

Art, Meaning, and Perception: A Question of Methods for a Cognitive Neuroscience of Art

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Neuroscience of art might give us traction with aesthetic issues. However it can be seen to have trouble modeling the artistically salient semantic properties of artworks. So if meaning really matters, and it does, even in aesthetic contexts, the prospects for this nascent field are dim. The issue boils down to a question of whether or not we can get a grip on the kinds of constraints present and available to guide interpretive behavior in our engagement with works of fine art. I argue that biased competition models of selective attention can be used to solve this problem, generalize to the affective content of our responses to artworks, and so show that research in cognitive neuroscience is germane to the types of problems of interest within the philosophy of art.

There has been a significant uptick of interest in research that explores the applications of theories and methods from neuroscience to our understanding of art in the past decade. This interest has not, however, generally spilled over to philosophical circles. It is an often-repeated platitude among philosophical sceptics that successful reductive explanations in psychology and neuroscience of art cannot account for the defining features of our artistic practices or the range of objects and events we ordinarily categorize as artworks. If sound, this worry entails that the methods of the neuroscience of art are not adequate for grappling with the range of issues and problems that define the philosophy of art.¹ I think these sceptical worries are misplaced. And I am not alone.² At the very least, research in the neuroscience of art can contribute to philosophical questions about the nature of our psychological engagement with artworks and related questions about the ontology of art. For instance, research in the neuroscience of dance has been used to model the way viewers recover the expressive content of choreographed movements.

1 See, for instance, L. Wittgenstein, *Lectures and Conversations on Aesthetics, Psychology, and Religious Belief*, ed. Cyril Barrett (Berkeley, CA: University of California Press, 1966), 19–20; G. Dickie, 'Is Psychology Relevant to Aesthetics', *Philosophical Review* 71 (1962), 285–302; and G. McFee, *The Philosophical Aesthetics of Dance* (Binsted: Dance Books, 2011), 185–91.

2 See N. Carroll, M. Moore, and W. P. Seeley, 'The Philosophy of Art and Aesthetics, Psychology, and Neuroscience: Studies in Literature, Music, and Visual Arts', in A. P. Shimamura and S. E. Palmer (eds), *Aesthetic Science: Connecting Minds, Brains, and Experience* (Oxford: OUP, 2012), 31–62. See also E. Schellekens and P. Goldie (eds), *The Aesthetic Mind: Philosophy and Psychology* (Oxford: OUP, 2012) for a broad view of the debate about this issue.

This research can be used to identify movement features that carry the expressive content of dance works. These results can, in turn, contribute to appreciative practices by helping shape the way consumers direct their attention and strategically approach the work, by informing them where to look and what they ought to be generally sensitive to when engaging with these kinds of works.³

Nonetheless, there is a general methodological difference between philosophy of art and empirical aesthetics that masks the full potential of the neuroscience of art. Artworks are operationally defined in empirical aesthetics as a class of aesthetic objects and events. Artistic salience is, as a result, generally modelled as a type of aesthetic salience within the neuroscience of art, and explanations of the nature of art within the field are generally couched in terms of the range of perceptual and cognitive processes that enable us to recognize the presence of familiar canonical formal aesthetic properties in artworks, e.g. by explaining the way the dynamics of Impressionist paintings emerge from our perceptual interactions with their formal compositional structure or the way a perceived balance between compositional coherence and formal complexity modulates aesthetic responses to a range of artworks.⁴ The trouble with this story is threefold. First, the vast majority of contemporary artworks are simply not intended to be engaged as aesthetic objects. Therefore, the aesthetic focus of the neuroscience of art limits its explanatory scope. Second, it is not clear that the kinds of explanations provided in the neuroscience of art are sufficient to account for the aesthetic dimension of these properties or associated experiences. Finally, aesthetic properties and effects are cheap. The universe is replete with them. They are equally present in natural scenes and objects, design objects, and a range of artworks and our interactions with them. The artistic salience of a work, its identity as an artwork, cannot therefore be explained or accounted for by the mere presence of aesthetic features per se. In both of these cases what matters is how the features of the work, including its aesthetic features, have been used to promote its point, to shape our understanding of its content or meaning.

The case studies from the neuroscience of art discussed below are narrowly focused on an intuitive notion of formal aesthetic properties. However, the difficulty generalizes to a broad range of aesthetic properties. Formal aesthetic properties are generally equated within empirical aesthetics with what Daniel Berlyne called *collative properties*, stimulus features whose qualitative character and behavioural effects depend upon comparisons between other elements present within a work or some knowledge of the general structure, function, and behaviour of object types and events derived from prior experience, e.g. symmetry, dynamic tension, relative complexity or coherence, novelty, surprise, uncertainty, or conflict. This concept of a collative property can be used to model a range of aesthetic properties that are of interest to philosophers of art, including those whose character depends on comparisons between a work and normative stylistic conventions governing artistic production within a particular genre,

3 N. Carroll and W. P. Seeley, 'Kinesthetic Understanding and Appreciation in Dance', *JAAC* 71 (2013), 177–86.

4 See, for instance, A. Chatterjee, 'Neuroaesthetics: A Coming of Age Story', *Journal of Cognitive Neuroscience* 23 (2010), 56–68; D. E. Berlyne, *Aesthetics and Psychobiology* (New York: Appleton-Century-Crofts, 1971); T. Jacobsen *et al.*, 'Brain Correlates of Aesthetic Judgments of Beauty', *NeuroImage* 229 (2005), 276–85; or M. S. Livingstone, *Vision and Art: The Biology of Seeing* (New York: Harry N. Abrams, 2002).

historical period, or other category of art: formal aesthetic properties already mentioned like the dynamics, gracefulness, or asymmetrical balance of a composition; historical properties like originality or derivativeness (which are forms of relative novelty); representational properties like realism and distortion (which are sources of surprise, uncertainty, or coherence); behavioural properties like the sluggishness or energy of characters (which are sources of relative dynamic tension); or the expressive properties that emerge from the formal dynamics of the human gestures depicted in figurative sculpture, e.g. Auguste Rodin's *Burghers of Calais*. However, we find all of these kinds of aesthetic properties in an equally wide range of non-art objects, events, and behaviours as well. Therefore, the difficulties discussed above generalize to theories that define artistic salience in terms of this broader range of aesthetic properties.

In what follows I will introduce a model for the emerging rapprochement between the philosophy and neuroscience of art, discuss a set of case studies from the literature to illustrate the limitations of prevailing formal aesthetic biases within the latter, and sketch a solution to this methodological problem that is derived from a *biased-competition model* for selective attention. Biased-competition models of selective attention suggest that what drive our perceptual engagement with the environment in ordinary contexts are determinations of the semantic salience of a stimuli, their identity as members of object and event types, along with the salience of some subset of their features to our current cognitive or behavioural goals. This, in turn, suggests that what drives our engagement with artworks is knowledge of the range of formal-compositional strategies, stylistic conventions, and appreciative practices that define relevant categories of art, e.g. Renaissance paintings, the minimalist post-modern dances of the Judson Theater Workshop, or the sculptural installations of Judy Pfaff (inspired by Jackson Pollack's early drawings). Biased-competition models therefore provide a mechanism to explain how the cognitive significance of the formal, aesthetic, expressive, and semantic content of a work shapes our understanding of its artistic salience.

