-level domains, or "problems". The "easy" problem is the task of mapping the brain and establishing how its various regions are anatomically and functionally

---

22 Regula Burri and Joseph Dumit, *Social Studies of Scientific Imaging and Visualization* (MIT Press, 2008).

23 The term "pretty pictures" recurs in literature on scientific visualisation as a derogatory description of an image whose intent is understood to be to appeal or to persuade in such a way that compromises scientific content. I draw specifically on its use in Anne Beaulieu's research on the imaging culture of human brain fMRI. Beaulieu, 'Images Are Not the (Only) Truth: Brain Mapping, Visual Knowledge, and Iconoclasm'.

connected. The (self-conscious) irony of the designation ‘easy’ is that, according to Cobb (2020):

> “A great deal of energy and resources are being devoted to describing the myriad connections between neurons in brains, to create what are called connectomes, or more crudely and metaphorically, wiring diagrams. There is currently no prospect of creating a cell-level connectome of a mammalian brain — they are far too complex — but lower-definition maps are being established. Such efforts are essential — we need to understand how bits of the brain are connected — but on their own they will not produce a model of what the brain actually does. Nor should we underestimate how long this might take. Researchers are currently drawing up a functional connectome that includes all 10,000 cells in a maggot brain, but I would be amazed if, in fifty years’ time, we fully understand what those cells and their interconnections are doing.”[24]

Chalmers’s “hard” problem, as Cobb hints, is that while establishing the human connectome is one step toward a general understanding of how the brain systematically processes sensory data and unconsciously regulates bodily functions, it is emphatically not commensurate with revealing how the brain conjures the existential experience of *what it is like* to be human: consciousness.[25]

Chalmers’s problems delineate practical, professional, and institutional divisions within neuroscience. Research on the connectome is instrumental, and belongs in the neuroimaging tradition in which fMRI (and other, more recently developed, computational and biological techniques such as the “Brainbow” and optogenetics) advance the project that Golgi and Cajal had begun in the nineteenth century: to comprehensively depict the physical brain in the highest possible resolution. Consciousness research is more disparate in its methods, but often depends on conceiving psychological experiments to test its theoretical propositions. Using the study of rodents, primates, and human patients with

---

24 Matthew Cobb, *The Idea of the Brain* (Profile Books, 2020), 15.

25 The hard/easy dualism is not universally applied in neuroscience. Anil Seth, whose work is discussed below, rejects the hard and easy problems in favour of a differently formulated “real problem”. It is not pertinent to the argument here to elaborate, since the basic distinction between understanding the brain physically and understanding how it creates consciousness is useful with respect to imaging. Anil Seth *Being You* (Faber & Faber, 2021).

brain dysfunctions, physical impairments, and surgical interventions, researchers attempt to deduce how the brain works by observing precisely how cognitive and perceptual states occur, or do not occur, when certain anatomical structures are absent, compromised, or manipulated. Interdisciplinary scientists who engage both problems, such as Hakwan Lau and Anil Seth, whose work is discussed below, might describe themselves as cognitive neuroscientists, psychologists, or even philosophers, as not all consciousness research necessarily has a basis in laboratory experiment. For the purposes of the following discussion, from an imaging perspective, the easy problem is concerned with visualising the brain's potentially knowable anatomy; and the hard problem with visualising its potentially unknowable, metaphysical essence.

In these four case studies, I analyse the communicative intent and technical origination of images (or image series) that occupy various positions on the production/engagement/deployment and anatomy/essence spectrums. The examples are discussed very selectively, paying specific attention to details that are pertinent to my observation of a tendency toward *defusion* in the contemporary presentation of neuroscience.

Anatomy of an fMRI-as-fusion image

In 5.1, above, I introduce fMRI as an archetypal fusion image and conjecture that its admixture of the pictorial and the statistical is sufficiently visually compelling that it creates problems of interpretation that might lead a non-scientific public to overestimate the scope and consequence of the neuroscientific research that it represents. However, despite the methodological significance and technological ingenuity of their origination, the separate visual elements that are fused in a typical fMRI presentation are extremely crude when compared to the template from which I derive the notion of the fusion image, Daston and Galison's example of the botanical illustrations contained in Carolus Linnaeus's *Hortus Cliffortianus* (FIG. 5.1.1.).

The cover of the 1 November 1991 issue of *Science*, the flagship journal of the American Association for the Advancement of Science, features the breakthrough experimental work of Jack Belliveau, then a graduate student at Harvard University, and his colleagues at the Massachusetts General Hospital, that marked the advent of fMRI as a viable imaging technology (FIG. 5.1.2).

Accompanying Belliveau's paper, 'Functional mapping of the human visual cortex by magnetic resonance imaging', the cover image shows a low-resolution, grayscale view of a hairless and disembodied human head. Its

resolution would seem to identify it more readily as a 3D-scan than a photograph. Seen from a rear, three-quarter perspective, the head is isolated against an apparently arbitrary dark blue graphic background. An angled slice reveals a cross-section of the brain within, identifiable to a non-scientist by the familiar symmetrical lobes of its two hemispheres. In the lower part of the cross-section, a cluster of unlabelled, blob-like forms that resemble a heat map are visible, ranging in colour on a gradient from bright yellow to mid-red. At the outer edges are some smaller, disparate forms. These appear mostly yellow, suggesting that the clustering of the centrally-positioned forms, and their greater degree of orange-red colouring, register an intensity of localised activity.

On the journal's first page, a caption reads, in its entirety:

> "Magnetic resonance image of the human brain, showing activation of the visual cortex. Regional changes in cerebral blood volume were measured during photic stimulation and reflect the task-induced changes in neuronal activity. The area of articulated visual cortex (colour) is mapped onto the three-dimensional anatomical structure (gray). This combined imaging method may be used in routine clinical examinations, permitting noninvasive high-resolution mapping of cortical function."[26]

Although this paratext discloses that the cover is a fusion image — comprising neuronal activity measurement data "mapped" onto anatomical structure — neither it, nor the main article, which the image accompanies, explicitly account for the arbitrary decision-making that determines its visual features. The figures that illustrate the main article are also, technically, fusion images, but their data is mapped onto highly simplified 2D schematics of brain anatomy, that make no appeal to anything that a non-scientist would recognise as pictorial space (FIG. 5.2.1, 5.2.2).

The cover image evidently occupies a distinct, unambiguously deployed position. Its presentation is consistent with other *Science* covers from this time period. Forty-eight issues of the journal were published in 1991, and their covers typically extract deployment images from de-contextualised production and engagement images, simplified by cropping, abstraction, and the removal of textual labels and data references. These images might originate in electron microscopy, or other forms of technical image with formal appeal: wildlife and

---

[26] *Science*, 1991.

environmental photography; data displays in novel formats; and commissioned illustrations. They are united, and made recognisable as a series, by their graphic treatment. Images either bleed off the page or are framed by solid, complementary colours, apparently artfully chosen. Typically, no label or interpretive text appears anyway on the covers, apart from the journal's unchanging typographic masthead. These decisions designate the cover as a non-scientific display context. Their effect — especially when the covers are seen as a series — seems intended to be appealing and enigmatic, and to avoid creating any impression that the journal's editorial content is strictly technical.

The crude appearance of the cover image's anatomical layer conveys, at once, its being at a technological limit of neuroimaging, and its preservation of the patient's anonymity, or, in truth-to-nature parlance, its identification of them only as an adult of unspecified gender and ethnicity. The head image itself may or may not actually be derived from the patient whose data is projected onto it. The superimposed data layer "maps" localised regions of a living human brain being activated in response to visual stimulation in an experimental situation. Its arbitrarily-coloured forms are the result of computational processing of measurement data, and software display protocols for rendering this numeric data graphically. The thresholds implicitly visualised — determinations of exactly what data values correspond to red, yellow, their relative gradation, and of measurements not mapped because their values are too high or too low, or their position anomalous — express only these display protocols and not any observable, naturalistic phenomena occurring in the brain. (As Roskies states, quoted in 5.1, above, fMRI measures neither light nor electricity, but the "timescale of the dephasing of water molecules", from which electrical responses are inferred.) In contrast to Linnaeus's expertly informed, ideal-yet abundantly-believable uber-specimen of a Rauvolfia plant (FIG. 5.1.1), the *Science* cover fMRI is a radically oversimplified, generic anatomical image fused with projected data, given graphic form whose colour, composition, superposition — their entire visual appearance — is cryptic and arbitrary.

This first appearance of an fMRI on the cover of a mainstream scientific publication immediately introduces ambiguous aesthetic tropes of the kind criticised by Bealieu and Roskies, quoted in 5.1, while seeming — from a non-scientist's perspective — to successfully render abstract experimental data highly legible. Although a non-scientist might be able to correctly surmise this image as a "brain heat map", its formatting for the implicitly non-scientific presentational context of a *Science* *cover* conceals not only its complexity as a graphic object, but the layers of abstraction and indirection between it and the

scientific object that it represents: a complete and comprehensive functional map of the human brain. Concealment of this nature — a byproduct of elements rendered partly or entirely inscrutable by their fusion — creates communication problems for scientists, and anticipates a tendency toward defusion.

Fusion images unwittingly confused

In December 2017, I taught a one-week workshop at the Fachbereich Gestaltung of the Hochschule Darmstadt in Darmstadt, Germany. The workshop drew on a visit I had made to the Deisseroth Laboratory at Stanford University (USA), in April 2017, and was delivered partly in collaboration with Matthew Wright, then a post-doctoral researcher at the Deisseroth Laboratory. Students were shown a PowerPoint presentation containing six slides prepared by Wright, including images derived from rodent brains, and tasked with manipulating or revisualising them for communicative clarity. These original slides did not constitute a complete, coherent presentation. They were compiled by Wright to be representative of the kinds of image material that he might present at a laboratory meeting — a typical engagement context, in Burri and Dumit's terms. During the workshop introduction, Wright joined the group by video call to describe the content, imaging technique, and communicative intent of each slide, and to participate in a question and answer session, which I led. Colour had not been proposed as a primary concern of the workshop, but Wright was initially questioned on this subject in relation to every slide. I recount four of these exchanges here.

Wright described this first slide (FIG. 5.2.3) as:

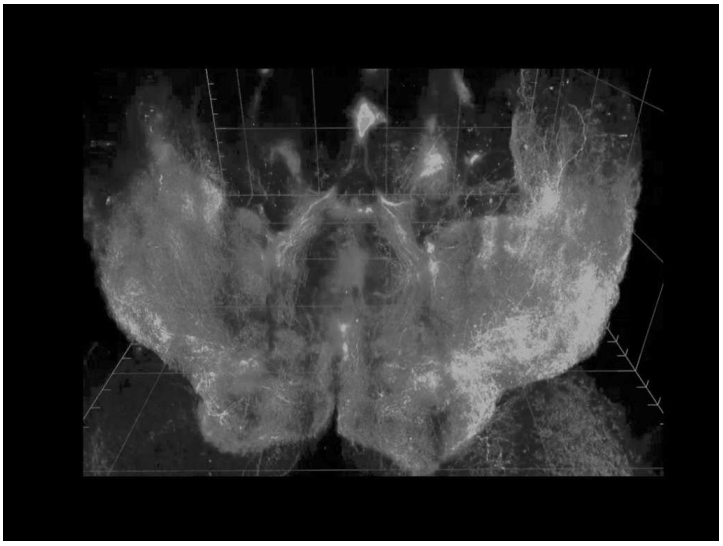
> "A traditional histology image of a mouse midbrain showing axon fibres that are passing through a central reward area."

In response to my question about the monotone green colouring of the image and whether it was specific to the technique or device that produced the image, Wright answered:

> "On the one hand that's arbitrary, so it is a good question. The label that I used is a yellow fluorescent protein, so in physical reality, the colour that is emitted by this protein is yellow. But when we image this with the microscope we can choose to view only this particular colour — the fluoresent yellow from this protein — and the microsope gives us an intensity, a grayscale



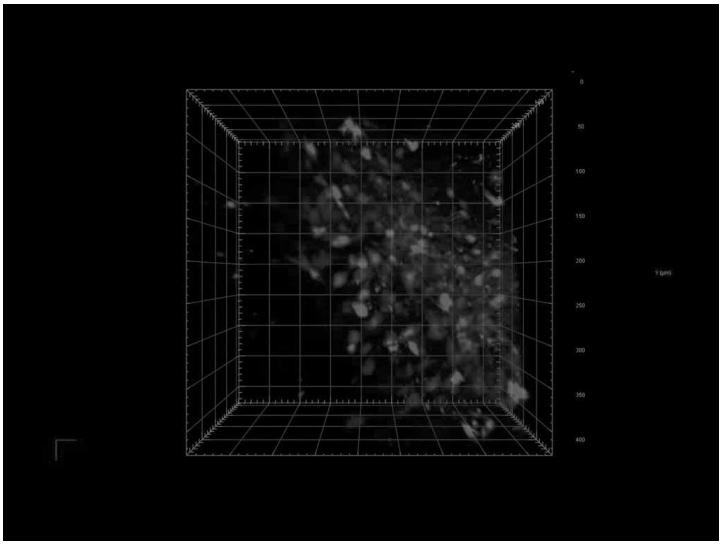
5.2.3. “traditional histology image of a mouse midbrain”.
Courtesy Matthew Wright.



