THE NEUROPHYSIOLOGY OF AESTHETIC EXPERIENCE:

THREE CASE STUDIES

by

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A dissertation submitted to the Graduate Faculty in Philosophy in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

2006

UMI Number: 3213152

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This manuscript has been read and accepted for the Graduate Faculty in Philosophy in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

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There is an explanatory strategy underlying current research in cognitive science and aesthetics, which suggests a model for naturalizing aesthetic experience. This model is derived from a general constructivist theory of vision and rests on the following claims about visual art: the visual system constructs visual representations by imposing order on the flux of sensory information reaching it from the retina; visual art somehow exploits the properties of these processes; and an intuitive awareness of how visual artworks exploit these processes is an integral part of the unique character of aesthetic experience. An explanation of the structure of the perceptual processes subserving the practices of visual artists and viewers can, as a result, explain aesthetic experiences. I refer to this model as *The Constructivist Hypothesis*.

I evaluate three theories that employ this model to explain the nature of aesthetic experience: Semir Zeki's assertion that visual art can be explained relative to the way artworks function to selectively stimulate discrete areas of the early visual cortex; Jennifer McMahon's claim that the phenomenal content of the experience of aesthetic form involves an intuitive understanding of sub-linguistic perceptual schemata; and a theory of art and imagination for the visual arts derived from Stephen Kosslyn's imagery feedback theory of visual search and

object recognition (Kosslyn, 1996).

There is a philosophical objection one can raise for this approach to cognitive science and aesthetics. It appears that, because of its perceptual bias, the model cannot account for the role of interpretation in viewers' aesthetic practices. Interpretation is ordinarily defined as a cognitive practice that involves contextualizing what one has perceived in terms of background knowledge of the aesthetics practices of a culture or historical period. I argue to the contrary that contemporary theories of vision integrate viewers interpretive and perceptual practices. This suggests that the meanings viewers ascribe to artworks play a role in structuring their perceptual content. I argue, as a result, that one can explain the aesthetic dimension of viewers interactions with artworks in terms of the role played by memory and attention in ordinary perception.

Acknowledgements

Special thanks are due to my dissertation adviser, David M. Rosenthal, without whose open mind, undying patience, and keen eye for detail, an interdisciplinary project of this type could not have been realized. I would also like to thank Richard Schwartz and Nickolas Pappas; Emily Michael, Robert Lurz, and the Department of Philosophy at Brooklyn College; Josh Weisberg, Roblin Meeks, and Doug Meehan for being a great cohort to come up with; my parents for setting the stage and making it possible; Parker and Raines who make everything worthwhile; and most importantly, Christine for her bottomless well of optimism and support.

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> The aim is not to replace a description of mental events by a description of brain activity. This would be like replacing a description of architecture with a description of building materials. Although the nature of the materials restricts the kinds of buildings that can be built, it does not characterize their function or design. Nevertheless, the kinds of designs that are feasible depend on the nature of the material. Skyscrapers cannot be built with only boards and nails, and minds do not arise from just any material substrate (Kosslyn and Koenig, 1995, p. 4).

What is cognitive science and aesthetics? In the most general sense, this new field encompasses a diverse range of interdisciplinary work that involves the application of theories and methods from philosophy, computer science, psychology, anthropology, art history, and cognitive neuroscience to the study of art and aesthetic experience. More specifically, it is an attempt to understand art in terms of the perceptual practices of artists and viewers. This approach has recently been referred to as a "psychological" or "cognitive turn."[1] In fact it is not so much a new direction as a contemporary spin on a traditional view of philosophical aesthetics. Alexander Baumgarten introduced the term 'aesthetics' in the eighteenth century to describe a new discipline dedicated to the study of sensuous cognition, or perception. Baumgarten conceived the study of sensuous cognition as an examination of the way perceivers translate the dense flux of sensory information in conscious experience into clear perceptual images. The computational model of cognitive science treats perceptual systems as sets of processes for transforming the dense flux of sensory input into the rich content of perception. As a result, the cognitive turn in the study of art and aesthetics can be conceived as an examination of the way perceptual systems transform

1. "Art, Mind, and Cognitive Science," NEH Summer Institute, 2002, University of Maryland, http://www.philosophy.ubc.ca/art-mind/ overview.html.

the sensory contents of artworks, e.g. the two-dimensional marks on a canvas or the series of tones that constitute a musical score, into clear perceptual representations.

There is a general explanatory strategy that I argue unifies this new research in cognitive science into a coherent field of enquiry. The subsequent model for aesthetics, which I call the constructivist hypothesis is derived from the conjunction of the following assumptions:

> (CH1) The Constructivist Thesis:
> Perception is an active process.
>
> (CH2) The Fry-Ruskin Thesis:
> Art exploits the properties of this process.
>
> (CH3) The Constructivist Hypothesis:
> An understanding of the way artworks exploit these processes plays a role in explanations of art and aesthetic experience.

The intuition underlying the constructivist thesis can be cashed out in terms of a constructivist theory of vision. These theories rest on two central claims. First, the sensory input to the visual system underdetermines the content of visual perception. Second, as a result, vision is an interpretive, or inferential process influenced by a perceivers' prior knowledge of the structure of the distal environment. The inverse problem can be used to illustrate the constructivist's first claim. The input to the visual system is a two-dimensional retinal image that is consistent with an infinite set of three dimensional, or inverse, projections. Imagine a simple line drawing of a place setting at the head of a long rectangular table (figure 1). If one initially masks the rest of the drawing so that only the dinner plate is revealed, normal subjects report that they see an ellipse, the

correct two-dimensional shape of the marks on the paper. However, when shown the same shape in the context of the whole drawing, they report that it is a round plate.[2] This demonstrates that the same image feature, the two-dimensional projection onto the retina of the elliptical figure that represents the plate, can be perceived as both a two-dimensional ellipse and a shallow, round, three dimensional object. Therefore, the retinal input to the visual system underdetermines the content of perception.

David Marr commented that what is most interesting about the inverse problem is not that it is a problem, but rather that the majority of alternate interpretations of retinal images never come to mind (Marr and Nishihara, 1978). Constructivist theories of vision can explain why this is the case. These theories assert that visual perception depends on a process of unconscious inference. On this account, prior knowledge of both the structure of the distal environment and the structure and function of general object types functions as a set of hidden assumptions that, in conjunction with sensory inputs, generate visual representations of perceived objects and scenes. For instance, in the dinner plate demonstration, differences in context indicate differences in function, which, in turn, trigger different sets of hidden assumptions. These different sets of assumptions enable the visual system to generate different visual representations from the same two-dimensional elliptical shape. Therefore, vision is an interpretive, or inferential process.

The constructivist hypothesis rests on the claim that visual artworks are

2. This example is derived from E. H. Gombrich's discussion of Henri Thouless (1931).

perceptual stimuli designed to exploit the interpretive nature of perception. This is not a novel view of either perception or the nature of artworks in philosophical aesthetics. Roger Fry argued that familiarity and practical necessity cause the functionally salient attributes of an object's appearance to become "labeled" by the visual system. Once this occurs, on Fry's account, viewers attend only to the object's "labels," and cease to perceive it as it actually appears in any particular context. Therefore, one's memory of the ordinary shapes and functions of object types, "interferes" with perception, and so renders the actual structure of a visual stimulus 'invisible' to the viewer (Fry 1909: 17 - 18; and Fry 1919: 33 – 34).[3] The goal of the artist in this context is to construct abstract perceptual stimuli whose formal structure is sufficient to trigger the hidden assumptions constitutive of an artwork's depictive content. The result, if successful, is that viewers perceive what the work depicts, and the actual formal structure of the stimulus is rendered invisible. For instance, the outline of the head of the figure in Picasso's "Baboon and Young" resembles the outline of a baboon's head. This cue causes viewers to categorize, or identify, the sculpture as a representation of a baboon. As a result they perceive the figure as a higher primate and fail to perceive the formal features that define the actual shape of the figure's head .[4]

This aspect of the Fry-Ruskin thesis is supported by psychological data. Henri Thouless demonstrated that subjects 'expectations' about the identity of an object effected their perception of its shape. The author asked subjects to match a dinner plate, presented at an obtuse angle analogous to the drawing in figure 4,

3. This view had been expressed 50 years earlier by John Ruskin (Ruskin 1857: fn. 27 – 28; see also Gombrich 1960: pp. 291 - 329).

4. The head is in fact a cast of a toy car.

to the member of a graded series of ovals that most accurately depicted its perceptual, or phenomenal, shape.[5] Subjects consistently overestimated the height, or 'roundness,' of the plate's perceptual shape across numerous trials. In fact, even trained draughstmen, artists' who understand the effects of knowledge on perception, misperceived the shape of the plate (Thouless 1931; Winner 1983: 92; Gombrich 1960: 302).

Fry and Ruskin both argued that artists' formal methods include viewing strategies that enable them to attend to the structure of appearances independent of interference from practical knowledge. These strategies enable painters to recognize scenes, artifacts, and natural objects as perceptual stimuli composed of the abstract visual cues necessary for accurate depiction (Fry, 1919, pp. 35 – 37). In other words, artists' methods include viewing strategies that enable them to recognize scenes and objects as artworks, e.g. paintings (Gombrich 1960, p. 298). Consider the dinner plate demonstration again. The two-dimensional elliptical figure representing the plate in the drawing is ordinarily perceived as a circular object in depth. This is useful from a practical perspective. It facilitates reaching for one's mashed potatoes. However, if one were to draw the dinner plate discussed above as a circle, it would float, detached from, and perpendicular to the picture plane. Rendering the plate so that it appears as a flat, round object viewed in perspective requires artists to know to draw it as an

5. The phenomenal shape of an object is the shape of its two dimensional retinal projection.

ellipse.[6] In the context of contemporary vision theory artists' productive strategies denote novel classes of semantic knowledge that define artworks in different media as distinct types of perceptual stimuli with their own unique shapes and functions.[7]

'Semantic knowledge' is defined in contrast to episodic memory. Episodic memory is one's memory of particular autobiographical events or experiences. Semantic memory is defined as a subclass of explicit or declarative memory that encodes knowledge of word meanings, concepts, and language. In the context of object recognition semantic knowledge refers to a subset of semantic memory that encodes one's knowledge of general facts about the world, including knowledge of the basic shapes and functions of general object types (Kandel, Schwartz, and Jessell, 2000, pp. 1230 – 1231, Ashcraft, 1998, p. 132; Ashcraft, 1994, p. 639; and Atkinson, Atkinson, Smith and Hilgard, 1985, p. 266).[8] The function of the formal structure of an artwork is to generate the depictive content of a painting by triggering the influence of this class of object knowledge in viewer's perceptual interactions with artworks. Therefore, artists' formal methods and vocabularies reveal their knowledge of the structure of appearances, which consists in a capacity to manipulate the unconscious inferences constitutive of what viewers perceive.

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6. Perspective illusions offer further illustration of this principle. For instance, the hallway illusion demonstrates that in order to make a distant object look the correct size one must know to draw it significantly smaller than it appears.

7. This view is derived from Gombrich's critique of John Ruskin and Roger Fry (Gombrich, 1960, pp. 291 – 329).

8. The differentiation of declarative long term memory into episodic memory and semantic knowledge is attributed to Endel Tulving (Tulving 1972). Semantic knowledge is also sometimes referred to as semantic memory (Ashcraft 1998, Tulving 1972) or knowledge of general facts as opposed to personal facts (Atkinson et al 1985).

Two correlated explanatory streams emerge from this model. The Fry-Ruskin thesis demonstrates that the formal structure of artworks can be explained in terms of what artists explicitly know about how to manipulate the structure of appearances. The constructivist thesis demonstrates that the formal structure of artworks can be explained relative to their functional structure, or how they work to trigger phenomenal experiences in perceivers. The functional structure of an artwork is defined in terms of the way perceivers receive and process its perceptual content, i.e. relative to the operation of perceptual systems. This entails that the study of cognitive science and aesthetics can be defined relative to two general projects: first, one must empirically establish the content of these two correlated explanatory streams; second, one must establish a link between them that explains the aesthetic dimension of art and aesthetic experience.

Baumgarten's original framework for aesthetics grounds the first stage of this project. However, this generates a problem for the second stage. Baumgarten considered aesthetic concerns separate from those that define the nature of art. He therefore thought of art and aesthetics as correlated, but not coextensive, fields of study that were linked by the common goal of understanding the structure of perception. This entails that one must distinguish between two uses of the term 'aesthetics': one that refers to the processes responsible for the perceptual content of artworks, and another that refers to what differentiates artworks and aesthetic experiences from their ordinary counterparts. Cognitive science can, at least in principle, explain aesthetics in

the former sense. However, it is an open question whether it has, as a result, explained aesthetics in the latter sense. In what follows, I will use the term 'aesthetics' primarily in its more contemporary, artistic sense.

1.0 The Constructivist Hypothesis

The value of the constructivist hypothesis as a theory of aesthetics rests on the assumption that an introspective understanding of the structure of perception is, in itself, aesthetically valuable. However, the validity of this assumption is not established by the perceptual practices of artists and viewers alone. Therefore, although the model demonstrates that the study of art and aesthetic experience is interesting to the cognitive neuroscience of perception, it does not, in itself, establish that an understanding of the psychology of perception plays a role in explanations of aesthetics in the artistic sense. What is needed to establish the latter is a theory that links the perceptual and aesthetic practices of artists and viewers.

The arguments and case studies used in what follows lean heavily on examples drawn from the history of painting. There are several reasons for this choice. First, painting is a two-dimensional visual medium that generates three dimensional visual experiences. Therefore, viewers' perceptual interactions with paintings exemplify the claim that vision is an active process. Second, painting has historically been closely associated with the study of perception. Therefore, the traditional conception of painters' formal methods exemplifies the Fry-Ruskin thesis (Fry, 1934; Gombrich, 1960; and Kemp, 1990). Third, case studies in the

cognitive neuroscience of visual aesthetics used to generate the model for the constructivist hypothesis lean heavily on the history of painting (Chatterjee 2004; Chatterjee 2003; Livingstone 1988; Livingstone 2001; Livingstone 2002; Zeki 1999; and Zeki and Lamb 1994). However, the model is not restricted to the study of painting. Given the constructive nature of perceptual systems in general, the constructivist hypothesis can be extended to cover sculpture, film, dance, and aesthetic mediums that exploit other perceptual modalities, e.g. music (see Livingstone, 2001; Smith, 1997; Montero, 2004; and Raffman 1993 respectively).[9]

In the remainder of Section 1 I introduce three approaches to cognitive science and aesthetics that exemplify the constructivist hypothesis: Semir Zeki's neuroaesthetics; Jennifer McMahon's claim that the phenomenal content of the experience of aesthetic form involves an intuitive understanding of sub-linguistic perceptual schemata; and a theory of art and imagination derived from Stephen Kosslyn's model of mental imagery. These theories demonstrate that an understanding of the cognitive neuroscience of vision can play a role in explanations of the perceptual practices of artists and viewers. However, I argue that this fact does not suffice to demonstrate that they play a role in explanations of the aesthetic practices denoted by the contemporary use of the term 'aesthetics'. In section 2.0, I expand on the relationship between Baumgarten's framework for aesthetics and the constructivist hypothesis. In section 2.1 and 2.2, I discuss the relationship between the constructivist

9. See Dowling, 2001, pp. 417 – 418 for a discussion of physiological similarities between the auditory and visual systems, and see Kandel et al, 2000, for the general constructive nature of perceptual systems

hypothesis and contemporary theories of aesthetics. In sections 3 I conclude by discussing some philosophical issues surrounding the integration of cognitive neuroscience and philosophical aesthetics.

1.1 Semir Zeki's Neuroaesthetics

Semir Zeki's discussion of the writing and work of Alexander Calder can serve as a case study to illustrate the constructivist hypothesis (Zeki and Lamb, 1994, pp. 629 – 630; Zeki, 1999, pp. 152 - 160). Zeki claims that the function of visual art is synonymous with the function of the visual system, i.e. the construction of representations of those "constant and enduring" properties of scenes and objects that enable a perceiver to categorize, and so recognize, them in perception. The visual system realizes this goal by comparing information extracted from retinal images via evolved neurophysiological mechanisms to stored records of the characteristic properties of object types. Artists approach the task by developing formal vocabularies that enable viewers to identify the representational content of their works by triggering the same visual processes. These formal vocabularies are derived from a detailed understanding of the structure of appearances. Zeki argues that this entails that visual artists' formal methods encode an intuitive understanding of the functional architecture of the visual system.

More specifically Zeki argues that artists' formal vocabularies encode an intuitive understanding of the receptive field properties of neurons in the early visual cortex. The receptive field properties of a cell are defined relative to the

features in the distal environment to which it responds. Zeki argues that the receptive field properties of the visual cortex represent evolved mechanisms for selecting salient information concerning color, form, and motion from retinal images to serve as the building blocks for visual representations. Artists develop their formal vocabularies by selecting salient visual cues from the distal environment to serve as the building blocks for the depictive, and transitively, representational content of their works. These cues work because they are the same visual cues that trigger the receptive fields of neurons in the visual cortex. Therefore, the formal structure of a visual artwork is directed at, can be explained relative to, and encodes an "intuitive" understanding of the receptive field properties of the color, form, and motion pathways of the visual brain.[10]

Alexander Calder wrote that motion was most efficiently represented by the juxtaposition of highly contrastive surfaces. As a result, he decided to limit himself primarily to the use of black, white, and red (which he thought was the color best opposed to black and white) elements in his mobiles. In addition he argued that all other colors confuse the clarity of motion (Calder, 1952, p. 43). Zeki argues that Calder's claim demonstrates that he intuitively understood the functional specialization of the color and motion pathways in the visual cortex.

Three types of evidence demonstrate the functional specialization of the color and motion pathways. First, PET studies show that, when one is viewing a moving array of black and white dots, a different area of the visual cortex, V5, is active than when one is viewing a static color pattern, V4. Second, damage to these discrete regions of the brain are associated with selective loss of motion

10. See also Latto, 1996, p. 66 – 72.

and color perception respectively. Third, behavioral evidence demonstrates that motion perception is, as Calder asserted, sensitive to luminance, and not color cues. For instance, V. S. Ramachandran and R. L. Gregory constructed an illusory motion display by counterposing two red-green random dot stereograms such that in the display normal subjects perceived a square central region shifting up and down (Ramachandran, 1978). Subjects were asked to manipulate the relative luminance of the colored regions by adjusting the brightness of the green dots. The red and green regions of the display remained clearly discernible throughout the task. However, illusory motion disappeared as they approached isoluminance.

The evidence confirming the functional specialization of regions in the visual cortex also confirms and explains Calder's comments about manipulating motion perception. It thereby establishes a link between the two correlated explanatory streams. However, a problem arises if one takes this to be an explanation of either the aesthetic properties of, or viewers' aesthetic interest in, Calder's mobiles. The link is established via explanations of the success of the perceptual practices of artists and viewers. Explanations of this type apply equally to our understanding of the functional success of many non-art perceptual objects as well, e.g. Ramachandran and Gregory's illusory motion display. Therefore, this link does not serve, in itself, to explain how either art or aesthetic experience differ from their ordinary counterparts. This, in turn, entails that it does not suffice to explain the notion of aesthetics in its artistic sense.

1.2 Jennifer McMahon's Theory of Aesthetic Form

Jennifer McMahon offers an alternative approach. She argues that aesthetic experience can be explained by attending to the way the visual system constructs the global perceptual form of visual images. She argues that the fact that the visual system is able to generate stable, three dimensional visual representations from the two-dimensional flux of varying lightness intensities received by the retina entails that it contains two types of computational structures: form primitives that enable it to organize visual inputs into lines, planes, local volumes, and global shapes; and transformational rules which govern the construction of, and relations among, form primitives. On this account form perception consists of several stages of image processing whose function is to transduce ambiguous two-dimensional retinal images into representations of the global structure of objects and scenes. For instance, sharp luminance boundaries in the retinal image are interpreted as lines, sets of overlapping or closely grouped lines form texture gradients that are interpreted as contours, and contours separating homogenous regions of sharply different luminance are interpreted as surface boundaries. McMahon hypothesizes that aesthetic experience can be explained as the product of an intuitive awareness of the role these computational rules play in form perception.

Evidence in support of McMahon's thesis can be drawn from theories of object constancy. Perceivers must be able to recognize objects from an infinite set of novel views whose appearances differ, often dramatically, when perceived from diverse viewing angles, at varying distances, and under different lighting

conditions. This entails that the visual system must employ a strategy for matching the perceptual form of disparate sets of initial visual images to stored records of the defining formal features of objects and scenes. McMahon appeals to a generalized, Marr-style model that, consistent with this hypothesis, divides visual recognition into two types of processing: bottom-up computational processes responsible for constructing the perceptual form of an image from ambiguous inputs, e.g. basic grouping processes; and top-down categorization processes responsible for subsequently identifying what an image represents relative to prior knowledge of the shapes and function of object types, i.e. a process for matching the form of an image to semantic knowledge. McMahon's explanation of aesthetic form rests on the claim that these processes can be dissociated in ordinary conscious experience. She argues that in certain contexts the perceptual form of an image challenges the visual system so that normal perceivers become aware of its key formal elements independent of the influence of semantic knowledge in object identification. Prior to becoming subject to these sorts of top down conceptual influences, the perceptual form of an image refers to, and so exhibits an awareness of, the transformational rules and form primitives from which it was constructed, not the object or scene that it represents. McMahon asserts that aesthetic interest is the product of this sort of perceptual event, and so reveals direct intuitive knowledge of the transformational rules responsible for the form of perceptual representations.

Evidence from computational theories of vision and the neuropsychology of perception support McMahon's claim. It is argued that, given the fact that

object identification involves matching the form of an image to prior world knowledge, form recognition must be computationally prior to, and logically distinct from, object identification (Marr, 1982, p. 35; Marr and Nishihara, 1978, p. 31). Further, the behavioral deficits of patients suffering from visual agnosia provide evidence that these two processes can be dissociated in viewers' perceptual experience (Warrington and Taylor, 1978, p. 696; Humphreys and Riddoch (1998), p. 105; Ogden (1996), p. 127; Parkin (1996), pp. 52 – 56; and C. M. Butter and J. D. Trobe (1994). Visual agnosia refers to a broad category of syndromes associated with modality specific deficits in visual recognition. Associative visual object agnosia is defined as a categorization deficit. Patients suffering from this syndrome cannot, due to damage to the visual cortex, identify objects visually. Nonetheless, they can match basic visual patterns, draw remarkably accurate copies of line drawings, and in some cases describe the forms of familiar objects they do not recognize. The standard explanation of this syndrome is that patients can recover the global form of visual images, but cannot, due to the nature of their brain damage, match these images to the semantic knowledge necessary to identify what they represent.[11] This evidence demonstrates that form recognition can be dissociated from object identification.

McMahon's theory rests on the hypothesis that principal axes serve as the

11. There is some controversy about how much of the global perceptual form of images patients can recover in the absence of top-down input from semantic knowledge. One theory is that they are able to recover the local geometry of the image but cannot integrate these features to generate the object's global form (Humphreys and Riddoch, 1998; Farah, 1992; and Ogden, 1993). Nonetheless it is generally agreed that these patients do have significantly intact form recognition capacities. This description of associative visual object agnosia suggests that semantic knowledge and top down processing plays a large role in structuring the content of visual perception, e.g. recovering the global structural features of visual images.

form primitives from which the global form of an image is constructed. These are axes of symmetry or elongation around which the local parts of images can be grouped to define the global form of a scene or object. In principle, an object could be enlarged, shrunk, or rotated around its principal axis to produce any of an infinite set of novel views. However, the relationship between the parts and the principal axis would remain constant across all of these variations. Marr argued, as a result, that principal axes provide a solution to the problem of object constancy. The representational power of principal axes can be illustrated by the representational success of stick figures and pipe cleaner models (see figure 3).