Philosophy and the Neuroscience of Art

Methodologically, the neuroscience of art can be categorized under the umbrella of research in cognitive science.⁵ Cognitive science, in its broadest sense, is an investigation of how organisms acquire, represent, manipulate, and use information from their environment in the production of behaviour. Artworks are stimuli intentionally designed to induce a range of affective, perceptual, and cognitive responses in consumers, including those affective responses associated with aesthetic appraisals and other kinds of appreciative judgements. Questions about our understanding and appreciation of artworks can, as a result, be interpreted as questions about the ways we as consumers acquire, represent, manipulate, and use information embedded in the surface structure of an artwork in order to understand and evaluate their formal-compositional, aesthetic, expressive, and semantic content. Cognitive neuroscience can be used to model these psychological processes. This,

⁵ For general discussions of the relationship between cognitive science, philosophy of art, and neuroscience of art, see Carroll *et al.*, 'Philosophy of Art and Aesthetics, Psychology, and Neuroscience'; and A. Shimamura, 'Towards a Science of Aesthetics: Issues and Ideas', in Shimamura and Palmer, *Aesthetic Science*, 3–28.

in turn, entails that cognitive neuroscience can contribute to our general understanding of the range of stimulus attributes, cognitive practices, and affective responses that underwrite our engagement with artworks; e.g. what is the range of stylistic features embedded in artists' formal compositional strategies that drive our engagement with artworks; how do these features contribute to categorization judgements that shape our understanding of the formal aesthetic, expressive, and semantic content of a work; and how do these factors contribute to evaluative judgements about a work and associated affective responses.⁶ So what's the take for philosophers of art? Whatever else we want to say about art, our best theories should be consistent with the way consumers actually engage with particular artworks. Research from the neuroscience of art can be used in this context to help achieve solutions to difficult conceptual problems and adjudicate between competing theories about the nature of art and consumer engagement with artworks; e.g. studies which demonstrate premotor contributions to semantic comprehension in both ordinary and narrative contexts lend support to embodied accounts of narrative understanding, narrative appreciation, and our engagement with characters.⁷

The contemporary source of this old-fashioned view is often attributed to Gombrich's discussions of the productive practices of artists.⁸ There are two steps to the story. First, artists in a wide range of media (probably all of them) engage in formal and compositional studies in order to test the relative success of different sets and arrangements of medium-specific 'marks', e.g. the use of drawing and colour studies in painting, or storyboards, animatics, and dailies in movie production. In this regard, artists' methods are tools for culling environmental features from ordinary experience sufficient to produce particular affective, perceptual, and cognitive responses in consumers and rendering them in a medium. These sets of features work in the more abstract context of an artwork precisely because they are fine-tuned to the ordinary operations of perceptual systems. A great deal of research in neuroscience of art is directed at uncovering and explaining these kinds of productive correlations between the artist's formal strategies and cognitive processes.⁹ Second, there is

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- 6 See, for instance, B. Calvo-Merino *et al.*, 'Towards a Sensorimotor Aesthetics of Performing Arts', *Consciousness and Cognition* 17 (2008), 911–22; C. Jola *et al.*, 'Motor Simulation without Motor Expertise: Enhanced Corticospinal Excitability in Visually Experienced Dance Spectators', *PLoS ONE* 7 (2012), e0033343; H. Leder *et al.*, 'A Model of Aesthetic Appreciation and Aesthetic Judgments', *British Journal of Psychology* 95 (2004), 489–508; and M. Nadal *et al.*, 'Towards a Framework for the Study of the Neural Correlates of Aesthetic Preference', *Spatial Vision* 21 (2008), 379–96.
- 7 N. K. Speer *et al.*, 'Reading Stories Activates Neural Representations of Visual and Motor Experiences', *Psychological Science* 20 (2009), 989–99; M. H. Fischer and R. A. Zwaan, 'Embodied Language: A Review of the Role of the Motor System in Language Comprehension', *Quarterly Journal of Experimental Psychology* 61 (2008), 825–50; and W. P. Seeley, 'Imagining Crawling Home: A Case Study in Cognitive Science and Aesthetics', *Review of Philosophy and Psychology* 1 (2010), 407–26.
- 8 E. H. Gombrich, *Art and Illusion* (Princeton, NJ: Princeton University Press, 1960), see generally chs 3, 5, and 9, and in particular pp. 103–9, 183–91, 313–14, 357, and 368–9; see also A. Kozbelt and W. P. Seeley, 'Integrating Art Historical, Psychological, and Neuroscientific Explanations of Artists' Advantages in Drawing and Perception', *Psychology of Aesthetics, Creativity, and the Arts* 1 (2007), 80–90; and Shimamura, 'Towards a Science of Aesthetics'.
- 9 See, for instance, Livingstone, *Vision and Art*; T. J. Smith, D. Levin, and J. E. Cutting, 'A Window on Reality: Perceiving Edited Moving Images', *Current Directions in Psychological Science* 21 (2012), 107–13; or S. Zeki, *Inner Vision* (Oxford: OUP, 1999).

no ideal system of marks necessary to implement these productive strategies. Consider, for instance, the case of realistic depiction in Western art. Any of a potentially infinite range of formal vocabularies and compositional strategies will suffice in these contexts (think of the range of painterly styles and compositional strategies that have been employed in the name of naturalistic depiction in Western landscape painting and the range of transparent abstractions viewers continue to happily ignore in each; e.g. issues of scale in Hudson River school paintings or the flat depth of field in Robert Bechtel's hyperrealist suburban landscapes). This simple fact entails that an artist must choose how to render the content of his or her work. What are the constraints on these choices? The content of the work, the aesthetic effects, expressive effects, and semantic associations an artist intends a particular work to produce, and the expressive capacities of the medium, its capacity to carry information.

Of course, the nature of pictorial realism in painting is an open question.¹⁰ The framework for artists' methods proposed in this illustration is not a theory of pictorial realism. It is rather a theory about the way cues encoded in the formal structure of artworks carry and convey information sufficient to convey their content; in the case of naturalism, these cues should be diagnostic for the subset of perceptual categories that define pictorial realism for an artistic community, however the latter may be defined.¹¹ Three general claims define this view of artists' methods and productive practices. First, artists learn which cues suffice for artistic production (for naturalism, abstraction, symbolism, etc.) within the context of their own artistic community through a directed, systematic process of perceptual experimentation, through trial and error in a medium directed in part by systems of productive schema inherited from past practice.¹² Second, even in the case of naturalism in visual art, artists have a great deal of leeway in the choices they make about how to render their subject matter. This is not a defence of relativism per se. Rather it is the observation that artists must choose how to render their subject matter relative to a range of desired perceptual, expressive, aesthetic, and cognitive effects that are constitutive of the content of their work, even in contexts where a critical desiderata is informativeness about the actual visual appearance of the depicted subject. Third, artists' productive practices do not arise in a vacuum. Rather they emerge from a communicative interplay with viewers, spectators, listeners, and readers. Therefore, there is a strong sense in which artists' methods belong to the artistic practices of the community rather than to the artist per se.¹³

10 For a review of theories and issues germane to questions about realism and artistic communication, see C. Abell, 'Pictorial Realism', *Australasian Journal of Philosophy* 85 (2007), 1–17; and J. Hyman, *The Objective Eye* (Chicago, IL: University of Chicago Press), 181–210.