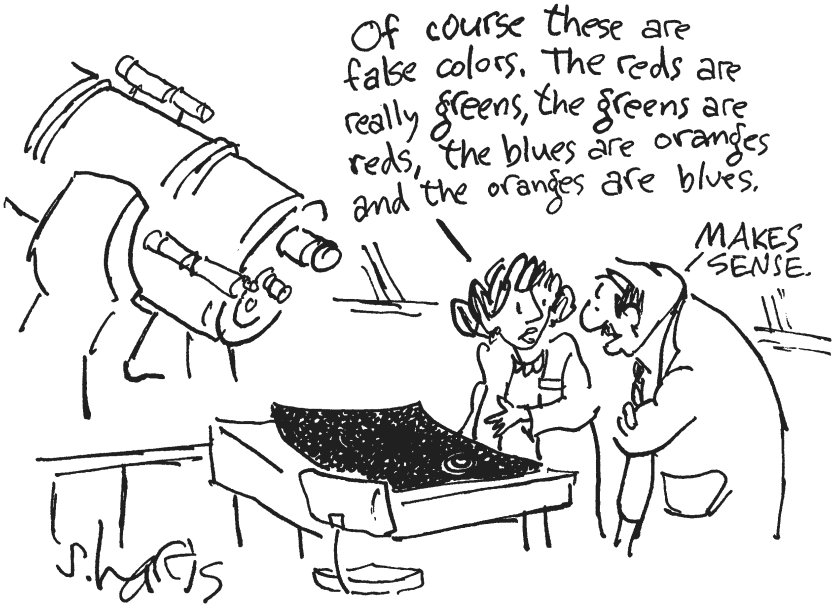
5.2.4. “a CLARITY image showing all of the axons that are emerging from a small neuromodulatory center”.
Courtesy Matthew Wright.



5.2.5. “individual neurons which increase their brightness when the cells fire”.
Courtesy Matthew Wright.



5.2.6. “a volume showing a plane of individual cells”.
Courtesy Matthew Wright.



5.2.7. Sidney Harris cartoon used by Bruno Latour.

> value. When we visualise it we can apply whatever colour map we want, in this case I chose a green colour map."

Wright described the second slide (FIG. 5.2.4) as an:

> "Image produced using CLARITY, showing all of the axons that are emerging from a small neuromodulatory centre. This is the type of advance that we gain by moving from traditional 2D histology, where we see only one slice at a time, to the 3D volumes that we can image with CLARITY, showing long range connections."

I posed the basic question of colour as a discussion point again. In this case, Wright responded:

> "In the second slide ... I simply chose a different colour map because it made it easier to see these processes. ... I used more of a rainbow colour map where the colour red shows a higher intensity, going down towards blue which is lower fluorescence. I chose that kind of rainbow colour map because I thought that it allowed the visualisation of these trajectories better than, for example, just using a pure green or pure red or whatever. I would say it's a combination of aesthetics and what displays the information most clearly."

The third slide (FIG. 5.2.5) was described as:

> "A video of individual neurons, which increase their brightness when the cells fire (through a fluorescent calcium indicator). This is imaged in a live, behaving mouse."

This animated image is presented in grayscale, which the group assumed was an attempt to mitigate its noisiness by maintaining high visual contrast. When I questioned Wright on this point, he accounted for the noise as follows:

> "The noise is related to a number of things. It's primarily related to the amount of light that gets through the lens that's relaying the image. And also the amount of light that is emitted by these neurons that I'm visualising. That's somewhat preparation dependent. With a bigger lens, or in a different area, or with a different amount of inflammation — because when we put these lenses in, it's putting something into the brain that causes

> inflammation. All these things can effect the quality of the signal that's received."

Slide four (FIG. 5.2.6) is a diagrammatic 3D volume labeled with spatial coordinates, showing an array of cells whose position is expressed by the animated rotation of the slide's perspective view. Elaborating on its red colouring, Wright offered:

> "There certainly are aesthetic decisions. In this case I was imaging a red fluorescent protein, which is why I chose the red colour map. But, similar to my answer to the previous question, one could use whatever colour map one wanted to visualise this."

While observing this question and answer session, a lack of common visual literacy was evident. Entirely different features of the images were assumed to be self-interpreting by Wright and the group. For the group, the fact that colour is inconsistently assigned in each of the images was immediately apparent, but, reflecting on the session, Wright was surprised that the conversation had focused on this aspect. Obvious to Wright, but completely unnoticed by the group, were implications about the experimental preparation of the images that could have been gleaned — by a neuroscience-literate interlocutor — from features of the images and semi-technical language used by Wright in his introductions. The group were not aware, for example, that by describing figure 5.2.3 as a "traditional histology", and figure 5.2.4 as an "image produced using CLARITY", Wright identified these images as products of experiments in which proteins were inserted into a living animal's brain, before that animal was sacrificed, and its brain either sliced into sections (FIG. 5.2.3) or chemically prepared to allow light from the microscope to penetrate its intact tissue structures (FIG. 5.2.4). Figure. 5.2.5, by contrast, was highlighted by Wright as having been "imaged in a live, behaving mouse", meaning that it derives from an animal into whose brain an 'optogenetic' probe has been surgically inserted, enabling light to be transmitted and received from the animal's brain in real time, as it interacts with an experimental situation in the laboratory.[27]

In these representative interactions, perhaps intimidated by the technicalities of Wright's presentation, and despite being briefed to approach the encounter imaginatively, the group seemed to fall back on the application of *reasonable*

---

[27] These experimental techniques — CLARITY and optogenetics — were developed at the Deisseroth Laboratory.

design *solutions* to Wright's surface-level *problems* of consistency and clarity. The apparent lack of common visual literacy — here demonstrated in relation to colour — is, however, undoubtedly significant for my argument, and instantiates a recurring theme in SIV, of assumptions not shared between scientists and non-scientists. Bruno Latour illustrates his essay 'The More Manipulations, the Better' with a cartoon by science satirist Sidney Harris (FIG. 5.2.7). Two scientists, in white coats, stand at a table inspecting a large printed image. Behind them is a telescope: they are astronomers, it seems. The print on the table, a black ground with spots and swirls of white, appears to be a representation of the cosmos. One scientist turns to the other and says: "Of course these are false colours. The reds are really greens, the greens are reds, the blues are orange and the oranges are blues." "Makes sense", their companion replies.

Practicing neuroscience on Shutterstock: the unavailable fusion image

In March 2019, I taught a one week workshop at L'École supérieure d'art et design de Valence in Valence, France. The workshop was delivered in collaboration with researchers at the Sackler Centre for Consciousness Science at the University of Sussex (UK).[28] In a development of the format used in Darmstadt, the students, working in small groups, were tasked with redesigning complete, existing visual presentations given by one of the researchers. The scientists provided original image and data assets to the students, made themselves available for questions during the week, and participated remotely in giving feedback on the work produced at the conclusion of the workshop. One group of students worked on *Your brain hallucinates your conscious reality*, a 2017 presentation by Anil Seth, director of the Sackler Centre.

Seth's talk was originally given at a high profile TED conference, and, as such, was intended for a general, non-scientific audience. The scripted content is an opinionated introduction to consciousness studies, in which Seth argues for a "bottom-up" model of consciousness. This view challenges the assumption that our perception of reality is primarily derived "top-down", from sensory data that

---

28 At their website, they describe their activity as follows: "Even in the late 20th century, consciousness was considered by many to be outside the reach of science. Now, powerful new combinations of functional brain imaging, theoretical and computational modelling, and basic neurobiology bring real hope that human ingenuity can resolve this central mystery of our existence. Practically, an enhanced understanding of consciousness will transform clinical approaches to a wide range of neurological and psychiatric disorders, from coma to insomnia, from depression and schizophrenia to autism and Tourette syndrome." Via: http://www.sussex.ac.uk/sackler/.

we receive from the outside world. Instead, he proposes prediction, inference, and "hallucination" as better characterisations of the brain processes through which we figure reality. The PowerPoint slides were prepared by Seth himself, including images and video produced by researchers in his laboratory; documentation of canonical experiments in the field; and generic stock photographs, combined in layout, to visualise the propositional aspects of the talk described above. Stock photography was all sourced from commercial provider Shutterstock, which was a sponsor of the conference, and to which Seth had unlimited, unpaid access.[29] Where Wright's presentation comprises only single images that fill the frame of each slide, Seth's slides have multiple images, arranged in layout, and sometimes presented with animated transitions and on-screen text.

For the purposes of the discussion here, I focus on one specific point of contention that arose in the group's engagement with Seth's presentation. Around four minutes into the talk, Seth characterises the brain as a "processing" organ, not a "sensing" organ. He says:

> "Now imagine being a brain. You're locked inside a bony skull trying to figure what's out there in the world. There's no light inside the skull. There's no sound either. All you've got to go on are streams of electrical impulses which are only indirectly related to things in the world, whatever they may be. So perception — figuring out what's there — has to be a process of informed guesswork in which the brain combines these sensory signals with its prior expectations or beliefs about the way the world is, to form its best guess of what caused those signals. The brain doesn't hear sound or see light. What we perceive is its best guess of what's out there in the world."

As he delivers this description of the isolated brain, sealed inside its dark chamber, Seth shows a slide that contains, at its left, a stylised digital illustration of a human head, coloured blue, and rendered translucent. The brain itself is highlighted with a glowing orange effect. To the right of the slide, a grouping of everyday objects: coffee cup, dishwasher, light bulb, newspaper etc. These are shown in a cartoon style completely incongruous with the anatomical image — evidently they are from a different collection on Shutterstock. Two arrows are

---

[29] Shutterstock also acts as a reseller for more specialised stock image providers.

overlaid to establish a cyclical perceptual flow between these two elements. The slide's background, used throughout the presentation, is a blurred version of another generic brain illustration found on Shutterstock (FIG. 5.2.8).

In the course of the group's initial interview with Seth, led by me, the appropriateness of these images, and their layout, to the message expressed in the script was questioned. Seth was asked a series of related questions, such as: If the point is to show the brain in an enclosed space, why is the representation of the head transparent? Why not use a cutaway illustration style, or reformat the presentation as an interior view? If you want to convey the impression of a space that light and sound cannot reach, why does the head seem so porous and the brain glow bright orange? Is the brightest glowing spot in the lower left of the brain important? If objects are only experienced through electrical impulses, why not abstract them instead of illustrating them? Or elaborate visually on the transformation implied by the arrows?

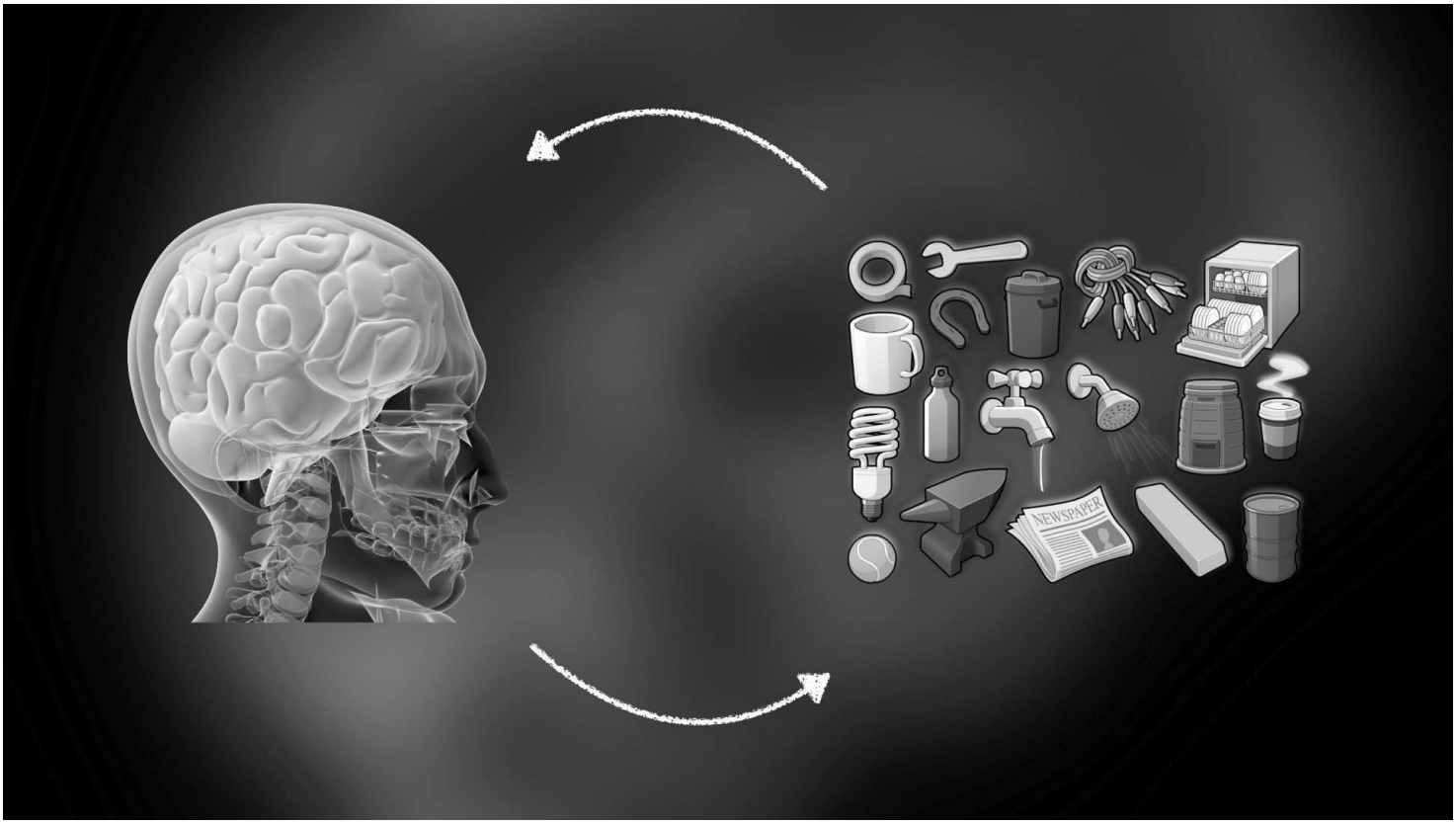
In a separate interview, conducted a year later, Seth reflected on these general disparities that the group noted between his script and slides:

> "When I was assembling those images there was a certain length that I felt I could go to in trying to do it. And to be honest, I didn't pick up on that point because I was already thinking of those images in terms of illustrating the difference between top-down and bottom-up signalling in the brain. So, as you say, there was a misalignment with the set-up to that which was the idea of the isolated brain, occupying a dark and cold and quiet space inside the skull. I thought it was enough to show the brain first, and to use the arrows to suggest the direction of the signals. Even though I spent a lot of time on those images for TED, I wasn't getting any professional help from graphic designers."[30]

There are three subtly dissonant metaphorical oppositions in play at this point in Seth's presentation: "top down" and "bottom up" signalling; "inner" and "outer" physical realms; and "processing" and "sensing" cognitive capacities. In the script, these nuanced distinctions are under Seth's close control, but their communication in his choice and layout of generic images is compromised by his dependence on Shutterstock, and his lack of experience in image

---

30 Anil Seth, interview with the researcher (September 2020).



5.2.8. Anil Seth, presentation slide.
Courtesy Anil Seth.

manipulation and communication design. Seth simply lacks the means to coherently fuse these elements into images that would reinforce his argument.

Collapsing the fusion image

Consciousness & Fear is a slide presentation made available in July 2020 by the Consciousness and Metacognition Lab at University of California, Los Angeles (UCLA), as a three-part, pre-recorded video on the lab's YouTube channel.[31] The presentation was written and delivered by its lead researcher, Hakwan Lau, and accompanied by visual material produced and compiled by Lau, and a research assistant under his supervision. The lab's focus on consciousness is made explicit in the top-level description of its activities at its website: "we are a group of cognitive neuroscientists trying to understand why there's something it is like to be the owner of an awake human brain".[32]

By turns entirely avoiding, actively embracing, even humorously exaggerating, the communication design problems evident in Seth's presentation, Lau's presentational style seems self-consciously to operate at the least demanding level of visual literacy. His slides mix occasional data displays from laboratory experiments with a glut of informal, "found" images and video: internet memes, cartoons accessed through rudimentary online image searches, oversized emoji, default software animations and effects. (FIG. 5.2.9, 5.2.10, 5.2.11.)

These materials are used as a layer of illustrative commentary on basic scientific and non-scientific concepts pertinent to Lau's argument: how neuroscience distinguishes between conscious and non-conscious entities; experimental protocols that Lau considers not credible; the dependence of certain experimental protocols on studying very rare and debilitating brain conditions whose sufferers may not be capable of participating in scientific experiments, and so on.

Figures 5.2.12–5.2.14 show, built up across a sequence of slides, a conceptual diagram relating how neuroscientists experimentally define the neural correlates of consciousness (NCC), the changes in brain state that can be shown to derive from particular conscious experiences. The slides arrange images from various

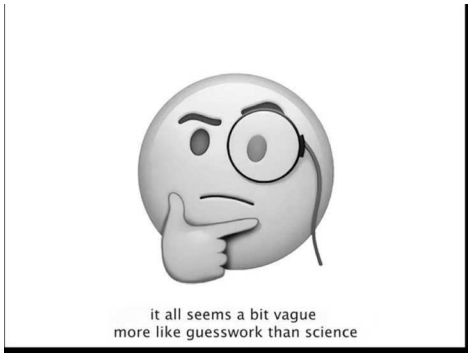
---

31 Several versions of the same presentation, delivered in different public speaking contexts, exist on YouTube. The specific images shown are drawn from two versions.

32 Consciousness and Metacognition Lab website (2020). Via: https://sites.google.com/view/hakwan-lau-lab/home?authuser=0.



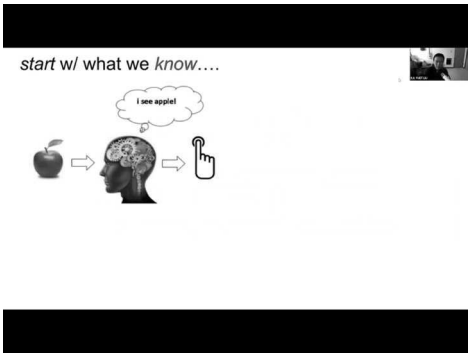
5.2.9.



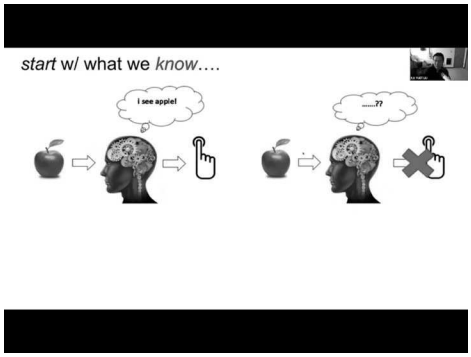
5.2.10.



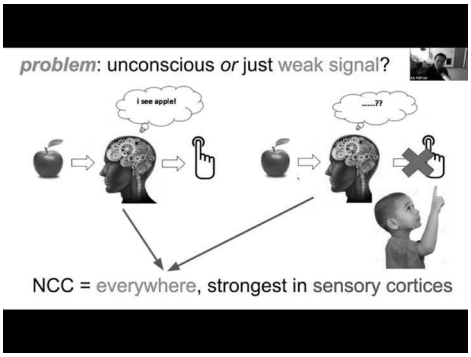
5.2.11.



5.2.12.



5.2.13.



5.2.14.

5.2.9.–5.2.14. Hakwan Lau, presentation slides.
Courtesy Hakwan Lau.

sources in layout, similar to Seth's diagram differentiating top-down and bottom-up signalling in the brain (FIG. 5.2.8).

Where possible, Seth chooses images from credible science illustrators who distribute their work on Shutterstock. His central anatomical image, (FIG. 5.2.15), is produced by SciePro, an agency that describes itself as "the world's leading provider of licensable scientific illustrations".[33]

Lau, by contrast, uses an image typical of the non-scientific material that proliferates on stock image websites: a stylised head whose brain is illustrated as a metaphorical system of gears. (This metaphor has no particular resonance in Lau's NCC diagram and is not referred to in the talk.) Other images on the slide have visible digital watermarks, suggesting that they have not been licensed, and are included as low-resolution placeholder images downloaded from stock photography websites.

In common with Seth, Lau unashamedly admits a lack of skills and experience in producing images and communication design. His presentational style, however, manifests a quite different communicative intent. If Seth's precisely scripted communication is undermined by the generic, uncoordinated effects of the images that he deploys, Lau has no intention of being visually convincing in the first place. He writes:

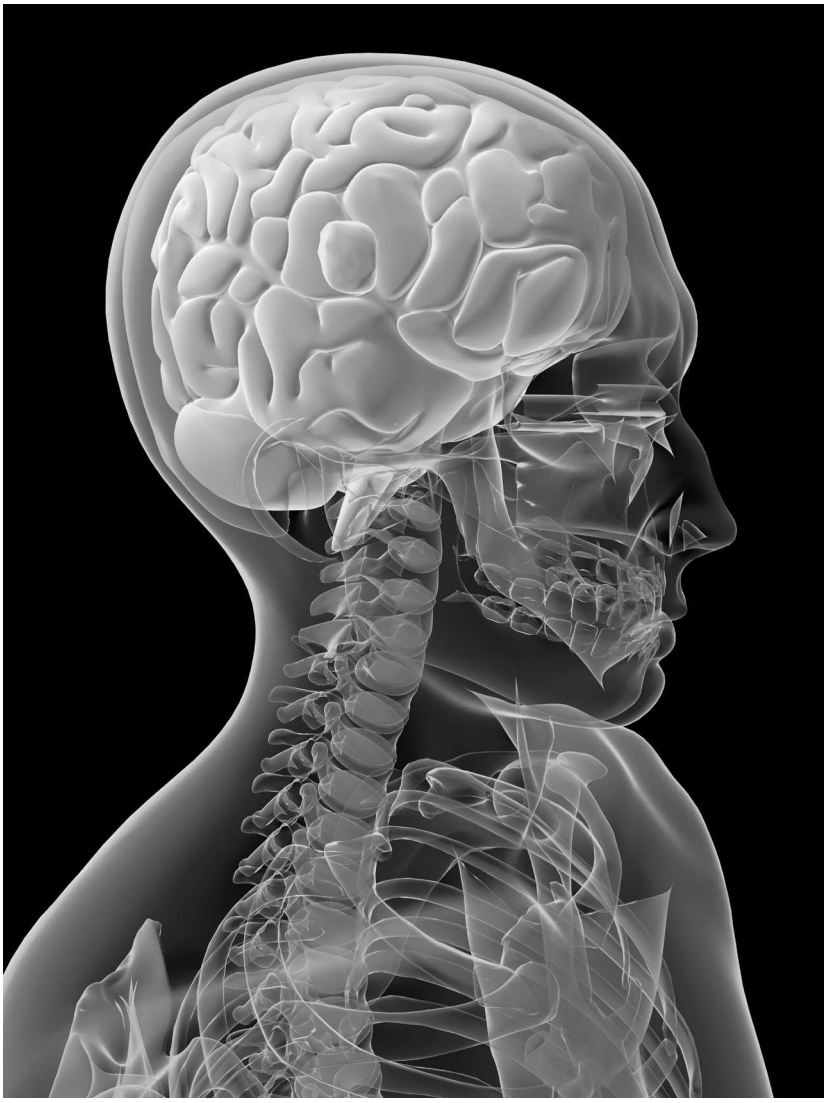
> "i feel... clarity is all there is to scientific communication. this is not to say i don't see the obvious: certain styles make things more convincing. but i think part of me feels that such a culture is bad, and i have often tried to pretend i don't care much about that. (although, like i said, i actually do, when it comes to really 'big occasions'. but most of the times i try to ignore things like that coz i think it is ultimately the right thing to do)."[34]

Lau's amateurish, unpretentious aesthetic can be read as a form of sincere didacticism, in which he simply prioritises communicative clarity over all other

---

33 The genre of image that Seth finds on Shutterstock are the descendants of the *Science* cover. In the age of the commodity digital asset, they are subject to forces that require them to compete with other images to be more attractive, more dynamic, more colourful, more technical. These conditions cause Seth, occupying his stated position as amateur, cautious/sceptic creates incongruous presentational moments in which a dark, existential proposition is visualised with banal, techno-positive stock imagery.

34 The orthography of this quotation, preserved directly from Lau's email, received August 2020, is consistent with the idea of a casual informal communicator.



5.2.15. SciePro illustration used by Anil Seth.

considerations when preparing visual presentations. Without disputing that understanding, I would claim that this aesthetic also operates strategically, on a meta-presentational level, to *authenticate* Lau's work, by disarming potential criticisms of the kind that I direct at Seth, above. Lau deliberately defuses his visual material, not only to make his ideas seem familiar and accessible to a general audience, but to implicitly reassure a scientific audience that he does not deploy communication design to persuade or convince.