Consider the fractured geometry of Braque's "Bouteille et Poissons" (figure 4). McMahon argues that Cubism defines figures in terms of their smallest perceivable units, i.e. local image features. The skewed structure of a Cubist painting is constructed by altering the orientation of these units relative to the global shapes of the figures represented. The representational content of a Cubist painting is, therefore, more or less recognizable relative to the degree to which these distortions retain a perceivable relationship to the principal axis that defines the form of the represented figure (McMahon, 2000b, p. 3). This entails that the success (or failure) of Cubist painting reveals Picasso and Braque's introspective understanding of how to control for the relationships between local image structure and global form primitives in viewers' perceptual experiences. The bottle in the upper left quadrant is clearly recognizable due to its strong axis of symmetry. However, the shapes of the variously sized fish piled on the table are partially occluded, depend on obscure axes of elongation, and so are difficult

to recognize. Further, the chair in the upper right quadrant is defined by an obscure occlusion boundary, and so is rarely spontaneously recognized by viewers.

McMahon claims that viewing an aesthetic object is akin to resolving a perceptual problem by culling the salient structural features necessary to identify its global form from the detail and variety of its appearance. On this account, paintings like Braque's serve as limiting cases that reveal the viewer's share, ordinarily unnoticed, in structuring the content of perception. However, McMahon's theory is subject to the same difficulty that confronts Zeki's. These recognition processes are operative in all ordinary visual recognition tasks. Therefore, McMahon's theory does not, in itself, suffice as an explanation of aesthetics in its artistic sense.

1.3 An Imagery Feedback Model for a Theory of Art and Imagination

The constructivist hypothesis represents an attempt to define art relative to the phenomenal content of aesthetic experience, i.e. the perceptual and expressive properties of viewers interactions with works of fine art. It is argued that this approach cannot account for the integral role played by interpretation in the construction of the content of artworks. Interpretation is canonically defined as a non-perceptual mode of interaction with artworks, and so outside the purview of theories of this type (Carroll, 1986, p. 59; and Danto, 2000, p. xx - xxiv). Kendall Walton and Gregory Currie's discussions of art and imagination

suggest a model that can resolve this objection.[12] Theories of art and imagination in the visual arts rest on the claim that thought contributes to perception. For instance, Walton asserts that, "Imaginings also, like thoughts of other kinds, enter into visual experience...The seeing and the imagining are inseparably bound together, integrated into a single, complex, phenomenological whole" (Walton, 1990, p. 295). This observation, if sound, entails that how one perceives an object depends in part on how one conceives it, and that interpretation and perception are not distinct mental events.

Theories of art and imagination are derived from the assertion that abstract visual cues embedded in the formal structure of visual artworks prompt viewers to "imaginatively see" what they represent. This suggests that artworks are degraded images whose content must be augmented by what viewers know. One can, following a constructivist theory of vision, interpret this to mean that the formal structure of a painting is analogous to a retinal image: it consists in a set of visual cues that underdetermines the content of perception, but is nonetheless, in conjunction with background knowledge, sufficient to enable viewers to reconstruct robust, three dimensional images of what it represents. For instance, a painting is simply a two-dimensional pattern of more and less translucent patches of pigment. Yet viewers perceive quite realistic three dimensional visual scenes in these paintings, scenes whose visual content includes occluded spaces, and extends beyond the boundaries of their frames, e.g. Robert

12. Kendall Walton, (1990); Gregory Currie (1995a), (1995b) and (2002). The theory that I present in this paper is derived from comments made by Walton and Currie (Walton, 1990, p. 295; Currie, 1995b). However, the heavy dependence on visual processing and first person visual experiences represents a significant departure from their approaches.

Bechtle's "Alameda Gran Torino" and Albert Bierstadt's "Looking Up Yosemite Valley" (figures 5 and 6). Theories of art and imagination therefore suggest that visual artworks are prompts for richer acts of seeing whose contents are filled-in by visual imagination. In this context 'richer' means "has broader perceptual content than the perceptible surface of the work itself due to top-down conceptual contributions from background knowledge, memories, etc."

Stephen Kosslyn's imagery feedback model for object identification, provides a mechanism for the role Currie and Walton ascribe to imagination in aesthetic experience. Kosslyn's theory of mental imagery is derived from a hypothesis testing model of object identification. The central claim of this model is that, during visual search and object recognition, ambiguous sensory data is matched to semantic knowledge concerning the shapes and functions of object types. When a near match is found, conceptual information is backpropagated into the visual system. This process generates a visual hypothesis about the structure and configuration of an object or scene which is, in turn, instantiated in the areas of the visual cortex responsible for object recognition as a low level pattern of activation. This process, in turn, primes the visual system to the expectation of object features at certain locations, and directs visual attention accordingly. If these "expectations" match further sensory data, then the process is complete. Otherwise it cycles through again.

The primary visual cortex is the region of the brain where the retinal image is initially encoded. This entails that images generated top down from background knowledge can themselves function as low grade, surrogate retinal

images that trigger the processes responsible for visual experience. Kosslyn argues that this is what occurs in mental imagery. The visual system is run off-line, triggered by an image generated top-down from concepts stored in long term memory rather than bottom-up from retinal stimulation.

Kosslyn argues further that this entails imagery plays an important role in the construction of the forms and identities of degraded images in ordinary perception. The critical feature of Kosslyn's model is the role he attributes to spatial working memory in imagery and visual recognition. Reciprocal connectivity between the areas of the prefrontal cortex associated with spatial working memory and the visual cortex functions as the mechanism for generating mental imagery. In ordinary perceptual contexts these same mechanisms function to shift attention and prime the visual system to the expectation of novel contours at particular locations in the visual field. In this manner, imagery feedback to ordinary visual processing functions to augment and amplify previously unnoticed image features necessary to recognize the content of fragmented, blurry, and otherwise degraded images.

Consider the following examples: Braque's "Bouteilles et Poissons" again, and Andrew Wyeth's "Christina's World." The title of Braque's painting functions as a strong semantic cue that helps viewers construct the representational content of the painting. In the absence of the title naïve viewers rarely recognize even the bottle in the upper left quadrant of the painting (see figure 4). I have found that introducing the title to these same viewers, in conjunction with a short discussion of Cubism, enables them to pick out most of the figures in the painting,

e.g. the bottle in the upper left quadrant, the five fish in the foreground, and the chair in the upper right quadrant.

Similarly, biographical information about Christina Olsen has a dramatic effect on viewers' aesthetic interactions with Andrew Wyeth's "Christina's World." Christina was in her fifties, had had polio as a child, could not walk, and regularly dragged herself by her hands across the field in the foreground to visit her parents' graves. This information functions to clarify the juxtaposition between the seemingly healthy young woman in the foreground and the bleak landscape, focuses viewers' attention on her, perhaps previously unnoticed, emaciated ankles and gnarled wrists, and amplifies the distance between the figure and the house. In this manner, background knowledge, consistent with Kosslyn's model, serves both to direct our attention towards unnoticed elements of a painting and augment its perceptual content.

The question is, "Do these sorts of explanations of the content of viewers interactions with artworks explain aesthetic interest?" The difficulty is, again, that the perceptual processes appealed by theories of art and imagination are the same cognitive processes operative in ordinary visual recognition tasks. Therefore, theories of art and imagination, as examples of the constructivist hypothesis, do not suffice as independent explanations of aesthetics in the artistic sense.

2.0 Art, Cognitive Science, and Aesthetics

The constructivist hypothesis rests on the claim that explanations of the

perceptual practices of artists and viewers can elucidate our understanding of the way artworks generate aesthetic interest. In the literature, this thesis is derived from two largely unexamined assumptions. First, part of what makes an artwork aesthetically interesting is its formal structure (Zeki and Lamb 1994, p. 607; McMahon, 2001, pp. 235 – 236). Second, what makes the formal structure of an artwork aesthetically interesting is the way it "resonates" with the operation of the visual system (Zeki 1999b, p.150; Latto, 1995, p. 68; and McMahon, 2001, p. 236). As a consequence of these assumptions, the constructivist hypothesis asserts that explanations of how artworks work as perceptual stimuli are also explanations of how artworks generate aesthetic interest.

However, explanations of the perceptual practices of artists and viewers do not demonstrate the validity of this aesthetic thesis. This is observation applies equally to theories of art and imagination and Zeki and McMahon's approaches. Artworks work as perceptual stimuli simply because they exploit the cues and processes operative in ordinary perceptual experience. As a result, explanations of the way artworks work as perceptual stimuli apply equally to artworks and non-aesthetic visual stimuli, e.g. the scene perceivable from my window. This observation suggests the following general objection to an aesthetic interpretation of the constructivist hypothesis. Cognitive science can explain the functional success of artworks as perceptual stimuli. Cognitive science can, as a result, augment our understanding of aesthetic experiences as a category of perceptual experience. However, these sorts of explanations do not, <u>in themselves</u>, add anything to our understanding of the aesthetic dimension

of these objects and activities. Therefore, the value of the constructivist hypothesis as an aesthetic thesis is not established by research in cognitive science. Rather, it depends on the existence of a complimentary theory of aesthetics which grounds aesthetic interest in an understanding of how artworks work.

A solution to this difficulty is forthcoming in the aesthetics literature. Noël Carroll argues that the search for latent structure in visual artworks is a source of aesthetic interest (Carroll, 1986, p. 61; Carroll, 2002, p. 165). The term 'latent structure' refers to the design features of an artwork responsible for its phenomenal, including aesthetic, effects. In this sense, the latent structure of an artwork is a hidden meaning that viewers uncover by contemplating how they come to recognize an artwork's content. Carroll claims that this practice is grounded in knowledge of the traditional European conception of aesthetics as the science of perception (Carroll, 1986, pp. 59 – 61). This tradition traces its roots back to Baumgarten. Therefore, aesthetic evaluations of how artworks work are interpretive acts loosely grounded in an understanding of the trace of Baumgarten's original framework remaining in contemporary 'aesthetics'.[13]

Baumgarten argued that clarifying the structure of one's phenomenal experience was a source of aesthetic pleasure (Beck 2003, p. 14; Guyer, 2001, p. 74; Guyer 1996, p. 84; Davies, 1997, p. 40). Evaluations of latent structure are a means to clarify the structure of the phenomenal content of one's interactions with an artwork. On Baumgarten's account, an artist's skill lies in his or her intuitive ability to cull image features from the flux of the sensory manifold that

13. See Chapter 4 below for a discussion of this claim.

enhance the clarity and vividness of perceptual representations. He believed that the resulting phenomenal experience yields a form of knowledge that is direct, intuitive, can not be resolved into explicit propositional form, and so cannot be explicitly described by perceivers. Rather, conscious access to this form of knowledge is mediated by a feeling or sensibility akin to the sense of cognitive consonance that accompanies the resolution of a particularly recalcitrant theoretical problem, e.g. proofs in mathematics, science, or logic (see discussion of McMahon above). Since this mental event plays a role in structuring the phenomena content of visual experience, contrary to Carroll's assertion, it generates a canonically aesthetic experience.

Cognitive science and aesthetics, as I have defined it, rests on the tacit assumption of this epistemic aspect of Baumgarten's program. Zeki and McMahon argue that both artists' aesthetic practices and viewers' aesthetic experiences are the product of an intuitive awareness of sub-linguistic perceptual processes dedicated to clarifying image structure. Further they argue that the aesthetic interest these perceptual experiences yield is measured relative to what they reveal about the structure of perception. Kosslyn's hypothesis testing theory of object recognition demonstrates that semantic knowledge contributes, via processes unavailable to perceivers' explicit awareness, to the process of clarifying visual images. Therefore, the constructivist hypothesis, as a theory of aesthetics grounded in an interest in the latent structure of artworks, can be conceived as an extension of Baumgarten's original framework for aesthetics.

2.1 Theories of Aesthetics

Theories of aesthetics are often associated with functional theories of art. Functional theories of art define artworks as artifacts designed to trigger certain types of responses in viewers. Theories of aesthetics assert that the canonical form of response to an artwork includes aesthetic content (Carroll, 1986, p. 57). Aesthetic content is traditionally defined relative to some subset of the phenomenal properties of a subject's interactions with artworks. Theories of aesthetics are therefore functional theories of art that define artworks as artifacts designed to trigger particular types of phenomenal experiences. Functional theories of art must answer two questions: what are the salient features of viewers' interactions with artworks; and how do artworks function to trigger these features. The constructivist hypothesis is the claim that explanations of the perceptual processes subserving viewers interactions with artworks will suffice to answer both of these questions. Therefore, the constructivist hypothesis can be interpreted as a functional theory of art.

The content of visual aesthetic experience can be divided into three types of features: a set of image features, a feeling that indicates that these features have been successfully apprehended, and the act of apprehending these features. Carroll argues that theories of aesthetics can be taxonomized into three categories relative to which of these features they grant priority in the production of aesthetic interest: content oriented theories, affect oriented theories, and active discovery theories (Carroll, 1986, p. 58 - 61). Content oriented theories of aesthetics rest on the ontological claim that aesthetic interest

is derived from the apprehension of some set of the formal properties of a work of art, natural object, or natural scene. Canonically, content oriented theories identify these attributes with the gestalt image features that enable viewers to cull the discrete perceptual content of a visual representation from the variety of its formal features, e.g. unity, harmony, rhythm, or balance. These are, consistent with McMahon's characterization of aesthetic interest, the image features that facilitate recovering the global structure of visual representation from its local geometry. However, this set of attributes can also be extended to include more concrete aesthetic image features like gracefulness, equipoise, brittleness, and etc. (Carroll, 1986, p. 61).

Affect oriented theories of aesthetics rest on the epistemic claim that the formal features of visual images are identified as aesthetic only relative to a feeling associated with aesthetic experience. These theories assert that, in the absence of the accompanying feeling, the formal image features identified by content-oriented theories are no different in kind than the ordinary formal features of non-aesthetic objects and perceptual stimuli. For instance, both Calder's mobiles and boom arm cranes exhibit balance and dynamic equipoise. However, in ordinary perceptual contexts only the former is categorized as an aesthetic object. This entails that the same set of abstract image features can be identified as aesthetic in one context, but not in another. Therefore, affect oriented theories argue that aesthetic interest lies in the affective responses through which viewers categorize artifacts and natural objects as aesthetic, not the formal features putatively identified as the cause of these responses (Carroll, 1986, p.

61).

Active discovery theories of aesthetics are a hybrid of content oriented and affect oriented theories. Active discovery theories rest on the claim that that the affective character of aesthetic experience is a product of apprehending the set of formal features of an artifact sufficient to identify it as an artwork. As a result aesthetic interest is not generated by either the formal properties of images or the affective character of viewers' aesthetic experiences alone. Rather, it is the product of an introspective evaluation of how the content of an artwork or natural scene functions as a stimulus to generate aesthetic experience, however the latter is defined (Davies, 1991, p. 51; Beardsley, 1983, p. 288 – 299; Carroll 1986, p. 61).

The constructivist hypothesis can be interpreted as an active discovery theory of aesthetics. The claim of the constructivist hypothesis is that artists' formal vocabularies are a means to manipulate the perceiver's share in the construction of the content of the structure of appearances. The content of works of visual art are a product of a functional relation between the formal structure of a work of art and the perceptual practices of viewers. This entails that the content of a particular work of art is a product of their latent structure. Active discovery theories define aesthetic experience as the product of a viewer's apprehension of the latent structure of a particular artwork (Carroll, 1986, p. 59). This entails that active discovery theories, analogous to Baumgarten's framework, define aesthetic interest as a product of the process of clarifying image structure. Therefore, if active discovery theories provide a sound account of aesthetic

experience, then the constructivist hypothesis can contribute to our understanding of aesthetics.

2.2 Do Active Discovery Theories Provide a Sound Account of Aesthetics?

The general problem that I have identified for the constructivist hypothesis also applies to content oriented theories of aesthetics. Many objects and events exhibit the abstract formal properties associated with content oriented theories of aesthetics, e.g., as discussed above, the equipoise, the dynamic physical structure, and smooth movement of a 30 story boom arm construction crane poised over the crowded New York City landscape may appear quite graceful. However, the phenomenal experiences triggered by perceiving that crane do not thereby necessarily become aesthetic experiences. Therefore, content oriented theories of aesthetics cannot differentiate between aesthetic and non-aesthetic perceptual experiences.

Affect-oriented theories of aesthetics fare no better. There is no question that some artworks trigger ordinary emotional responses, e.g. melancholy, joy, anger. This is most obvious in narrative media like film, in which spectators experience a sympathetic response to characters. However, there is reason to believe that ordinary emotional responses are not the locus of the aesthetic content of a viewer's interaction with the work. First, there are artworks that do not express any ordinary emotion, e.g. geometric abstraction like the sculpture of Sol Lewitt and Donald Judd (figures 8 and 9). Second, I might make an offensive gesture while driving on the highway with the intent of triggering a particular

affective response. However, the effectiveness of this act does not, in itself, transform the perceived symbol into an artwork. Similarly, soap operas, sit-coms, and police dramas are designed to capture the viewers' attention by triggering affective responses. The function of these responses is to keep a viewer riveted to the screen so that he or she will stay tuned for the duration of the advertisements. Although the ability of television programs to realize this function may be a mark of their effectiveness, it is not the source of their aesthetic worth. If it were then viewers' affective responses to stories on the evening news would count equally, and in the case of the crime reporting despicably, as aesthetic objects.

A discussion of R. G. Collingwood's expressionist theory of aesthetics suggests a solution to this problem. Collingwood argued that the function of art is to express emotions. Expressing an emotion involves representing one's subjective emotional state in some external form. Representing an emotional state in external form requires that one first clarify the structure of that emotional state (Collingwood, 1938, p. 112). Collingwood argued that the act of constructing a work of art functions to clarify the artist's emotion. Therefore, he argued that the function of an artwork is to clarify and make public the structure of the artist's subjective emotional states.

A viewer's aesthetic experience is, in this context, triggered by the recognition of those formal features that clarify the emotion it expresses. This entails that the affective response associated with aesthetic experience is not identical to the emotion expressed by the work. Rather it is a separate

epistemic response whose object is an understanding of how the emotion is represented (Collingwood 1938, p. 112). This, in turn, entails that the object of a viewer's aesthetic experience is neither the feeling associated with the apprehension of a work's expressive content, nor the formal properties that trigger this feeling themselves, but rather the act of coming to understand, or clarifying, how the work's latent structure determines its expressive content. Therefore, the aesthetic experiences associated with a work's expressive properties are the product of active discovery, not of the emotion the work expresses per se.

The Fry-Ruskin thesis rests on the claim that the aesthetic practices of artists and viewers are subserved by a similar perceptual strategy. Fry and Ruskin argued that artists derive the aesthetic content of their works from an understanding of the way perceptual cues function to trigger aesthetic responses in ordinary experience. Artists' formal methods are, therefore, epistemic strategies that function to clarify the content of their subjective perceptual experiences. Educated viewers recover the aesthetic content of artworks by adopting an analogous strategy in their interactions with artworks. The successful application of this epistemic strategy is associated with a feeling of cognitive consonance synonymous to the satisfaction of solving a difficult theoretical problem. The constructivist hypothesis adopts this aesthetic framework. This entails that the constructivist hypothesis is an active discovery theory that interprets aesthetic experience as the product of processes by which experienced viewers come to understand how the latent structure of works of art

generate their depictive and aesthetic effects.

2.3 What Can Cognitive Science Tell Us About Art?

What role does cognitive neuroscience play in this model for philosophical aesthetics? Aesthetic experiences are perceptual phenomena. Cognitive science defines perception as a cognitive process that involves the integration of sensory and cognitive content. The goal of cognitive neuroscience is, in part, to uncover neurophysiological constraints on psychological systems that elucidate the structure and function of cognitive processes, e.g. the relationship between visual agnosia research and theories of perception (see above, p. 15). Therefore, the short answer is that the role of cognitive neuroscience is to clarify our understanding of the nature of aesthetic experience.

The long answer rests on the fact that 'aesthetics' is an ill defined notion in need of clarification. Although, in practice, most of us are able to identify objects, scenes, and experiences as aesthetic, few of us can adequately describe their defining character. This difficulty for our commonsense understanding of aesthetics is not due to a lack of theoretical knowledge. There is no satisfactory consensus among experts in either philosophical aesthetics, art criticism, or art history about the defining features of artworks or aesthetic experiences. What is agreed is that the notion of the aesthetic is defined relative to the phenomenal character of perceivers interactions' with certain artworks and natural scenes. Cognitive science and aesthetics is an examination of the cognitive processes subserving this category of phenomenal experience. The goal of this research is,

analogous to the goal of cognitive neuroscience in general, to evaluate whether an understanding of the operations of perceptual systems can clarify our understanding of the nature and character of aesthetic experience.

This strategy can be couched in the language of a functional theory of art. The constructivist hypothesis explains artworks and aesthetic experiences relative to the way the former triggers perceptual experiences in viewers. The trouble is that these explanations do not suffice to differentiate artworks from other perceptual stimuli. In order to succeed as a functional theory of art the constructivist hypothesis needs to provide an explanation of how artworks trigger aesthetic, not merely perceptual, experiences. However, the defining features of aesthetic experience are notoriously difficult to resolve. As a result, it is difficult to determine exactly what must be explained by, or is missing from, the constructivist hypothesis. It is here that cognitive neuroscience can play a role in philosophical aesthetics. Researchers can use cognitive neuroscience to examine the cognitive processes, broadly construed to include sensation and perception, subserving viewers' interactions with art. If this research can clarify our concept of 'aesthetic experience', then cognitive science can contribute to our understanding of aesthetics. If these results contribute to our understanding of art, then the constructivist hypothesis succeeds as a functional theory of art.

3.0 The Structure of the Dissertation

The constructivist hypothesis asserts that art and aesthetic experience can be understood relative to the way artworks and aesthetic practices exploit the role

played by knowledge of the distal environment in visual perception. Semantic knowledge represents perceivers' explicit knowledge of the structure of the distal environment. However, this is not the only way that this type of knowledge is encoded in human cognitive systems. The operations of the visual cortex are realized by physiological mechanisms that have evolved to respond to particular types of stimulus properties. These stimulus properties represent the ordinary shapes, functions, and behavior of objects in perceivers' normal environments. The physiological mechanisms of the visual cortex are, therefore, sensory processes that encode perceptual knowledge of the structure of the distal environment (see Egan, 1996, p. 245, fn. 2).

Research in cognitive science and aesthetics can be divided into two categories of theories: bottom-up and top-down strategies.[14] Bottom-up strategies focus on the role played by sensory mechanisms in perception. These processes have been thought to operate independently of any influence from semantic knowledge, and so have been characterized as stimulus driven or automatic. Top-down strategies focus on the role attributed to memory and attention in object identification.[15] Kosslyn's hypothesis testing theory of perception suggests that the division of labor between bottom-up and top-down processes in perception should not be as sharply drawn as suggested by the traditional characterization of perception (see also Cavanaugh 1991; Moore and

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14. This distinction is derived from Raffman, http://www.aesthetics-online.org/ideas/freeland.html, retrieved December 23, 2004.

15. My approach differs from Raffman's in that I mark this as a division between the types of processing associated with the production of aesthetic interest. She marks it as a distinction between top down (psychological) and bottom up Neuroscientific) research strategies.

Cavanaugh 1998; and Peterson and Gibson, 1994). His model demonstrates that attentional mechanisms function to integrate the outputs of cognitive and sensory processes in order to generate the rich phenomenal content of visual perception. This, in turn, suggests a more flexible model for the constructivist hypothesis which integrates viewers interpretive and aesthetic responses. In the dissertation that follows I evaluate Semir Zeki's neuroaesthetics, Jennifer McMahon's theory of aesthetic form, and theories of art and imagination in the context of this claim in order to motivate a Kosslyn-style interpretation of the constructivist hypothesis.

3.1 Chapter 2: Zeki's Thesis

In Chapter 2 I evaluate Zeki's neuroaesthetics as both a theory of artists' methods and viewers' aesthetic practices. Zeki's aesthetic thesis rests on the observation that artists formal vocabularies are, consistent with a functional theory of art, a means to control for the viewers phenomenal responses to artworks. However, there is a difficulty for this interpretation of Zeki's theory. The case studies which support Zeki's research confirm that artists' formal vocabularies are a means to control for viewers' perceptual responses to artworks. However, in this regard artworks are no different than any other type of non-aesthetic perceptual stimuli. This generates weak and strong interpretations of neuroaesthetics:

> weak interpretation (perceptual hypothesis):
> Neuroaesthetics explains the functional success of visual artworks as a

class of perceptual stimuli.

strong interpretation (aesthetic hypothesis):
Explanations of the way the formal structure of artworks function to trigger perceptual responses in viewers suffice to explain the aesthetic quality of viewers interactions with at least some artworks.

