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Philosophy and Aesthetics Inform Science Illuminating the complex dynamics of seeing

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Abstract: Aesthetic responsivity and the phenomenology of arts processes reflect integrative self-world engagements, and are informative about the nature of the world and our biology in ways that are often not be made evident through scientific research. Akins' and Hahn's research regarding human trichromatic visual perception brings together the art of photography, neuroscience, and psychophysics, along with analyses of perspectives on vision in science and philosophy, to invoke anti-reductive, holistic understandings of how we see colour. We bring aesthetics and the phenomenology of arts processes to bear in exploring creaturely responsivity to the complex inter-relational dynamics of light perception, and offer reflective metaphors for human engagements that challenge Darwinian utilitarian conceptions. We argue that attending to aesthetic and phenomenological aspects of experiences is essential to understanding how the shared circuits of cognition and sensory-motor engagement shape our perceptive responsive interactions.

The complex behaviour of light in the environment and how that interacts with human actions and perceptions have generated conflicting understandings of the *what* and *how* questions about colour and our engagements with it. Empirical approaches in science and philosophy tend to work in a reductionist manner and can therefore exclude knowledge from other disciplines and lived responsive engagement. In the case of human sensory experiencing, this can produce an unbalanced and inaccurate picture. Aesthetic responsivity and the phenomenology of arts processes reflect integrative self-world engagements,

and are informative about the nature of the world and our biology in ways that may not be made evident through a positivist approach to scientific research. In 'More than Mere Colouring: The Role of Spectral Information in Human Vision'(2014) and their chapter 'Colour Perception'(2015), new understandings offered by Kathleen Akins and Martin Hahn show up how reductive methodologies have contributed to researchers' blindspots about the holistic, phenomenological, qualitative or aesthetic aspects of experiences they study. Akins' and Hahn's research and results suggest to us that analyses of cognitive and perceptual capacities should acknowledge the holism of human cognition in a way that goes beyond the terms that usually constrain biological inquiry.

Akins and Hahn looked critically at a wide spectrum of ideas and research about light, colour and vision, and used the art of photography to clarify understanding of human trichromatic visual perception. Their view of colour perception not only takes a fuller account of contemporary research in neuroscience, but also clarifies how theories of colour ontology, from Aristotle's to those generated by contemporary psychophysics, have shaped and directed the focus of scientific research and thought about visual perception. Their research is an example of how multidimensional perspectives which include arts processes generate new and informative interpretations of, and metaphors for, human experience in the world.

We will explore two trains of thought:
- the background assumptions of social/functional Darwinism can narrow research perspectives and understandings of creaturely engagement in the world;
- understandings of human cognitive and sensory experiencing are enriched through the interplay of arts phenomenology, aesthetic sensibilities, and the sciences.

Akins and Hahn challenged some of the stereotypical utilitarian Darwinian tenets about the instigation for evolutionary change. Competition for food, mates, and the survival of one's genetic material are often recited rote by scientists as the functional determinants of biology and human behaviour. Phenomenological research suggests that creativity and responsive loving engagement with others are significant survival imperatives for social creatures. The phenomenology of arts engagements and the dimensions of aesthetic appreciation, and their central place in human cultures, support an assumption that pleasure in multimodal and somatosensory experience are also reasons for capacities to develop in the evolutionary continuum.

The foundations of our aesthetic sense-abilities are in our creaturely sensorimotor responsiveness and our intuitive responsivity to qualities of things with which we engage. The 'sense' of something takes account of the intricate interrelational dynamics of our experience. The meanings and judgements we make about qualities that inhere in 'things' are responsive to the proportioning of intrinsic elements as we perceive them. The interpretation of 'natural

selection', that all characteristics and behaviours evolve from and are reflective of selfish survival and propagation needs, is often tempered for humans with an argument for altruism as being useful based on our social natures. But the paradigm doesn't really fit with the complexity of our responses to aesthetic qualities or the integrative multidimensionality of our neural networks in which sensorimotor processes are integral with 'higher functions'.[1] The communicative expressions of artistic endeavours generate empathy and shared responsiveness, and the pleasure we experience in creative engagement with each other and the material world isn't inevitably machiavellian.