11 See P. G. Schyns, 'Diagnostic Recognition: Task Constraints, Object Information, and Their Interactions', *Cognition* 67 (1998), 147–79 for a discussion of the role played by diagnostic cues in perceptual recognition.

12 See, for instance, Gombrich, *Art and Illusion*, ch. 5; or E. Lanteri, *Modelling and Sculpting the Human Figure* (New York: Dover, 1985).

13 Although the view expressed in this article diverges from a standard anti-intentionalist position about audience engagement with artworks, nothing in this particular point turns on that fact. The claim here is simply that audience responses are among the constraints that shape the development of an artists' formal-compositional strategies (see also Carroll and Seeley, 'Kinesthetic Understanding and Appreciation in Dance'). For a discussion of the anti-intentionalist position, see M. C. Beardsley, 'Intentions and Interpretations: A Fallacy Revived', in M. J. Wreen and

There is nothing unique about art in this story – it could potentially be applied to medium specific communicative practices in any of a range of different domains and contexts. This is a strength of the model. It treats artistic communication as one among many ordinary cognitive behaviours. This entails that the same psychological methods that are used to study the latter can be fruitfully employed to explain the former.¹⁴ More to the point, cognitive neuroscience can be used to model the way the formal and compositional structures of particular artworks are used to induce artistically salient affective, perceptual, and cognitive responses in consumers that are responsible for their artistically salient expressive, aesthetic, and semantic content. Therefore, cognitive neuroscience can be used to model the ways that the artistically salient features of an artwork emerge from the formal and compositional strategies of the artist. Within this context, I propose a case-study approach to the neuroscience of art. Cognitive neuroscience can be used to explore correlations between the formal strategies of artists and the psychological processes through which consumers recover the contents of particular artworks. These explorations can, in turn, be used to generate testable hypotheses about the general nature of our engagement with artworks and the range of attributes that mark off different categories of art.

A Case Study in Neuroaesthetics (or Two)

Margaret Livingstone has demonstrated that a range of artistically salient dynamic effects emerge from the way artists manipulate spatial frequency information in paintings. The most familiar example is her discussion of Mona Lisa's smile.¹⁵ Livingstone filtered a cropped image of Leonardo's painting to produce low-, middle-, and high-spatial-frequency images of the face of the depicted figure. The luminance contours that define

D. M. Callan (eds), *The Aesthetic Point of View: Selected Essays* (Ithaca, NY: Cornell University Press, 1982), 188–207. For a discussion of actual intentionalist alternatives to anti-intentionalism, see N. Carroll, 'Interpretation and Intention: The Debate between Actual and Hypothetical Intentionalism', *Metaphilosophy* 31 (2000), 75–90. For a discussion of hypothetical intentionalist alternatives to anti-intentionalism see J. Fodor, 'Déjà vu All over Again: How Danto's Aesthetics Recapitulates the Philosophy of Mind', in M. Rollins (ed.), *Danto and His Critics*, 2nd edn (New York: Wiley-Blackwell, 2012), 55–68; and J. Levinson, 'Intention and Interpretation: A Last Look', in G. Iseminger (ed.), *Intention and Interpretation* (Philadelphia, PA: Temple University Press, 1992), 221–56. I am sympathetic to Carroll's *modest actual intentionalism*, which holds that an artists' actual intentions are among the constraints on, but don't fully determine the meaning of, a work. However, the proposed model is equally consistent with the hypothetical-intentionalist position that the critical constraint on the meaning of a text is the interpretation an ideal, fully informed reader would ascribe to it independently of the actual intentions of the artist.

- 14 For a discussion of related issues germane to artists' methods and artistic communication, see N. Carroll and W. P. Seeley, 'Cognitivism, Psychology, and Neuroscience: Movies as Attentional Engines', in A. Shimamura (ed.), *Psychocinematics* (Oxford: OUP, 2013), 53–75. See also Abell, 'Pictorial Realism, 11–12; and Carroll and Seeley, 'Kinesthetic Understanding'.
- 15 Livingstone, *Vision and Art*, 68–73; see also L. Bonnar, F. Gosselin, and P. Schyns, 'Understanding Dali's *Slave Market with Disappearing Bust of Voltaire*: A Case Study in the Scale Information Driving Perception', *Perception* 31 (2002), 683–91.

Mona Lisa's expression were apparent in the low- and middle-, but not the high-spatial-frequency images. Foveal neurons in the retina are blind to low- and middle-spatial-frequency information, but peripheral neurons are fine-tuned to this kind of information. Therefore, Livingstone argues that Mona Lisa does, in fact, have a dynamic expression that waxes and wanes with the eccentricity of our gaze as we scan from the face of the figure to the background and back. I want to talk about a set of related examples here: the tacit use of McKay and Enigma effects to induce a sense of movement in Monet's renderings of flowing water, e.g. *Railway Bridge at Argenteuil* (1874) and *The Ice Floes* (1880).¹⁶

Op Art provides the most clear cut examples of these kinds of spatial frequency effects in visual art, e.g. the shimmering movement of Bridget Riley's *Fall* (1963)¹⁷ and the pulsing flow within the concentric circles of Isa Leviant's *Enigma* (1981) after which the latter illusion was named.¹⁸ How do these illusions work? There is some disagreement about the particulars, but the general theory is that shifts in the relative size and retinal position of luminance gratings due to accommodation and microsaccades produce contrast-reversal patterns that repeat over time. These optic signals are interpreted as motion cues in the case of the McKay effect, producing a shimmering motion, or perceived transpositional illusory motion orthogonal to the orientation of the luminance grating; in other words, changes in the retinal position of the lines in the painting over time make it look like they are moving back and forth very quickly.¹⁹

The explanation of the pulsing motion within the equiluminant channels in *Enigma* is a little more involved. The larger receptive fields of motion-sensitive neurons in area MT/hMT+ of the human visual system sum local motion cues derived from retinal shifts in the image. These cells respond most strongly to motion orthogonal to the orientation of edges, accounting for the fact that illusory motion is strongest in a direction perpendicular to the orientation of luminance gratings in both kinds of illusions. Feedback projections from MT/hMT+ to earlier visual areas reinforce the perception of coherent motion in ordinary contexts. The effects of these kinds of feedback projections are cancelled out by new contradictory sensory information about change in position of the grating in the case of the McKay effect, so we perceive a back-and-forth shimmer rather than illusory motion in a direction across the pattern. However, the luminance grating doesn't cross the circular, equiluminant channels in *Enigma*. Therefore, there is no such intervening contradictory information to drive a McKay effect. Rather, the receptive fields of MT/hMT+ neurons overlap the boundaries between the equiluminant channel and the surrounding patterns of lines, forming a spatial reference frame that produces weak motion signals within the equiluminant channels. These signals are enhanced by feedback projections to earlier visual areas and interpreted as coherent unidirectional motion that is

16 See Livingstone, *Vision and Art*, 160–1; Claude Monet, *Railway Bridge at Argenteuil* (1874), in N. Katalina and N. Brodskia (eds), *Claude Monet* (New York: Parkstone Press International, 2011), 56 (print); *The Ice Floes* (1880), in D. Skeggs (ed.), *River of Light: Monet's Impression of the Seine* (New York: Alfred A. Knopf, 1987), 119 (print).