Neuroaesthetics establishes the weak interpretation. It remains an open question whether there is a salient connection between these perceptual responses and the aesthetic content of viewers phenomenal experience that suffices to establish the strong interpretation. I argue, as a result, that the value of neuroaesthetics to explanations of aesthetics in the artistic sense depends on the development of a complimentary formalist theory of aesthetics.

3.2 Chapter 3: McMahon's Theory of Aesthetics Form

Jennifer McMahon argues that viewers' aesthetic interest in the formal properties of artworks can be understood in terms of the way the visual system constructs the global structure of visual images from ambiguous local sensory inputs. In Chapter 3 I evaluate this theory as a means to establish the strong interpretation of neuroaesthetics. Formalism can be divided into two types of theories: narrow formalism and neoformalism. The narrow formalist argues that aesthetic interest is the product of attention to the formal structure of a work of art independent of its representational content. The neoformalist argues, to the contrary, that aesthetic interest is the product of attention to how the representational content of a work of art inheres in, or is embodied by, its formal structure. This latter family of theories identifies aesthetic experience with an interest in latent structure, or how the formal structure of a work functions to generate its broader expressive and representational

content.

McMahon argues that any adequate theory of aesthetics must be able to account for the way relations among ideas and percepts give rise to aesthetic experience. She argues further that neuroaesthetics is a narrowly formalist theory because, by Zeki's own admission, it cannot account for the relationship between memory and sensation in perception. Unfortunately, this objection to Zeki generates a difficulty for McMahon's theory. McMahon argues that the experience of aesthetic form represents the apprehension of critical elements of the global perceptual form of a visual image prior to, and so independent of, the top down influence of semantic knowledge in object identification. As a result, it appears that in practice her theory cannot account for the relationship between memory and sensation in perception either.

This difficulty is the consequence of an inconsistency in McMahon's discussion of aesthetic form. McMahon argues both that object identification and form recognition are discrete processes, and that object identification plays a top down role in form recognition. The evidence that McMahon uses to illustrate her theory demonstrates that how one categorizes an object influences how one perceives its form. Therefore, object identification and form recognition are not discrete processes. Correcting for this inconsistency generates a neoformalist reading of McMahon's theory of the constructivist hypothesis. On this account, the aesthetic interest generated by the content of a work of art is a product the manner of its presentation, the way its formal structure functions to trigger its representational content. These processes, consistent with Zeki's account of

aesthetics, involve the role of memory in perception. Therefore, McMahon's theory is not an objection to, but rather an extension of Zeki's theory to encompass higher level visual processing.

3.3 Chapter 4: Art and the Imagination

The constructivist hypothesis is an aesthetic theory of art. Aesthetic theories of art define artworks generically as artifacts designed to trigger aesthetic experiences, or to generate aesthetic interest. Aesthetic interest is, in turn, defined as a feature of feature of perceptual experience, e.g. as a sense of cognitive consonance that accompanies the discovery of those formal features responsible for the dynamics of Boccioni's "The City Rises." McMahon's theory of aesthetics is designed to provide a role for prior knowledge of the history of art and cultural practice in a formalist theory of aesthetics. She argues that prior knowledge of the shapes and functions of object types contributes to the way an artworks function as a perceptual stimuli. This entails that background knowledge influences the way one perceives the formal structure of an artwork. Therefore McMahon's theory can be interpreted as an aesthetic theory of art derived from the role attributed to semantic knowledge in perception.

McMahon limits her explanations of the role of background knowledge in aesthetic experience to the role played by what Kosslyn calls categorical knowledge in perception. Categorical knowledge is the type of knowledge of perceptual features that enables viewers to identify X's as horses, or to discriminate a Palomino from a Clydesdale and an Appaloosa. In this regard

McMahon's theory can explain how an artwork functions to generate its depictive content in the phenomenal experience of a viewer. However, one can argue that this does not adequately explain the role of prior knowledge of the history of art and cultural practice in aesthetic experience. The difficulty is that McMahon equivocates between two senses of the term representational content. This term can either refer to the depictive content of an artwork or to its meaning. McMahon's theory can explain how categorical knowledge influences the way viewer's interpret the depictive content of a work of art. But, it does not, as a result, suffice to explain the work's meaning. As a result, McMahon's theory is, like Zeki's, limited to explanations of the way artworks generate perceptually striking effects.

In chapter 4 I develop a theory of art and imagination that is designed to resolve this general difficulty for Zeki and McMahon's versions of the constructivist hypothesis. Paintings are, as discussed above, abstract two dimensional perceptual stimuli that trigger realistic three dimensional perceptual experiences of scenes, objects, and abstract spaces. Kendall Walton has argued that viewers' perceive the content of a painting by imaginatively projecting a scene, object or space onto the canvas. He refers to this type of mental event as an act of imaginative perceiving the content of a painting. Gregory Currie has argued that Stephen Kosslyn's theory of mental imagery can function as a model to explain the notion of imaginative perception. Kosslyn argues that selective attention functions as a mechanism to mediate the mutual influence of memory and sensation in perception. I argue that Kosslyn's model therefore provides a

mechanism to explain how knowledge of the broad representational content of an artwork, including its meaning, influences the way viewers perceive its formal structure. However, given that memory and attention contribute to all ordinary perception, it would appear that this model suffers the same general objection as Zeki and McMahon's: it does not differentiate aesthetic from ordinary perceptual experience and does not explain how artworks function to generate aesthetic interest, or trigger aesthetic experiences. I conclude that the fate of the constructivist hypothesis rests on an account of the role of art historical knowledge in viewers' perceptual interactions with artworks. I leave discussion of this issue to chapter 5.

3.4 Chapter 5: Art and Cognitive Neuroscience

I argued above that the status of the constructivist hypothesis as a theory of aesthetics depends upon a definition of 'aesthetics' that links the perceptual and aesthetic practices of artists and viewers. In Chapter 5 I discuss the role attributed to cognitive neuroscience by the constructivist hypothesis in explanations of art and aesthetic experience. One difficulty that plagues the study of aesthetics is that the term 'art' denotes a notoriously diverse category of objects and events. In practice ordinary viewers identify objects as artworks relative to their commonsense understanding of aesthetic experience. On this account aesthetic experiences are defined as a species of phenomenal experience. Therefore, viewers' phenomenal experiences play an important epistemic role in our understanding of what art is. The trouble is that there is no

general agreement in the philosophical literature about the specific nature of these experiences. This suggests that the difficulties I have identified for the constructivist hypothesis may be due to the vagueness of the contemporary use of the term 'aesthetics'. In the absence of a clear conception of the nature of aesthetic experience, there is no clear target for research in art and cognitive neuroscience.

The goal of cognitive neuroscience is, in part, to uncover physiological constraints on psychological systems that elucidate the structure and function of cognitive processes, e.g. Zeki's research on the functional differences between areas V1 and V5 and the relationship visual agnosia research and theories of object recognition. This suggests a strategy for resolving the vagueness of the artistic sense of 'aesthetics'. Although philosophers find it difficult to come to any agreement about the explicit meaning of 'aesthetics', in practice viewers effortlessly identify natural scenes and objects as aesthetic relative to the phenomenal quality of their interactions with them. Therefore, the use of the term 'aesthetics' in common practice is not as vague as its philosophical definition. One can therefore define 'aesthetics' operationally, in terms of the psychological processes correlated with judgments of aesthetic interest. Consistent with the research program of cognitive neuroscience, one can then ask whether an understanding of physiological and computational constraints on the mental states correlated with judgments of aesthetic interest elucidate our understanding of art and aesthetic experience in a way that contributes to the resolution of problems in philosophical aesthetics.

I discuss a contextualist objection to aesthetic theories of art to illustrate this model for cognitive science and aesthetics. Aesthetic theories of art define artworks as artifacts designed to generate aesthetic experiences. Philosophers like Noël Carroll and Arthur Danto have objected to aesthetic theories of art on the grounds that aesthetic responses to artworks do not represent the central defining form of viewers' interactions with artworks. They argue instead that the canonical interactions with artworks are non-aesthetic cognitive events in which viewers interpret the content of an artwork in the context of their understanding of art history and aesthetic practice (Carroll, 1986; Carroll, 1991; and Danto 2001). This knowledge includes an understanding of artistic movements and styles, the formal vocabularies of particular artists, and how to read the formal structure of works in different media. Carroll argues that theories of aesthetics, due to their focus on the perceptual and expressive properties of aesthetic experience, cannot accommodate viewers interpretive interactions with artworks (Carroll, 1986, p. 59; Carroll, 1991, p. 308 - 309; see also Davies 1991, p. 3 and 66 – 77). This objection to theories of aesthetics rests on the conjunction of two claims. First, an artifact's status as an artwork is the product of how one categorizes its content. Second, interpretation is, as a result, a cognitive process distinct from the act of perceiving an artwork.

Theories of art and imagination, as discussed above in Section 1.3, identify artworks as degraded images, incomplete stimuli whose content is augmented and amplified by cognitive and perceptual contributions from viewers. For instance, oil paintings are flat piles of more and less translucent paint whose

content is derived perceptually by the processes mentioned in the paragraph above. However, viewers interactions with visual artworks are also interpretive in a different sense. Determining their meanings involves explicitly categorizing their representational content, including their formal compositional features, relative to background knowledge of a set of cultural conventions that define aesthetic practice. This suggests that there are two senses of the term 'interpretation': one that refers to the role of semantic knowledge in perception and another that refers to the cognitive processes by which viewers determine the meaning of a work of art. The question is whether the second sense of interpretation plays a role in the first.

I argue that the answer is yes. E. H. Gombrich argued that learning to make art involves learning to see objects and natural scenes as artworks. For instance, on Gombrich's account learning to paint requires an understanding of the formal features necessary to depict three dimensional scenes and objects adequately in a two-dimensional media. This entails that artists formal methods are subserved by a novel category of semantic knowledge identifying the content of the visual field as a unique object type, an artwork. Likewise, learning to interpret artworks involves learning to categorize them as artworks, not perceptual representations. This involves, at the very least, the same understanding of artistic movements and styles, the formal vocabularies of particular artists, and how to read the formal structure of works in different media that underlies viewers interpretive practices. This is knowledge of the "shapes and functions" of the formal vocabularies constitutive of the formal features that

define works of art in particular media. Therefore, the knowledge underlying viewers interpretive practices functions as a form of semantic knowledge defining artworks as artifacts relative to their particular media. Kosslyn's hypothesis testing model for perception provides a mechanism through which this knowledge can influence the content of perception. I conclude that research in the cognitive neuroscience of perception demonstrates that the argument for the contextualist's objection to aesthetic theories of art is not sound. This entails that cognitive science can contribute to philosophical aesthetics.

Chapter 2: Zeki's Thesis

> The view that motion is a separate visual process was not known at that time...We must therefore assume that it was something of an instinctive process, based more of their visual perceptions, that led artists to their view of the autonomy of motion as a perceptual phenomena, and thus one that merited autonomous depiction [as a source of aesthetic interest] (Zeki, 1999b, p. 150).

Semir Zeki's work on the relationship between art, aesthetics, and the neurophysiology of perception can function as a limiting case to illustrate the constructivist hypothesis (Zeki and Lamb, 1994; Zeki, 1999a; Zeki 1999b). Zeki's claim is that works of visual art are perceptual stimuli designed to selectively stimulate neurons in the discrete processing pathways of the early visual cortex that are responsible for form, color, and motion perception. These regions, areas V1 – V5 respectively, can be conceived as physiological mechanisms for constructing the basic formal elements of visual representations from retinal inputs. Zeki argues that, in order to succeed as visual stimuli, visual artworks must be tuned to the operations of these physiological mechanisms. He concludes that the formal structure of any work of visual art is constrained by, and can be explained in terms of, facts about the functional architecture of the early visual system. Zeki has coined the term neuroaesthetics to describe this research.

I argued in Chapter 1 that cognitive science and aesthetics can be divided into two broad research projects: first one must work out the two separate explanations of the functional success of artworks represented by the Fry-Ruskin and constructivist theses; and second one must establish that there is a link

between these different explanations of the formal structure of artworks that explains the aesthetic practices of artists and viewers in terms of their perceptual practices. Zeki argues that the stimulation of the receptive fields of neurons in the early visual cortex is a necessary condition for the success of a visual artwork. He argues further that artists formal methods are a means to cull sets of visual cues sufficient to control for the selective activation of the receptive fields of neurons in the visual cortex from the structure of appearances. A correlation can therefore be drawn between artists' formal vocabularies and the operation the visual system that explains the functional success of artworks as perceptual stimuli. This entails that cognitive science can be used to establish correlations between descriptions of the formal structure of artworks derived from the Fry-Ruskin and constructivist theses. These correlations, in turn, can be used to explain the functional success of artworks as perceptual stimuli.

Zeki argues further that correlations among artists' formal methods, the formal structure of artworks, and the operation of the visual system can serve as the foundation for a biologically based theory of aesthetics. Artists' formal methods and vocabularies are a means to clarify and convey aesthetic content respectively. Correlations between artists' formal vocabularies and the operation of perceptual systems explain how the formal structure of an artwork functions to trigger, or convey, its content. Therefore, explanations of correlations between artists' formal vocabularies and the operation the visual system are, on Zeki's account, sufficient to explain the contemporary artistic sense of aesthetics.

In what follows, I evaluate Zeki's theory as both a claim about artists'

methods and a theory of aesthetics. In section 1, I provide a sketch of the basic principles of neuroaesthetics. In section 2, I evaluate Zeki's use of Alexander Calder's mobiles to illustrate his theory (Zeki ad Lamb 1994, p. 607; Zeki, 1999, p. 144). I argue that Zeki's discussion of Calder fails to establish that correlations between the Fry-Ruskin and constructivist theses explain how his mobiles convey their content. This, in turn, throws a wrench in Zeki's assertion that a neurophysiological explanation of Calder's knowledge of the structure of appearance plays a role in explanations of the aesthetic features of his mobiles.

However, despite difficulties for Zeki's discussion of Calder, there are case studies in the literature that support neuroaesthetics. I discuss two of these examples in sections 2.3 and 2.4: the use of irradiation to enhance figure-ground segregation in paintings (Latto, 1995, p. 72 – 75; Ratliffe, 1992, pp. 92 – 97) and the use of sfumato to depict Mona Lisa's smile (Livingstone, 2000, p. 1299; Livingstone, 2002, pp. 71 - 73). These case studies demonstrate that the representational success of artworks can be explained relative to correlations between the operations of perceptual systems and artists' knowledge of the structure of appearances. This, in turn, yields a weak interpretation of Zeki's theory: neuroaesthetics explains the functional success of visual artworks as perceptual stimuli. However, this is not sufficient to establish neuroaesthetics as an aesthetic hypothesis. In order to accomplish the latter, Zeki needs the further claim that, explanations of the way the formal structure of artworks function to trigger perceptual responses suffice to explain the aesthetic quality of viewers' interactions with at least some artworks. The case studies discussed in section 2

do not, by themselves, establish this strong interpretation of Zeki's theory. As a consequence, I argue in section 3 that the value of Zeki's thesis to explanations of art and aesthetic experience in the artistic sense turns on how one interprets the role of the formal structure of an artwork in theories of art and aesthetics.

This objection is a variant of the split I identified between Baumgarten's original and the contemporary sense of aesthetics. Recall that Baumgarten's use of 'aesthetics' refers to the perceptual practices of artists and viewers responsible for the production of the depictive and representational content of artworks. This is distinct from the more contemporary use that refers to whatever distinguishes artworks from ordinary non-aesthetic perceptual stimuli. Neuroaesthetics seems well suited to explain Baumgarten's sense of 'aesthetics'. However, it is not clear that in doing so it has explained the more contemporary, artistic sense of the term. As a result, the value of the constructivist hypothesis as an aesthetic hypothesis rests on the development of a complimentary theory of aesthetics that links the perceptual and aesthetic practices of artists and viewers.

1.0 What Is Neuroaesthetics ?

Neuroaesthetics rests on two central assumptions, the conjunction of which generate Zeki's thesis: visual artists are unwitting, intuitive neurophysiologists studying the organization of the visual brain by their own unique methods:

(Z1) The functions of art and vision is synonymous.

(Z2) Artists' methods are analogous to experimental methods in the neurophysiology of perception.

(ZT) Therefore artists are intuitive neurophysiologists.

Zeki focuses on visual art to illustrate his theory. (Z1) entails that the production of a visual artwork is subject to the same functional constraints as visual perception. (Z2) is the claim that artists' methods are a means to both uncover and harness these constraints in order to enhance the functional success of artworks as perceptual stimuli. As a result, Zeki argues that artists are unwitting neurophysiologists. In this section I sketch the detail of this model for understanding the function of artworks as perceptual stimuli.

1.1 The Functions of Art and Vision Are Synonymous

Zeki argues that the function of the visual system is to provide representations of the formal properties of the visual field that enable perceivers to recognize scenes and objects in ordinary visual contexts.[16] This task is constrained by the fact that the retinal inputs to the visual system underdetermine the rich content of perception. I used the inverse problem to illustrate this claim in Chapter 1 (see pp. 2 – 4 above). Zeki employs a related argument. Retinal images are two-dimensional records of the relative luminance of light reflected from discrete points in the visual field over time. This two-dimensional array is in constant flux due to alterations in lighting conditions and movements of both

16. Computational theories of vision argue that object identification begins with the identification of non-accidental features in the visual field. These are elementary formal features of perceived objects as opposed to accidental features of the particular configurations of objects in a scene. In theory, non-accidental features are formal image features that persist across diverse views of objects and so function as sound ecological cues to the form and identity of objects in the visual field. Although Zeki does not use this terminology I interpret "constant and enduring properties" as referring to these types of image features.

objects and perceivers. Yet what perceivers see is not a constantly changing pattern of points of light, but stable, three dimensional objects and scenes in color. Areas V1 – V5 are processing mechanisms designed to transduce, or transform, ambiguous retinal inputs. The function of these mechanisms is to reconstruct visual cues encoded in the dynamic retinal array. This entails that even the basic formal features of images, e.g. the ambiguous set of geometric features that must be interpreted to solve the inverse problem, are the product of independent contributions from perceptual processing. Therefore, Zeki argues that vision is an active, or constructive, process.

Zeki uses the notion of a receptive field property to establish a functional analogy between the formal structure of artworks and the operation of the visual system. The receptive field properties of neurons in the visual system are defined as the parts of the retinal field, or their projection onto the visual field, that result in the reaction of either a neuron or group of neurons within the visual system.[17] The receptive fields of neurons in areas V1 – V5 are selectively sensitive to color, form, and motion cues in the visual field. This information is, in turn, employed to build up representations of the constant and enduring properties of scenes and objects. Zeki argues that the receptive fields of neurons in the early visual cortex can therefore be considered evolved mechanisms for selecting salient visual cues from the environment to serve as the building blocks for visual perception.

The function of the formal structure of an artwork is to provide viewers with

17. For instance, simple cells in the form pathway respond most efficiently to static edges in a particular orientation in the visual field.

a set of visual cues sufficient to enable them to recognize its representational content. The sets of cues embedded in the formal structure of an artwork work because they trigger the same sets of visual processes by which perceivers recognize objects in ordinary visual contexts. Visual artists derive these cues via a detailed examination of the phenomenal structure of ordinary perceptual experience. Zeki argues as a result that artists' formal methods are the product of perceptual practices designed to cull visual cues from the rich content of ordinary perception that are sufficient to trigger the receptive fields of neurons of the early visual cortex.

1.2 Artists Methods and Experimental Methods in Neurophysiology

Zeki argues further that visual artworks are functionally analogous to the stimuli employed in neurophysiology labs to study perception. The early visual cortex, as mentioned above, is functionally specialized to process color, form, and motion information. Laboratory displays used to study the neurophysiology of vision are designed to vary normal subjects' perceptual experience along one or another of these dimensions. The purpose of these displays is to determine the stimulus properties that most efficiently trigger the receptive fields of neurons in the visual system. Visual artists employ sketches, color studies, and maquettes to develop both their signature formal vocabularies and the particular formal structure of their works. Zeki argues that these formal exercises are designed to alter the structure of appearances along the three basic visual dimensions in order to determine the best means to manipulate the perceptual

experiences of viewers. Therefore, artists also construct displays whose function is to vary the properties of the stimulus in order to determine the means to most efficiently trigger the receptive fields of neurons in the visual system.

1.3 Artists Are Unwitting Intuitive Neurophysiologists

Zeki's theory of neuroaesthetics is derived from the claim that the functional analogy between the practices of artists and vision scientists demonstrates that artists are unwitting intuitive neuroscientists studying the brain via their own unique methods. Zeki does not explicitly define what he means by 'intuitive'. I interpret his use of the term along the lines of the following definition of 'intuition': "a mode of understanding or knowing characterized as direct and immediate and occurring without conscious thought or judgment...a response to subtle cues and relationships apprehended unconsciously" (Reber and Reber, 2001, p. 369). I take it that the terms 'conscious' and 'unconsciously' are being used here in a pre-theoretic way to mean 'without direct awareness'.

Consider the following example as an illustration. I once worked with a steel fabricator who had an uncanny knack for welding a true joint without setting a jig to hold the work in place. This task is complicated by the fact that the two elements to be welded will expand and contract unevenly as they are heated by the electric arc and subsequently cool. My colleague would carefully tack the corners of the joint to set the work, and then alternate filling in the edges. When done the angle would be set up well within an acceptable tolerance without his having had to measure more than once. However, Ralph could not explain to

anyone how he had managed this feat. One can argue therefore that he had an intuitive sense of the structural properties of the steel, i.e. its propensities to expand and contract when heated. However, he was unable to represent this knowledge as a set of explicit rules that could be conveyed to others. Rather, this knowledge was embedded in his behavior, in the way explicit features of his practice enabled him to control for variables like the effects of the heat of the electric arc and the thickness of the material. Similarly, artists' knowledge of the operation of the visual system is encoded in their ability to control for the perceptual effects of their works on ordinary viewers independent of their ability to describe how their works generate these perceptual effects. Therefore, it is sufficient to establish Zeki's thesis that an artist deliberately and consistently manipulate his or her medium for perceptual effect in a way that is fine tuned to the receptive field properties of the visual cortex whether or not he or she explicitly understands how this occurs (see Zeki, 1999, p. 155 – 156).

2.0 Kinetic Art: A Case Study

> Physiologically speaking, kinetic art represents a reductionist approach which emphasizes motion and de-emphasizes both form and color, or at least renders them insignificant. Using it artists have, almost certainly unknowingly, tried to obtain aesthetic effects by stimulating optimally only a limited number of visual areas in the cerebral cortex, specifically those concerned with visual motion. Kinetic art therefore provides fertile ground on which to begin an exploration of the relationship between the physiology of visual perception, brain activity, and the aesthetic experience of visual art (Zeki and Lamb, 1994, p. 607).

Zeki argues that kinetic art represents a reductionist approach to artmaking. This use of the term 'reductionist' is particular to his theory. His claim

is that the work of the pioneers in kinetic art, e.g. Alexander Calder and Yves Tanguely, represented an attempt to isolate and control for the particular formal features of ordinary motion perception. This strategy is not unique to kinetic art. On Zeki's account artists' methods are, for practical reasons, naturally reductive. They are a means to isolate the formal features that most efficiently trigger the receptive fields of neurons in the early visual system. For instance, as discussed above, painters and printmakers engage in color studies to discover the palette and formal composition that will most effectively trigger a representation of the appearance of a scene or object in the perceptual experience of viewers. Likewise, kinetic artists engage in formal studies to discover the abstract compositional features of the visual field that most efficiently trigger an experience of the dynamics of motion in the perceptual experience of viewers.[18]

The constructivist hypothesis rests on the claim that there are two explanatory streams that converge in explanations of the functional properties of the formal structure of visual artworks: explanations that rest on the Fry-Ruskin thesis and explanations that rest on the constructivist thesis. The former are descriptions of knowledge of the structure of appearances embedded in the formal vocabularies of artists, or artists structural knowledge (ASK). This structural knowledge is what enables their formal vocabularies to function as a means to visual representation. The latter are descriptions of the detail of the operation of perceptual systems (OPS) that explain how the formal vocabularies of artists' works function to trigger the content of viewers' perceptual interactions

18. The monochromatic palettes used in Monet's paintings of Rouen Cathedral, according to Zeki, represent a similar strategy for selectively stimulating form perception from luminance contrast alone (Zeki 1999, Chapter 21, pp. 209 – 215).

with artworks. Correlations between (ASK) and (OPS) can be used to explain the functional success of artworks as perceptible objects. Zeki argues that the existence of these explicit correlations entails that artists are unwitting intuitive neurophysiologists exploring the visual brain via their own unique methods.