5.3 – Fusion images and isomorphism

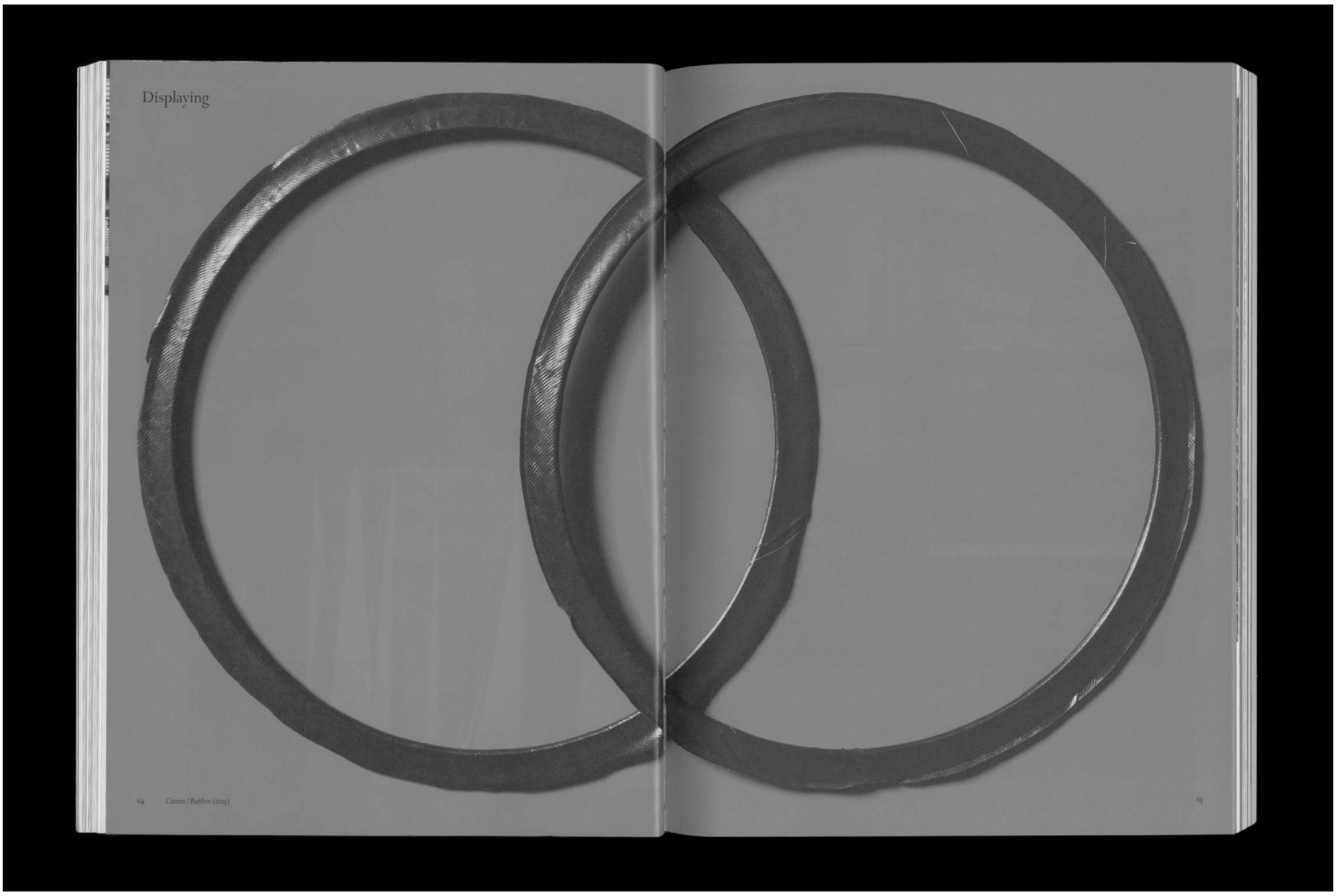
The fusion image has a sympathy with relational and conceptual features of the isomorphic design decision articulated in my general introduction. The term could readily be transposed to the image of a rubber fragment in the monograph that I designed for artist Céline Condorelli, which, despite its obviously having no *scientific* content, is, nonetheless, a semi-mimetic image that incorporates conceptually-reasoned elements (FIG. 5.3.1).

This image belongs to a series whose colour separation and print specification in pure black and red inks (graphic labour *imposed* on the image by me, as the communication designer) retain their photographic, *image* resemblance to the original rubber fragment (their *mechanical objectivity*), while taking on a conceptual *logic* (their *truth-to-nature*), in which colour is codified as elementary and deployed in a black and red display by the artist, informed by her artistic research undertaken at the Settimo Torese factory, where the rubber is processed and manufactured into tyres, and including her interactions with its staff, organisational protocols, industrial processes, and institutional archives. The significance of this fusion is reinforced implicitly in the thirty-two pages of the book that are constrained to black and red printing, and the subjection of all photographic, graphic and typographic material contained there to this colour scheme; and explicitly in the "note on the design", included and discussed in 0.4, above.

This fusion image is notionally successful as an isomorphic design decision simply by virtue of its being negotiated with, and approved by, the artist. To the book's uninitiated public, the fidelity of the rubber fragment photograph to the physical object that it represents is not unduly compromised by its two-colour reproduction. This is deliberately explicated by the practically indistinguishable transition that occurs on pages 64 and 65, between two preparations of the same image, printed, respectively, in full-colour CMYK and two-colour black and red



5.3.1. Condorelli, two-channel digital image prepared for two-colour printing.



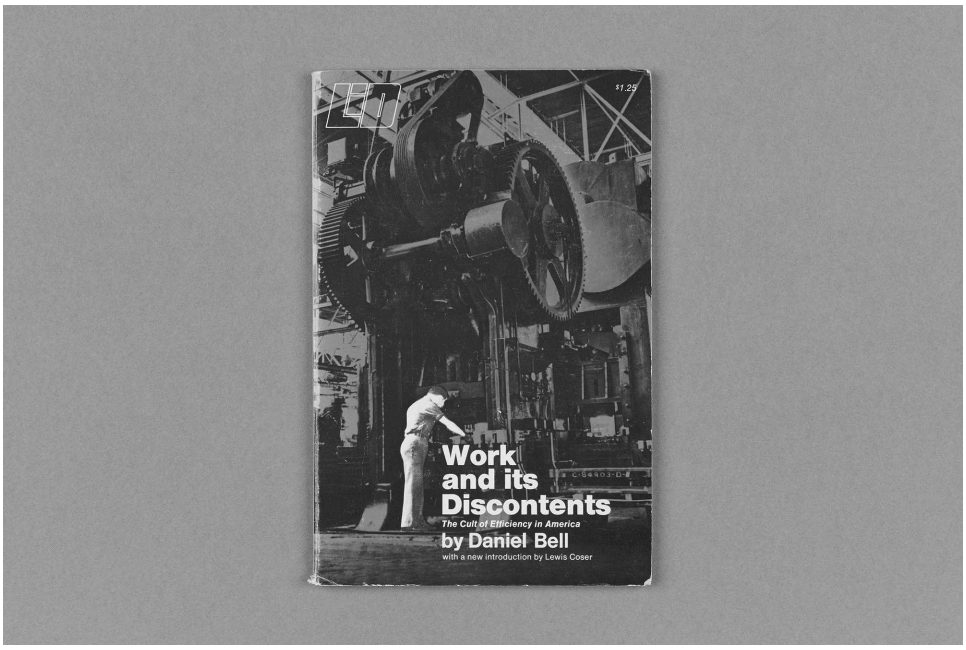
5.3.2. Condorelli, *bau bau*, pages 64–65.



5.3.4. Condorelli, *bau bau*, two-colour constraint extended to other image materials.



5.3.5. Condorelli, *bau bau*, detail of two-colour printing.



5.3.6. Visual reference, Daniel Bell's *Work and its Discontents*.

(FIG. 5.3.2, and discussion in 0.5, above). There is no immediate cost to a reader for failing to recognise or interpret the significance of black and red, or failing to appreciate the graphic labour involved in the preparation of these images. The images remain functionally mimetic at all times. This applies equally to the entire thirty-two black and red pages of the book. Other photographs included there are prepared with variations on the graphic approach used for the rubber fragments. A photograph of a tyre that has been sculpturally manipulated by the artist directly in the factory is prepared so that her intervention is *highlighted* in red (FIG. 5.3.4). Photographs documenting her conversations with workers in the factory are prepared so that the figures print in black and red, and the factory environment in black only (FIG. 5.3.5), an inversion of the colour scheme used for the cover of a reference book on industrial labour, discussed during the design process, Daniel Bell's *Work and its Discontents* (FIG. 5.3.6).

By being indistinguishable from its *mechanically objective*, full-colour original on page 64, the two-colour reproduction of the photograph on page 65, as a fusion image, is as visually sublimated, and therefore potentially inscrutable as the fMRI presentation discussed in 5.2, above. There are subtle signals that betray the difference between the two reproductions of the image, but, particularly in the preparation of the red ink to match the appearance of the full colour CMYK red discussed in 0.5, above, these differences are skilfully de-emphasised. In the context of a contemporary art monograph, this concealment will likely not be construed as unethical or misleading, but framed as poetically consistent — isomorphic — with the artist's overall proposition.

Figure 5.3.7 operates differently, and in a different context. This image was produced in 2011, as part of a graphic identity that I designed for the contemporary art space Eastside Projects, in Birmingham, UK, of which I was a founding director from 2008–2018. The original photograph, and the printed announcement on which it appeared, relate to the institutional identity of the organisation, as opposed to a single artist's work. The work of multiple artists is encompassed in its presentation. The curatorial approach of Eastside Projects during this period was primarily authored by Gavin Wade, drawing on — and prominently signalling the influence of — a number of experimental twentieth-century precedents for organising group exhibitions. Eastside Projects publications continually researched, documented, and acknowledged these references.

Russian artist and designer El Lissitzky's *Abstract Cabinet* (1926/1930) at the International Kunstausstellung Dresden and Hannover Museum was considered by Wade to be representative of the emergence of the 'artist-curator', a radical role in which decisions about the display of artworks were made not according to the discrete, museological norms of the "white cube", but as artistic moves in themselves. Adopting this role, Wade designed and constructed bold structures on which artworks were hung, sometimes requiring considerable negotiation with artists whose works were transformed by these unusual exhibition conditions.

The exhibition, *The work shown in this space is a response to the existing conditions and/or work previously shown within the space* (1978–1979), organised by Peter Nadin, Christopher d'Arcangelo, and Nick Lawson at Peter Nadin Gallery, New York, comprised a dynamic spatial practice in which the included artists responded iteratively to each others' works during the course of the exhibition. Informed by this example, Wade rejected the conventional view of the exhibition as static and unchanging. This approach also contradicted normal institutional protocols for exhibition-making, in which the installation of the artworks is not on public view, and the content of the exhibition does not change for the duration of its being open to the public.

From these, and other references, Wade formulated a curatorial approach that emphasised the cumulative display of artworks for various, overlapping, durations, and treated exhibition design and the manual aspects of curating as a spatial (and not purely academic or administrative) practice. Artworks were introduced at irregular intervals, individually, or in groups, often as new commissions, and often addressed to certain functional elements of the space, such as the door handle, a temporary office, or a wall. Their presence was maintained for various durations, decided on an informal, circumstantial basis. Display devices such as shelves, plinths, temporary walls, and other, more sculptural, constructions, would be continually reused and redesigned. One such material and artistic process is described in an extract from a 2011 Eastside Projects publication:

> "A square plinth was constructed in MDF to support artworks by Athanasios Argianas, Michael Dean, Tatiana Echeverri Fernandez, Lothar Hempel, Marko Lulic and Franz West during *Sculpture Show* (May to June 2009). These materials were upcycled by artists Joanne Tatham and Tom O'Sullivan to construct an artwork in the form of a painted tunnel for the

> exhibition *Does your contemplation of the situation fuck with the flow of circulation?* (July to September 2009). *Abstract Cabinet Show* (September to November 2009) upcycled the tunnel in the following ways. One side was re-covered with wallpaper by DJ Simpson; one wall was extended with a service point for a performance; the back was converted into a commercial gallery art fair stand; lighting was added to the inside of the tunnel for an exhibition of hanging instructions called *This Way Up* curated by Magnus Quaife and David Osbaldeston; and finally Stan's Cafe undertook a five hour performance entitled *The Commentators* on the roof of the tunnel during a busy launch night. For the following exhibition, *Two Short Plays* by Liam Gillick (November 2009 to January 2010), the tunnel was dismantled and the painted and wallpapered panels were used to construct a new gallery wall as the backdrop for Gillick's plays. In July 2010 the walls were dismantled and the materials used to construct tables, book cases and a plan chest for the Eastside Projects office."[35]

Eastside Projects' graphic identity was designed and improvised-in-practice to parallel these curatorial approaches. This was done typically through the re-use and overprinting of print materials, and, as in figure 5.3.7, through the manipulation of images. The exhibition *Narrative Show* (May to September 2011) was organised around an evolving narrative *scripted* by artists, and implemented according to the curatorial methods outlined above. In collaboration with Wade and artist Stuart Whipps, a set of simple wall-mounted brackets was conceived, onto which a camera could be mounted, enabling repeat photographs from identical positions to be taken over the course of the exhibition. In figure 5.3.7, four photographs taken from the same position at different times in the four-month duration of *Narrative Show* are combined in print. This process took place concurrently with the evolving spatial reconfiguration of the exhibition, with each colour separation overprinted on a different occasion, over several months.[36]

In May 2011, 10,000 typographic announcements for the opening of the exhibition were printed in green ink by a local printer. 1,000 of these were

---

35 James Langdon (ed.), *Eastside Projects User's Manual #3* (Eastside Projects, 2011).

36 In FIG. 5.3.6–5.3.11, these are shown as digital images composed of the original layers. In FIG. 5.3.12 a photograph of the printed matter is included.



5.3.7. Eastside Projects, composite image.

finished and distributed to the gallery's mailing list, and the remaining 9,000 were stored, untrimmed, at the printer's factory. At a further five points in the exhibition, the entirety of the remaining sheets were overprinted, each time in a different coloured ink. New information was added, redundant or outdated information was graphically obscured, and copies of the updated, overprinted document were distributed to the mailing list, diminishing the number of copies remaining at the factory.