17 Bridget Riley, *Fall* (1963), in Livingstone, *Vision and Art*, 163; see also Bridget Riley, *Current* (1964), in R. Kudielka (ed.), *The Eye's Mind: Bridget Riley* (London: Thames & Hudson, 1999), 67.

18 See T. Kumar and D. A. Glaser, 'Illusory Motion in Enigma: A Psychophysical Investigation', *Proceedings of the National Academy of Sciences of the United States of America* 103 (2006), 1947–52.

19 Kumar and Glaser, 'Illusory Motion in Enigma'.

propagated down the channel simply because there are no contravening spatial features to cancel it out. In other words, change in the relative size and retinal position of the surrounding grating is experienced within the equiluminance channels in much the same way as the changing patterns of lights on an old-style movie marquee.²⁰ This explanation is supported by the fact that the Enigma effect is cancelled out if the luminance grating is extended across the equiluminant channels.²¹ It is interesting to note that the illusory shimmering motion in *Fall* can be perceived to rise up through its wavy composition. I suspect that this is due to an Enigma-like effect: the white regions within the luminance grating serve as equiluminance channels, and the sharp compression of the waves in the lower portion of the painting serves as a reference frame to drive the perception of illusory motion.

Livingstone argues that Monet regularly juxtaposed long, low luminance contrast channels (formed by the shadows of trees and bridges) against orthogonal luminance gratings (formed by waves, vegetation in the water, or floating ice) in his paintings of flowing water. She suggests that this compositional strategy, exemplified in *The Ice Floes*, is sufficient to induce a mild form of the Enigma effect. Likewise, she suggests that the waves in *Railway Bridge at Argenteuil* are rendered with a spatial frequency sufficient to produce a mild form of the McKay effect. I'm not sure whether or not we should find these cases compelling. However, they certainly yield testable hypotheses. We could simply analyse the spatial frequency patterns to see if the relative size and spacing of the elements of the luminance gratings are within a range adequate to produce these effects by means of lab stimuli – if the retinal displacement of the gratings are adequate to produce the right kind of contrast-reversal pattern in practice.²² I propose that we treat these two cases as thought experiments for the time being. If Livingstone's suggestion about the way these paintings produce dynamic perceptual effects is correct then they are canonical examples of the kinds of productive correlations between formal strategies and perceptual processes that ground research in neuroscience of art. However, the first thing to note is that everything turns on a claim that these dynamic perceptual effects are aesthetic effects. It is not obvious that this claim is correct. I take it that it is not true of the laboratory stimuli used to study the McKay and Enigma effects. I also take it that it is not clear that it is at all true of *Fall* or *Enigma*. Illusory motion is cheap. We find it anywhere the conditions are right, e.g. Venetian blinds, hubcaps, and barbershop poles. Therefore, these case studies do not, in and of themselves, establish that the observed McKay or Enigma effects are aesthetic properties of the paintings.

The preceding is a standard difficulty for any attempt to explain the aesthetic dimension of art in terms of ordinary cognitive processes. One needs a story that differentiates aesthetic features and experiences from their ordinary, run of the mill, affective and perceptual cousins in these particular contexts.²³ However, let's continue to treat the case

20 C. Fermüller, R. Pless, and Y. Aloimonos, 'Families of Stationary Patterns Producing Illusory Movement: Insights into the Visual System', *Proceedings of the Royal Society of London, Series B* 264 (1997), 795–806.

21 S. Zeki, 'The Cortical Enigma: A Reply to Professor Gregory', *Proceedings of the Royal Society of London, Series B* 247 (1994), 243–5.

22 See Kumar and Glaser, 'Illusory Motion in Enigma', for a discussion of these measures for Enigma illusions.

23 Note that appeals to neurophysiological processes associated with pleasure or reward won't suffice here unless one can identify a unique type of aesthetic pleasure or reward that differentiates these behavioral contexts from others.

studies as thought experiments and assume that the perceived dynamic quality of Monet's rendering of moving water is among the aesthetic effects of the paintings. This is a critical assumption. Livingstone's argument is dependent upon it:

- (1) The dynamics of the rendering of moving water are among the aesthetic effects of *The Ice Floes* and *Railway Bridge at Argenteuil*.
- (2) Neuroscience can explain the way these dynamic effects are induced in the perceptual experience of consumers.
- (3) Therefore, neuroscience can explain how these artefacts function as artworks.

The trouble is that aesthetic properties, effects, and experiences are also cheap. The world is, as mentioned above, replete with them, e.g. aesthetically salient features of perceived sunsets, mountain vistas, stormy seascapes, sports cars, standing lamps, coffee mugs, and the experiences they induce. So, being an aesthetic property isn't, in and of itself, sufficient for being an artistically salient feature of a work. What matters is the particular way that aesthetic property is used to convey the content of the work. Therefore, (3) doesn't naturally follow from (1) and (2). The argument isn't valid. And herein lies the rub. Research in the neuroscience of art, as it is ordinarily practised, is focused on explanations of perceptual effects that putatively ground aesthetic appraisals and the attribution of aesthetic properties to artworks.²⁴ But, on the one hand, it is not clear that perceptual explanations alone suffice to explain the aesthetic quality of these perceptual effects. And on the other, even if they do, this isn't sufficient to explain the artistic salience of those aesthetic features of the work. So, even if we grant the neuroscience of art traction on the question of aesthetic effects/properties, it is not clear that it can contribute more generally to an understanding of the range of attributes, practices, or conventions constitutive of different artistic genres, or more broadly categories, of art. This is troublesome. Research in object recognition and identification shows that categorization processes in which sensory stimuli are matched to general declarative knowledge of the structure and function of object and event types play a critical role in perceptual analysis, form recognition, object recognition, and naming.²⁵ I argue alternatively that our knowledge of structured categories of art in this sense is what enables us to perceptually differentiate works of fine art from other kinds of objects and events, and guides our interpretive and evaluative behaviours by enabling us to identify particular artworks as belonging to different historical, stylistic, genre, or art-critical categories.²⁶

24 See, for instance, Calvo-Merino *et al.*, 'Towards a Sensorimotor Aesthetics'; Livingstone, *Vision and Art*; Nadal *et al.*, 'Towards a Framework for the Study of the Neural Correlates of Aesthetic Preference'; and Zeki, *Inner Vision*.

25 For discussions of the role categorization processing plays in perception, see S. E. Palmer, *Vision Science* (Cambridge, MA: MIT Press, 1999), chs 2 and 9; and P. G. Schyns, R. L. Goldstone, and J.-P. Thibault, 'The Development of Features in Object Concepts', *Behavioral and Brain Sciences* 21 (1998), 1–54.