2.1 Calder's Claim

The discussion of Calder's work and practice is the most plausible case study Zeki employs to illustrate this thesis (Zeki and Lamb, 1994; Zeki, 1999; and Zeki, 2000). Calder wrote, "I have limited myself primarily to the use of white and black in my mobiles because these are the most contrastive colors. Red is the color best opposed to white and black, followed by the other primary colors. Secondary colors and intermediate shades do nothing but confuse and blur the clarity and vividness of motion."[19] Calder's comments reveal his understanding of the structure of the appearance of motion. Zeki interprets Calder's claim as follows:

> Calder's Claim: Luminance contrast enhances and color confuses the clarity of motion perception.

Zeki argues that Calder's claim demonstrates that he understood both the functional specialization of the color and motion pathways in the early visual cortex and the receptive field properties of the motion pathway. Therefore, Zeki's

19. "Je me suis principalement limité à n'user que du blanc et du noir comme étant les couleurs plus constrastées. Le rouge est la couleur las plus opposées à ces deux dernières et aussi finalement lest autre couleurs fondamentales. Les couleurs secondaire et les ombres intermédiaire ne font que rendre confuses et embrouillées la netteté et la clarité." Alexander Calder, in eds. Alvard, Julien and R. V. Gindertael, Témoignages Pour L'Art Abstrait: 1952, (Bologne (Seine): Editions "Art d'aujourd'hui," 1952), pp. 43 – 44, my translation.

discussion of Calder's claim establishes a salient correlation between (ASK) and (OPS).

The conjunction of three types of neuropsychological evidence support Calder's claim. First, localized damage to discrete geographic regions of the early visual cortex, areas V4 and V5 respectively, can cause selective deficits in either color or motion perception. Second, imaging studies using normal subjects demonstrate that V4 is sensitive to static color but not motion cues, and that V5 is sensitive to motion but not static color cues. Third, behavioral studies using illusory motion displays demonstrate that motion perception is sensitive to luminance not color cues, and that in these contexts motion perception can be dissociated from form perception (Zeki, 1999, pp. 143 – 145 and p. 162; Zeki et al, 1991, p. 644; and Zeki and Lamb, 1994, pp 608 – 613).

Patients with naturally occurring cortical lesions associated with the color pathway in area V4 suffer a syndrome called achromatopsia. Patients with achromatopsia report a loss of color vision. They see the world in a monochromatic palette of grays or dull browns. Motion and form perception remains intact in these patients. Conversely, patients with localized lesions associated with area V5/MT suffer from a syndrome called cerebral motion blindness, or akinetopsia. These patients cannot see objects in motion, but retain the ability to perceive the form and color of static objects (Zihl et al, 1983; Zihl et al, 1991). This evidence establishes a double dissociation between color and motion perception. As a result it suggests that these aspects of normal perceptual experience are subserved by separate perceptual processes realized

by V4 and V5 respectively.

However, there is a difficulty with these types of behavioral studies. Brain damage is rarely, if ever, so localized as to effect only one discrete functional area of the brain. As a result, these studies are unable to screen off the possibility that damage to some other geographically associated region is causally responsible for the behavioral deficit (Zeki and Lamb, 1994, p. 641). Zeki has used PET studies involving normal subjects to overcome this difficulty (Zeki et al, 1991; and Beckers and Zeki, 1995). These studies show that, when one is viewing a moving array of black and white dots, V5 is active and V4 is not. Conversely, when one is viewing a static color pattern V4 is active and V5 is not. Therefore, this set of experiments establishes a double dissociation between the role of V4 and V5 in ordinary perception. This double dissociation confirms the hypothesis that these areas are independently correlated with color and motion perception respectively.

The functional specialization of area V5 for motion perception is further confirmed by imaging studies using repetitive transcranial magnetic stimulation (rTMS). rTMS can be used to produce a transient, or temporary focal lesion in a discrete area of the cortex that effectively removes the contribution of that area to cognitive processing for a short period of time. rTMS can therefore be used to evaluate the causal connection between a discrete cortical area and some behavioral effect. rTMS studies demonstrate that the creation of a transient lesion localized to area V5/MT disrupts normal motion perception (Sparing et al 2002, pp. 92 – 93; Kosslyn et al, 1999, p. 168; Beckers and Zeki, 1995, p. 49 –

50; Zeki and Lamb, 1994, p. 611; Hotson et al 1994, p. 2115; and Beckers and Homberg, 1992, p. 173). Further, lower frequency rTMS directed at area V5/MT can be used to artificially stimulate motion perception in both normal and retinally blind patients, e.g. the non-retinal generation of moving visual phosphenes (Walsh and Pascual-Leone, 2003, pp. 71 – 73 and 121; Sparing et al, 2002, p. 93). Therefore, rTMS studies demonstrate a central role for V5/MT in motion perception.

The conjunction of evidence from imaging studies and the behavioral deficits of patients with localized lesions in the early visual cortex demonstrates that color and motion are the product of separate processing systems. However, this is not, in itself, sufficient to establish Zeki's thesis. Zeki's claim is that Calder's understanding of the functional segregation of the color and motion pathway is mediated by an intuitive understanding of the receptive field properties of neurons in the motion pathway. Calder's knowledge of the receptive field properties of motion sensitive neurons is encoded in his explicit understanding of the structure of appearances. Therefore, Zeki's thesis relies on the further claim that color and motion can be perceived separately in normal visual contexts (Moutoussis and Zeki 1997a, p. 1407; Moutoussis and Zeki 1997b, p. 397; Zeki and Bartels, 1998, p. 1583; and Bartels and Zeki 1998, p. 2330).

Behavioral evidence from experiments with normal subjects demonstrates that motion perception can be dissociated from color perception in normal vision. For instance, V. S. Ramachandran and R. L. Gregory constructed an illusory

motion display by counterposing two red-green random dot stereograms.[20] In the display a square central region, perceived in depth, was seen by normal subjects to shift up and down. Subjects were asked to manipulate the relative luminance of the colored regions by adjusting the brightness of the green dots. The red and green regions of the display remained clearly discernible throughout the task. However, illusory motion disappeared as they approached isoluminance. This demonstrates that motion perception can be dissociated from color perception in normal vision, and that motion perception is, as Calder claims, sensitive to luminance and not color cues.

2.2 Zeki's Thesis Evaluated

> Artists have thus tailored their kinetic creations to the physiology of area V5. Put in another way, these artists discovered something about the physiology of the brain in their experiments, namely that motion is an autonomous visual attribute, and that it has certain characteristics, which are the characteristics of the physiology of V5 (Zeki, 1999b, p. 144).

Zeki's reading of Calder's claim can be cashed out relative to the following two propositions describing Calder's structural knowledge and the attributes of the visual system to which it correlates:

(ASK) Luminance contrast enhances and color confuses the clarity of motion perception.

(OPS) The cells in area V5 are sensitive to luminance and not color cues.

The latter proposition explains the former. Therefore, Calder's claim reveals a coarse grained knowledge of the receptive field properties of the motion sensitive

20. V. S. Ramachandran and R. L. Gregory, "Does Color Provide an Input to Human Motion Perception?" Nature 275 (1978): 55 – 56.

neurons in V5. This knowledge in turn represents an intuitive understanding of the functional specialization of the motion and color pathways. Therefore, Calder's claim establishes Zeki's thesis concerning artists' knowledge.

Zeki argues further that these types of functional correlations between (ASK) and (OPS) serve as the foundation for a biologically based aesthetics. However, one can raise an objection to this claim. Zeki asserts that the functional correlation between (ASK) and (OPS) exploited by neuroaesthetics explains the manner in which the formal structure of particular visual artworks function to convey their aesthetic content. In this regard correlations between (ASK) and the formal structure of particular artworks is important. The motion perception pathway exploits luminance contrast to generate a boundary between foreground and background against which it interprets change of position as motion. However, Calder's work does not rely on this compositional strategy. First, Calder made no effort to control for the relative luminance of the component elements of his mobiles and the varied backgrounds against which they are displayed. Second, he did not control for the relative luminance of the individual elements. Third, he did not control for the way the individual elements cross in front of one another. In fact, he wrote that the motion of the individual elements was designed to be random and unpredictable (Zeki and Lamb, 1994, p. 629 - 630; Zeki 1999, p. 157). This entails that luminance contrast does not play the role Zeki suggests in the formal structure of Calder's mobiles. Therefore, although Zeki's arguments establish that Calder's claim encodes an intuitive understanding of the operation of the visual system, <u>they do not establish that</u>

this knowledge plays a role in explanations of the way Calder's mobiles function to perceptually convey their aesthetic content.

2.3 Mach Bands, Lateral Inhibition, and Irradiation

> Observe a white wall standing out against the sky: you will see a white line, lighter than the surface of the wall and a blue or grey line darker than the mass of the sky. This line of irradiation remains unnoticed by the majority of painters but nevertheless it is of the greatest importance to copy it exactly (David Sutter, 1880, cited by Latto, 1995, p. 74).

Despite the failings of Zeki's discussion of Calder's work, there are cases in which there is an appropriate link between artists' structural knowledge and the perceptual experience of viewers. In this and the following section I introduce two such cases: irradiation and the use of sfumato to depict Mona Lisa's smile. In section 2.5 I evaluate these case studies as aesthetic hypotheses. Irradiation is a formal technique that is designed to enhance edges and amplify figure ground segregation in paintings. This technique is derived from the observation of Mach bands in the visual field. Mach bands are perceived light and dark stripes that occur at luminance boundaries in the visual field, but do not correspond to any objective features of the distal environment (see figure 10). They are instead artifacts of the way the visual system initially records information concerning the light that impinges on the retina. Therefore, irradiation is an example of an explicit feature of artists' formal vocabularies whose functional success in paintings is explained by the operation of a discrete mechanism in the visual system.[21]

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21. Interestingly, although the scientific discovery of Mach bands is attributed to Ernst Mach in the mid-nineteenth century, painters have copied this feature of the

The appearance of Mach bands in the visual field is explained by lateral inhibition in the retina. Lateral inhibition is an architectural feature of neural networks that enables a neuron to modulate the outputs of its nearest neighbors. For instance, a ganglion cell in the retina that receives an excitatory signal from a particular photoreceptor also receives an inhibitory signal from the ganglion cells that surround it. In the array described in figure 11 the excitatory connection strength between photoreceptors and ganglion cells is 1 and the inhibitory connection strength is .2, or 1/5. The ganglion cells that respond to the homogenous "light" field ordinarily receive identical excitatory inputs from their photoreceptors and identical inhibitory inputs from each of their neighbors. The same is true of the ganglion cells that respond to the homogenous dark field. However, the ganglion cell along the light side of the border between the two fields receives less inhibition from its neighbor in the dark field. Therefore, its overall response is higher than its neighbors to the left in the light field. The converse is true for the cell along the dark side of the border. Therefore, lateral inhibition produces an illusory light and dark stripe along the border between the two fields that does not match the actual intensity of light reflected by the surface of the image. Lateral inhibition works on the same principle when expanded into two dimensions except that the inhibitory effect of any given cell spreads in all of the directions of the compass rather than along a single line (see figure 12).

Mach bands are quite useful to the visual system. There are no sharp luminance boundaries between the light, dark, and grey regions of the image in

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structure of appearances into their paintings since at least Robert Campin (1406 – 1444) and Leonardo da Vinci (1452 – 1519) (Ratliffe, p. 94; Latto, 1995, pp. 73 – 74).

figure 10. Rather, the broad grey region consists of an even gradient from white to black. However, one perceives a light and dark stripe, Mach Bands, marking sharp boundaries between three discrete areas of different luminance. Therefore, Mach bands help the visual system identify edges in the visual field. Further, they aid in form recognition by enhancing the luminance contrast between figure and ground (Palmer, 1999, p. 282). For these reasons, painters have used irradiation to amplify the contrast between coherent figures and their surround in paintings. For instance, Seurat used irradiation to enhance the contour defining the backs of the three right facing upright figures in "Bathers at Asnieres" above (figure 13). This technique is a mainstay of representational painting.[22] In fact, once one learns to recognize it, it is surprising just how ubiquitous it is (and how distracting it can be).

The technique of irradiation is derived from artists' understanding of a feature of the structure of appearances that is strongly correlated with a basic neural mechanism. The functional success of this feature of their formal vocabularies can therefore be explained relative to facts about the operation of the visual system. Further, irradiation is a means by which artists consistently and deliberately control for a feature of viewers' perceptual responses to their artworks. The explanatory connection between irradiation and lateral inhibition thereby confirms Zeki's thesis both as a claim about artists' structural knowledge and the way that the functional properties of artworks exploit the constructive nature of vision.

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22. This technique has been in use in paintings since the late Baroque period. It first appears in Robert Campin's paintings in the late 15th Century (Ratliffe, 1992, p. 95).

2.4 Mona Lisa's Smile

It has been argued that one source of aesthetic interest in Leonardo's painting of Mona Lisa is the ambiguity of her expression (see for instance Gombrich 2002, pp. 303). E. H. Gombrich described this expression as an elusive smile that disappears when one fixes one's gaze on her face. He argued that this effect is a product of the formal technique, sfumato, that Leonardo used to render the features of Mona Lisa's face. Painting in sfumato involves blurring any sharp edges that define object features so that the boundaries between figures in a painting disappear into soft, "smoky" shadows. Margaret Livingstone argues that differences between the way high and low spatial frequency information is recorded by the retina explains how the formal features of the painting generate Mona Lisa's ambiguous expression (Livingstone, 2000, p. 1299). Therefore, sfumato is another example of a formal technique that is explicitly used by artists to control for viewers' perceptual responses to artworks, and whose functional success is explained by neurophysiological features of the visual system.

Livingstone used a computer program to generate a display that selectively represents the low, middle, and high spatial frequency information in the Mona Lisa (figure 14 above). Roughly speaking the difference between low, middle, and high spatial frequency information is analogous to the difference between shading and the use of discrete narrow lines to depict the boundaries of an object feature in a drawing. The contours defining Mona Lisa's smile are

much more apparent in the medium and coarse grained shading of the left two (low and middle frequency) images than the sharp lines of the rightmost (high spatial frequency) image. For instance, the slight upturn of the corner of her mouth, barely visible in the right image, is extended and exaggerated in the left image. Therefore, the critical formal features defining Mona Lisa's smile are depicted only in low and middle spatial frequency information, e.g. the hollow between her cheekbone and jaw (Livingstone, 2000, p. 1299; Livingstone 2002, p. 73).

The spatial resolution of human vision decreases dramatically as one moves from the center of the visual field towards the periphery. Livingstone reports that the spatial resolution of normal vision diminishes by a factor of 10 just seven degrees from the central fixation point of one's gaze. This difference in spatial resolution between central, or foveal, and peripheral vision is explained by the fact that the receptive fields of peripheral retinal neurons are dramatically larger than those of their foveal counterparts (Kandel et al, 2000, p. 418; Purves et al, 2001, p. 238; see also below pp. 128 – 129 and 142 – 143). The net result is that foveal neurons are sensitive to sharp, narrow luminance boundaries that carry high spatial frequency information, but are unable to register coarse, broad luminance gradients that carry low and medium spatial frequency information like those depicted in sfumato. Conversely, the wider receptive fields of neurons in the peripheral field are well suited to record the latter category of contours, but are nearly blind to high spatial frequency information.

Livingstone argues, as a result, that Mona Lisa's expression is perceived

more clearly peripherally than foveally. Staring directly at Mona Lisa's face causes her smile to, in fact, disappear. This effect is explained by the disparity in size between the receptive fields of peripheral and foveal retinal neurons. This, in turn, demonstrates that Leonardo's formal method and painterly practice correspond to a physiological feature of the visual system that explains viewer's perceptual responses to the painting. Therefore, Livingstone's explanation of Mona Lisa's smile establishes a link between artists' structural knowledge, the formal structure of artworks, and viewers' perceptual responses that confirms Zeki's thesis.

2.5 What Can These Case Studies Tell Us About Aesthetics?

The manner in which artists exploit the constructive processes of the visual system explains the depictive practices of artists and the functional success of the formal structure of artworks. Explanations of the functional success of formal techniques like irradiation and sfumato therefore confirm Zeki's thesis concerning artists' methods. The success of artists' depictive practices demonstrates that their formal vocabularies encode an implicit understanding of the operation of the visual system. This, in turn, establishes an explanatory link between the Fry-Ruskin and constructivist theses that confirms the constructivist hypothesis. Therefore, an understanding of the operation of the visual system does contribute to explanations of art and aesthetic experience.

However, a problem arises if one takes these case studies as explanations of the aesthetic interest generated by Calder's mobiles, Seurat's

paintings, or Mona Lisa's smile. The link between an artist's methods, an artwork's formal structures, and a viewer's response is established via explanations of the success of the perceptual practices of artists and viewers. Explanations of this type are equally relevant to our understanding of the functional success of many non-art perceptual objects as well, e.g. Ramachandran and Gregory's display and the Mach band illusion in figure 10 above. However, consciously attending to the formal features responsible for these perceptual effects does not necessarily function to generate an aesthetic experience.

Consider Livingstone's explanation of the "elusiveness" of Mona Lisa's smile. Gombrich identifies this perceptual effect as a source of aesthetic interest. One could argue that by deliberately controlling for this feature of viewers' interactions with the artwork, Leonardo has controlled for an aspect of viewers' aesthetic experience. However, Livingstone argues that sfumato exploits an evolved mechanism for recognizing facial expressions. Facial expressions are defined by soft, broad contours produced by deep muscle structure. These facial features, like the formal features used to depict Mona Lisa's smile, are more easily perceived peripherally than foveally (Livingstone 2002, p. 73). This entails that Livingstone's explanations of the perceptual practice and formal features that account for the appearance of Mona Lisa's expression, e.g. the peripheral perception of coarse grained image features defining a person's smile, can be generalized to explain the perception of similar facial expressions in ordinary perceptual contexts. However, the latter do not function as a source of aesthetic

experience. Therefore, the explanatory link between the Fry-Ruskin and constructivist theses established by neuroaesthetics does not, in itself, explain the way the Mona Lisa functions to perceptually convey its aesthetic content.

3.0 Conclusions

> ...implicit in our approach is the supposition that physiological stimulation of specific visual areas can create aesthetic experience, which is not the same thing as saying that the aesthetic experience that results from kinetic art is due solely to the activity of the areas which we highlight... (Zeki and Lamb, 1994, p. 607; see also Zeki, 1999b, pp. 1 – 2).

I argued in Chapter 1 that one can differentiate between two senses of the term 'aesthetics': Baumgarten's use of the term as the name for the study of perception in general, and a more contemporary use denoting those properties of phenomenal experience that differentiate artworks and aesthetic experiences from their ordinary counterparts. Zeki argues that the aesthetically interesting formal features of an artwork are a subset of the formal features that enable viewers to identify their depictive content. He argues further that these formal features are aesthetically interesting because they transparently reveal their role in the production of perceptual experiences to the viewer. Therefore, in order to establish his aesthetic hypothesis, Zeki must demonstrate that an awareness of the functional properties of the formal structure of a work of art is a source of aesthetic interest.

However, an evaluation of Zeki's analogy between artworks and experimental displays shows that his theory fails to establish this claim. The criteria of success for artworks and displays is not the same. Although both are

designed to elicit particular perceptual responses in viewers, there is a further criteria for success for artworks. The perceptual responses triggered by artworks must also function as vehicles for aesthetic experience. Therefore, explanations of the way artworks function as perceptual stimuli do not alone suffice as explanations of the way they function as aesthetic stimuli. In what follows, I discuss this disanalogy between artworks and displays. I conclude that it is an open question whether Zeki's aesthetic hypothesis is sound. The resolution of this question rests on the role attributed to the formal features of artworks in contemporary theories of aesthetics. I leave discussion of this latter issue to Chapter 3.

3.1 Are Artists Methods and Experimental Methods in Vision Science Synomymous?

One can explain aesthetic phenomena relative to the aesthetic practices of artists and viewers. The aesthetic practices of artists and viewers can, in turn, be understood relative to their cognitive commerce with artworks. This suggests that one way to explain art and aesthetic experience is to divide explanations of aesthetic phenomena into three interrelated categories: artist, artwork, and viewer. For instance, as discussed above, visual artists derive their formal vocabularies from an understanding of the structure of appearances. They employ this knowledge to construct visual stimuli designed to elicit particular types of responses in viewers.[23] In this sense artworks are artifacts that function

23. This is equally true of a work of visual art that is canonically conceptual as it is of a work that is canonically aesthetic. Both objects are artifacts designed to elicit a

as triggers for perceptual responses in viewers. These perceptual responses are, in turn, the vehicle for delivering the content of the work. The success or failure of an artwork as an aesthetic object is, on this account, judged relative to the ability of its formal structure to elicit something approximating the desired response in viewers.

It is in this sense that artworks are like the displays used by vision scientists to test their hypothesis. Neurophysiologists employ their understanding of the functional architecture of the visual system to construct displays. The "formal structure" of these displays is designed to elicit particular responses. The success or failure of an experimental display is measured relative to its utility for evaluating hypotheses about the structure of perceptual systems. The utility of a display is a measure of its ability to elicit a desired perceptual response. Therefore, there is a functional analogy between artworks and displays which demonstrates that both encode their creators understanding of how to manipulate the structure of appearances.

However, what, if anything, does this tell us about aesthetics? Zeki's answer to this question turns on what he means by 'create' in the statement, "...implicit in our approach is the supposition that the physiological stimulation of specific visual areas can create aesthetic experience." It is not clear how Zeki intends for the reader to interpret this sentence. In some places he asserts that

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particular cognitive response in viewers. The difference between these two types of artworks lies in the type of response they elicit. Conceptual artworks trigger responses whose content is primarily interpretive. Aesthetic artworks trigger responses whose content is primarily phenomenal, e.g. composed of perceptual and expressive properties. I will discuss the relationship between these two types of responses in greater detail in Chapter 4.

aesthetic experience is the product of memory, learning, cultural upbringing, and perception. In this context he argues that correlations between the formal features of artworks and the structure of perceptual systems are not, in themselves, sufficient to generate aesthetic experience. This suggests that aesthetic experiences are complex cognitive events whose content should be conceived as broader than, and at least in part distinct from, the perceptual experiences that trigger them.

However, he also asserts that the practices of kinetic artists demonstrate that the formal features of artworks are themselves aesthetically interesting. Although Zeki does not elaborate on this point, the following argument is implicit in his writing. Kinetic art is an abstract medium. The aesthetic content of an abstract work of art is arguably exhausted by its formal geometry. One of the goals of kinetic art is to reproduce the dynamic properties of motion for aesthetic effect. The formal features of kinetic artworks are thereby designed to selectively stimulate the receptive fields of motion sensitive neurons for aesthetic effect. Therefore, the practices of kinetic artists demonstrate that the formal features of artworks are themselves aesthetically interesting.

Richard Latto's definition of an aesthetic primitive can be used to illustrate this reading of kinetic art (Latto, 1996, p. 67 – 68). Latto agrees with Zeki that artists' methods are experiments that reveal interesting facts about the visual system through what they reveal about the structure of appearances. He defines an aesthetic primitive as a stimulus feature that is fine tuned to, or resonates with, the processes of a perceptual system. He argues that artists' methods are a

means to uncover aesthetic primitives in ordinary perceptual experience and that the formal structure of an artwork is "intrinsically interesting" by virtue of what it reveals to us about perception itself. Therefore, aesthetic primitives are both epistemically valuable and aesthetically interesting by virtue of their resonance with the operation of the visual system.