The 'survival of the fittest' paradigm is more easily applied to the behaviour of animals because they can't argue back about human interpretations of their experience. As aesthetic responsivity is grounded in our environmental interactions, there is no reason to assume that humans are the only creatures who take pleasure in sensory experiences. That this writer has observed in her cat a love of organised sound might be explained by her cat's cognitive development in a musician's household. Whenever the cat heard the cello or piano, she would come running and find an ideal position in which to lounge about basking in the flow of organised sound waves. She also had an excellent ear for intonation, and would stop twitching her ears and start purring when the cello's strings where perfectly tuned—understandable as the Western musical system is based on natural harmonic resonances. These responses evinced the attunement of the cat to a world of music and mine to my cat, rather than a strategic function related to her conventionally understood survival or propagation needs.

The cat never showed any interest in the paintings on the wall, but after all cats don't have the human sort of trichromatic colour discrimination, and the static nature of paintings plausibly make them irrelevant or incidental configurations of visual properties in a cat world. The visual sense in humans is highly complex and integrated in cognitive function, and it provides expansive depth of field and contrast capacities that allow us to assess a scene and the options for action from a useful distance. These factors sometimes make vision seem to be the dominant sense in our environmental assessments, but all of the senses, our cognitive schemas, and our imaginative capacities are integrated in the neural processing of our multi-sensorimotor engagement with the world. Because of this paintings are evocative objects of interest. The interactive complexity of our visual perception means that colour vision in humans *for seeing*, in the innumerable ways that shape and enhance our experiences in the world, makes more holistic sense than *colour for colour* discrimination primarily as a function for identifying ripe fruits, healthy vegetables, and blushingly nubile young women. These Darwinian explanatory stereotypes were mentioned by Akins and Hahn as commonly cited by numerous researchers.[2]

Akins and Hahn offered a well researched and useful perspective on the flow of evolutionary change in terrestrial vertebrate vision:

- *from* the complexity of colour perception in our common tetrachromat ancestors from 400 million years ago—with the potential capacity for complex wavelength discrimination from the combinations of four cones and coloured oil droplets as colour filters;
- *to* convergent simplification that exploits contrast for discernment—through luminosity perception by rods that favours the intensity of stimulus to photoreceptors and the pooling of wavelength information;
- *to* the divergence of capacities—rods responsive to luminosity and three types of cones favouring differential wavelength discrimination, which are then *neurally* harmonised in complex ways to provide both functional and fine-grained, rich and subtle aesthetic relationships with the environment. The concept 'harmony' is used here, as it was in ancient Greek understanding, as the bringing of unlike elements into relationship so as to create new and richer orders of experience and understanding.

To comprehend the nature of 'colour', and our engagements with it and theories about it, it is useful to consider that colours in substances demonstrate different properties than the colours of light that we see through our contact with particular wavelengths within the visible spectrum. Colours are not properties of objects per se, but rather of the light that is absorbed by or reflected from them, in other words, '. . . the causes of colour experiences do not resemble the colours as they appear to us in perception'.[3] Seeing a banana as 'yellow' is an interpretive description of my perception of the light that is absorbed and reflected by a banana and bounced around the environment with which I am engaged. That interpretation links the banana to aspects of my experiences of being immersed in a scene suffused by light—where I am alive and responsive to the world.

How light is absorbed and reflected by objects and surfaces allows certain wavelengths (and intensities) to impact on eyes and their associated neural pathways. The visual system of a person therefore responds differently to light than substances do. When dyes, pigments and substances absorb certain wavelengths, they *subtract* those 'colours' from the reflected light that we see. When light impacts on our retinas, we *mix and interpret* the responses of the rods and cones to wavelengths, luminosities and polarities *simultaneously*, at the same time that we are also combining other multiple sources of information. This happens not only as a function of eye and brain, but also as part of a whole extended person/environment system of interaction and historical experiencing, and the available qualities of touch contact with the world's ambient possibilities for sensory interplay. In my experience, a banana is yellow, it also comes in a bunch, grows on a tree, and is a fruit that I eat with a certain taste that is different when it is yellow from what it is when green. Yellowness in that case is a property of my experience with the world that includes the banana, light and the dynamics of my visual perceptive capacity at a particular time and place. It also implicates memory, imagination and language, all aspects of my organismic and aesthetic engagement

with a 'banana situation' full of human possibilities. The concept yellow is a reference to interactions situated in the environment within which I define, indwell, and enjoy my experience. Colour is a quality of experience not a thing, it is a property of relationships between unlike things, a harmony of engagement, and it resonates with cues and echoes of the whole of which it is a part.