26 See K. Walton, 'Categories of Art', *Philosophical Review* 79 (1970), 334–467. See also N. Carroll, 'Four Concepts of Aesthetic Experience', in *Beyond Aesthetics: Philosophical Essays* (Cambridge: CUP, 2001), 56–7, at 61; Carroll and Seeley, 'Cognitivism, Psychology, and Neuroscience', 70–2; and Carroll and Seeley, 'Kinesthetic Understanding and Appreciation in Dance'. An analogous story can be told about the psychological processes that contribute to our capacity to differentiate literary from other non-art texts (see, for instance, N. Carroll, 'Moderate Moralism', *BJA* 36 (1996), 226–7).

A Quick Story about Artistic Saliency

The question of artistic saliency is the critical question for a neuroscience of art. Artistic saliency, if I can borrow a distinction from Arthur Danto (and paraphrase a bit), isn't a matter of what we *see*, but rather of what that which is seen *shows* us, or what rendering the subject of a work in a particular way means in the context of salient artistic practices.²⁷ It is a type of semantic saliency carried in the way the features of a work contribute to our capacity to recognize its identity as a member of a genre, historical period, or other category of art and thereby constrain our understanding of its content or meaning. Danto's stock examples of this claim are Warhol's *Brillo Boxes* and van Meegeren's Vermeers. Make the Brillo boxes as perceptually indistinguishable as you want from Brillo cartons. The perceptual features of the work, the distinguishing features of the original commercial design, are not artistically salient for their striking aesthetic quality. What matters is the semantic role these aspects of the work play in the critical history of mid-twentieth century American art. Conversely, make van Meegeren's canvases look as distinct from a Vermeer as you can. These obvious perceptual differences are, by themselves, irrelevant. The artistic saliency of the formal features of these paintings emerges from their semantic role in the ruse played on Abraham Bredius, from the relevant associations between the content of the paintings and Bredius's (mistaken) theory about Vermeer's life.

Danto's examples tend to be conceptual through and through. But his observations about artistic saliency generalize to canonically abstract works as well. Consider Kasimir Malevich's *Painterly Realism: Portrait of a Peasant Woman in Two Dimensions* (1915)²⁸ and Ad Reinhardt's *Abstract Painting* (1963).²⁹ The square figure in *Painterly Realism* is rendered in a striking hue of red, displayed against a densely saturated off-white field. Its skew shape is whimsically juxtaposed to the usual hard-edged suprematist aesthetic. The latter is a hint about the potential semantic grounds for the artistic saliency of these aesthetic features. Malevich was a Bolshevik. Red Square would have been important to him. The Tsars had turned their backs on this symbol of the Russian people when they moved to St Petersburg. Peasant farmers would also have been important to him. They were both the foundation of the future industrialization of Soviet Russia, and a group whose agrarian values and deep ties to the land stood in its way. The formal aesthetic features of the work snap into sharp focus and are significantly enhanced by these attributions of semantic saliency. *Abstract Painting* consists of a three-by-three grid of nine equal squares. Each square is a different shade of black. The differences in hue between the squares is small. Therefore, the painting appears to be a solid-black canvas at first. Discerning its formal and compositional structure requires prolonged careful looking. This forces the viewer to reflect on the apprehensive quality of his or her engagement with the painting, which, as a result, becomes a canonical case of self-reflective aesthetic engagement. However, the artistic saliency we attribute to this practice in this context emerges from its use in the construction of the

27 A. C. Danto, 'Seeing and Showing', *JAC* 59 (2001), 1–9; 'Art and Meaning', in N. Carroll (ed.), *Theories of Art Today* (Madison, WI: University of Wisconsin Press, 2000), 130–40.

28 K. Malevich, *Painterly Realism: Portrait of a Peasant Woman in Two Dimensions* (1915), in R. Crone and D. Moos, *Kazimir Malevich: The Climax of Disclosure* (Chicago, IL: University of Chicago Press, 1991), 23.

29 A Reinhardt, *Abstract Painting* (1963), in *MoMA Highlights: 350 Works from the Museum of Modern Art*, 2nd edn (New York: Museum of Modern Art, 2004), 243.

semantic content, the meaning, of the work – which is something about the nature of aesthetic engagement generally, as opposed to the particular formal aesthetic properties of the composition or the putative aesthetic quality of the associated apperceptive experience.³⁰

A quick caveat may be in order here. I can imagine some resistance to my interpretation of the content of *Painterly Realism*. Malevich is claimed to have painted the feeling of consciousness independent of any logical, rational, semantic understanding of the world. For instance, he wrote that

the representation of an object, in itself (objectivity as the aim of representation), is something that has nothing to do with art ... For the Suprematist, therefore, the proper means is the one that provides the fullest expression of pure feeling and ignores the habitually accepted object ... Feeling is the decisive factor.³¹

If you find my interpretation of *Red Square* wanting, I ask that you simply entertain it as a thought experiment. However, this isn't the only suprematist painting by Malevich whose title suggests a representational reading. There are, for instance, also: *Suprematism (Self-Portrait in Two Dimensions)* (1915); *Painterly Realism: Boy with a Knapsack* (1915); *Suprematism: Painterly Realism of a Football Player* (1915); and a range of abstract rectilinear compositions inspired by aerial photographs like *Suprematist Composition: Airplane Flying* (1915).³² In each of these cases the attribution of semantic salience to a set of abstract formal features enhances the coherence of the composition and the expressive force of the work independent of any facts about their aesthetic qualities. Therefore, this set of Malevich paintings suffices to illustrate how the explicit representational content of a work influences, and in many cases accounts for, the artistic salience of even its aesthetic formal and compositional features.

Noël Carroll's *functional definition of artistic form* can be used to articulate the intrinsically semantic quality of the formal structure and composition of an artwork.³³ We can easily discern what we call the formal structure of a work in most cases. If one stops to think about it, this is a remarkable capacity. A full description of all of the formal elements and relations within an artwork would be an intractable task. How do we go about winnowing the possibilities? Well, the artistic form of a work is composed of those features and relations that are critical to the way it conveys its content. So, we focus our attention on *the ensemble of choices used to realize the point or purpose of the work*. What's the filter that enables us to effortlessly recover the artistically salient formal structure of the work in this manner: its content, its meaning, what it shows, and not what we see per se. How do artists render these formal features transparently accessible to us? Carroll argues that a range of editing techniques and narrative devices are used as formal strategies to *criterially prefocus*, or prime, viewers to a range of narrative expectations about the behaviour of characters and the outcomes of events in Hollywood movies.³⁴ Jenefer Robinson,

30 See N. Carroll, *The Philosophy of Art* (London: Routledge, 1999), 131–2; N. Carroll, 'Art and Interaction', *JAAC* 45 (1986), 60–1; and Danto, 'Art and Meaning'.

31 Quoted in H. Read, *A Concise History of Modern Painting* (London: Thames & Hudson, 1959), 204.

32 See M. Drutt (ed.), *Kasimir Malevich: Suprematism* (New York: Guggenheim Museum Publications, 2003), 22, 128, 146, and 145.