This suggests a means to resolve the ambiguity in Zeki's treatment of the relationship between formal structure and aesthetic experience. Although background knowledge in the form of memory and cultural upbringing plays a critical role in the production of aesthetic experience, in some cases artworks are about the aesthetic primitives that function to trigger aesthetic experience. In these cases viewers experience aesthetic primitives as independently interesting. Descriptions of the way aesthetic primitives resonate with the operation of perceptual systems explain why viewers experience these formal features as aesthetically interesting. Therefore, explanations of the way the formal structure of artworks function to trigger perceptual responses in viewers suffice to explain the aesthetic quality of viewers' interactions with at least some artworks. Further, artists' formal vocabularies are constructed from aesthetic primitives. These formal features function as the triggers for all aesthetic experience. Therefore, their effects are not limited to aesthetic experiences triggered by artworks that are about their own aesthetic effects.

However, this does not suffice to resolve the general problem identified for Zeki's aesthetic hypothesis. The trouble is that neuroaesthetics rests on an awareness of the structure of appearances that is equally, if not more readily,

available to viewers in ordinary perceptual experience. For instance, Mach bands are ubiquitous in the ordinary environment. They appear at the edges of all shadows and the boundaries between light and dark color fields. However, even if we find Mach bands perceptually interesting, ordinary visual experiences do not become aesthetic experiences in the artistic sense by virtue of either what they reveal to us about the structure of appearances or how they resonate with the visual system. This entails that explanations of the way the formal structure of an artwork functions to trigger perceptual responses in viewers does not establish that the formal properties of the work are aesthetically interesting. Therefore Zeki's theory does not capture the notion of 'aesthetics' in the correct sense.

3.2 It Is an Open Question Whether Zeki's Aesthetic Hypothesis Is Sound

> The purpose of art is to force us to notice. Since perception is usually too automatic, art develops a variety of techniques to impede perception or to call attention to itself...Thus, it not only bears meaning, it forces an awareness of its meaning upon the viewer" (Lemon & Reis, 1965).

The constructivist hypothesis explains art and aesthetic experience in terms of the processes subserving ordinary perception. This is one of its strongest virtues. It generates a simple, elegant theory that abides by the rule of Occam's razor. Explanations of aesthetics need not, on this account, appeal to further culturally opaque practices or murky aesthetic sensibilities. However, it also entails that the constructivist hypothesis cannot, in itself, differentiate aesthetic from ordinary visual experience.

Zeki's theory is an attempt to resolve this difficulty. In this regard, his goal

is twofold. First, he argues that the fact that one can explain the perceptual effects of artworks neurophysiologically establishes that artists' understanding of the structure of appearances encodes an intuitive understanding of the operation of the visual system. Second, he asserts that neurophysiological explanations of the ways in which the formal structure of artworks generate the perceptual content of aesthetic experience can serve as the foundation for a biologically based theory of aesthetics. This division of labor yields a weak and strong interpretation of Zeki's theory that mirrors the distinction between the two senses of 'aesthetics' introduced in Chapter 1:

> weak interpretation (perceptual hypothesis):
> Neuroaesthetics explains the functional success of visual artworks as a class of perceptual stimuli.
>
> strong interpretation (aesthetic hypothesis):
> Explanations of the way the formal structure of artworks function to trigger perceptual responses in viewers suffice to explain the aesthetic quality of viewers' interactions with at least some artworks.

The functional relationship between artists' practice, the formal structure of visual artworks, and the neurophysiology of the visual cortex establishes only the weak interpretation of Zeki's theory. However, if Zeki's thesis is restricted to the weak interpretation, then he has not demonstrated that it can serve as the foundation for a biologically based aesthetics. What is needed to establish the strong interpretation is evidence that an awareness of the functional properties of the formal structure of an artwork is a source of aesthetic interest. What is needed to establish this latter claim is a theory of aesthetics that links the perceptual practices explained by neuroaesthetics to the aesthetic practices constitutive of art and aesthetic experience.

A broader evaluation of artists' methods suggests a way to establish this link. One can argue that artists' formal vocabularies are derived in part from an understanding of correlations between formal features of the visual field and their own aesthetic experiences. This knowledge is reflected in the way an artist chooses to render an object, scene, or abstract composition, i.e. the style in which they depict the content of the work. Educated viewers learn to read this information off the latent structure of a work of art. This process of active discovery in turn enhances their aesthetic experiences (chapter 1, pp. 28 – 29). It is therefore plausible to expect that an argument for Zeki's aesthetic hypothesis is forthcoming. However, neither the case studies discussed above nor Zeki's analogy between the practices of artists and vision scientists suffice to explain the aesthetic properties of either artists' or viewers' aesthetic experiences. This entails that the value of Zeki's thesis, and consequently the constructivist hypothesis, to explanations of art and aesthetic experience depends upon the discovery or development of a complimentary theory of aesthetics that identifies an interest in the functional properties of the formal structure of artworks as a source of aesthetic interest.

Chapter 3: Jennifer McMahon's Critique of Narrow Formalism

Cognitive science can explain how visual artworks function as perceptual stimuli. This is the strength of the constructivist hypothesis. However, this strength is also the root problem for neuroaesthetics. The constructivist hypothesis is a functional theory of art. Functional theories of art define artworks as artifacts designed to trigger aesthetic experiences in viewers, or to generate aesthetic interest (Beardsley, 1982, p. 239; and Carroll, 1986, p. 57). Neuroaesthetics rests on the assumption that attention to the way the formal structure of an artwork functions to convey its content is a source of aesthetic interest. All works of fine art are artifacts designed to convey their content perceptually, e.g. paintings, dances, and musical performances. Therefore, neuroaesthetics rests on the assumption that an understanding of how works of fine art function as perceptual stimuli should suffice to explain how they generate aesthetic interest (Zeki and Lamb, 1994, p. 607; see also p. 77 above).

Zeki argues that explanations of the way the formal structure of an artwork functions to selectively stimulate discrete areas of the visual cortex suffice to explain the way they function to generate aesthetic interest (see above pp. 58 – 60). However, there is a difficulty for this approach. There is no difference between the way perceptual cues function in aesthetic and non-aesthetic perceptual stimuli (Cavanaugh, 1999, p. 548). For instance Ramachandran and Gregory's illusory motion displays and Isia Leviant's Op Art painting "Enigma" are both perceptual stimuli designed to selectively stimulate areas of the visual

cortex responsible for the perception of illusory motion.[24] However, only the latter functions as a trigger for aesthetic experience. As a result, explanations of the way artworks function as perceptual stimuli do not suffice to explain how they function to generate aesthetic interest. Therefore, the contribution that neuroaesthetics makes to our understanding of art does not establish the constructivist hypothesis as a functional theory of art.

Zeki acknowledges this difficulty. He concedes that the content of aesthetic experience is not ordinarily limited to the sensory content of viewers' interactions with artworks (Zeki and Lamb, 1994, p. 607). Rather, he defines aesthetic experience as a complex cognitive event that is the product of both sensory stimulations and subsequent semantic associations. Zeki asserts that this entails that neuroaesthetics does not provide a complete explanation of aesthetic experience. Nonetheless, he argues that selectively stimulating a perceptual system via the right sets of formal features is sufficient to trigger this type of cognitive event. Further, he argues that attention to the way formal features in an artwork function to trigger perceptual effects does sometimes, alone, suffice to trigger aesthetic interest, e.g. Calder's mobiles or Leviant's Op Art painting. Therefore, Zeki asserts that attention to salient features of the formal structure of a work of art is a source of aesthetic interest.

Zeki's conception of viewers' interactions with artworks naturally lends

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24. Zeki and Lamb, 1994, pp. 623 – 624. Viewers report that they see pulsating centrifugal motion in the rings of Leviant's painting. See p. 60 above for a discussion of Ramachandran and Gregory's display.

itself to a formalist theory of art.[25] The central claim of formalism is that the content of an artwork inheres in, and so is derived from attention to an artwork's formal structure. Noël Carroll identifies two distinct interpretations of this claim: narrow formalism and neoformalism (see Carroll, 1999, pp. 152 – 153). Narrow formalists assert that aesthetic interest is a product of attention to the formal structure of an artwork independent of either its meaning or representational content (Bell 1913, pp. 17 – 18; see also Carroll, 1999, p. 110). Neoformalists assert, alternatively, that aesthetic interest is derived from attention to the way the meaning and representational content of an artwork is embodied by its formal structure (Carroll, 1999, pp. 126; Eldridge, 1985, p. 308 and Goldman, 1998, pp. 82 – 83). Therefore, neoformalism represents an approach to art and aesthetics that can accommodate a broad range of cognitive influences on aesthetic experience.

The appeal of a narrow formalist theory of art is that it can explain our interest in artworks from past eras and different cultures independent of any knowledge of the culture that produced them.[26] For instance, I might appreciate the visual design of a particular work of Oceanic Art in the Rockefeller Wing of the Metropolitan Museum of Art independent of knowledge of the creation myth it is designed to symbolize visually. If the source of aesthetic interest in a work is simply the perceptible features of its formal structure, then one does not need any detailed familiarity with the history or meaning of an artwork to appreciate its

25. This observation is supported by the fact that Zeki draws heavily on early modernist abstraction to illustrate his theory.

26. I would like to thank Jennifer McMahon for pointing this out to me in correspondence.

aesthetic value (McMahon, 1999, p. 15; and Carroll, 1999, p. 110). In this regard, Richard Latto writes:

> Aesthetic interest in art is generated through the forms created by the artist on the surface of the canvas or in the three dimensional space of a sculpture. Even with representational art, narrative content is not usually central to its appreciation and is often indeed not fully understood by the viewer, particularly if the art originates in a different historical period or a different culture...The move to abstraction in the visual arts in the beginning of the twentieth century was a recognition of this dominance of form over narrative content (Latto, 1996, p. 66).

However, despite its putative strengths, one can raise an objection to narrow formalism. It is more often than not the case that viewers need to learn something about the significance of a work in order to recognize and appreciate its aesthetically salient formal features. I recall long hours as a young child dutifully following my parents through gallery after gallery of agonizingly boring 18th and 19th Century landscape paintings at the Metropolitan Museum of Art. These paintings have since become some of my favorites. What has changed? I now understand the technical accomplishment and art historical significance of the works. This enables me to recognize and appreciate the way they embody their content, e.g. the way the artists manipulated both scale and the quality of light to render their conception of the landscape. Attention to these facts about the formal features of the work, in the context of the appropriate background knowledge, is a source of aesthetic interest. Therefore, facts about viewers' ordinary interactions with artworks seem to favor a neoformalist over a narrow formalist theory of art.[27]

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27. Although some philosophers and art critics have pushed narrow formalist theories of art and aesthetics, I doubt that there has ever been a genuinely narrow formalist artist. The reasons for making certain abstract formal choices over others, or

Paradoxically, the role of background knowledge in aesthetic experience can be most clearly illustrated by abstract artworks. Consider the paintings of Kasimir Malevich and Piet Mondrian. Both painters are known for their abstract works and their formalist aesthetics. However, both painters also employed descriptive titles that infuse their works with representational and narrative content. Malevich is known for his views on the expressive power of pure geometry. However, the full title of his painting "Red Square: Painterly Realism of a Peasant Woman in Two Dimensions" contains references to his Bolshevik politics, e.g. Red Square in Moscow which is the site of the Czar's palace, and peasant women, who were identified by Bolsheviks as members of the proletariat (figure 16). Knowledge of these facts about Malevich's politics and aesthetics causes viewers to contemplate the purpose of rendering the square as an irregular trapezoid. The act of contemplating the function of this formal feature is, in turn, a source of aesthetic interest. Therefore, the full aesthetic content of the painting is a product of the conjunction of its formal features, the representational cues in the title, and background art historical knowledge.

Likewise, Mondrian's painting "Broadway Boogie Woogie" visually references the dynamics of New York City life (figure 17). The title names both Manhattan's main thoroughfare and an upbeat New York style of music popular in the 1940s. The deep reds, bright yellows, and gridded structure of its formal composition symbolize both the bright lights of Broadway and the orderly chaos

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even choosing formalism in the first place, are conceptual biases that inform the content of the work. For the artist the beliefs underlying these choices ground the aesthetic interest generated by their works, e.g. Kandinsky and Mondrian believed that certain types of color relationships symbolized spirituality.

of commerce on New York's gridded streets. Knowledge of these facts can function to alter how one perceives the formal structure of the painting. For instance, the educated viewer might perceive an abstract depiction of the dynamics of a Broadway marquee or congested city street instead of a static geometric composition.

One can distinguish among three types of content in "Red Square" and "Broadway Boogie Woogie:" depictive content, broader representational content, and meaning. The distinctions between these types of content can be defined by example. "Red Square" depicts, or visually presents, an irregular trapezoid. This figure, in the context of the title of the painting, represents both a peasant woman and a location in Moscow, and by virtue of its color symbolizes, or means, something about Malevich's Bolshevik politics. The above descriptions of the way these paintings function to convey their content demonstrate both that a viewer's perceptual interaction with an artwork is influenced by his or her understanding of its meaning and broader representational content and that the way a viewer perceives an artwork can influence the way it generates aesthetic interest.

Jennifer McMahon has argued that an adequate theory of aesthetics must be able to account for these sorts of cognitive influences on viewers' aesthetic interactions with artworks. Narrow formalism cannot do so. Therefore, she argues that narrow formalism is not an adequate theory of aesthetics. McMahon's critique of narrow formalism targets twentieth century theories of art canonically represented by Clive Bell's theory of significant form (McMahon,

2000a, p. 31). Bell argued that aesthetic interest is a product of the formal structure of an artwork alone, independent of its meaning or representational content (Bell, 1913, pp. 17 – 18):

> The representative element in a work of art may or may not be harmful; it is always irrelevant. For to appreciate a work of art we need bring with us nothing from life, no knowledge of its ideas and affairs... (Bell, 1914, p. 27).

> If the representation of three-dimensional space is to be called 'representation,' then I agree that there is one kind of representation which is not irrelevant. Also, I agree that along with our feeling for line and color we must bring with us our knowledge of space if we are to make the most of every kind of form...every other sort of representation is irrelevant (Bell, 1914, p. 28).

Therefore, Bell's theory cannot account for the fact that knowledge of the meaning and representational content of a work contributes to the way it generates aesthetic interest.

McMahon raises a similar objection to neuroaesthetics (McMahon, 2000b, p. 3). Zeki's theory rests on the role of physiological processes in the early visual cortex in perception. These processes occur prior to, and so operate independently of, the influence of semantic knowledge in vision. The outputs of these processes represent the form of an image independent of its representational content. These facts entail that Zeki's theory does not provide a mechanism to account for the role of background knowledge in aesthetic experience. Therefore, despite the fact that Zeki defines aesthetic experience as a complex cognitive event, neuroaesthetics is, in practice, a narrow formalist theory.

Zeki's own conception of neuroaesthetics supports this objection. He hypothesizes that neuroaesthetics could, in principle, be generalized to include

the influence of learning and memory in aesthetic experience. However, he argues that the neurophysiological processes subserving these types of cognitive events are poorly understood. As a result, he has intentionally limited the scope of his theory to explanations of the types of sensory, or purely formal, effects that can be explained in terms of well understood processes in the early visual cortex. These processes operate independently of the influence of learning and memory in perception. Therefore, Zeki's rationale for the limited scope of neuroaesthetics confirms McMahon's claim that, in practice, it is a narrow formalist theory.

McMahon does not deny that attention to the formal structure of an artwork can sometimes function as a source of aesthetic interest. Rather, she argues that this perceptual event is itself a product of relations between ideas and percepts, or cognitive influences on form recognition. Therefore, one can interpret her theory as an attempt to incorporate the narrow formalist intuition about aesthetics into a broader neoformalist framework.

McMahon's theory is derived from a constructivist approach to vision:

> According to what is called a constructivist or structural description theory of object recognition by contemporary cognitive scientists, visual processes build visual form in part from visual primitives during perception. This is necessary because the only information that hits the retina is an array of varying light intensities. Visual form construction is therefore driven by principles of form embedded in the visual system...Perhaps when these principles are employed in a way likely to draw our attention away from straightforward object recognition to the processes of perception as a solution to a problem, then we experience [aesthetic pleasure] (McMahon, 2001, pp. 235 – 236).[28]

The input to the visual system is a two-dimensional retinal image that is

28. McMahon defines aesthetic pleasure as a general feeling of cognitive consonance, or satisfaction, that functions as the mark of aesthetic interest. In this sense I interpret her use of the term 'aesthetic pleasure' as synonymous with the use of the term 'aesthetic interest' in functional theories of art.

consistent with an infinite number of three-dimensional interpretations (Palmer, 1999, p. 23; Goldstein, p. 173; Winner, p. 82; chapter 1, pp. 2 – 4; and below, p. 91 – 94). However, despite this ambiguity in the input, the visual system is able to recover the structure of an object's appearance quickly, consistently, and accurately in most contexts. Constructivists argue that this fact about human behavior entails that visual perception relies on some extra source of information beyond the retinal image. The solution they suggest is that prior knowledge of the general structure of scenes and objects functions as a set of hidden assumptions that influence visual processing. McMahon interprets this to entail that all visual perception is the solution to a problem whose resolution involves relations between ideas and percepts.

Constructivists argue that prior knowledge of the structure of scenes and objects is stored in the human visual system in two ways: perceptual principles and semantic knowledge. Perceptual principles are general rules that describe the way the visual system recovers the formal structure of an image from ambiguous sensory inputs. Constructivists interpret these rules as assumptions about the relationship between sensory inputs and the structure of the stimulus. Therefore, constructivists argue that perceptual principles encode knowledge about the basic structure of the perceiver's ordinary environment.[29] For instance, neurons in the form and motion pathways of the early visual cortex respond preferentially to sharp luminance boundaries (Marr and Nishihara, 1978, pp. 168

29. In this sense, perceptual principles denote the type of knowledge artists gain when they learn to successfully control for viewers perceptual experiences by manipulating relations among the formal features of their work, e.g. sharp differences in brightness will be perceived as object boundaries. See the discussion of irradiation above (pp. 62 – 66).

– 169; Zeki and Lamb, 1994, pp. 608 – 610; Kandel et al, 2000, pp. 533 – 536). These image features are represented in the visual system as oriented lines. Oriented lines are interpreted at later stages of processing as edges that define the outlines of objects and their parts. In this context the recovery of object boundaries from the retinal image is governed by two general perceptual principles: interpret sharp boundaries in the sensory input as oriented lines and interpret oriented lines in sensory representations as edges that define the boundaries of objects and their parts in the distal environment.

Viewers determine the identity of objects in the visual field by matching, or categorizing, the form of sensory images in the visual system to knowledge of the general shapes and functions of objects. This type of knowledge is referred to as semantic knowledge because it refers to propositionally stored knowledge of general facts about the world. Constructivists argue that categorization processes influence form recognition. Therefore, categorization processes mediate the influence of semantic knowledge on the structure of perception. Cubism can be used to illustrate this claim. The fractured formal geometry of Cubist paintings can make it quite difficult for viewers to recover their representational content. However, Cubist paintings ordinarily have descriptive titles like "Man with a Guitar," "Woman with Accordion," and "Bottle and Fishes." Information in the title tells the visual system in advance how to categorize, or identify, the depictive content of the image. This information, in turn, influences the way the visual system groups the image features in the paintings (see below, p. 37 – 38). Therefore, prior knowledge of the identity of an image can influence

the way viewers perceive the formal structure of a painting.

This model for vision can accommodate the intuitions of both neoformalist and narrow formalist theories of art. Given the assumption that semantic knowledge influences form recognition, a constructivist theory of vision can accommodate a role for meaning and broader representational content in a formalist aesthetics. However, form recognition need not draw upon on the influence of semantic knowledge. Sometimes perceptual principles alone suffice to recover the form of a scene, object, or image from ambiguous inputs. This entails that perceivers can, at least in principle, become aware of the form an image independent of its identity, e.g. the geometric shapes that define the abstract space of a Cubist painting. Therefore, McMahon argues that some works of art generate aesthetic interest by virtue of their formal features alone. However, she argues, contra narrow formalism, that the formal structure of an artwork is itself the product of relations between ideas and percepts, e.g. perceptual principles and image features.

In what follows, I evaluate McMahon's solution to the problem of narrow formalism in order to motivate an interpretation of the constructivist hypothesis that is consistent with Zeki's broad definition of aesthetic experience (see p. 80). McMahon's theory of aesthetics is derived from David Marr's model for visual perception. In section 1 I discuss Marr's model as a constructivist solution to the inverse problem and introduce McMahon's theory of aesthetics. In section 2 I discuss evidence that supports McMahon's theory of aesthetics. In section 3 I evaluate McMahon's theory in the context of her critique of narrow formalism.

The difficulty for narrow formalist theories of art and aesthetics is that they cannot account for the productive role played by background knowledge in aesthetic experience, e.g. a viewer's understanding of art history, aesthetic practice, and the meaning of the artwork (McMahon, 2000a, p. 31). McMahon claims that her theory can resolve this problem. On the general constructivist account, object identification and form recognition are not discrete processes. Therefore, categorization processes can function as a mechanism to mediate the influence of background knowledge in the perception of artworks.

However, this characterization of McMahon's theory generates a problem. McMahon's explanations of the influence of background knowledge in aesthetic experience rest on the role played by perceptual principles in form recognition. Perceptual principles encode knowledge of the spatial structure of a perceiver's ordinary distal environment. In this regard McMahon's theory is designed to explain how an intuitive awareness of the psychological processes subserving form recognition functions, independent of the influence of semantic knowledge in object identification, as a source of aesthetic interest. This entails that McMahon's theory, like Zeki's, fails in practice to account for the productive role of the meaning and representational content of a work in aesthetic experience.

The difficulty for McMahon's thesis is not due to the model of vision that she endorses. Her criticisms of narrow formalism support the constructivist claim that semantic knowledge influences form recognition. In addition she asserts that what individuals in one culture find aesthetically pleasing may "leave individuals in another culture cold" because members of the latter group lack the

cultural knowledge necessary to recover the aesthetically salient formal features of the work (McMahon, 2001, p. 236; and 1999, p. 19). Therefore, McMahon's general model for perception, independent of the arguments and case studies she uses to illustrate her theory, can account for the role of prior knowledge in viewers responses to paintings. I conclude that the basic framework of McMahon's critique of narrow formalism can be used to generate a neoformalist interpretation of the constructivist hypothesis. The ensuing model for a functional theory of art identifies the source of aesthetic interest as attention to the interplay of formal image features and semantic knowledge in object recognition.[30]

1.0 Art and the Inverse Problem

The general constructivist model for vision can be thought of as a solution to the inverse problem (Palmer, 1999, p. 56; and Winner, p. 89 – 90; see also above, p. 2). The inverse problem refers to a difficulty for visual form recognition: the information in the retinal inputs is spatially ambiguous, and so is insufficient to enable the visual system to uniquely determine the three dimensional shapes of object in the visual field (Palmer, 1999, p. 23; and Scholl, 2005, p. 41). Consider the problem as follows. The input to the visual system is a two-

30. It is important to note that McMahon does not make a distinction between semantic knowledge and perceptual principles in her writing. She argues that the role of perceptual principles in form recognition suffices to demonstrate the influence of background knowledge in aesthetic experience. In this chapter I argue that this is a mistake. McMahon defines the type of knowledge encoded in perceptual principles as tacit knowledge of the general structure of the distal environment (McMahon, 1999, p. 16). The type of knowledge alluded to by the term, 'background knowledge' in her critique of narrow formalism is explicit knowledge of art history and cultural practice. Therefore her arguments and case studies fail to either demonstrate or account for the influence of background knowledge in aesthetic experience.

dimensional projection of the overall form of the visual field (Palmer, 1999, p. 25). The structure of this initial image is arrived at by simply flattening out the surface geometry of the visible world, much like one projects a slide image or movie onto a wall. In this regard, each point in the visual field maps to a unique point on the two-dimensional surface of the retina. However, the relationship between the retinal image and the visual field is not well defined. The two-dimensional retinal input to the visual system is consistent with an infinite number of three-dimensional, or inverse projections (Palmer, 1999, p. 23; Scholl, 2005, pp. 40 – 41; Goldstein, 2002, p. 173). For instance, the retinal image in figure 18 could have been produced by any member of a mathematically infinite set of distinct shapes whose two-dimensional projection is a square. Therefore, the input to the visual system is a spatially ambiguous retinal image that underdetermines the structure of perception.