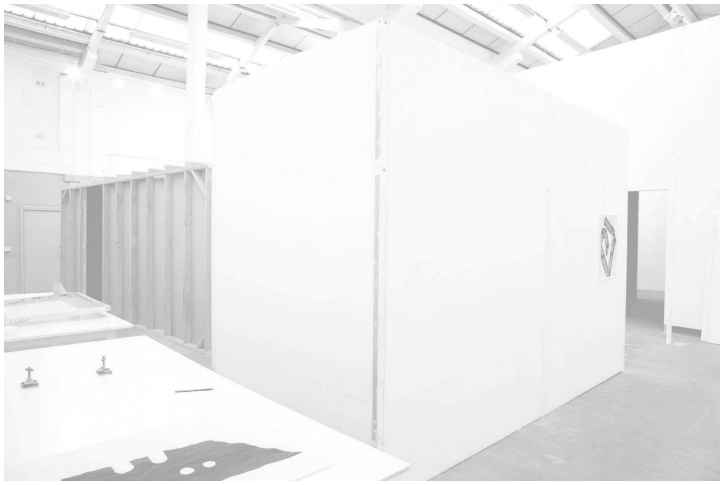
For the second printing, in blue ink, a photograph by Whipps from one of the fixed position camera mounts was included (FIG. 5.3.8). As each overprinting added only a single colour, the photograph was digitally converted to the CMYK colour gamut (which would in any case be an essential and routine part of preparing it for printing in full-colour process), but only the cyan colour separation was printed (FIG. 5.3.9).

A second overprinting added the magenta colour separation (FIG. 5.3.10) from a *rephotograph* taken from the same fixed position at a later point in time than the original in figure 5.3.8. The effect of this overprinting is shown in FIG. 5.3.10. Elements of the exhibition scenography that were unchanged in the interval between the original photograph and the rephotograph being taken — the floor at the bottom right, parts of the ceiling — begin to resolve convincingly into a naturalistic and believable full-colour image. Elements that were changed, however, expose the layers of their overprinting and produce curious temporal effects. In figure 5.3.8 (the original photograph), the empty wall visible at the centre-left is painted white, which means its cyan colour separation contains relatively little detail, and the first printing (FIG. 5.3.9) registers almost-unprinted paper in this area of the image. In the rephotograph, (whose magenta channel is overprinted in FIG. 5.3.10), this wall was removed, causing objects and spatial features of the gallery that were concealed by it in the original photograph to be revealed. The almost-unprinted paper from figure 5.3.9 makes the content of the second overprinting, in magenta ink, highly visible, creating an effect in which the wall appears to become transparent, making these two distinct *photographic* moments of the exhibition simultaneously legible in print.

Two further overprintings used the yellow and black channels from two further rephotographs taken from the fixed camera position. (The yellow channel was actually printed in a bright orange ink, as the corresponding typographic additions to the announcement would not have been sufficiently readable in yellow ink.) Each of these overprintings, and the rephotographs they added to



5.3.8. Eastside Projects, original photograph.



5.3.9. Eastside Projects, cyan separation.



5.3.10. Eastside Projects, cyan and magenta separations.



5.3.11. Eastside Projects, composite image, detail.

the composite image, coincided with significant changes taking place in the exhibition scenography. Temporary walls were taken down and replaced in new positions. Artworks were deinstalled and others installed. A performance took place (FIG. 5.3.7).

As a document of any one of these individual artworks, or of the overall exhibition scenography on a given day when one of the rephotographs was taken, the resulting five-times overprinted image is entirely unsuccessful. Its visual muddle hardly conveys the content, or the spatial experience, of the exhibition. But as an expression, through communication design, of Wade's curatorial proposition — cumulative, dynamically combinatory, subject to ongoing revision — this printed image achieves conceptual fidelity. The process of printing a full-colour image on an offset printing press, normally a matter of fractions of a second as the sheet of paper moves rapidly through the four modules of the press, is refigured as an episodic production occuring over several months. The considerable graphic and organisational labour required to achieve this are consistent with the *unreasonable* expectation of an isomorph.

At the conclusion of the exhibition, the remaining untrimmed announcements were manufactured into envelopes, whose number and dimensions were taken as constraints on the format of announcements conceived for two exhibitions following *Narrative Show* in the Eastside Projects programme (FIG. 5.3.12, FIG 5.3.13), which were then, subsequently, overprinted with further messages (FIG. 5.3.14, 5.3.15), continuing the ongoing, improvisational approach.

There are minor technical problems with the five-times overprinted image that result from difficulties in combining colour separations from digital photographs taken on different days (with the camera having been removed and replaced on its mount each time). The digital image files themselves exhibit subtle distortions from minute differences in the position of the replaced camera. Other, material factors, such as changes in the condition of the paper during the time it was in storage, and variations in temperature and humidity in the factory on the days overprinting was done, contribute to the extreme difficulty of accurately registering the different printings on press.

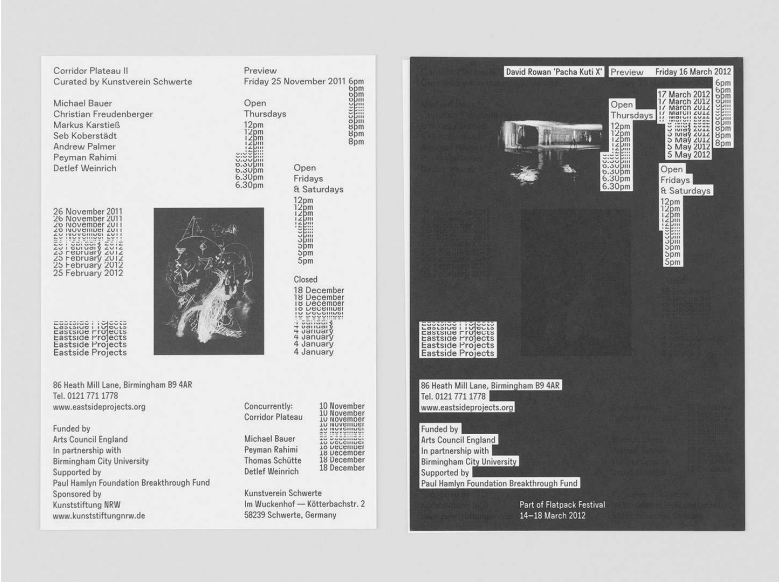
The visibility of these technical registration problems in the printed announcement provides a productive basis for differentiating the interpretation of this as an example of a fusion image, both from the Condorelli image discussed above, and from the images discussed in 5.2, in the context of neuroscientific presentations.



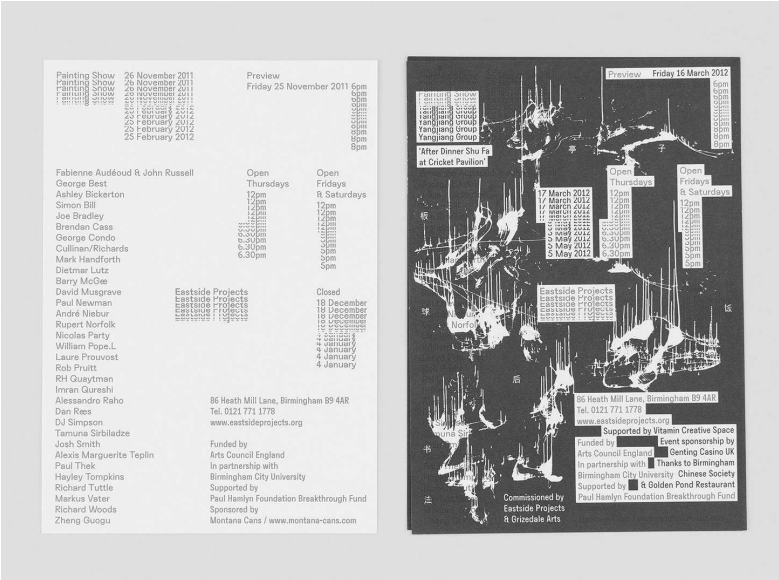
5.3.12. Eastside Projects, final overprinted announcement.



5.3.13. Eastside Projects, envelopes manufactured from leftover announcements; subsequent announcements.



5.3.14. Eastside Projects, further overprinting.



5.3.15. Eastside Projects, further overprinting.

In a scientific context, obvious technical defects — "artefacts" in SIV parlance — render an image unusable. Irrespective of scientific judgements, even a straightforward, conceptually unassuming photograph that registers a slight movement of its subject as a blur betrays a "condition of the image, not of the referent", that "implies the failure of the image to capture that movement".[37] In a scientific context, artefacts are therefore "trouble" for several reasons.[38] On a basic level, they are seen to convey a negative impression of the precision with which a laboratory conducts its imaging experiments. As a worst case scenario, they have potentially disastrous consequences for the erroneous interpretation of scientific images. Bredekamp et al. (2010) discuss the distinctive "style" of microphotography, and incidents of the miscontrual of artefacts arising from this style as natural features of the bacterial cells they represented:

> "For a long time, the clearly visible dark artifacts in the samples were falsely identified as a special type of cell organelles, the so called mesosomes."[39]

Conversely, misregistration of the colour separations in the Eastside Projects announcement image serve both to *fuse* and *defuse* the individual elements that comprise the image. The intent, expressed in the image, to *fuse* the photographic documentation of the exhibition with a graphic enactment of Wade's durational, curatorial proposition is made legible — and thus *defused* — precisely by these artefacts. Where the artefact is "trouble" in a scientific context, in the context of communication design for contemporary art, it is opportune. In communication design for contemporary art, the artefact that creates divergence from strictly mimetic appearances is permissible — desirable, even — if such divergence is consistent with the poetics of the *reasoning* (in this case, curatorial reasoning) being fused.

5.4 – Isomorphic of what?

A reasonable approach dismissed

---

37 Ernst von Alphen, *Failed Images: Photography and its Counter-Practices* (Valiz, 2018), 119.

38 Michael Lynch, *Art and Artifact in Laboratory Science* (Routledge, 1985), 84.

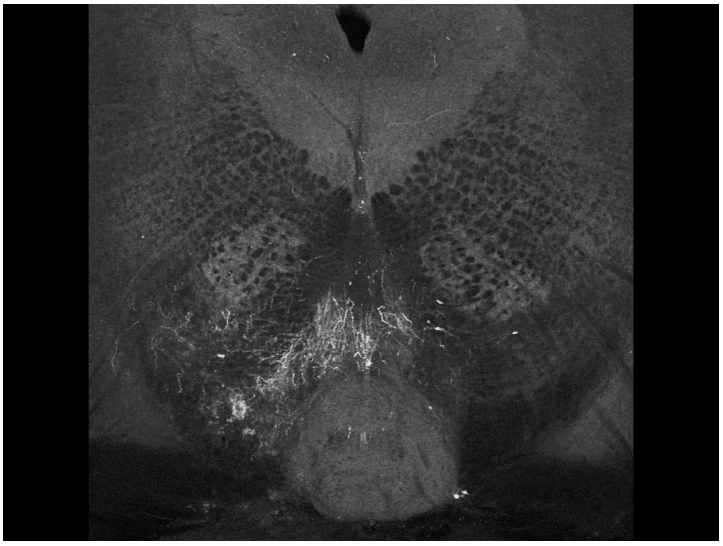
39 'A Conversation with Horst Bredekamp, A History of Styles of Technical Imagery: Between Description and Interpretation', *The Technical Image*, Horst Bredekamp, Vera Dünkel, and Birgit Schneider (eds.), (University of Chicago Press, 2015), 20.

In establishing the thesis, in 5.2, above, that there is presently a tendency toward defusion in the origination and use of images in communication design for neuroscience, I document four presentations that exhibit elementary problems in their use of images that are byproducts of that tendency. *Problems* such as Wright's inconsistent approach to colour, or Seth's lack of conceptual coherence between image and script, that would be entirely within the remit of a communication design practice to *solve*. The isomorphic approach to communication design set out in my general introduction is not necessarily incongruous with such problem-solving. The practice-based examples given there (Condorelli, Hultén, *Rare Bird Economics*) could be considered as problems of representation *emphatically* solved. Nevertheless, in this section I take the position that while it might be *reasonable* to recolour the images in Wright's presentation always to refer to the labelling protein used in the experiment being imaged; and while it might be *reasonable* to find a different image to illustrate Seth's description of the enclosed, isolated, brain; or to manipulate Seth's chosen image so that the brain's glowing appearance is dulled; these are categorically not the moves with which the transposition attempted in this chapter is concerned. In order to address any perception that neglecting these problems obscures my argument, however, allow me to first simply *solve* them, in a few figures.