33 Carroll, *The Philosophy of Art*, 137–48.

34 N. Carroll, *The Philosophy of Motion Pictures* (Malden, MA: Blackwell Publishers, 2008), 167–9.

following Leonard Meyer, argues that composers use rhythmic devices and the global ebb and flow of the tempo of their works to shape and control a listener's interpretation (and experience) of the expressive content of music.³⁵ Analogous strategies for *criterially focusing* consumers are utilized in every artistic medium. This is an empirical claim, but I'll play philosopher for a bit and stand by it as an analytic entailment. If the claim is correct, it entails that the meaning of a work isn't just an epistemic constraint on the recovery of its artistically salient features. It is what I suppose we could call a constitutive constraint – it is what determines the formal structure of the work, e.g. Malevich's *Red Square* (note that, curiously, this entails that the paintings in Danto's gallery of perceptually indiscernible red canvases are both formally and aesthetically distinct by virtue of their semantic differences!).³⁶ This view of artistic form is implicit in the general model for a rapprochement between neuroscience and philosophy of art outlined above. It is also explicitly alluded to in the theory and background sections of many research papers in neuroaesthetics.³⁷ But it is conspicuously missing in practice from successful research within the field.

Art, Meaning, and Perception

The natural environment is replete with sensory information. Cognitive systems are limited-capacity processing systems. Therefore, selectivity is a critical feature of perception. Smooth, efficient responses in a replete, dynamic environment require a capacity to ignore distractors and focus attention on task-salient behaviourally significant environmental features, aspects of the local environment salient to both the instrumental and apical goals of an organism. This raises a question. How do perceptual systems assign salience to environmental features? One means is perceptual salience. Some features stand out simply because they contrast starkly with their surround, e.g. sharp brightness or colour contrast, sudden changes in brightness, or abrupt movements against a static backdrop. However, behaviourally significant features of the environment are not always the most perceptually salient. Cognitive systems must, therefore, employ an independent means to flexibly bias perception in real time. Biased-competition models for selective attention suggest that in goal directed contexts frontoparietal and corticofugal attentional networks bias perception by priming sensory systems to the expectation of features *diagnostic for*, or sufficient to determine the identities, shapes, and affordances of, task-salient objects or events.³⁸ In other words, we attribute salience to sensory features on the fly relative to an interpretation of current behavioural contexts.

How does this model work? The schematic answer is that a crossmodally integrated network of reciprocal feedback loops connect the brain regions involved with object

35 J. Robinson, *Deeper than Reason* (Oxford: OUP, 2005); and L. Meyer, *Emotion and Meaning in Music* (Chicago, IL: University of Chicago Press, 1956).

36 A. C. Danto, *The Transfiguration of the Commonplace* (Cambridge, MA: Harvard University Press, 1983), 1.

37 See, for instance, Calvo-Merino *et al.*, 'Towards a Sensorimotor Aesthetics', 911; S. Zeki and M. Lamb, 'The Neurology of Kinetic Art', *Brain* 116 (1994), 607–36.

38 M. Hayhoe and D. Ballard, 'Eye Movements in Natural Behavior', *Trends in Cognitive Sciences* 9 (2005), 188–94; Schyns, 'Diagnostic Recognition'.

categorization, spatial working memory,³⁹ motor planning and preparation,⁴⁰ and appraisals of the emotional significance of a stimulus for our current goals to areas responsible for unimodal sensory and perceptual processing, as well as those responsible for our gut reactions to environmental stimuli.⁴¹ This broad range of cognitive, sensorimotor, and affective processes bias perception in selective attention by enhancing the processing of expected features salient to our current behavioural goals and inhibiting the processing of local distractors, or inhibiting noise in the sensory signal that would interfere with the perception of potentially salient information. In short, minimal sets of diagnostic cues are collected with every shift of attention, matched to knowledge of the structure and function of object and event types, and used to generate categorial expectations about the identity, structure, dynamics, and emotional significance of local objects and events, expectations that shape what we perceive, how we perceive it, and even how we emotionally experience it.⁴² The result is an integrated crossmodal biased-competition model for selective attention that is a means to direct attention, encode the cognitive, behavioural, and emotional significance of objects and events in the distal environment, and maintain stable, enduring perceptual representations over iterations of perceptual processes.⁴³

My proposal is that artworks can be thought of as attentional engines, or as stimuli intentionally designed to direct attention to formal features diagnostic for their artistically salient expressive, aesthetic, and semantic content, and that an integrated crossmodal biased-competition model for attention can be used to model the way artworks work in this regard.⁴⁴ If sound, this proposal resolves the problem of artistic salience for the neuroscience of art. Perceptual categorization processes, as a rule, drive our perceptual and affective engagement with stimuli in the environment. Artworks are no exception. In engaging with the artistic practices that are common to our community, we develop a tacit, procedural knowledge

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- 39 See S. Kastner, 'Attentional Response Modulation in the Human Visual System', in M. I. Posner (ed.), *Cognitive Neuroscience of Attention* (New York: Guilford Press), 144–56; and B. E. Stein *et al.*, 'Crossmodal Spatial Interactions in Subcortical and Cortical Circuits', in C. Spence and J. Driver (eds), *Crossmodal Space and Crossmodal Attention* (New York: OUP, 2004), 25–50.
- 40 See R. I. Schubotz and D. Y. von Cramon, 'Functional-Anatomical Concepts of Human Premotor Cortex: Evidence from fMRI and PET Studies', *NeuroImage* 20 (2003), 120–31.
- 41 See S. Duncan and L. F. Barrett, 'Affect Is a Form of Cognition: A Neurobiological Analysis', *Cognition and Emotion* 21 (2007), 1184–211; L. Pessoa and R. Adolphs, 'Emotion Processing and the Amygdala: From a "Low Road" to "Many Roads" of Evaluating Biological Significance', *Nature Reviews Neuroscience* 11 (2010), 773–82; and L. Pessoa, S. Kastner, and L. G. Ungerleider, 'Attentional Control of the Processing of Neutral and Emotional Stimuli', *Cognitive Brain Research* 15 (2002), 31–45.
- 42 See S. Grossberg, 'The Link between Brain Learning, Attention, and Consciousness', *Consciousness and Cognition* 8 (1999), 1–44; 'How Does a Brain Build a Cognitive Code?', *Psychological Review* 87 (1980), 1–51; Schyns, 'Diagnostic Recognition', 148–51; and Pessoa *et al.*, 'Attentional Control of the Processing of Neutral and Emotional Stimuli'.
- 43 For a more detailed description of this model and how it potentially modulates our engagement with artworks in a range of media, see Carroll and Seeley, 'Cognitivism, Psychology, and Neuroscience', 69–72; Kozbelt and Seeley, 'Integrating Art Historical, Psychological, and Neuroscientific Explanations', 84–9; and Carroll and Seeley, 'Kinesthetic Understanding and Appreciation in Dance'.
- 44 See Carroll and Seeley, 'Cognitivism, Psychology, and Neuroscience'; Smith *et al.*, 'Window on Reality'; and M. Rollins, 'What Monet Meant: Attention and Intention in Understanding Art', *JAAC* 62 (2004), 175–88.