One might object that this characterization of form recognition is artificial. The world is more spatially complex than a line drawing. The input to the visual system will ordinarily contain a number of complimentary cues that function to limit the number of possible interpretations of the retinal image. For instance, in a real world example the position of the square relative to other objects in the visual field would generate depth cues to indicate which three dimensional projection is correct. Therefore, it would seem that the majority of alternate interpretations of the retinal image can ordinarily be rejected as implausible.

The trouble is that this is not always the case. Complimentary cues do not always adequately constrain the interpretation of the retinal image. Consider the

images of Thomas Macaulay's environmental sculpture in figure 19. Macaulay's site specific installation was created to be viewed from a particular window in the second floor gallery at the Blackhawk Mountain Art School in Colorado. The image on the left represents the view of the installation from the gallery window. The image on the right represents the actual configuration of stones used in the installation. One thing to note is that the hill and crossing stream bed contain clear depth cues indicating the general spatial structure of the scene surrounding the sculpture. The difficulty in this case is twofold. First, there is a straightforward, highly plausible interpretation of the retinal image generated by this sculpture that is incorrect. The two-dimensional retinal projection of the sculpture when viewed from the gallery window is a circle. This type of smooth, uninterrupted contour is ordinarily evidence for a discrete object in the visual field. Second, the correct inverse projection of this image feature is an implausible figure, or a shape that one would not ordinarily expect to encounter in a natural scene. Therefore, despite the presence of contrary depth cues, the visual system incorrectly interprets the sculpture to be, as it appears from the gallery window, a ring of rocks.

David Marr argued that what is interesting about this problem is not that it appears insurmountable, but rather that it is so easy for the human visual system to overcome in ordinary visual contexts (Marr, 1982, pp. 218 – 219; and Palmer, 1999, p. 55 – 56). Constructivist theories of vision can explain why this is the case. These theories are derived from the claim that vision is an inferential process that rests on hidden assumptions about the ordinary structure of objects

in the visual field:

> The paradox then is that the bounding contours in Picasso's "Rites of Spring" [figure 20] apparently tell us more than they should about the shapes of figures. For example neighboring points on such a contour could in general arise from widely separated points on the original surface, but our perceptual interpretation usually ignores this possibility...[B]ecause we can interpret the silhouettes as three dimensional shapes, then implicit in the way we interpret them must lie some priori assumptions that allow us to infer a shape from an outline (Marr and Nishihara, 1978, p. 177).

Marr's general model accounts for the "misperception" of Macaulay's sculpture. Smooth, continuous contours, like the ring of rocks perceived through the gallery window, are ordinarily good indicators of the shape of a discrete object. Knowledge of this fact is encoded in the visual system as a perceptual principle that functions as a hidden assumption about the most likely shape of the stimulus. Therefore, the visual system (mis)interprets the sculpture as a ring of rocks, and fails to perceive that it is, in actuality, composed of three spatially discontinuous stone walls.

McMahon's theory of aesthetics is derived from Marr's solution to the inverse problem (Marr and Nishihara, 1978; and Marr, 1982).[31] Marr hypothesized that the visual system consists in sets of hierarchically ordered processes which yield consistently more complex representations of the spatial information encoded in the retinal inputs (see Marr and Nishihara, 1978, pp. 169

31. The detail of Marr's theory of vision has been significantly augmented and corrected since it was first published over 20 years ago. However, vision scientists like Stephen Palmer argue that his model still serves as a good framework for understanding the way the visual system recovers the shape of the stimulus from ambiguous inputs (Palmer, 1999, p. 85). In what follows, I discuss the way McMahon's theory of aesthetics emerges from her interpretation of Marr's theory of vision. In chapters 4 and 5 I will discard the detail of this model in favor Stephen Kosslyn's hypothesis testing model for visual search and object identification (Kosslyn, 1996; and Thompson and Kosslyn, 2000).

– 178; Thompson and Kosslyn, 2000, p. 536; Palmer 1999, p. 85; Palmer and Rock, 1994, p. 516; Cavanaugh, 1991, p. 303; Biederman, 1987). There are four stages of visual processing on this account. Each stage is defined relative to the set of form primitives constitutive of its output and the perceptual principles that are used to generate those primitives from the outputs of the prior stage of processing. McMahon hypothesizes that an intuitive awareness of the role played by form primitives and perceptual principles in vision functions as a source of aesthetic interest.

Marr referred to the first stage of visual processing as the primal sketch. The retina records information about the relative brightness of light reflected from points in the visual field (McMahon, 2001, p. 235; Palmer, 1999, pp. 23 and 85; and Marr and Nishihara, pp. 165 and 167). However, it does not itself encode knowledge about how these points in the visual field are related to one another. This information is recovered later in the visual system by processes that compare the inputs from individual retinal cells. In this sense the initial input to the visual system is analogous to the spatially ambiguous snowy pattern of television static that plagued New York City residents in the days before the introduction of cable TV (figure 21). The visual system is an evolved set of processes whose function is to assign structure to these ambiguous inputs. As a first step in this process it represents sharp differences in brightness as lines. Figure 22 represents a primal sketch derived from Braque's "Bouteilles et Poissons" (figure 4). The lines that constitute the structure of this image are form primitives and the rule used to calculate them, interpret sharp differences in

luminance in the retinal image as lines in the primal sketch, is a perceptual principle (see above, p. 84).

Viewers naturally perceive objects and depth in representations of the primal sketch, e.g. figure 22. However, strictly speaking, the output of this stage of processing is an interpretation of the overall, abstract, two-dimensional structure of the retinal image, not a representation of either the structure of a scene or the form of objects in the visual field (Marr, 1982, p. 68). Information about edges, surfaces, volumes, and depth is extracted from this image only relative to perceptual principles constitutive of later stages of processing. As a result, at this stage of processing, a sensory image in the visual system is an undifferentiated, two-dimensional abstract pattern of lines. The reason viewers perceive objects and depth in representations of the primal sketch is straightforward. They do not perceive these representations as they would if their visual experience were limited to the output of the processes responsible for the primal sketch. Rather, in normal contexts perceptual stimuli like figure 22 are subjected to the full range of visual processing, e.g. higher level processing that involves semantic knowledge and perceptual principles, necessary to perceive discrete objects in natural scenes. Therefore, they are perceived as representing objects and scenes in depth.

Marr called the second stage of processing the 2½-dimensional sketch. The purpose of this stage of processing is to recover the surface, or frontal geometry of a visual image from the primal sketch. The surface geometry of an image consists of a pattern of oriented planes perceived in depth that represents

the visible surfaces in the visual field as if they were constitutive of a single continuous object. One can therefore think of the structure of the image at this point as analogous to a close up view of the undulating contours of a rock face, a crumpled paper bag, or a blanket casually strewn on the floor at the end of a bed. In this regard a Cubist painting is like a 2½-dimensional sketch (figure 23). Importantly, like the primal sketch, the output of this stage of processing is a global abstract pattern that has not yet been segmented into discrete objects or object parts.

Marr called the last two stages of visual processing the 3-dimensional object representation and categorization processing. These two stages of visual processing can be referred to as form recognition and object identification respectively. Marr argued that, at the third stage of processing, the oriented planes of the 2½-dimensional sketch are grouped together relative to their proximity, luminance, and orientation to form local volumes. These local volumes are, in turn, grouped together to form three dimensional representations of discrete objects in the visual field relative to the same types of information (see below, p. 100). For instance, a dark surface next to a bright surface might be interpreted as evidence of a cast shadow. If so, these surfaces would be interpreted as two sides of the edge of an object part. In the last stage of visual processing, the forms of objects represented in the 3-dimensional object representation are categorized, or matched to semantic knowledge to recover the identity of the visual image.

McMahon does not explicitly identify the way her theory of aesthetics

maps to the detail of this model for perception. However, in several places she identifies an intuitive awareness of the processes by which the visual system generates the "unified form of a scene or object" as an important source of aesthetic interest (McMahon 1999, pp. 20; McMahon, 2000b, pp. 4 – 5; and McMahon, 1999, pp. 13 – 14). The transition between the 2½- dimensional sketch and the 3-dimensional object representation is the process by which the visual system generates the unified global forms of scenes and objects from information about the local geometry of visual images. At this stage of processing perceptual principles are used to parse and match the parts of the surface geometry of visual images in order to construct representations of the shapes of, and relations among, discrete objects in the visual field.

Marr argued that principal axis representations are the form primitives from which the global forms of objects and scenes are recovered from the surface geometry of an image. Principal axes representations define the central axes of objects and are employed in the visual system to group image features and object parts into representations of the global, or unified, shapes of objects, e.g. the long vertical line defining the torso in a stick figure drawing is used to group disparate, abstract parts of the image into a unified representation of the shape of a person (see also the pipe cleaner models in figure 26b below). Therefore, one can interpret principal axis representations as critical aesthetic primitives for McMahon's theory of aesthetics.

McMahon's discussion of Cubism supports this interpretation. She argues that the form of a work of fine art functions as a source of aesthetic interest by

virtue of the way it either epitomizes or challenges the use of form primitives and perceptual principles to construct representations of the unified forms of objects in perception:

> ...what we experience as aesthetic form is some kind of play on the processes involved in processing within-object relations (constructing perceptual form [from form primitives]) during the course of perceiving certain objects...The idea would be that the perception of certain objects employs perceptual processes involved with detecting within-object relations in such a way as to cause us to experience perception as a solution to the problem of constructing a cohesive form, which is itself pleasurable. It might be that the perception of certain objects employs these perceptual processes in a way that epitomizes their normal operations or employs them in a non-typical way, which causes us to experience something of the processes of perception itself. We would not normally be knowledgeable of the true source of the experience, attributing the feeling of pleasure [e.g. aesthetic interest] to the objective properties of the object (McMahon, 2000, p. 34).[32]

McMahon argues further that the figures in the fractured surface of a Cubist painting are recognizable only relative to the degree to which the rendering of their parts retains a perceivable relationship to the principal axes that define their global, or unified, forms (McMahon, 2000b, p. 2; see also p. 16 above). Consider Braque's painting again (figure 25). The shape of the bottle in the upper right quadrant of Braque's painting is defined by a clear silhouette that functions to group a set of abstract formal image features symmetrically around a strong vertical axis, or axis of symmetry. Consequently, it is the figure most easily recognized in the painting because it "epitomizes" the use of form primitives in visual processing.

The shapes of the five fish in the foreground of the painting are not symmetrical. Consequently the forms used to depict the fish are defined by axes

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32. See also McMahon, 1999, p. 21 – 22; and McMahon, 2001, p. 236.

of elongation. Axes of elongation are used to group the surfaces defining objects with non-symmetrical shapes by their proximity, luminance, and relative orientation. These axes are difficult to recover in the painting, and so challenge the processes by which the visual system constructs the unified form of the object. There are three reasons for this. First, the planes defining their visible parts are the same luminance as their surround. Second, the relative orientation of these planes have been skewed from normal. Third, the tails of the fish are occluded by the way they are piled on the table. This entails that the form cue indicating the correct orientation of the axis elongation for each fish is missing, e.g. an axis extending from its mouth to the center of its tail fins. As a result, the fish are hard to perceive. McMahon argues, following Marr, that the ability to perceive the global form of an object rests on the capacity of the visual system to recover principal axis representations from the flux of information in the input to the visual system. Therefore, one can interpret principal axis representations as the salient aesthetic primitives for McMahon's interpretation of Cubist paintings.

2.0 McMahon's Aesthetic Hypothesis

McMahon's characterization of aesthetic interest is similar to Latto's formalist characterization of neuroaesthetics (see above, p. 67 – 68). Latto argues that:

> a form is effective because it relates to the properties of the human visual system. To describe this process I have coined the term 'aesthetic primitive' which, using 'primitive' in the sense of primary or fundamental, is defined as a stimulus or property of a stimulus that is intrinsically interesting, even in the absence of narrative meaning, because it resonates with the mechanisms of the visual system processing it (Latto,

1996, p. 67 – 68).

McMahon argues analogously that it is possible for an artist to exploit form primitives in such a way that their resonance with the system alone triggers an aesthetic experience:

> Because of the extraordinary employment of these principles [in an artwork] they may come to our attention to be experienced as a solution to a problem: the problem of constructing a coherent form from [abstract] elements, which is the problem vision is designed to solve. Aesthetic pleasure may be the experience of perception as the solution to this problem (McMahon, 2000b, p. 4).

In this regard McMahon argues, like Zeki, that an artist's knowledge of the structure of appearances represents an intuitive understanding of the operation of the visual system (McMahon, 2000b, p. 2).[33] She argues further that artists' formal vocabularies are a means to selectively control for the perceptual experiences of viewers, and that attention to the way form primitives function in the formal structure of an artwork, is a source of aesthetic interest. Therefore, if sound, her theory demonstrates that attention to the way the formal structure of an artwork functions to convey its content is a source of aesthetic interest.

McMahon's characterization of aesthetic interest rests on the conjunction of the following three claims: the visual system employs form primitives to construct the perceptual form of an image from ambiguous sensory inputs; form recognition can be dissociated from object identification in a viewer's ordinary perceptual experience; and, therefore, viewers can become aware of the form of a scene, image, or object independent of its identity. In what follows, I discuss these claims. In section 2.1 I discuss theoretical and experimental evidence that

33. See the discussion of Zeki's thesis pp. 52 – 54 and 73 above.

confirms the role of principal axis representations in form recognition. In section 2.2. I discuss clinical evidence from the study of visual agnosia that supports the claim that form recognition can be dissociated from object identification. In section 2.3 I discuss McMahon's claim that an awareness of the form of a visual sensory image, independent of its identity, is a source of aesthetic interest.

2.1 Principal Axis Representations

The use of Cubism as a case study to illustrate McMahon's theory rests on her claim about the role of principal axis representations in form recognition. Evidence in support of this claim can be drawn from two sources: theories of object constancy and perspective effects in recognition tasks. The appearance of an object can change radically relative to differences in viewing angle, distance from the viewer, and local lighting conditions. Nonetheless, viewers perceive objects as having a constant shape and size across most changes in viewing perspective. This entails that the visual system must employ a strategy for recovering the ordinary shapes of objects, from a vast range of novel views, whose appearances may differ dramatically.

On the standard account, the visual system solves this problem by matching a visual representation of an object's appearance to stored records of the ordinary shapes of objects and object types.[34] Principal axis representations provide a means to realize this strategy (Marr and Nishihara, 1978, p. 181; and Tarr and Bülthoff, 1998, p. 12 – 13). Objects can be rotated, enlarged, or shrunk

34. See Tarr and Bulthoff, 1998 for a review of current approaches to; see also Zeki, 1999, p. 3; and McMahon, 1999, pp. 12 – 14).

around their principal axis to generate any possible view. The relationships between the parts of an object and its principal axis remain constant over all of these transformations. Therefore, as long as the axis is recoverable, the ordinary shape of the object should remain recognizable. Conversely, if the principal axis defining the shape of an object is obscured in a view, then the ordinary shape of the object should be difficult to recognize, e.g. if the principal axis is foreshortened by a rotation as in the lower two images in figure 26a (Marr and Nishihara, 1978, p. 182). Therefore, principal axes provide a mechanism to explain the success and failure of object constancy in ordinary perception.[35]

The hypothesis that principal axis representations play a critical role in object constancy gains support from Bülthoff and Edelman's studies of perspective effects in object recognition (Bülthoff and Edelman, 1992; and Edelman and Bülthoff , 1992). The authors used a set of novel, computer generated wire frame objects for their experiments (figure 27). The methodological virtue of using these objects is that they are unfamiliar to normal subjects and they have no preferred principal axes. This allows an experimenter to define the principal axis of the object explicitly by rotating it in space. Therefore, the use of these figures enabled Bülthoff and Edelman to isolate the role of principal axis representations in form recognition.

Subjects were initially shown several static views of the object related by a rotation around either a horizontal or a vertical axis. The function of this training set was to define the shape of the object relative to a principal axis. In

35. The representational power of principal axis representations is illustrated by stick figure drawings and pipe cleaner models (figure 26b).

subsequent trials, subjects were better at recognizing the objects from changes in perspective related by rotations around the axis defined in the training set than views that foreshortened, and so obscured, that axis (Bülthoff and Edelman 1992, p. 61). For instance, if subjects were first shown the center and left views of the wire frame object in figure 27 they were better at recognizing the right view as the same object as the original, i.e. as having the same shape, than either the top or the bottom view.

Bülthoff argues that these studies demonstrate that novel views of an object are easier to recognize relative to the degree to which they preserve relations between an object's parts and the principal axis that defines its shape (Tarr and Bülthoff , 1998, p. 12; see also McMahon, 1999, p. 14). Therefore, this study supports Marr's general hypothesis about the role of principal axes in form recognition. This, in turn, supports McMahon's claims about the function of principal axes as form primitives in Cubist paintings.

2.2 Associative Visual Object Agnosia

The behavioral deficits of patients suffering from associative visual object agnosia support McMahon's claim that form recognition can be dissociated from object identification (Humphreys and Riddoch, 1998; Ogden, 1993; Ogden 1996; Parkin, 1996). Associative visual object agnosia is defined by three general symptoms. First, patients can not identify object presented visually. They are unable to name visually presented objects, group visually presented objects together by semantic category, e.g. animal, dog, or terrier, or gesture to indicate

the normal function of visually presented objects, e.g. hammering, sawing, or answering the phone. Second, patients' general knowledge of the shapes and functions of objects is unaffected. Associative agnosics have no trouble identifying the same objects when they are presented via verbal description or through other sensory modalities. For instance, M.H. cannot visually recognize a telephone. However, he can identify it by the sound of its ring or the verbal description "ring ring" (Ogden, 1996, p. 133). Third, patients have intact visual sensory capacities and appear to have generally good form recognition. They are able to match simple geometric shapes and familiar objects (figure 28). They can accurately copy simple line drawings of objects (figure 29). They can draw the outlines of some of the simple objects they cannot identify, e.g. forks and spoons. And, in some cases, they can even describe the shapes of the parts of objects.

These three types of evidence demonstrate that associative agnosics have generally intact visual sensory capacities, memory, and cognitive capacities. Associative visual object agnosia is, as a result, defined as a categorization deficit, or a deficit in the processes by which viewers match the perceptual form of an image to stored records of the general shapes and functions of object types. Therefore, the deficits of associative visual object agnosia support the claim that form recognition represents an independent stage of visual processing that can be dissociated from object identification.

The performance of associative agnosics on copying and matching tasks was traditionally interpreted to demonstrate that they could adequately perceive

the global perceptual form of objects they could not identify (Teuber, 1968).[36] However, there is a problem for this interpretation. Despite their success in copying and matching tasks, clinical evidence suggests that these patients do not have normal form recognition (Farah, 1992, p. 61; Farah, 2004, p. 74). For instance, associative agnosics are unusually sensitive to the quality of a stimulus. They often fail to match a shape or object in one drawing to its counterparts in a second, cleaner copy because they mistake ink smudges or other imperfections in the original for aspects of the represented pattern or object. This demonstrates that they are not able to parse and match image features adequately in the drawings, i.e. they fail to differentiate spurious image features from the image features that define an object's shape, and so cannot construct perceptual representations of the shapes of the discrete objects that the drawings depict (Farah, 1992, p. 62). Neuropsychologists like Martha Farah hypothesize, as a result, that visual agnosics do not perceive the line drawings that they accurately copy as depictions of the global forms of scenes and objects, but rather as undifferentiated abstract visual patterns that are similar in structure to a primal sketch or 2½-dimensional sketch.[37]

This hypothesis is supported by the drawing strategies associative agnosics use in copying tasks. Agnosic patients construct their drawings piecemeal, from slavish point by point comparisons between the drawing and the

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36. Cited in Farah 1992, p. 59

37. Although Farah's discussion of associative visual agnosia in the second edition of her book Visual Agnosia is somewhat critical of the interpretation of the syndrome from the first edition, she reports that the Humphreys and Riddoch's original observations have been replicated with other agnosics (Farah, 2004, p. 78; Ogden, 1993). Further, the case study she reports from Ruebens and Benson (1971) is consistent with this interpretation (Farah 2004, p. 70 – 71),

target. This evidence is interpreted to show that they are copying local image features without any knowledge of the global structure of the represented object (Farah, 1992, p. 60; Farah, 2004, p. 74). Therefore, the accuracy of associative agnosics' drawings does not demonstrate an ability to perceive the form of the object. Rather, it appears that they can recover and copy the local structure of images, e.g. the local relationships among the formal parts of a line drawing, but are unable to group these parts together to construct the global forms of objects depicted in the image (Farah, 1992, p. 60).

Evidence from two cases studies further supports Farah's interpretation of associative visual object agnosia: M.H. and H.J.A. (Ogden, 1996; and Humphreys and Riddoch, 1998). These patients are sometimes referred to as integrative agnosics. Both have a limited ability to recognize objects visually. However, the manner in which they do so is abnormal. When asked to identify line drawings of familiar objects, they first describe the shapes of their parts, and then use these descriptions to identify the object. For instance, when M.H. was shown a drawing of a toothbrush he responded, "It has a long handle, similar to a spoon or a fork with bits coming up...a toothbrush!" (Ogden, 1996, p. 134). Ogden, Farah, and Humphries and Riddoch all argue that what these patients recognize is, as a result, a verbal description of the shapes of discrete parts of the image, not the global visual shape of the depicted object.

This conclusion is supported by reports of the types of identification errors made by H.J.A. and M.H. Although these patients can identify the parts of some familiar objects, they often describe these parts as if they belonged to different

objects. For instance, Humphreys and Riddoch report that H.J.A. describes a drawing of a nose as a ladle (figure 30). The authors argue that this occurs because he segments the long hooked line defining the silhouette of the nose as a separate object from the contour that represents the nostril (Humphreys and Riddoch 1998, p. 59 – 60).

Farah argues that this type of evidence demonstrates that associative visual object agnosia is a general deficit in feature integration (Farah, 1992, pp. 59 – 63; see also Humphreys and Riddoch, 1987, p. 105; Ogden 1993, pp. 584 – 585). She hypothesizes that the cause of this deficit is the failure of categorization processing. Since associative agnosics cannot match the local form of visual images to semantic knowledge, they cannot group the local elements of visual images, and so cannot construct representations of the global forms of scenes and objects. This interpretation suggests that the traditional characterization of associative agnosia is incorrect. Nonetheless, the ability of M.H. and H.J.A. to recognize the shapes of object parts, in conjunction with the general ability of associative agnosics to copy local parts of drawings, demonstrates that these patients do have some capacity to perceive the form of a visual image independent of its identity, e.g. features of its local, abstract structure independent of the shapes of the discrete objects it represents. Therefore, clinical evidence from the study of associative visual object agnosia supports McMahon's claim that form recognition can, at least in a limited way, be dissociated from object identification.[38]

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38. One can interpret the perceptual deficits of associative visual agnosics as a failure to recover the principal axis representations that define the global forms of objects

2.3 McMahon's Theory of Aesthetics

> Each rule of beauty is at the same time a psychological discovery. For, since it contains a prescription of the conditions under which a beautiful object can have the best effect on our mind, it must be possible for the rule to be derived from the nature of the human spirit [mind] and explained on the basis of its properties. Thus, if the philosopher pursues the traces of sentiments on their obscure paths, new perspectives in psychology must open themselves up to him, ones which he would otherwise never have uncovered by rational inferences and by experience (Moses Mendelssohn, 1771, p. 169).