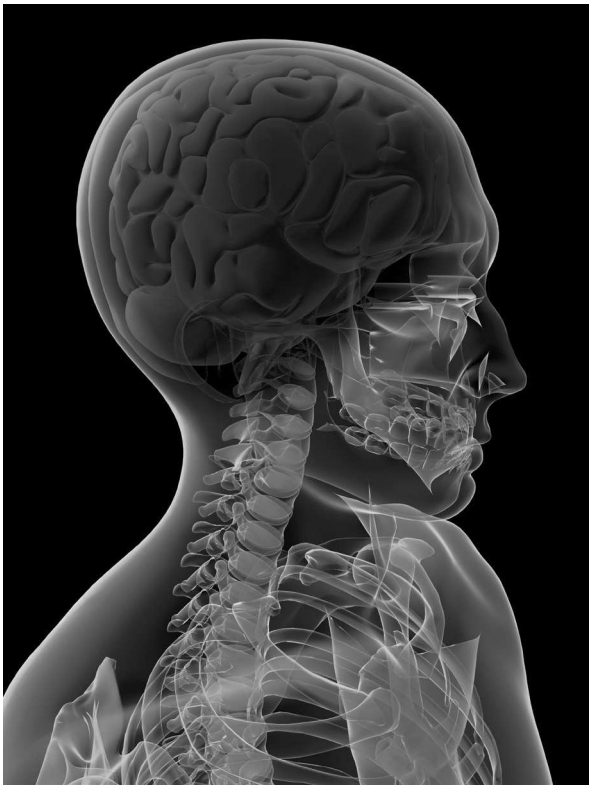
Concerning colour in Wright's presentation, figure 5.4.1 is a version of the mouse brain histology image recoloured to correspond to the yellow protein label that Wright described using in the experiment (original shown in FIG. 5.2.3, above). I opened the image in Photoshop, navigated to Image/Adjustments/Selective colour/Greens and dragged a slider toward yellow. Less that a minute's work. No problem.

Onto Seth's inexplicably glowing brain image. I'll take the easy approach first. I located the image used by Seth on Shutterstock, using their website's 'Search by image' function, licensed it, and downloaded the high resolution file. In Photoshop, I selected the Brush tool, specified its Hardness as zero so as to avoid leaving any awkward edges visible around my image manipulation work, selected the relevant area of the image by making a Quick Mask around the brain using the soft Brush, navigated to Image/Adjustments/Saturation and dragged the slider to reduce. From the same menu, I also dragged the Brightness slider to reduce. Five minutes. Done.

It's certainly a solution (FIG. 5.4.2), but the result is not very satisfactory. To improve on it would indeed require a more engaged approach than is practicable



5.4.1. Recoloured histology image.



5.4.2. Manipulated SciePro image.

for a scientist dependent on stock photography. In 2013, I initiated a project to revisualise material from cognitive neuroscientist Michael Gazzaniga's experiments with the first human patients to undergo split-brain surgery — the severing of the corpus callosum that connects the two hemispheres of the brain — in Los Angeles, in the early 1960s. I commissioned and art-directed a regular collaborator, Karl Nawrot, to make images for this project, and his work, printed on large format slide film, was used in a performative lecture presented at the GfZK in Leipzig, Germany, and later published in the book *A School for Design Fiction* (Langdon, 2014). The macabre, monochrome aesthetic that Nawrot developed for this project may well be more fitting to the point that Seth is making (FIG 5.4.3, 5.4.4).

How, then, to figure the *unreasonable* quality described in the general introduction, and elaborated in 5.3, above, in the transposition of isomorphic communication design approaches to neuroscientific presentations?[40] Following the Eastside Projects example in 5.3, I argue that one suitably *unreasonable* move would be to formulate such a transposition from a more wholistic, critical perspective. To invoke not the *rigour* and *technical precision* of brain imaging, but its uncertainties and unknowables. To be faithful to Cobb's cautionary statement:

> "Despite a bedrock of understanding, we have no clear comprehension about how billions, or millions, or thousands, or even tens of neurons work together to produce the brain's activity."[41]

'Molecular graphics' and speculative abstraction in neuroimaging

The visual communication of unsubstantiated scientific theories is by no means a new problem. Wendler (2015) demonstrates how the graphic design of James Watson's 1965 textbook *Molecular Biology of the Gene* broke from the conventional strictures of illustrating biological publications that had "prevailed from the 1940s to the 1960s": [42]

---

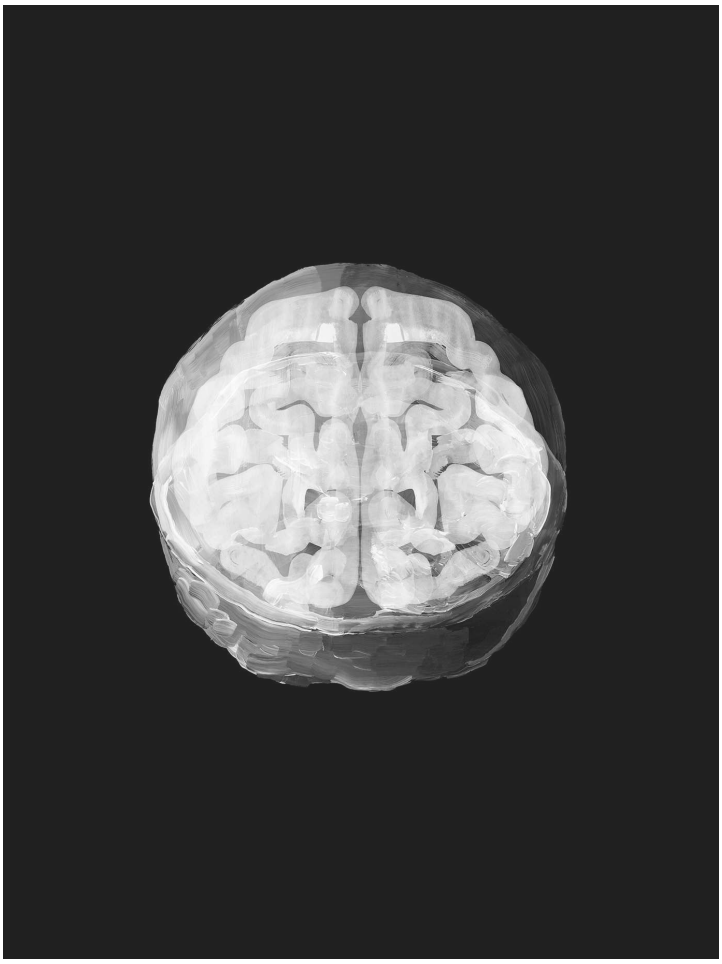
40 The fusion image is, almost by definition, a reasonable image, achieved, in Daston and Galison's account, by the "imposition of reason upon sensation and imagination and by the imposition of the naturalist's will upon the eyes and hands of the artist." The word "reason" here means to stabilise and to normalise. It appeals to a secure definition of the known and the scientifically rigorous.

41 Cobb, *The Idea of the Brain*, 11.

42 I focus here on Wendler's reading of Watson because the term "tentative concretization" is useful for my argument. Neither Wendler's analysis, nor the graphic language of *Molecular Biology of the*



5.4.3. Drawing by Karl Nawrot.



5.4.4. Drawing by Karl Nawrot.

> "the layout and illustrations ... reflect and carry forward the playful form of thinking with material models that was of fundamental significance to establishing the structure of DNA."[43]

Wendler terms the book's principle innovation as "tentative concretization". Tentative concretisation describes a graphic language that is designed to be consistent with its authors' conceptual model of reasoning, without the need to fuse such reasoning onto a mimetic visualisation of its corresponding human biology.

Describing one of the book's introductory illustrations (FIG. 5.4.5), Wendler writes:

> "A single small schematic illustration ... encapsulates how the book harnessed visual means to present its argument. It consists of three simple bronze-coloured circles with black borders that bear designations from molecular biology ... The caption notes: 'These are the smallest known group of E. coli viruses', a proposition that is not as plain as it may seem at first glance — in fact, taken literally, it is false, since what we see are not viruses but three abstract colour compositions on paper."[44]

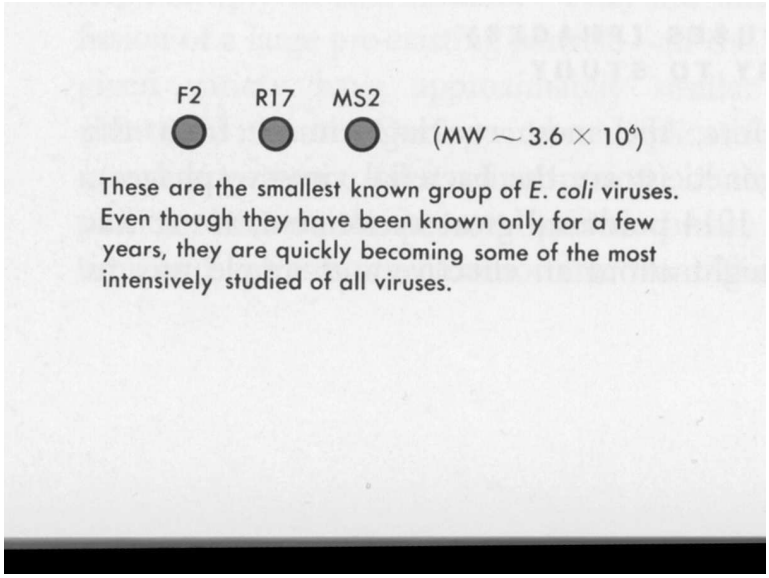
The book's graphics vary in the degree of their morphological appeal to naturalistic molecular structures. The forms in figure 5.4.6 are shown to derive from the T-even phage particle, presented elsewhere in the book as an electron micrograph image (FIG. 5.4.7). Figure 5.4.8 presents a non-mimetic diagram of interactions between repressor, co-repressor and inducer enzymes. Despite its abstraction, the figures are clearly encoded with graphic information about how, according to Watson, the components of this process do, and do not, interact as biological objects. Figure 5.4.9 presents another non-mimetic diagram, representing the formation and catalysation of an enzyme-substrate that maintains aspects of figure 5.4.8's visual logic, but, in its puzzle-like form tends more toward the pictorial than the strictly diagrammatic. Figure 5.4.9's captions contain less precision than figure 5.4.8's, indicating a simplified, or less clearly

---

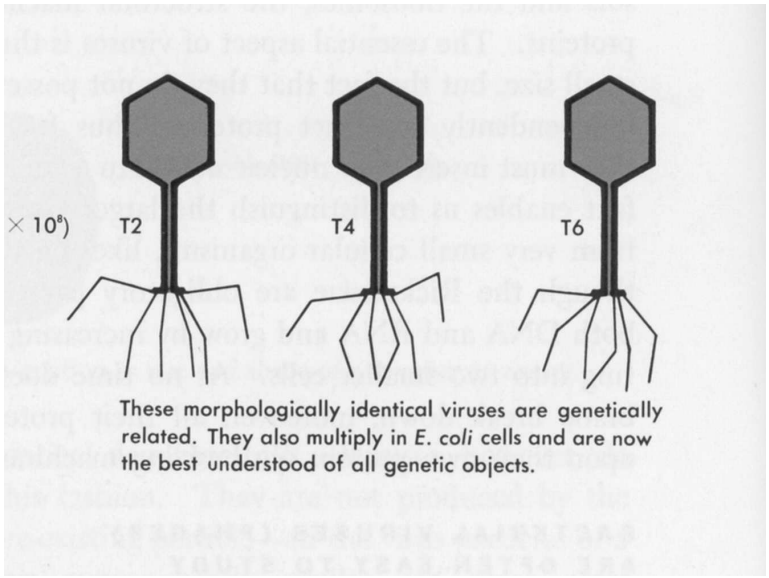
Gene are unique, however. Elkins (1995) has a number of other examples of speculative imaging approaches.

43 Reinhard Wendler, 'Thinking with Models: On the Genesis of James Watson's Molecular Biology of the Gene', *The Technical Image*, Horst Bredekamp, Vera Dünkel, and Birgit Schneider (eds.), (University of Chicago Press, 2015), 74.

44 Wendler, *The Technical Image*, 74.



5.4.5. *Molecular Biology of the Gene*, illustration.



5.4.6. *Molecular Biology of the Gene*, illustration.

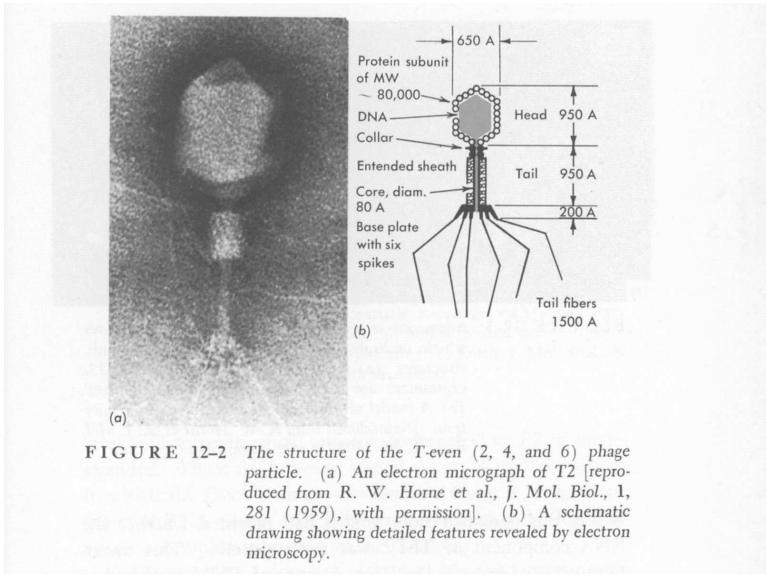


FIGURE 12–2 *The structure of the T-even (2, 4, and 6) phage particle. (a) An electron micrograph of T2 [reproduced from R. W. Horne et al., J. Mol. Biol., 1, 281 (1959), with permission]. (b) A schematic drawing showing detailed features revealed by electron microscopy.*

5.4.7. *Molecular Biology of the Gene*, illustration.