of the range of stylistic conventions that both define and constrain artistic production in particular genres, historical periods, and other categories of art. This kind of categorial knowledge drives our attention into artworks and helps anchor attributions of semantic salience to their formal features. This works because artists use a common understanding of shared categories of stylistic conventions to capture our attention and constrain attributions of semantic salience. How do artists successfully deploy these categories? Carroll's view of criterial prefocusing depends to a large degree on cinematic cues that drive ordinary perceptual, affective, cognitive, and subsequently attentional processes. We respond as we do to film narratives because they are fine-tuned to ordinary psychological processes that drive ordinary cognitive, emotional, and social behaviour.⁴⁵ My argument is that this claim generalizes. Artists use their tacit understanding of ordinary psychological processes to deploy stylistic conventions as expressive devices. I would argue that this is true of a broad range of artistic practices from classical Renaissance painting to contemporary mass media art forms like pop music, punk rock, and popular movies. Of course our knowledge of the categories of artistic conventions need not be tacit. It could just as easily be explicitly articulated, as it is in the case of expert art historical knowledge of the stylistic conventions that define different categories of art. The key issue is whether categories of art are sufficiently structured to play a role in our engagement with artworks analogous to that played by object categories in goal-directed visual and emotional attention. It seems that they are – just think of all the times you've solved the crime just before your favourite TV sleuths did. But this is an empirical question, a testable hypothesis open to exploration.

So what's the methodological point in the end? The problem is not that a successful neuroscience of art is methodologically incompatible with, and so cannot accommodate, issues of content, meaning, and artistic salience that are central to the philosophy of art. It is rather simply that neuroscience of art hasn't paid sufficient attention to these kinds of artistically salient variables. Why is this the case? The problem is not, as recently argued by Nicolas Bullot and Rolf Reber, that neuroscience of art lacks a theoretical framework within which to assimilate this kind of information.⁴⁶ A number of multistage hierarchical models have been proposed that include the mechanisms necessary to explain artistic salience.⁴⁷ However, the focus of this research is the influence of cognitive processing and attention on aesthetic appraisals. Aesthetic appraisals are, in turn, defined operationally relative to evaluative judgements and autonomic responses associated with prototypical aesthetic experiences, e.g. the experience of beauty.⁴⁸ This strategy explicitly ignores the

45 See Carroll and Seeley, 'Cognitivism, Psychology, and Neuroscience'; Smith *et al.*, 'Window on Reality'; and U. Hasson *et al.*, 'Neurocinematics: The Neuroscience of Film', *Projections* 2 (2008), 1–26.

46 See N. J. Bullot and R. Reber, 'The Artful Mind Meets Art History: Toward a Psycho-Historical Framework for the Science of Appreciation', *Behavioral and Brain Sciences* 36 (2013), 123–80.

47 A. Chatterjee, 'Neuroaesthetics: Growing Pains of a New Discipline', in Shimamura and Palmer, *Aesthetic Science*, 299–317; Leder *et al.*, 'A Model of Aesthetic Appreciation'; and Nadal *et al.*, 'Towards a Framework for the Study of the Neural Correlates of Aesthetic Preference'.

48 See also S. Brown *et al.*, 'Naturalizing Aesthetics: Brain Areas for Aesthetic Appraisal across Sensory Modalities', *NeuroImage* 58 (2011), 250–8; Chatterjee, 'Neuroaesthetics: A Coming of Age Story'; C. DiDio and V. Gallese, 'Neuroaesthetics: A Review', *Current Opinions in Neurobiology* 19 (2009), 682–7; and Thomas Jacobsen, 'Beauty and the Brain: Culture, History, and Individual Differences in Aesthetic Appreciation', *Journal of Anatomy* 216 (2010), 184–91.

importance of non-aesthetic formal and compositional features that are diagnostic for the art-critical meaning, content, or purpose of a wide range (and likely the majority) of contemporary artworks. So the trouble is that these entrenched aesthetic biases yield a narrow aesthetic view of art that is exemplified in comments like the following: ‘This kind of work [Sol LeWitt’s wall drawings] is often invested with a heavy conceptual weight, though, not surprisingly, many find it aesthetically wanting and question its claim to art.’⁴⁹ The model I have proposed is a means to rectify this difficulty.

What do we need in order to evaluate the proposed model? A range of case studies, stories about the ways real consumers engage with particular artworks, that illustrate dynamic interactions between attentional processing and the formal/compositional structure of a work. The psychology literature is replete with examples of category effects in the perception of bistable ambiguous pictures that capture the general idea.⁵⁰ Alfred Yarbus’s early eye-tracking studies clearly demonstrate these sorts of perceptual effects in the way viewers engage with paintings.⁵¹ The Reinhardt painting discussed above is a straightforward perceptual attentional engine. The dim trace of the compositional structure of the work, barely visible on first encounter, draws the viewer in, thereby engaging him or her in precisely the kind of apperceptive reflection that is its point. The *Mona Lisa* is also an attentional engine, albeit one that isn’t, in itself, very semantically rich. If Livingstone’s description of the painting is accurate, natural eye movements should be sufficient to produce a peripheral awareness of change in the depicted expression, which should, in turn, drive attention back to *Mona Lisa*’s face. Livingstone argues that Leonardo used the dynamics of these perceptual processes to render the face more life-like. The dynamics of our formal interactions with the painting may thereby function as a cue to imaginatively engage the figure in a quasi-Gricean dialogue – a result that is sometimes mistakenly thought to be excluded by the low-level perceptual description Livingstone has provided for *Mona Lisa*’s expression. Finally, the Malevich painting is a rather simple and clunky example of semantic content driving attention and shaping the formal, compositional, aesthetic, and expressive content of a work. My guess is that the literature on our engagement with film and our affective responses to music is replete with more complex and exciting examples. But in the end the devil is in the detail. These are empirical questions about the adequacy of our best theories and the intuitions that drive them – questions about the ways theories and intuitions map in practice to real-time engagements with particular artworks.

Some Caveats by Way of Conclusion

Neuroscience of art is a rapidly growing field comprised of a diverse range of research projects across a broad range of artistic media that engage different perceptual, affective, and cognitive processes. Within this context a number of different approaches have been

49 B. R. Conway and M. S. Livingstone, ‘Perspectives on Science and Art’, *Current Opinion in Neurobiology* 17 (2007), 476–82, at 477.

50 See Bonnar *et al.*, ‘Understanding Dali’s *Slave Market with Disappearing Bust of Voltaire*’.

51 A. L. Yarbus, *Eye Movements and Vision* (New York: Plenum Press, 1967), 171–96.

proposed. There are theories that focus on correlations between particular artists' formal strategies and particular neurophysiological processes.⁵² There are theories that focus on correlations between artists' formal strategies and more general laws of perceptual processing encoded in the neurophysiological structure of perceptual systems, e.g. the peak shift effect,⁵³ perceptual constancies,⁵⁴ or a simplified physics of perception.⁵⁵ There are also multistage theories which model aesthetic appraisals as the product of hierarchical networks of cognitive processes that include sensation, perceptual analysis, explicit classification (involving declarative knowledge of categories of art), affective responses, evaluation, and those decision-making processes involved in aesthetic judgements.⁵⁶ What differentiates the hierarchical model I have proposed from these other models is its focus on artistic salience as opposed to aesthetic properties, appraisals, or experiences. I have argued that this is a critical distinction – that the aesthetic features of a work are only artistically salient relative to the way they are used by the artist to communicate its content, that what matters for art is not what is seen, but rather what is shown, what is communicated in our engagement with what is seen or experienced.