The critical feature of McMahon's theory of aesthetics is her claim that viewers can become aware of the form of a scene, object, or image independent of the perceptual processes subserving object identification. The evidence discussed above for this claim is twofold. First, the visual system identifies objects in the visual field by matching the forms of visual images to stored records of the shapes and functions of object types. Therefore, some type of form recognition must precede object identification. Second, the perceptual abilities of associative visual agnosics, limited as they are, confirm the claim that some type form information is available to the perceptual system independent of categorization processing. McMahon argues, consistent with behavioral evidence from the study of visual agnosia, that viewers cannot explicitly resolve the content of this type of perceptual experience (McMahon, 1999, p. 11). Rather, a normal viewer's understanding of the form of an image at this stage of

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in the visual field. Further, given that associative agnosics perceptual deficits are attributed to an inability to categorize objects visually, one can infer that there is a computational relationship between a subject's ability to categorize objects visually and their ability to recover principal axis representations defining the global shapes of objects. Therefore, the perceptual deficits of visual agnosics provide independent evidence for the influence of semantic knowledge in perception, e.g. the integration of object identification in form recognition (see below, p. 118).

visual processing is mediated by a sense of cognitive consonance, a feeling or intuition that is the mark of a resonance between the form of a scene, object, or image and the operation of the perceptual system. She identifies this type of phenomenal experience as a source of aesthetic interest in art.

One can interpret this aspect of McMahon's theory as an extension of Baumgarten's original framework for aesthetics. Baumgarten identified a perceiver's knowledge of the salient formal features of scenes, objects, and artworks as clear but confused. This sense of aesthetics is derived from Leibniz's notion of perceptual knowledge. Leibniz argued that perception is clear but confused when one can discern the thing represented from other objects, but cannot explicitly identify the marks by which one makes this discrimination. Leibniz identifies the aesthetic judgments of painters as a paradigm case:

> ...we sometimes see painters and other artists correctly judge what has been done well or been done badly; yet they are often unable to give a reason for their judgment, but tell the inquirer that the work which [pleases or] displeases them lacks 'something I know not what (Leibniz, 1684, p. 291).

Baumgarten argued similarly that, when the focus of a viewer's attention is the structure of a scene, object, or image itself, he or she experiences the clarity of perceptual knowledge as a feeling of pleasure, a sense of cognitive consonance that functions as the mark of a resonance between a perceptual representation and the stimulus.

McMahon's theory is predicated on the claim that this type of perceptual knowledge is a source of aesthetic interest. Moses Mendelssohn's elaboration of Baumgarten's aesthetics can be used to illustrate this claim. Mendelssohn

argued that the function of artists' methods and formal vocabularies is to "beautify nature." In this regard, when an artist paints a scene or object he or she does not necessarily copy its appearances. Rather, the goal is to render the subject matter in a manner that enhances the harmony, or resonance, between its appearance and the processes of perception (Mendelssohn, 1771, pp. 174 – 176). Viewers, in turn, experience the resonance between an artwork and their perceptual faculties as a sense of satisfaction or pleasure, which is the mark of the perception of beauty. Mendelssohn concluded that artworks function as a source of aesthetic interest by virtue of the resonance between their formal structure and the faculties of perception (Guyer, 1996, p. 134 – 135).

McMahon's theory of aesthetics rests on a similar claim. McMahon argues that stimuli that either epitomize or challenge the processes of perception function as sources of aesthetic interest:

> Perhaps certain relations in the object, in the course of being perceived, challenge or stretch the relevant perceptual principles in an unprecedented or non-typical way. On the other hand, the relation of the elements within some objects, such as natural forms (and certain artworks, for example the sculptures of Constantin Brancusi, 1876 – 1957), might epitomize these perceptual principle. Perhaps when these principles are invoked in any way likely to draw our attention from straightforward object recognition to the process of perception as the solution to a problem, we experience [aesthetic pleasure].[39] That is, when it is as if the very process of perception itself is experienced as...the solution to the problem of constructing a coherent form from the array of [form] primitives, then we experience [aesthetic pleasure]... (McMahon, 1999, pp. 21 – 22).[40]

A scene, object, or artwork whose shape or formal structure epitomizes a set of

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39. In this context 'object recognition' refers to the form recognition processes responsible for identifying that there is a discrete object in the visual field with a particular shape. These processes are ordinarily thought to be a logically prior to, and so a necessary precursor of, object identification.

40. See also, McMahon 2001, p. 236; McMahon 2000a, p. 34.

form primitives is a perceptual stimulus that exhibits a strong resonance with the operations of the visual system. A stimulus that challenges the operation of the visual system is only recognizable by virtue of the sets of image transformations that function to enhance the resonance between a sensory representation and the faculty of perception in order to facilitate form recognition and object identification. In both cases successfully recovering the coherent, or unified form of a scene, object, or artwork from sensory inputs is dependent upon the resonance between a sensory representation of the stimulus and the operation of the visual system. McMahon's theory therefore suggests that viewers experience the resonance between a perceptual stimulus and the operation of the visual system as a source of aesthetic interest.

3.0 McMahon's Critique of Narrow Formalism and Her Theory of Aesthetics

There are two objections that can be raised against McMahon's theory of aesthetics. First, the theory does not meet her own desiderata for an adequate theory of aesthetics (see above, p. 80). It cannot explain the way background art historical knowledge influences the formal content of aesthetic experience. Therefore, despite her claims to the contrary, her theory is a narrow formalist theory of aesthetics. Second, her theory fails to differentiate between the role of form primitives in aesthetic and ordinary perceptual experience. Therefore, it does not suffice to explain even how narrow formalist works of art generate aesthetic interest. In what follows, I discuss both of the these objections and then argue that McMahon's own general constructivist model for vision provides

her theory with the resources to resolve both of them.

3.1 McMahon's Critique of Narrow Formalism

McMahon's primary objection to narrow formalist theories of aesthetics is that they cannot account for the role played by knowledge of the meaning, representational content, and art historical significance of an artwork in formal aesthetic experiences (2000a, p. 31). This objection can be extended to her own theory of aesthetics. The salient conceptual structures involved in her account of aesthetic interest are perceptual principles. Perceptual principles represent knowledge of the geometric structure of the environment that is used to generate form primitives in form recognition. She argues that these processes operate independent of the categorization processes by which one identifies the meaning and representational content of a visual image. Therefore, the types of perceptual processes McMahon appeals to in her explanations of aesthetic interest are not sufficient to explain the influence of art historical knowledge in aesthetic experience. This entails that her theory is, by her own definition, narrowly formalist.

3.2 McMahon's Theory of Aesthetics

The first objection to McMahon's theory narrows its scope to explanations of narrowly formalist works of art. However, it does not threaten its status as a theory of aesthetics. The second objection threatens the status of the theory as a theory of aesthetics. McMahon identifies formal aesthetic interest as the

product of a perceived resonance between a scene, object, artwork, or visual image and the processes of perception. However, the success of all visual perception depends on the resonance between a stimulus and the processes of perception. Therefore, one can object that, like neuroaesthetics, McMahon's theory does not suffice to differentiate artworks and aesthetic experiences from non-aesthetic perceptual stimuli and ordinary perceptual experiences.

Consider the problem as follows. Visual perception depends upon the presence of image features in the sensory input that accurately represent aspects of the structure of the stimulus. However, the inverse problem demonstrates that this set of visual cues does not suffice to define the structure of the stimulus for perception. The general constructivist solution to this problem consists of two types of processes: image transformations that function to augment and enhance the structure of the retinal inputs, and categorization processes that function to match the form of a visual image to stored records of the ordinary shapes of object types. Image transformations are governed by perceptual principles and form primitives that define the structure of an image or representation in the visual system at a stage of processing (see above pp. 91 – 96). The resonance between a form primitive and the structure of the stimulus is defined as a measure of the degree to which that form primitive accurately represents, or resonates with, the actual structure of the stimulus. One function of perceptual principles is therefore to preserve, or maintain, the relationship between image features and the environment across image transformations in form recognition.

McMahon identifies the resonance between the structure of an artwork and form primitives in the visual system as a source of aesthetic interest. However, the success of visual perception in all cases depends on the fact that there is a strong resonance between the structure of the stimulus and the use of form primitives in perceptual processing. This entails that, from the perspective of McMahon's theory of aesthetics, there should be no difference between artworks and non-aesthetic perceptual stimuli. Both should function equally well as sources of aesthetic interest, e.g. a Thomas Cole landscape and Bülthoff and Edelman's wire frame objects. This is not the case. Therefore, like neuroaesthetics, explanations of the way these cues function in artworks do not suffice to explain how they function to generate aesthetic interest.

3.3. Aesthetics and an Integrated Model for Form Recognition

McMahon's critique of narrow formalism suggests a way to resolve both of these problems. Neoformalists argue that attention to the way the formal structure of a work embodies its content is a source of aesthetic interest. The way an artwork embodies its content is determined by its mode of presentation, e.g. the way an artist manipulates relations among perceived objects and image features to trigger the sets of semantic associations that determine the meaning of the work (Carroll, 1999, p. 127). In this regard, aesthetic interest is the product of a form of visual play through which one uncovers a hidden meaning embedded in its surface, e.g. Malevich's "Red Square." Therefore, consistent with Zeki's characterization of aesthetic experience, aesthetic interest should be

interpreted as the product of attention to the mutual influence of formal structure and semantic knowledge in the construction of the an artwork's content, not attention to the formal structure of the work alone.

McMahon's general model for perception suggests a mechanism to implement this neoformalist interpretation of art and aesthetic experience. Constructivists argue that the output of the form recognition system functions to trigger sets of semantic associations that, in turn, function to augment and enhance the formal structure of perceptual representations in the visual system. Therefore, they argue that the content of all ordinary visual experience is a product of the integration of formal image features and semantic knowledge.

Consider Braque's "Bouteille et Poissons" again (see figure 25). The title serves as a strong semantic cue guiding peceivers' experience of the painting. Without this cue very few naïve viewers spontaneously identify the fish in the foreground. In fact many are incredulous when told that the foreground contains five discrete objects. However, when given the title, these same viewers often spontaneously recognize the large, abstractly depicted fish in the lower right quadrant. This demonstrates that semantic knowledge plays a strong role in the perception of the form of an image. Further, educated viewers know that Cubist artworks invite a specific form of visual play that is intended as a source of aesthetic interest. The conjunction of this knowledge with the title functions to focus their perceptual interactions with the painting, and so influences the way they perceive its form. Therefore, the aesthetic interest generated by a Cubist painting is a product of the integration of particular formal image features and

prior knowledge of the general structure and function of Cubist artworks.

This model for understanding art and aesthetic experience provides the constructivist hypothesis with the means to differentiate artworks and aesthetic experiences from non-aesthetic perceptual stimuli and ordinary perceptual experience. A viewer's interaction with an artwork is a game of visual play in which he or she attends to the way the formal structure of a work embodies its content. Attention to the reciprocal relationship between the identity and perceptual content of a work of art is itself a source of aesthetic interest. The function of an artwork is to focus a viewer's attention on this relationship. Therefore, what differentiates artworks and aesthetic experiences from non-aesthetic perceptual stimuli and experiences is the fact that categorizing an object as an artwork causes one to attend to the way its formal structure embodies its content. In the remaining two chapters I will develop this model in more detail.

The failing of McMahon's theory of aesthetics is therefore, like Zeki's neuroaesthetics, not due to her general framework for understanding aesthetic experience. Her critique of narrow formalism is predicated on the role played by knowledge and memory in aesthetic experience. However, in practice she limits the explanatory scope of her theory to explanations of the role played by perceptual principles and form primitives in form recognition. Further, she explicitly characterizes these processes as computationally distinct from the processes that mediate the influence of semantic knowledge in perception. In this sense, she interprets aesthetic interest as a product of the form a visual

representation independent of either its meaning or representational content. Therefore, despite the potential richness of her model, in practice McMahon ignores the broad range of cognitive influences on aesthetic experience identified in her critique of narrow formalism.

Chapter 4: Art, Imagination, and Perception

The constructivist hypothesis is a functional theory of art. Functional theories of art define artworks generically as artifacts designed to generate aesthetic interest (Beardsley, 1982, p. 239; see chapter 3, p. 79). In this context 'aesthetic interest' refers to the aesthetic character of one's interactions with artworks, and the aesthetic character of a viewers' interaction with an artwork is defined as a feature of perceptual experience, e.g. a feeling associated with the apprehension of a work's latent structure (see above p. 23 – 24; Carroll, 1986, p. 57; Beardsley, 1982, p. 238; Walton, 1990, p. 21 – 22). Therefore, the status of the constructivist hypothesis as a theory of art rests on the ability of the model to explain how artworks function as perceptual stimuli to generate aesthetic interest, or to trigger aesthetic experience (see above, pp. 77).

The central claim of the constructivist hypothesis is that attention to the way the formal structure of an artwork functions to perceptually convey its content is a source of aesthetic interest. McMahon's theory of aesthetics suggests a neoformalist interpretation of this claim. The success or failure of a work of fine art, as a perceptual means of communication, is a function of the way its formal structure embodies its content. In this sense the term 'embodies' refers to the way the formal structure of a work of art functions to convey its content perceptually. Neoformalist theories identify the act of attending to the way the formal structure of a work of fine art embodies its content as a source of aesthetic interest (Carroll, 1999, pp. 125 – 127; see also Carroll, 1986, pp. 60 - 61). Therefore, if sound, neoformalism provides support for the interpretation of

the constructivist hypothesis as a functional theory of art.

Consider the following example. Imagine I have painted a red triangle and a horizontal black line onto a freshly jessoed canvas so that the apex of the triangle meets the bottom of the line roughly one third of the way along from right to left. Imagine further that this is an isosceles triangle whose base is parallel to the line. Imagine I add two blue squares, one three times the size of the other. I place the smaller square at the right end of the shorter line segment and the larger square at the left end. I call this work "Formal Construction #31857-0 (Small Cube of Very Dense Material)" (figure 31). If I have constructed the "painting" correctly, it is aesthetically interesting by virtue of the fact that it embodies the dynamic properties of a cantilever.

The constructivist approach to object recognition suggests a natural explanation of how the content of this artwork is embodied by its formal structure. "Formal Construction #31857-0" is not a cantilever (figure 2). It is a formally static, abstract, two-dimensional geometric construction. Gravity, the environmental force that generates the dynamic properties of cantilevers, has no bearing in the painterly world of geometric abstraction. Therefore, the dynamic properties that this image is perceived to have are not properties of the painting itself, i.e. they are not properties of the physical object composed of the canvas and the pattern of paint. Rather, they are the product of the conjunction of the formal structure of the painting and prior knowledge of the way fulcrums, levers, and cantilevers look and behave, i.e. they are formal image features that are a product of the psychological processes subserving viewers' perceptual

interactions with the work. Therefore, "Formal Construction #31857-0" embodies its content by virtue of the fact that its appearance is a product of the conjunction of formal image features and semantic knowledge.

However, there is a difficulty for this interpretation of the constructivist hypothesis. The source of aesthetic interest for neoformalist accounts of aesthetic experience, as I have defined them, is attention to the way artworks embody their meaning (see Carroll, 1999, pp. 125 – 127). McMahon's theory rests on the role of semantic knowledge in object recognition. In this context, semantic knowledge refers to a subclass of declarative memory that encodes knowledge of the ordinary shapes and functions of object types, e.g. knowledge of the shapes and dynamics of cantilevers (see above, p. 5 – 6; Ashcraft, 1998, p. 165). This category of knowledge contributes to the processes by which the visual system projects depth into the picture plane, segregates figure from ground, and groups image features to form representations of discrete objects. In this regard every visual image embodies its identity, or depictive content. However, semantic knowledge, as it is here narrowly defined, does not encompass knowledge of the broad range of art historical facts and cultural practices necessary to determine the meaning of a work of art. As a result, although a constructivist theory of object recognition does provide a mechanism to mediate the influence of background knowledge on viewers' perceptual interactions with artworks, it does not identify an explicit role for knowledge of the meaning of an artwork in these processes.

This objection reveals an equivocation in McMahon's discussion of art and

aesthetics. On the one hand, she uses the term 'representational content' to refer to the depictive content of a work, e.g. a scene, object, or abstract geometric space. On the other hand she uses it to refer to what an artwork means, e.g. a commentary on the mundane character of suburban California life (figure 4, p. 19) or the metaphorical blood spilled by peasant labor in the name of the Tsar (figure 16, p. 83). The interpretation of the constructivist hypothesis that emerges from McMahon's theory of aesthetics rests on the influence of semantic knowledge on form recognition. This entails that her theory can explain how artworks embody their depictive content. However, she does not address whether, and if so how, the meaning of an artwork affects the way one perceives it. Therefore, it is an open question whether her model can be extended to explain how the formal structure of an artwork embodies its meaning (see above, pp. 79 – 80).

Kendall Walton's theory of visual imagination suggests an interpretation of the constructivist hypothesis that can resolve this problem. Walton argues that the broad representational content of a work of art, including both its meaning and depictive content, is the product of an imaginative event triggered by its formal features (Walton, 1990, p. 138). He argues further that these types of mental events influence the way viewers' perceive works of art (Walton, 1991, p. 295). These two claims can be illustrated by an examination of viewers' perceptual interactions with paintings. Oil paintings are, like "Formal Construction #31857-0," flat perceptual stimuli composed of overlapping patches of pigment suspended in linseed oil. These objects are literally, as Fry and

Ruskin described them, abstract two-dimensional patterns of color patches. However, viewers naturally perceive paintings as realistic three dimensional scenes, objects, and abstract geometric spaces. Therefore paintings can be defined as a type of degraded image whose content is filled in by the act of perceiving them. Walton describes the mental events that underlie these experiences as instances of imaginative perception. Imaginative perception is defined as a species of mental event whose content includes modality specific perceptual properties, e.g. the act of visualizing the kitchen table in order to recall where one has left the car keys. Walton argues that viewers' perceptual interactions with works of fine art are augmented by these types of mental events.[41]

Consider the role Walton attributes to the narrative content of a painting in imaginative perception. In this context, narrative content refers to the story depicted on the visible surface of the work. Walton asserts that one experiences the perceptual detail of a painting as if it emerges from the way one interprets its narrative content. For instance, the posture of the little girl in Richard Estes, "Water Taxi, Mt. Desert Island," indicates an event off the starboard side of the boat. Perhaps a sailboat is coming about or a seal is bobbing playfully in the waves. Curiosity about the nature of this imagined event affects the way one attends to the painting, and so influences the way one perceives it visible surface. This functions to reveal otherwise unnoticed details in the scene represented on

41. Walton uses paintings to illustrate this claim, but research by Justin London demonstrates that imaginative perception plays a similar role in the way listener's experience familiar beats in popular music like the blues (London, in conversation; 2003, p. 1; and 2004, Chapter 1)

the canvas, e.g. the casual but reserved posture of the girl's mother and the fact that the wake of the taxi indicates that it has not slowed down. These details, in turn, indicate that the passengers are most likely looking at a pedestrian event.[42] In this context, one's interpretation of the narrative content of the work drives the way one attends to the formal features on its perceptible surface. The way one attends to the formal features on its perceptible surface, in turn, influences what one perceives in the painting, e.g. what one actively visualizes on the picture plane. Therefore, a viewer's interpretation of the narrative content of a work influences how one perceives the painting.

Walton argues that a viewer's familiarity with the type of scene depicted in a painting guides the way one interprets its narrative content. In order to conceptualize seals and sailboats outside the fame of "Water Taxi one must have some knowledge of the type of scene it depicts. Some of this information can be read off of the surface of the painting. This painting simply looks like the sort of place one would go sailing. However, one must first identify the scene as a sheltered ocean harbor in a northern clime in order to recognize that there could be seals off to the left. This fact is not obviously depicted in the painting (the water taxi doesn't appear to be very "seaworthy").[43] It must be recovered from the title that names a resort town on the Maine coast. Cognitive associations derived from familiarity with the location of Mt. Desert Island, in turn, trigger

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42. For a psychological discussion of this phenomena see research on boundary completion, e.g. Intraub and Richardson (1989).

43. For instance the taxi is a type of boat more likely found in a placid confines of a lake community than an ocean harbor and the island landscape in the background is consistent with flora and topography of the large lakes of Maine, Southern Ontario, and Minnesota.

semantic knowledge about the appearances and behavior of seals and sailboats on the Maine Coast. This cognitive event, in turn, directs attention to salient formal features that enable one to visualize the event depicted in the painting.

The meaning of a work can play a similar role in determining the way one perceives a painting. The seats in the water taxi are high back wicker porch chairs. One might, in the context of appropriate background knowledge, interpret this unique feature of the taxi as a symbol of the eccentrically staid manner of Northern New England culture. This, in turn, might draw one's attention to the pattern of the little girl's summer dress, the prim pose the mother in the background, and the subdued manner in which both express their interest in whatever is happening off to the starboard. Therefore semantic associations derived from the meaning of the work can function to drive attention and influence the way viewers' perceive the scene depicted on the canvas.

None of the events described in these paragraphs actually happen on the perceptible surface of the painting. They are, as in the case of "Formal Construction #31857-0," properties of the mental states subserving viewers' perceptual interactions with the painting. Walton's theory of visual imagination provides a model to explain the broad range of cognitive influences that contribute to these perceptual events. Therefore, his theory of visual imagination generates a more flexible interpretation of the constructivist hypothesis than McMahon's theory of aesthetics.

Gregory Currie argues that Stephen Kosslyn's model for mental imagery can be used to generate a psychologically plausible interpretation of Walton's

theory of imagination (Currie and Ravenscroft, 2002, p. 80; see also Currie, 1995b, pp. 31). Currie, like Walton, defines visual imagery as a form of "perception like" imagining that can function to shape the structure of viewers' perceptual interactions with visual stimuli (Currie and Ravenscroft, pp. 11 and 29). There has been significant philosophical debate about what it means for visual imagery to be "perception-like." The primary focus of this debate concerns whether the format of imagery in a modality is identical to the format of perception in that modality, e.g. are visual mental images like pictures in the head? (see Kosslyn, 1995; Kosslyn 1999; Pylyshyn, 2000; and Pylyshyn 2003). I will not address the debate about the format of visual imagery in what follows. My interest in theories of visual imagination is limited to the role attributed to imaginative seeing in viewers' perceptual interactions with artworks. Walton and Currie argue that imagination is a cognitive process that contributes to the way viewers fill-in, or project, the rich, three dimensional content of paintings onto their two-dimensional surfaces. I interpret this use of the term 'imagination' to refer to psychological processes that mediate a broad range of cognitive influences on ordinary object recognition. In this regard, what is important to my theory is not the format of imagery, but rather the claim that imagination and imagery function as mechanisms through which background knowledge influences ordinary perception.

The constructivist hypothesis is grounded in a constructivist approach to vision. Constructivist theories of vision can be conceptualized as a solution to the inverse problem (see above, pp. 2 – 4, 13 - 14, and 87 – 90). Recall that the

inverse problem arises because the inputs to the visual system are spatially ambiguous: the sensory input to the visual system is a two dimensional array that is consistent with a mathematically infinite set of three dimensional, or inverse, projections. Facts about the spatial resolution of the retinal image compound this difficulty. The retina only collects fine grained, or high detail, information from a small region of the visual field at the center of a viewers' focal attention. The areas of the visual field peripheral to this region are recorded as a set of coarse grained, or low grade, image features (figure 34).[44] This entails that fine grained, or high detail, spatial information needed to determine which of several competing interpretations of the sensory input is correct is not recorded from peripheral regions of the visual field (see figures 33 – 35).[45] This, in turn, entails

that the sensory input to the visual system is not only ambiguous, it is also incomplete.[46] However, despite this limitation, visual recognition is fast, efficient, and reliably successful. Therefore, the visual system must contain mechanisms that enable it to make due with sensory inputs that are incomplete.

Kosslyn argues that an approach to object recognition that integrates form

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44. Interestingly, peripheral regions of the visual field are not perceived as blurry. Rather, they are perceived as focused image areas missing fine grained information. For instance, subjects fixating on the center of the photograph in ideal laboratory contexts report a clear image all the way out to the periphery of their vision. The peripheral regions in the images below are presented as blurry in order to represent the loss of acuity caused by the increasingly coarse grain of the peripheral retinal neurons. Interestingly, when subjects fixate on the center of the image of San Diego in figure 34 from the correct distance, they report perceiving a clear image all the way out to its boundaries.