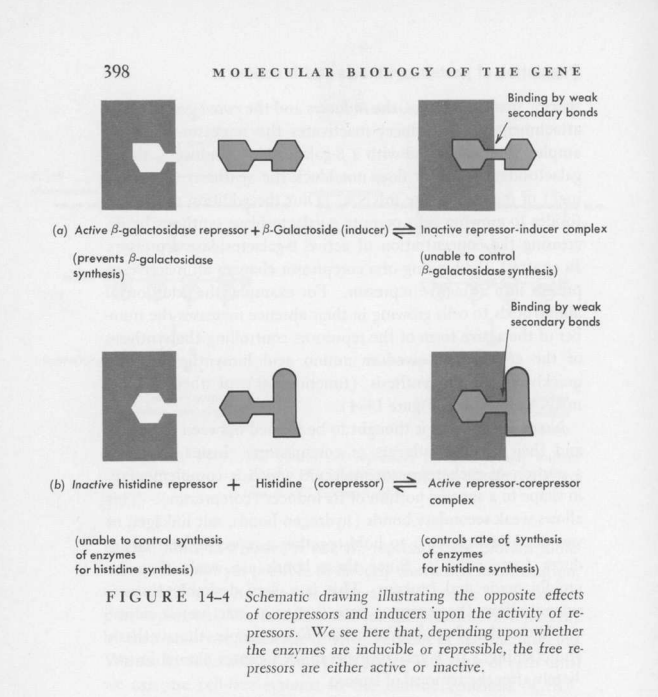


FIGURE 14–4 *Schematic drawing illustrating the opposite effects of corepressors and inducers upon the activity of repressors. We see here that, depending upon whether the enzymes are inducible or repressible, the free repressors are either active or inactive.*

5.4.8. *Molecular Biology of the Gene*, illustration.

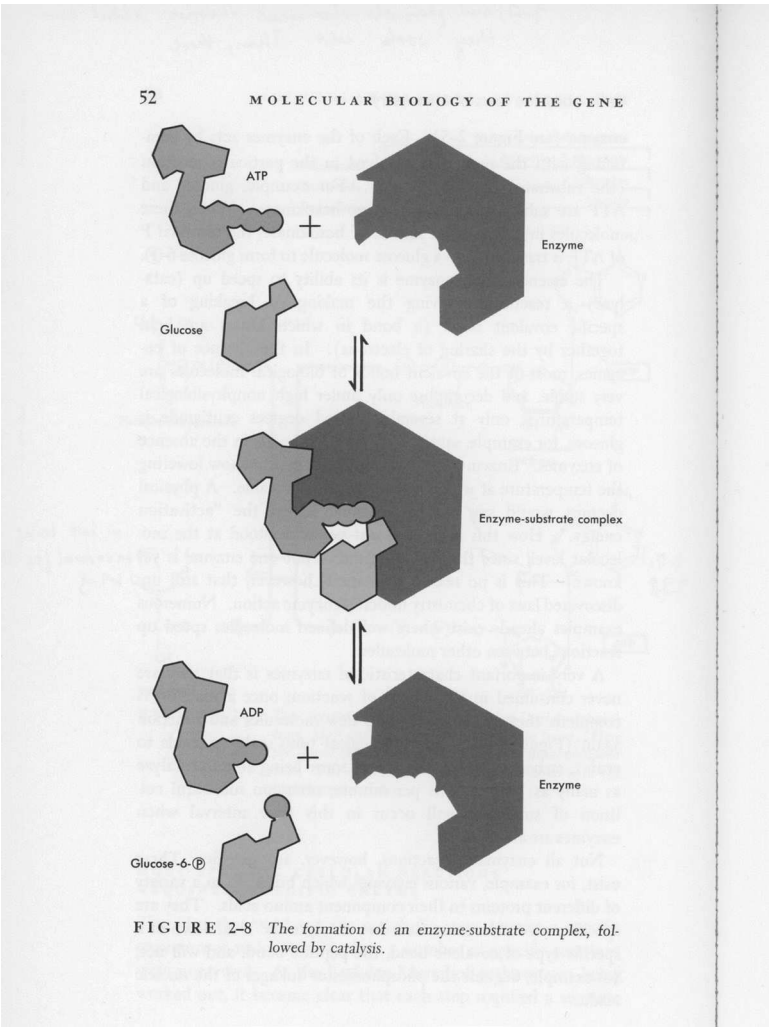
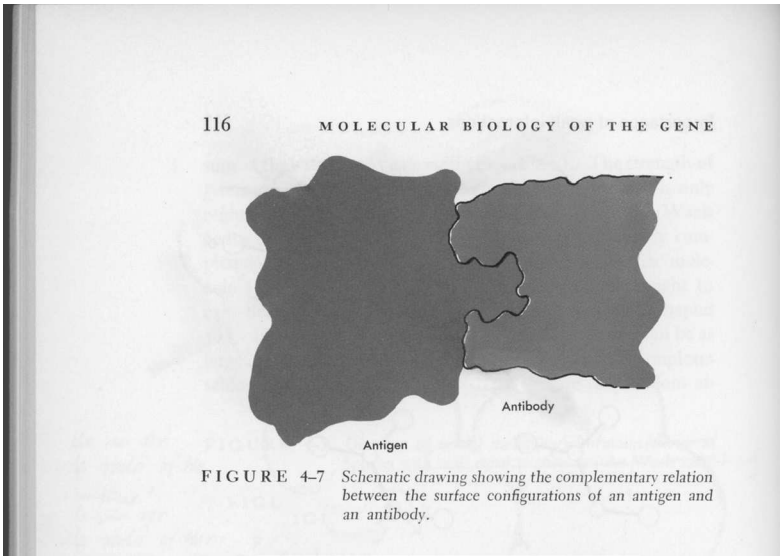


FIGURE 2–8 *The formation of an enzyme-substrate complex, followed by catalysis.*

5.4.9. *Molecular Biology of the Gene*, illustration.



5.4.10. *Molecular Biology of the Gene*, illustration.

understood process. Figure 5.4.10 — in complete contrast with figure 5.4.6 — is potentially the most abstract and formally non-specific graphic in the book. The edges of its graphic elements (especially the “antibody”, whose bronze-coloured fill is surrounded on three edges by a black keyline) are vague and nondescript, suggesting that no particular biological object is being invoked, or needs to be comprehensively understood, in relation to the communicative intent of the illustration. Every detail of this diagram — from its morphology, to its colour, to its generic labelling — seems intended to “reinforce” that *it doesn’t look like this*, but *it operates like this*.

Both the fusion image and the isomorphic communication design decision have, until this point in my argument, been predicated on their *looking like* and *operating like* their referents. Wendler’s tentative concretisation seems compatible with the Eastside Projects example from 5.3, in which visual fidelity is construed not mimetically, in relation to the appearance of any particular artwork or feature of the exhibition scenography, but, instead, to a meta-level, programmatic, yet highly contingent, approach.

Neurovague

Neurovague is a speculative-but-sincere neuroscience communication design practice, initiated by me in 2020. In its present form, it exists as a website with functionality to specify and download parametrically generated, high-resolution digital images, intended for use in neuroscience presentations and freely offered without commodity licenses. Certain features of these images — the number, uniformity, and connectivity of their constituent “objects” — are user-defined with a simple interface. Being procedurally generated, no two Neurovague images are the same, even when identical specifications are input.

Figure 5.4.11 is generated with the parameters *objects: 1*, *uniformity: 0*, *connectivity: 0*.

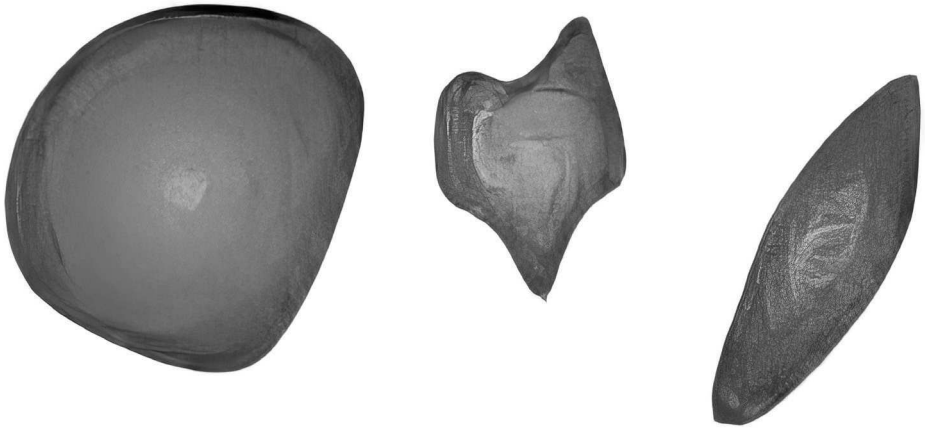
Figure 5.4.12: *objects: 3*, *uniformity: 0*, *connectivity: 1*.

Figure 5.4.13: *objects: 3*, *uniformity: 0*, *connectivity: 2*.

Figure 5.4.14 has identical specifications to figure 5.4.13, but the output image differs due to the exact form, size, position, and colour of the objects in Neurovague images being randomised, within predetermined constraints.



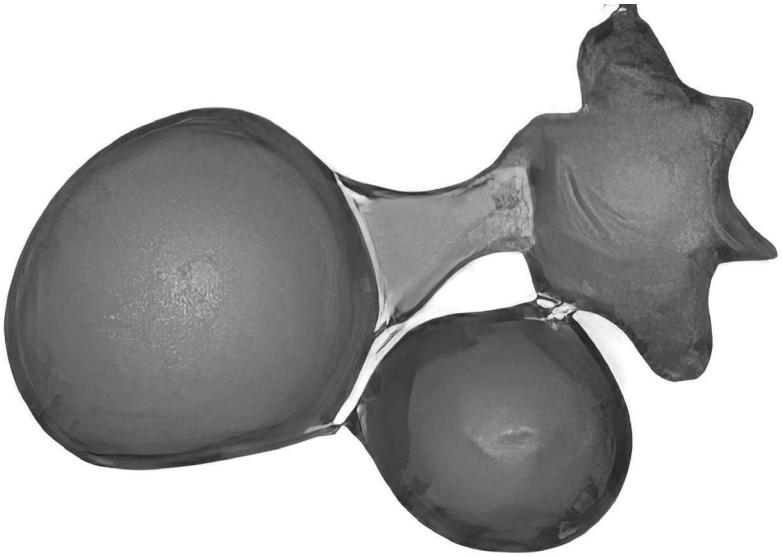
5.4.11. Neurovague image.



5.4.12. Neurovague image.



5.4.13. Neurovague image.



5.4.14. Neurovague image.

The interface allows *objects* to be specified from the variables 1, 2, 3, 10, 20, 302; *uniformity* in degrees of 0, 1, 2, 3; and *connectivity* in degrees of 0, 1, 2.[45]

The aesthetic characteristics of the generated images are the result of an ongoing process of experimentation. They are generated using Gigapixel AI, a commercial software application for enlarging digital images without introducing excessive pixelation.[46] More involved than the bicubic, bilinear, and nearest neighbour resizing functions offered in the industry-standard image manipulation software, Adobe Photoshop, Gigapixel AI uses machine-learning to inform its treatment of different types of image:

> "Gigapixel AI helps you do a single thing very well: increase image resolution in a natural way. ... Most upscaling algorithms don't know how to accurately fill in missing pixels, so you end up with blocky low-quality results. To solve this problem, Gigapixel AI's neural networks are continuously trained on a wide variety of sample images to understand how photorealistic detail looks. After learning from millions of images, it can now believably increase resolution on a wide variety of different subjects (portraits, wildlife, landscapes, architecture, etc) and image types (DSLR, web/compressed, CG)."[47]

Neurovague repurposes Gigapixel AI's functionality by giving it extremely low-detail and low-resolution images as input, forcing the software to infer "photorealistic" detail where none originally existed. Gigapixel AI is evidently optimised to find and exaggerate minor differences in pixel values. Figure 5.4.15 shows a 100% scale detail of an object edge, with a typical level of visual intricacy.

Input images are produced using Javascript to systematise basic compositional parameters. The resulting input images are extremely low resolution RGB PNG files — typically 64 × 48 pixels. Gigapixel AI allows the specification of

---

45 302 is the number of neurons in the connectome of a *C. elegans* worm, at the time of writing the only organism whose connectome has been completely mapped.

46 As commercial software, I don't have access to any greater detail about the nature of the machine learning functionality that Gigapixel AI employs other than what is available on the website of its provider, Topaz Studios. I have not sought this information as the argument here does not depend on establishing any isomorphism between the technical production of the images and their intended abstract qualities.