Akins and Hahn argue effectively that colour is an integral and essential element *for seeing* all in, not simply for colour discrimination. They brought together neuroscience and psychophysics with the art of photography to clarify the interactions of wavelength, luminosity, and polarity with the human visual system. Of particular interest here are the results of their photographic experiments which demonstrated that: contrast—an artefact of visual processing—is key to perceiving and defining objects, boundaries, shadows and dimensionality; and importantly, *shadows* contribute spatial, dimensional, and boundary definition information in interaction with *both* luminosity and colour. Significantly, whereas previously shadow discernment was generally assumed to be dependent on luminosity contrasts alone, their analysis demonstrates that shadows are disambiguated through the holistic integration of wavelength and luminosity perceptions. All of those elements contribute to our (embodied, concerned) interpretations of experiences in the environment.[4]

In simplistic biological terms, humans experience visual stimuli through comparisons and syntheses made possible by the diversity, commonalities and complexities of photoreceptors' responsivity in interaction with the whole nervous system. Humans also *interpret and make meanings from* visual experience, *they see*, through the holism of sensory engagement that includes: current contextual visual perception; present and past psychosocial, propositional, and environmentally-situated sensorimotor action; and aesthetic responsivity.

It is clear that reductive foci in scientistic methodologies or perspectives can cause researchers to misunderstand the parts and the whole of the big picture. With regard to visual perception, it is the complexity and interfusion of differences that generates experience, reflection, and sensually meaningful and pleasurable comprehension. And part of our psychosocial world is a whole range of symbols and icons that resonate with us at many levels of our psychology. The phenomenology of aesthetic experience and shared artistic expressions are therefore deeply ingrained at levels of our neural networks that grip and move us. Thus human life is only partially illuminated by a blinkered view of what is of use to us (in some constrained understanding of use).

There is a different field of human endeavour that involves generations of observers who, through their direct experience with substances in the world, have engaged in reflective analysis and experimentation leading to the development of theories and practical applications, including ongoing peer review

and critical assessment in statistically significant and diverse populations. They have created innumerable models representing colour, intensity, light and shadow, and the interplay of those elements, as well as those elements' production of and effects on object and spatial-dimensional discrimination in all sorts of environmental and psychosocial conditions. So—ask any *painter* if luminosity, colour, and shadow are discrete elements in visual perception. I asked the artist Julie Emerson, who said when she paints a red apple, for example, she must: consider the core shadow on the apple itself and within that dark shadow, the reflected light from the yellow wall beside it, then the occlusion shadow on the blue tablecloth directly beneath the apple, which extends out on the creased surface of the tablecloth the bumpy oval cast shadow, containing not only that blue but also the red of the apple and its complementary colour, green, as projected by the human visual system.

Akins' and Hahn's photographic studies demonstrated that shadows are the result and expression of the intermingling of all elements in visual processing. This is something that artists get and many scientists did not. Perhaps scientists did not partly because their way of seeing colour was to see it as a some*thing* that inhered in things and which would then be represented and deciphered or detected as a colour 'thing' (or category of stimulation directly related to an external property) in the brain. Rather than colour as existent in objects, we can understand that colour is a summation of the movement, absorption and reflection of light, as interpreted through a neural network shaped by situated relational experiences. Also, in the twentieth century, perception was understood for a time in physicalist, mechanistic or behaviourist terms as things acting-on reactive responders-to who are causally oriented towards somewhat limited (and therefore scientifically tractable) goals. In those sorts of paradigms there are discretely defined objects with fixed natures and trajectories that have a survival related effect on us. A view influenced by quantum science sees human beings as observers who interact with the world such that perception is an holistic process of human-world intra-active engagement. The aesthetics of engaging with colour and light, and the sensory appreciation of light, inform our understandings of colour.

Interdisciplinary studies bring the methodologies and results of different disciplines together in useful ways, and often ways in which clear-cut functional simplifications elude us. Many contemporary philosophers are interested in neuroscience within an interdisciplinary inquiry, perhaps because 'the brain is the zone of intersection where matter meets mind: subjectivity, consciousness, agency—or whatever else supposedly constitutes the core of "the human"'.[5] What Akins and Hahn refer to as the *colour for colour* mind set has a long and complex history that involves systems of philosophical and scientific belief that tend to exclude the continual practical and creative experiential meaning-making that underlies artistic pursuits and aesthetic appreciation. However, there is a philosophical conception compatible with an

holistic perspective, and it can be found in Aristotle's insights gained through observations of the natural world and human actions.