I can imagine someone objecting that the methodological focus on aesthetic appraisals within neuroscience of art is an instrumental strategy, not an end in itself. One common experimental strategy within the field is to record cortical activations, autonomic responses, and preference ratings while systematically manipulating some accepted aesthetic feature in a range of stimuli. However, preference ratings and autonomic responses associated with aesthetic appraisals are not the end target in these studies. Rather, they are used as markers to identify a range of neurophysiological processes associated with our engagement with artworks. An understanding of the information-processing role of these networks of cortical activation, in turn, enables a researcher to model some target range of cognitive processes involved in our aesthetic engagement with art. These kinds of studies certainly have the potential to contribute to our understanding of a range of canonically aesthetic artworks and experiences.⁵⁷ However, given the methodological focus on aesthetic preferences, as discussed above, the role played by a broad range of non-aesthetic art-critical variables in our engagement with artworks is opaque to this strategy. The artistic salience of the vast majority of contemporary artworks is conceptual, tied to the art-critical or socio-political content of the work. Therefore, this seems to be a significant problem – even for multistage hierarchical models of aesthetic appraisals.

52 Livingstone, *Vision and Art*; and Zeki and Lamb, 'The Neurology of Kinetic Art'.

53 V. S. Ramachandran and W. Hirstein, 'The Science of Art: A Neurological Theory of Aesthetic Experience', *Journal of Consciousness Studies* 6 (1999), 15–51.

54 Zeki, *Inner Vision*.

55 P. Cavanaugh, 'The Artist as Neuroscientist', *Nature Reviews Neuroscience* 434 (2005), 301–7.

56 Brown *et al.*, 'Naturalizing Aesthetics'; Chatterjee, 'Neuroaesthetics: Growing Pains of a New Discipline'; Leder *et al.*, 'A Model of Aesthetic Appreciation'; Nadal *et al.*, 'Towards a Framework for the Study of the Neural Correlates of Aesthetic Preference'.

57 For a discussion of difficulties related to the appeal to preference ratings in empirical aesthetics, see V. Bergeron and D. M. Lopes, 'Aesthetic Theory and Science: Prospects for Integration'; and P. J. Silvia, 'Human Emotions and Emotional Experience: An Overview of Empirical Aesthetics', in Shimamura and Palmer, *Aesthetic Science*, 70 and 250–75, respectively.

I have not explicitly addressed the roles that sentiment, feeling, and emotion have been thought to play in art. These aspects of experience are among the diagnostic cues that facilitate recognizing a work as a member of the genre, historical period, or other category of art against which the artistic salience of its content can be determined and understood. Although there is not space for a full discussion of these issues, the proposed model has the resources to accommodate the role that these aspects of experience have been thought to play in our understanding and engagement with artworks.⁵⁸ Attributions of affective and emotional significance to a stimulus influence affective attention via the same integrated crossmodal network of perceptual processes discussed above and thereby shape the way we recognize and perceive formal-compositional features of a work that are diagnostic for its aesthetic, expressive, and related semantic properties.⁵⁹ These processes, in turn, shape our gut reactions and emotional responses to valenced stimuli, including the positive affect associated with aesthetic preferences and successful aesthetic appraisals.⁶⁰ Further, consistent with the proposed model, recent research demonstrates that endogenously cued attentional processes that reflect the cognitive influence of object recognition, task demands, and the current goals of an agent guide and shape affective perception and associated autonomic and emotional responses. However, just as in the case of aesthetic properties more generally, these kinds of affective responses play a critical role in our emotional and evaluative engagement with a broad range of non-art objects and events, e.g. our responses to the expressive gestures of ordinary individuals in everyday contexts or positively valenced aesthetic responses to commercial design objects. I argue, therefore, that what matters for understanding and explaining the role feeling, sentiment, and emotion play in our engagement with art is not the affective profile of associated responses per se, but rather the contribution they make to our understanding of the point or purpose of the work, its content or meaning, e.g. the role sympathetic and empathetic responses to characters play in narrative understanding.⁶¹

Let me conclude with a quick comment about one thing this model is not. It is not a model for the neural correlates of interpretation, the art-critical meaning, or more generally the artistic content of a work. Rather, it is an attempt to model the influence of attentional processes on a range of behaviours canonically associated with our engagement with artworks. The goal is to enhance our understanding of the ways that

58 See Pessoa and Adolphs, 'Emotion Processing and the Amygdala'. For a discussion of the details of this account of our affective engagement with artworks, see Carroll and Seeley, 'Cognitivism, Psychology, and Neuroscience', and Carroll and Seeley, 'Kinesthetic Understanding and Appreciation in Dance'.

59 See Pessoa *et al.*, 'Attentional Control'.

60 See Duncan and Barrett, 'Affect Is a Form of Cognition'; and Silvia, 'Human Emotions and Aesthetic Experience'.

61 See N. Carroll, 'Aesthetic Experience Revisited', *BJA* 42 (2002), 163–6; 'Four Concepts of Aesthetic Experience', 59–62; and Silvia, 'Human Emotions and Aesthetic Experience'. See also Amy Coplan, 'Empathetic Engagement with Narrative Fiction', *JAAC* 62 (2004), 141–52; N. Carroll, 'Simulation, Emotions, and Morality', in G. Hoffman and A. Hornung (eds), *Emotion in Postmodernism* (Heidelberg: Universitäts Verlag C. Winter, 1997), 383–400; A. I. Goldman, 'Imagination and Simulation in Audience Responses to Fiction', in S. Nichols (ed.), *The Architecture of Imagination* (Oxford: OUP, 2006), 41–56.

non-aesthetic artistically salient cognitive variables, e.g. knowledge of the stylistic conventions and art-critical concerns that define different categories of art, are used to direct attention to features of artworks that are diagnostic for their meaning or content, and thereby influence perceptual, interpretive, and affective behaviours associated with the common artistic practices associated with artworks in a broad range of media; e.g. differences in gaze strategies and the perception of depicted distance associated with differences in the interpretation of the depicted action in Andrew Wyeth's *Christina's World* and similar behavioural differences associated with the different questions Yarbus asked participants about the content of Ilya Repin's *The Unexpected Visitor* in his seminal eye-tracking studies.⁶²

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62 T. Catania, A. Chemero, and W. P. Seeley, 'The Influence of Art Historical Knowledge on Gaze Strategies in Viewers' Engagement with Andrew Wyeth's *Christina's World*' (unpublished); Seeley, 'Imagining Crawling Home'; and Yarbus, *Eye Movements and Vision*.