47 Gigapixel AI product description at Topaz Studios website (2021). https://www.topazlabs.com/gigapixel-ai.



5.4.15. Neurovague image, detail.

enlargements either by factor or by target resolution. Repeatedly enlarging the same images in small increments increases the degree of intricacy that the software adds to the final, generated images. Although it would be possible to generate the images at the target resolution of 3,072 × 1,728 pixels in a single enlargement operation, Neurovague images are enlarged in three incremental steps.

This procedure was developed in iterative phases. In each phase, a large batch of several thousand input images were processed, and their resulting output images discussed in the studio.

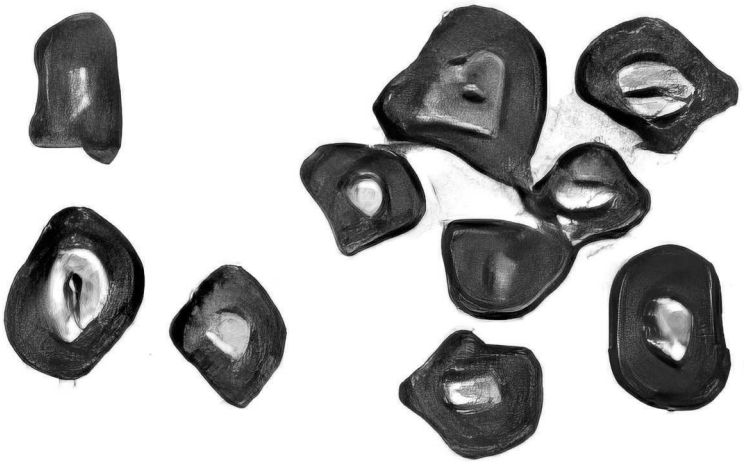
Figure 5.4.16: *objects: 10*, *uniformity: 1*, *connectivity: 1*. This is an image from the first phase of experimentation, whose textural detail was considered "dry" and "brittle", and prompted minor changes to the preparation of input images in the following phases.

Figure 5.4.17: *objects: 20*, *uniformity: 0*, *connectivity: 2*. This image, from the fifth phase of experimentation, was considered too indistinct — the objects are agglomerated and might be an unsuitable output based on an *object* specification of 20.

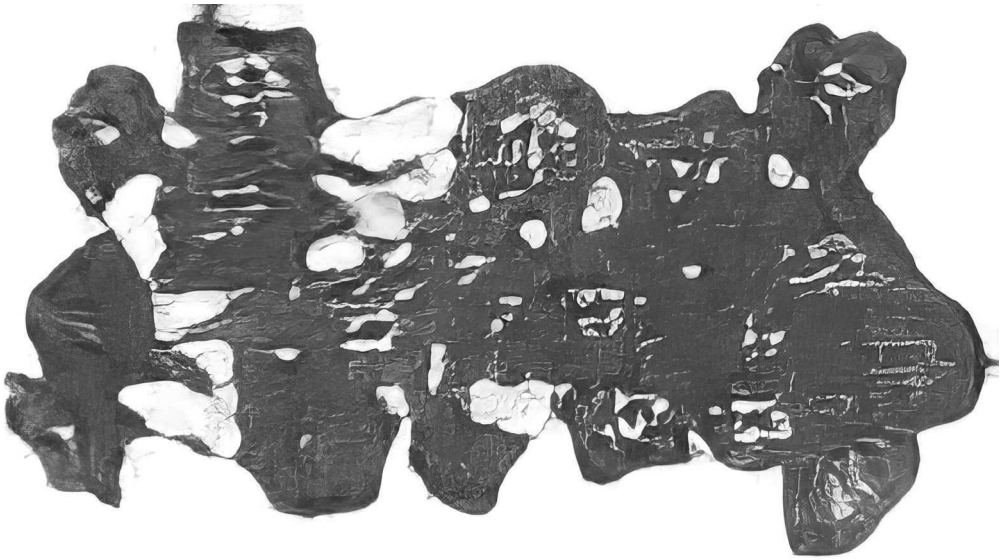
Figure 5.4.18, from the fully-resolved production phase, has an identical specification to figure 5.4.17, but the input image specification has been adjusted to have fractionally more contrast at object edges, producing a more satisfactory result from Gigapixel AI.

Neurovague images are intended to suggestively convey a cusp between the photographic and the diagrammatic; the biological and the digital. Like the antigen and antibody represented in figure 5.4.10, no object form has a biologically mimetic identity. No two images repeat exactly the same form, composition, colour, or texture of objects. Image objects are *unassigned* in the website's specification interface, and non-anatomical language is used to describe them. They might be construed as neurons, or brain regions, or concepts, but none of these words are associated with them in the website's paratexts. Neurovague images are explicitly intended to be neither technically impressive nor pointlessly simplistic. They are meant to stand in for phenomena that cannot be completely or definitively visualised, and whose potential significance is unknown. They might be post-fusion images.

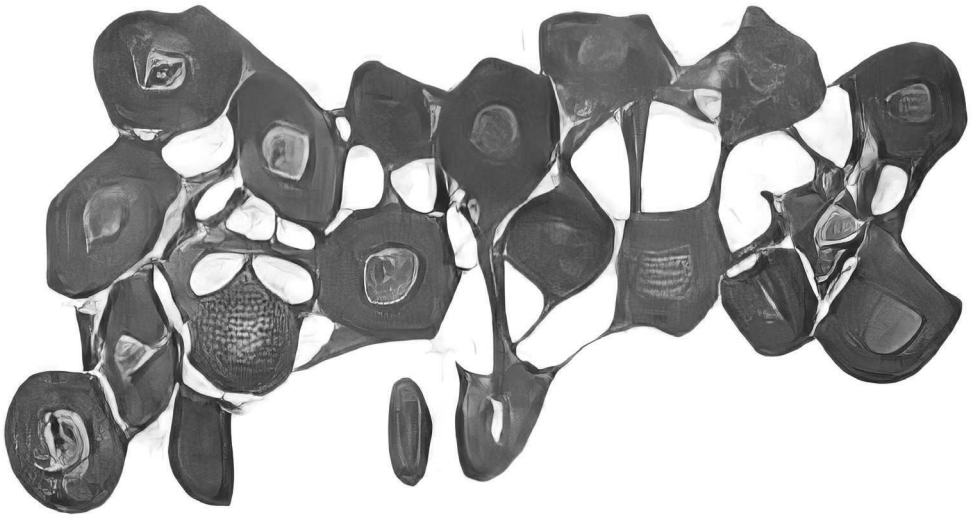
Neurovague is self-evidently speculative and has not been developed in a problem-solving mode, or in response to the concerns of any particular



5.4.16. Neurovague image.



5.4.17. Neurovague image.



5.4.18. Neurovague image.

neuroscientist's work. Its images clearly do not fit any existing model of neuroscience communication, as demonstrated in 5.3, above. Its provocation is framed with political intent, however. Rather than establish it as a conventional commercial design practice, Neurovague will operate as a decentralised autonomous organisation, recruiting members from contemporary art, design, science communication, and neuroscience, to participate in critical discussion of the concerns raised in this chaper, and to develop visual materials according to new paradigms of digital distribution that do not need to follow the same logics of commodity as existing stock photography providers. In an effort to foster such a community, the textual content of the website is a series of short statements, also posted from a Neurovague Twitter account, whose transdisciplinary polemic is intended to address neuroscientists and science communicators:

These texts read:

> One hundred and fifty years after the pioneers of neuroscience isolated the ephemeral neuron against its dull ambience of grey matter, we have grown overfamiliar with the brain's image.
>
> The non-scientific public are everywhere confronted with sophisticated digital visualisations that fuse biological imagery with statistical data to create the illusion that the brain is a knowable scientific object.
>
> These compelling fusion images have become the instruments of *neurohype*, deployed to facilitate new forms of governance and capitalism.
>
> The dismally low resolution of neuroscience's imaging devices is concealed. Neuroscientists are not heroically illuminated by optogenetic light and brainbows, they are groping in the dark cave of the skull.
>
> Assuming a continued pace of technological progression, neuroscience is decades away from comprehensively mapping the brains of even the simplest creatures on this planet. From our current vantage, plotting the human connectome is a Borgesian fiction.

> Alarmed by this reality, conscientious neuroscientists, unskilled in visual communication, resort to impoverished presentations of their work, using stock photography, default templates and online memes. All so as not to be seen to be *persuasive*.
>
> Meanwhile, the ascendant neurotech industry gladly assumes the persuasive aesthetics of commodity technology to market brain augmentations — that *will* reinforce inequalities in our society — as innocent accessories to a digital life well-lived.
>
> Their pacifying, pastel-coloured presentations will render us the unwitting subjects of cognitive capitalism.
>
> Neurovague is a call for uncertainty and abstraction in the visualisation of the human connectome. Ambiguous, considered, sincere abstraction.
>
> Neurovague is *not* neuroscience sceptical. Neurovague is image critical.

5.5 – Conclusion to chapter five

General applicability

In transposing features and practices of the isomorphic design decision to neuroscience, I address the *general applicability* of the isomorph prefigured in section 0.0 of my general introduction. This transposition assumes dissimilar cultures of reasoning around the presentation of images in contemporary art and neuroscience, and admits a lack of practice experience in the latter field. The chapter reveals an unanticipated sympathy between the historically qualified fusion image and the isomorph (both concerned with *looking like* and *operating like* their referents), but, in its case studies, dissimilar approaches to images deployed in communication design, are abundantly evident between the two fields.

The crux of this dissimilarity is not the matter of implementing — or failing to implement — the *reasonably* conventional and rational practices of communication design decision-making that I dismissed in 5.4, above. Nor is there an implied critique of neuroscience or neuroimaging in general. I would argue that this dissimilarity might not relate to the production practices of

imaging at all. Consider how essentially similar, as graphic objects, are the *Science* cover discussed in 5.2, and Condorelli's image of a rubber fragment discussed throughout this dissertation. Both singular objects of attention, isolated against graphic backgrounds. Both maintaining a minimal photographic appeal to the mimetic, while incorporating, through digital image manipulation, conceptual-statistical-analytical features. Both qualified in separate paratexts, not visible in the display content. Given this procedural and conceptual sympathy in the production of the fusion image and the isomorph, I suggest that different evaluations of such images in contemporary art and neuroscience are evidence of incompatible notions of visual literacy in the two fields.

The idea that images are themselves scientific objects, that they represent actual sites of scientific enquiry, appears frequently in SIV.[48] As I posit in section 5.2, above, however, this idea seems only to encompass images in their production and engagement contexts. Wright, Seth, and Lau, all evidently appear to regard the presentation of images — Burri and Dumit's deployment context — as accessory to their research. In each of the case studies in 5.2, the fusion image is shown to be *out of control* of the scientist. Inscrutably visualised in the case of the *Science* cover; lacking reasonable, communicative clarity in Wright's colour mapping, inaccessible to Seth — constrained by Shutterstock — and disavowed — considered too risky — by Lau. The isomorphic design decisions that I have recounted from my practice, by contrast, are closely controlled, by practices of researching, and facilitating, opportunities to adopt isomorphic approaches — be they graphic, technical, or distributive — and by negotiating those approaches with the collaborators whom they will represent.

Four eyes

Whatever the fusion image and the isomorph might have in common as graphic objects, the relational practices that produced them (and the disciplined, professional contexts in which their production occurs), are distinctly different. The only identifiable individual in the role of communication designer in the four neuroscience case studies is Sebastian Kaulitzki, the founder of SciePro, the agency responsible for the glowing brain image used in Seth's presentation. SciePro create commodity digital images, and consider that their "medical correctness and visual aesthetics are paramount".[49] In this formulation, "visual aesthetics" describes only a vague notion of stylised, technological appeal.

---

48 See, as examples, Beaulieu, Burri and Dumit, cited above.

49 Marketing text at Sciepro website (2021). Via: https://www.sciepro.com/about.

Implicit in 5.3 is the assertion that the business model of speculatively producing generic assets for sale in an online store is the opposite of the kind of isomorphic approach, articulated in my general introduction, and chapters two and three, that might have engaged with, and supported, Seth's argument.

Daston and Galison's four-eyed metaphor is an inadequate description of the relationships that produced the Eastside Projects case study discussed in 5.4. Four-eyed sight is an interdisciplinary description of the kind that, by neatly embodying each discipline in one practitioner, only entrenches a disciplined reading of their collaborative work.[50] Both collaborators in the immediate production of the Eastside Projects overprinted image — Wade and I — interchangeably occupied both roles implied in the four-eyed metaphor, with the exception of only the most strictly technical aspects of the work, such as the preparation of the digital files for print, which I did alone. This was enabled by our long-term collaboration, helped by the relative adjacency of our practices, having fostered a shared vocabulary in which the concerns and expressions of curatorial practice and communication design could be mutually understood. In this model, my experience with print production enabled me to see the opportunity to transpose Wade's curatorial methodology in this way, but once this possibility was established, Wade, too, could become quickly conversant with the conceptual and technical possibilities, which were then elaborated and refined in discussion. The role of communication design at Eastside Projects was, therefore, never accessory, but rather a distinct expression and initiative of an overall organisational proposition.

---

[50] I am subverting Daston and Galison's metaphor here to make my point, but absolutely not to suggest any lack of nuance in its original context.