Aristotle's reasoned intuitions about substances of transmission and responsivity make sense in application to light as a medium of interaction for our experiences of colour. These often referenced sections of *De Anima* clarify Aristotle's experientially grounded phenomenological insights (philosopher Eugene Gendlin's translation, parentheses and bold are Gendlin's):

> Universally ("*katholou*"), with regard to all sense-perception, we must take it that the sense is that which can receive perceptible forms without their matter, as wax receives the imprint of the ring without the iron or gold,[6]

> **For the instrument** which perceives must be a particular extended magnitude, while what it is **to be able to perceive** and **the sense** is surely not a magnitude but rather **a certain proportion** (*logos*) and potentiality of that thing.[7]

Here is our interpretation, in concert with Gendlin, using musical metaphor and referencing cognitive neuroscience:[8]
i. That which perceives is like an instrument.
ii. A sense is the ability to perceive, the capacity to respond to the perceptible. The tuning proportions the pitches of the strings such that the instrument can be played and music as responsive meaning can be generated. The tuning of the instrument creates a ratio of relationships and a range of responsive capacity, just as an holistically integrated perceptual system proportions the weighting of inputs from sensory neurones according to their contribution to the organism's adaptation to the situations in which it has lived and developed the ability to perceive.
iii. The perceptible engages with the instrument by affecting its proportioned capacity. The way in which that capacity responds defines the perceptible, within the instrument and in expression as communication.

The complex interrelational dynamics of light in the world and the multiple dimensions of our creaturely responsivity to those dynamics provide metaphors for human being-in-the-world that are different from those provided by the reductive functional abstraction that is social Darwinism. This can be appreciated not only in terms of biological functions, but also through the intra- and interactions of perceptual systems that inform the deliberative activity of environmentally embedded social beings. After all, what do we and other creatures do but learn our way through living processes and environmental responsivity, integrating experience, tuning and attuning our capacities in responsive engagement, and sharing capacities and knowledge as we go? Our aesthetic responsivity grounds our capacity to comprehend the coordinations of interconnections in the world as rich holisms, and the dynamics of our brain structure and function reflects those processes. Aesthetic

appreciation is an holistic response to the nature of our creaturely human existence. Holistically integrative learning processes, meaning-making, creative actions and expressive arts are human evolutionary imperatives for autopoietic social creatures such as we are.

Colour is an experience of the properties and actions of light in relationship to elements of the environment and the historically and holistically shaped perceptual capacities of creatures who live, move and play in that environment as part of it. Identifying 'colours' as concepts that delineate and circumscribe our visual experiences is an articulation of our interpretation of the complexities and responsivity of our presence in and engagement with the world *so that it becomes thinkable*. Western scientific thought operates with categories that pigeonhole an inherently dynamic state of being into things, events, and processes (organised and tendentious series of conceptually reified events). Akins' and Hahn's work illuminates ways in which the intersections of science, philosophy, the arts, and 'real life' engagements can be influential in and mutually informative about how we make sense of the world and our experiences. In artistic endeavours, people study, comprehend, express and communicate, play with and enjoy through sensorimotor inter- and intra-action, aspects of the world and our engagements with them. They do this through the creation of art objects and shared sensory experiences which are not primarily functional, and this brings us into resonant focused contact with the nature of being-in-the-world.

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NOTES

1. 'John Hughlings Jackson was a pioneer in neurology who thought deeply about the structure of the brain ... He enunciated a theory of the evolution and dissolution of neural function based on the idea that basic sensorimotor processes become embedded in networks of connections that relate them in successively more complex ways to allow for performance of more and more nuanced and adaptive functions ... Consistent with the framework offered by Hughlings Jackson, recent research on embodied cognition emphasizes pre-existing sensorimotor function as the basis of higher order cognitive (i.e. conceptual) processes which underlie our complex actions' Franz and Gillett 2011, 3114, 3116).
2. Akins and Hahn 2014, 126,127.
3. Akins and Hahn 2015, 426.
4. 'A light wave also gives information about: ... its direction of propagation and velocity. So when sunlight is reflected, refracted, absorbed, filtered, and scattered by the various media and surfaces within an environment, each of these dimensions is affected in profoundly complex yet law-like ways. The laws of optics, and the laws of physics below the level of optics, apply to all three dimensions, with different effects upon different dimensions. Thus, each dimension of light carries the potential for information about its causal history, the media through which it was transmitted, the surfaces from which it was reflected or by which it was absorbed, and so on. The multiple dimensions of

light embody both dependent and independent sources of information about the distal world.' Akins and Hahn 2014, 138).

5. Slaby 2015, 16.
6. 424a17-20, Aristotle, in Gendlin 2012, 197.
7. 424a26-28, Aristotle, in Gendlin 2012, 199.
8. Gendlin 2012, 194-202.

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E.T. Gendlin: `http://www.focusing.org/aristotle/Ae_Bk_1-2.pdf`