45. See also the discussion of Mona Lisa's smile pp. 66 – 68.

46. See pp. 91 – 93 above for a discussion of the ambiguity of visual sensory inputs.

recognition and object identification can explain how the visual system is able to make due with incomplete sensory inputs. However, his model differs from McMahon's solution to the inverse problem (see above, p. 110). McMahon's theory of aesthetics is derived from David Marr's theory of vision. Marr's theory is a structural description theory (Tarr and Bülthoff , 1998, pp. 2 – 3). Structural description theories assert that visual recognition depends on a full representation of the three dimensional form of objects in the visual field, e.g. Marr's three dimensional object representation (see p. 98). Kosslyn suggests, alternatively, that small sets of image features which represent the coarse grained structure of regions of the visual field often suffice for object identification. He argues that these image features can be used to generate perceptual hypotheses about the identity of perceived objects. Semantic associations derived from perceptual hypotheses are, in turn, used to direct focal attention and prime the visual system to the expectation of fine grained object features at particular locations in the visual field. If these expectations match further sensory data, the visual system treats a hypothesis as confirmed. Otherwise the process cycles through again. There is no need to generate a structural description of the global shape of the object on this account. A small set of local image features that confirm the current perceptual hypothesis will suffice. Therefore, Kosslyn suggests that incomplete visual representations of the form of a visual image more often than not suffice for object identification.

Kosslyn identifies the priming function of perceptual hypotheses as the mechanism responsible for visual imagery. He argues that semantic

associations derived from perceptual hypotheses are used in both imagery and ordinary vision to instantiate representations of expected objects, parts, or image features in the areas of the visual system responsible for form recognition. These representations are realized by patterns of neural activation whose function in vision is to amplify aspects of the retinal input as it is processed. Kosslyn argues that, in imagery, these same patterns of activation function as surrogate retinal images to trigger the neurophysiological processes responsible for visual experience independent of sensory inputs.

One consequence of this model is that imagery can play a role in ordinary vision. Kosslyn argues that, given the function of patterns of neural activation in imagery, low level representations instantiated in the visual cortex by perceptual hypotheses can be used to augment missing, occluded, blurry, or otherwise degraded features of ordinary visual images. Kosslyn refers to this feature of his model as imagery feedback. Given that paintings are a form of degraded image, Kosslyn's discussion of imagery feedback lends support to Walton's claim that "imaginative seeing" pervades ordinary vision. However, in this context, terms like 'imagery' and 'imagination' refer to the ordinary role of background knowledge in perception. The ensuing model for the constructivist hypothesis is not a theory of art and imagination per se, but rather an integrated neoformalist theory of art and aesthetics that can accommodate a broader range of cognitive influences than McMahon's theory of aesthetics.[47]

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47. I have argued elsewhere that this entails that the notion of imagination falls away from a theory of art and imagination as a heuristic designed to illustrate the character of the perceptual events subserving our interactions with visual artworks (Seeley, 2005, p. 10).

In what follows, I develop this claim in more detail. In section 1, I describe the role Walton attributes to imaginative perception in visual art. In section 2, I sketch Kosslyn's imagery feedback model for visual search and object identification and argue that it can be used to generate a psychologically plausible interpretation of Walton's notion of imaginative perception. In section 3, I introduce an interpretation of this model as a functional theory of art that can accomodate a broader range of cognitive influences on perception than McMahon's neoformalism, e.g. the meaning and narrative content of paintings. In section 4, I evaluate this model relative to the general objection raised against the constructivist hypothesis in previous chapters. I argue that the types of cognitive influences that contribute to the way viewers project scenes and objects onto the picture plane of a painting play a role in all form recognition. This entails that explanations of the role played by imagery feedback in perception are not sufficient to establish the constructivist hypothesis as an aesthetic hypothesis.

1.0 Art and Imagination

Walton argues that paintings are perceptual stimuli that function as props for games of visual play in which viewers' imaginatively see, or visualize, what is depicted on their visible surface.[48] Walton defines a 'prop' as an object that

48. My interest in this chapter is narrowly focused on what it means to imaginatively see the content of a painting. I will therefore try to get by without delving into the complicated machinations of Walton's theory and focus only on what is necessary to motivate a correlation between a theory of art and imagination and Kosslyn's imagery feedback model for the perception of degraded images. I have no axe to grind with those who find his terminology otiose. I interpret his discussion of props and principles of authorization as an attempt to explain the role of conventions in viewers' interactions with artworks.

authorizes a particular game of make-believe, and so serves as a prompt that prescribes particular imaginings. Props authorize games of make-believe relative to principles of generation. Walton defines principles of generation as general conventions that function to contextualize objects relative to a set of shared practices. These conventions, in turn, direct the way an agent interacts with the object. In this sense, a work of fine art is a prop that prompts imaginings by virtue of being "perceived or otherwise experienced" (Walton, 1990, p. 22). Walton argues that these types of objects prompt a viewer to imagine of himself that he is actively perceiving what they represent.

Consider the case of paintings again. Walton argues, consistent with a constructivist theory of perception, that the abstract two dimensional marks on the surface of a painting function to trigger, or generate, an imaginative event that influences the way viewers perceive the scene depicted in the painting. This means that, although a viewer recognizes that he is looking at a flat abstract pattern of pigment hanging on a wall, doing so prompts him to visualize a scene, object, or abstract space in that painting, or to perceive it as if he or she were looking at what it represents, e.g. Hobbema's "Watermill with the Great Red Roof" (figure 36; and Walton, 1990, p. 301). Therefore, to define a painting as a prop is to describe it as a type of artifact whose function as a perceptual stimulus depends on prior knowledge of both the shapes and functions of objects and the conventions governing perceptual interactions with artworks.

Walton introduces the notion of a 'prop' by analogy to children's games of

make-believe. There are two critical features to this analogy: Walton's notion that a child's prop is transformed by his or her psychological participation in a game of make-believe. Objects are transformed into the objects they represent by virtue of how they are used in children's games of make-believe. For instance, my two year old daughter's field hockey stick becomes a horse when she turns it upside down and "rides" it by skipping around the house (see Gombrich, 1984, p. 1 – 2; and Walton, 1992, p. 22). Props are not, of course, literally transformed. My daughter does not literally believe that her stick is an Appaloosa. Rather, by virtue of their use in games of make-believe, props realistically engage the full range of psychological participation of ordinary experience. The ensuing imaginative event feels realistic by virtue of the fact that it is, like ordinary experience, phenomenally replete.

Walton's notion of psychological participation can be illustrated by the following story.[49] Imagine that you are walking on a wooded trail by yourself in a national forest. The weather is perfect for a hike. It is warm, but not overbearingly hot in the sun, and it is early enough in the day that the shade under the tall canopy of pines is still pleasantly cool. Perhaps you are lost in thought, daydreaming as you follow the path towards a secluded cascade or a mountain overlook. Somewhere in the back of your mind lingers the recollection of a campsite warning. A ranger told you over breakfast to make sure to pack your coolers and food storage containers carefully in order to thwart the curiosity of black bears. However, here, far away from the detritus of crowded camping

49. This story has been extrapolated from Walton's own example (Walton, 1991, p. 21)

areas, this seems like a distant concern...until the rustling of the wind in an alder bush draws your attention to a large black object in the periphery of your vision.

You freeze in your steps. The hair on the back of your neck stands straight on end like a stiff bristled brush. Your heart rate leaps briefly by what seems like a factor of ten. You are suddenly hyperaware of the peanut butter sandwich and box of raisins in your small backpack. Then, just as quickly, you are overcome by a sense of foolishness. What you have seen is not a bear. It is the tall stump of an old fallen down tree whose silhouette is roughly the size and shape of a standing bear. The moving branches of the alder bush in your peripheral field have animated the stump, causing you to momentarily visualize a black bear standing just off the trail. The structure of this brief glimpse subsequently triggered the full range of natural psychological responses to this type of event, and briefly transformed your hike into an actively imagined bear encounter.

The psychological event that generated your hypothetical bear encounter is governed by two types of inputs: the appearance of the stump and your background knowledge about the dangers and likelihood of encountering a bear while hiking alone in the park. The movement of the bushes generated the temporary illusion that the stump was moving. The perceived motion of the stump, in turn, prescribed the particular content of your imaginative bear encounter. The principles of generation that authorized this imaginative event, or determined its general psychological structure, were provided by background knowledge of the risks of hiking in a bear infested forest with a backpack full of

snacks. Therefore, the perception of the stump through the rustling bushes functioned, in the context of your morning conversation with the ranger, as a prop that prompted you to imaginatively perceive a bear.

Walton argues that children's games of make-believe are like this imaginary bear encounter in that, in both cases, the actors themselves are the objects of their own imaginings. You didn't just imagine that you perceived a bear as if you were an outside observer. You imagined of yourself, however briefly, that you were actually encountering a bear. Likewise, my daughter's ability to conceptualize that a hockey stick is a horse transforms her skippings into a wild ride on an untamable mustang.

Walton notes that one interesting feature of these types of imaginative events is that props need not really resemble what they represent. In this sense, what makes something an appropriate prop for either a game of make-believe or a spontaneously imagined event is not its actual appearance, but rather the manner in which one's understanding of the context of its use determines what one does with it. For instance, the same stump, encountered in an open field, would not likely trigger an imagined bear encounter. Likewise, a hockey stick held with its blade high in the air during an actual game is rarely, if ever, visualized by the players to be a bucking bronco.

Walton's claim in this context is not that a prop's appearance is not important. The appearance of an object is indicative of its physical structure. The physical structure of an object, in turn, determines how it can be used. A field hockey stick makes a far better hobby horse than a dictionary because it is

lighter, easier to carry, and the junction between its blade and shaft resembles the neck of a real horse. However any object whose appearance enabled it to be used appropriately in the game would suffice, e.g. a broom handle, a baseball bat, or a length of hose. For that matter, a child might imagine that a dictionary was a saddle and ride it all the same. Therefore, what is important about a hobby horse is how one rides it, not what it looks like.

The functional definition of a prop is critical to Walton's discussion of artworks. Paintings do not literally resemble what they represent. They are two-dimensional patterns of paint and brushstrokes displayed on surfaces varying from rough plywood to fine linen. These formal and physical features are not invisible to viewers. In order to perceive them, one need only focus on categorizing a painting as a painting, and not as a depiction of a visual scene (see chapter 1, pp. 5 – 6).[50] However, viewers ordinarily ignore this possible mode of interaction with a painting because they recognize that artworks authorize particular types of practices (see below, pp. 176 – 179). The function of a painting within the context of these practices is to prompt a viewer to visualize what it depicts, not to scrutinize the way it was made. Therefore, Walton argues that there is a sense in which paintings are analogous to the props used in children's games of make-believe: they are transformed into visualizations the scenes or objects that they depict by the way viewers use them as perceptual stimuli in aesthetic contexts.

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50. Some degree of learning is required here. For instance, knowledge of the techniques and physical structure of medium enhances one's ability to recover formal detail from a painting.

2.0 Art, Imagination, and Perception

> The phenomenal character of the perception is inseparable from the imagining which takes it as an object. It is by now a commonplace that cognitive states of many sorts – beliefs, thoughts, expectations, attitudes, desires – enter into our perceptual experiences, that there is no such thing as an "innocent eye," a purely receptive capacity yielding data distinguishable from what one thinks about it, how one interprets it, what one does with it. (Walton, 1990, p. 295).

The surface of a painting is, like the retinal image, a two-dimensional projection of the visual field. Therefore, the same sets of cognitive processes that are involved in recovering the form and identity of a visual image are involved in perceiving a painting. McMahon's theory of aesthetics demonstrates a role for semantic knowledge in these processes. However, the cognitive influences her theory can accommodate are limited to knowledge of the shapes and functions of ordinary object types. Walton argues alternatively that the full range of thoughts one associates with a painting function to augment and amplify the way one perceives its visible surface. These thoughts might include knowledge of the shapes of occluded parts of depicted objects, semantic associations that color the narrative of a depicted scene, or art critical speculations about the meaning of rendering the subject matter of a painting in a particular way. Therefore, Walton's theory of visual imagination can accommodate a broader range of cognitive influences in viewers' perceptual interactions with paintings than McMahon's theory of aesthetics.

Walton does not provide an explicit psychological mechanism to explain how his theory might work in practice. However, an interpretation emerges from the quote above. His critique of the notion of an "innocent eye" is a reference to

E. H. Gombrich (Gombrich, 1960, pp. 297 – 298). Gombrich's theory of aesthetics was derived from a constructivist theory of vision. Constructivist theories of vision rest on the claim that prior knowledge of the shapes and functions of objects play an irreducible role in perception. Therefore, the conjunction of Walton's reference to Gombrich and his claim that thought and seeing are inseparably bound in perception suggests that his theory of imaginatively seeing is grounded in a constructivist account of vision.

Currie's discussion of Walton's theory of imagination supports this interpretation. Currie has argued that Walton's notion of 'imaginatively seeing' can be cashed out relative to a simulation theory of visual imagination. He argues further that Kosslyn's theory of visual mental imagery can serve as a model to illustrate this interpretation of visual imagination (Currie, 1993, p. 370; and 1995b, p. 26). A simulated mental event is one in which some ordinary mental process is run "off-line," i.e. in the absence of its normal inputs, outputs, or both.[51] Mental imagery is defined as the process of visualizing an absent object, action, or scene by generating a non-perceptual visual image in the visual system from memory (Kosslyn, 1995, p. 257; Palmer, 1999, p. 602; and Reber and Reber, 2001, p. 241). Therefore, visual imagery can be interpreted as the capacity to simulate the phenomenal properties of visual representations by running the visual system in the absence of its ordinary inputs (Currie and

51. Simulation theory is a broad theory about how viewers plan actions, make decisions, and interpret the thoughts and beliefs of others. My interest in Currie's version of simulation theory is limited to his argument that Kosslyn's model for mental imagery can serve as a model for a theory of visual imagination. As a result I will not address these broader issues and will concern myself only with the relationship between Kosslyn's theory of imagery and a theory of visual imagination.

Ravenscroft, 2002, p. 71; and Kosslyn, 1995, p. 268).[52] On this account, a painting is defined as an abstract perceptual stimulus, or prop, that triggers a rich perceptual event whose visual content is filled in by imagery.

Kosslyn's theory of mental imagery is derived from a hypothesis testing theory of object identification. There are four general stages of visual processing on this model: a visual buffer responsible for collecting information from the retina, a pattern recognition system responsible for recovering the general form of perceptual representations from sensory inputs, a system for generating perceptual hypotheses about the identity of visual images that involves associative memory, and an attention shifting system that functions to guide attention and prime the visual system to the expectation of objects or object parts at particular locations in the visual field. These processes involve the full range of topographically organized regions of the cortex associated with the visual system:

> One of the most striking features of the organization of sensory...systems is that the peripheral receptive surface – the retina of the eye, the cochlea of the inner ear, and the surface of the skin – is represented topographically throughout successive stages of processing. Neighboring groups of cells in the retina, for example, project to neighboring groups of cells in the visual portion of the thalamus, which in turn project to neighboring regions of the visual cortex. In this way an orderly neural map of information from the receptive surface is retained at each successive level in the brain [from area V1 where retinal inputs are originally recorded in the occipital cortex to area 46 in the prefrontal cortex associated with spatial working memory] (Kandel et al, 2001, p. 323, emphasis added).

The general supposition in the literature is that topographically mapped regions

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52. This hypothesis is supported by evidence that visualizing an object in advance decreases response times and increases accuracy in visual recognition and tasks that require subjects to reach for objects presented in awkward or unfamiliar views (For a review of these studies see Kosslyn, 1995 and Kosslyn 1996).

of the cortex function to maintain sensory information in the visual system for use in higher level perceptual and cognitive processing. These same areas and processes are responsible for generating and maintaining mental images. Kosslyn argues that the fact that imagery and vision are generated from the same processes entails that mental images and visual images are structural similar, or share significant sets of formal features.[53]

Kosslyn identifies the visual buffer as the region of the human occipital cortex that records the initial retinal input to the visual system. This area is alternatively referred to as the primary visual cortex, V1, or area 17. The function of the primary visual cortex is to collect information from the retinal image for distribution to the color, form, and motion pathways for further processing. This information is updated each time one's eyes fixate on a region of the visual field. Therefore, the visual buffer can be conceptualized as a short term holding area for retinal inputs to the visual system.

The time scale of perceptual processing is fast. Human eyes saccade, or shift position and fixate, on average three times a second (Ross and Ma-Wyatt, 2003, p. 65). This entails that information in the visual buffer is constantly being refreshed and sent downstream for processing. However, this claim comes with a caveat. High detail form information is, as discussed above, only collected from a small region of the center of one's gaze called the fovea. The spatial acuity of the retinal image decreases significantly as one moves away from the

53. This type of evidence has been used to argue that mental images have spatial features (see above p. 8). I choose to remain agnostic on this point. My claim is simply that mental images and ordinary visual perceptual images share the same format by virtue of shared processing systems, regardless of whether that format is propositional or spatial.

central point of fixation. In fact, the acuity of spatial vision decreases by a factor of 10 just seven degrees from the center of one's gaze (Livingstone, 2000, p. 1299; see above, pp. 63 – 64). This entails that the majority of the visual field is represented in the visual system by coarse grained sensory information, e.g. the area of the fovea dedicated to recovering fine grained spatial information is represented in figure 37 by a circle just larger than the subject's right eye (see also figure 34).

This generates the problem for object recognition discussed above on page 129. The fine grained information necessary to discriminate between competing interpretations of ambiguous sensory inputs is not recorded in the coarse grained structure of peripheral vision, e.g. the visual information necessary to determine that the lower right image in figure 35 represents a squirrel not a rock (p. 130 above), to recognize that the head of Picasso's baboon is a car (p. 142 above), or to differentiate me from my brother. Therefore, the visual system must contain a strategy for recovering the form and identity of scenes and objects from sensory inputs that are not only ambiguous, but also incomplete.

Kosslyn argues that the visual system solves this problem by what he calls cooperative computation. Incomplete information about the form of a visual image is shunted downstream from each coherent glimpse, processed through the pattern recognition system, and then matched to semantic knowledge in associative memory. The pattern recognition system is divided into two subsystems. Information collected in the visual buffer is segregated and sent

downstream via anatomically distinct pathways: the dorsal and ventral processing streams. Although there is debate about the purpose of this division of labor in form recognition, there is agreement about the type of information processed in these pathways (Kandel et al, 2000, p. 502; Purves et al, 2001, p. 272; see also Milner and Goodale, 1998; and Mishkin, Ungerleider, and Leslie, 1983).[54] The dorsal stream functions to recover information about the overall spatial structure of the visual field, including motion, depth, and the relative spatial location of coarse grained image features. The ventral stream functions to recover detailed, or fine grained information about the shapes and colors of objects and their parts. The function of associative memory is to assign spatial locations to the outputs of ventral processing relative to prior knowledge of the general shapes and functions of object types (Thompson and Kosslyn, 2001, p. 537). As a result, associative memory can be conceived as a categorization processing system that functions to integrate the sensory outputs of dorsal and ventral processing with semantic knowledge.[55]

The output of categorization processing in associative memory serves as a perceptual hypothesis about the form and identity of the scene or object represented in the sensory input. The function of perceptual hypotheses in object identification is to prime the visual system to the expectation of image features in the visual field that could, in principle, confirm the identity of the perceived object or scene. If these features are subsequently perceived, the

54. Vision scientists differ as to whether the structure of these representations is targeted for object identification or action.

55. See above, p. 98. In this regard Kosslyn's model for object recognition is analogous to Marr's computational theory of vision.

hypothesis is confirmed. Otherwise the process cycles through again. Therefore, perceptual hypotheses provide a mechanism through which the conjunction of a number of incomplete perceptual representations of the visual field suffice for object identification.

The attention shifting system guides hypothesis testing in object recognition. There are three basic components to this system: a region of the prefrontal cortex that functions to maintain perceptual hypotheses in memory over short periods of time, an attention shifting mechanism, and a priming mechanism that tunes the pattern recognition system to the expectations of objects, parts, or image features (Thompson and Kosslyn, 2001, p. 538). Kosslyn argues that perceptual hypotheses generated in associative memory are shunted forward to the topographically organized region of the prefrontal cortex that are associated with spatial working memory. The function of this process is to generate a visual representation of the information contained in the perceptual hypothesis that can be maintained "online" for active use in further visual processing.[56] At this stage of processing, additional information is accessed from memory in order to identify object properties or image features that are diagnostic for a particular perceptual hypothesis (Thompson and Kosslyn, 2001, p. 538; Kosslyn and Koenig, 1995, p. 77). Diagnostic properties are perceptual

56. See Goldman-Rakic, 1987, and Constatinidis et al, 2001 for a discussion of the role of dorsolateral prefrontal cortex in spatial working memory. Working memory can, in general, be thought of heuristically like a scratch pad or the desktop of your PC. The hypothesized function of working memory is to actively maintain representations generated from cognitive systems for short periods of time in a format readily available for in cognitive tasks like decision making and perception. Therefore, relative to the processes subserving cognition, one can think of information stored in long term or associative memory as having been taken offline and information held in working memory as being maintained online.

characteristics sufficient to confirm a perceptual hypothesis if it is sound, e.g. if the sculpture in figure 38 represents a Baboon, one would expect to find eyes and a mouth on its face, not a windshield and bumper (Schyns, 1998, pp. 148 – 149; see also below pp. 189 – 190 and figure 51).

Kosslyn argues that representations of perceptual hypotheses in spatial working memory are used by the attention shifting system both to guide attention to the expected location of diagnostic image features and to prime the pattern recognition system to the expectation of particular diagnostic image features, e.g. a contour that would define the brow over the baboon's left eye. The priming mechanism is the critical feature of this system for discussions of visual imagination. This system exploits non-reciprocal connectivity between salient areas of prefrontal cortex (Kosslyn, 1996, p. 251; and Thompson and Kosslyn, 2001, p. 538) and areas of the ventral stream associated with form recognition. The function of these connections is to instantiate low level neural representations of objects or their parts in topographically organized areas of the inferior temporal cortex. These representations, in turn, function to amplify the sensitivity of the system to expected diagnostic image features in the sensory inputs (Kosslyn, 1996, pp. 287 – 289; see below, chapter 5, p. 186 and 189).[57] Therefore, the attention shifting subsystem is a top down mechanism designed to

57. Kosslyn's model for attentional priming is supported by research on the neural mechanisms of selective attention. This research demonstrates that selectively attending to spatial locations, objects, object parts, and image features functions to raise the baseline firing rates of populations of neurons associated with a spatial location in the visual field (dorsal stream processing), amplify the firing strength of neurons associated with the perceptions of objects and features ventral stream processing), and inhibit the firing rates of distractor stimuli (ventral stream processing). For a review of this research see Kanwisher and Wojciulik (2000), Chun and Marois (2002), and Driver and Frith (2000).

tune form recognition to the content of perceptual hypotheses.[58]

Hypothesis testing in the visual system functions to mediate the influence of background knowledge in perception. Imagery is generated and maintained on this account by the same set of processes. Kosslyn argues that information about the global spatial structure of a scene or object is accessed from memory and the priming mechanism of the attention shifting system is used to instantiate a neural representation of that object or scene in the primary visual cortex itself via connectivity between the inferior temporal cortex and V1. This representation, in turn, functions as a surrogate retinal image that triggers the full range of sensory processing non-perceptually, or in the absence of its ordinary inputs.[59] Therefore, there is a sense in which one "imaginatively perceives" what one visualizes, and, as a result, by the general definition offered above, visual mental imagery is the simulation of vision.

3.0 Imagery Feedback, Artworks, and Degraded Images

> The hypotheses that I have developed...suggests that imagery plays an essential role in normal perception. The central idea is that, when the input to the pattern activation sub-system activates a representation sufficiently strongly, a representation of the most likely candidate is activated and imagery feedback is sent to the visual buffer. The mapping function of this feedback is adjusted to maximally augment the input image [emphasis added] (Kosslyn, 1996, p. 145).

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58. There are similar non-reciprocal pathways connecting the amygdala to all levels of visual processing in the occipital and inferior temporal cortices. It has been suggested that these connections function to mediate the influence of emotional states on the structure of visual perception. This suggests that a Kosslyn style processing model for the constructivist hypothesis could, in principle, be generalized to include explanations of the way artworks embody their expressive content as well.

59. See Kosslyn et al, 1999, for a demonstration of the productive role of area V1 in imagery.

The primary visual cortex is the region of the brain where retinal stimulations are initially recorded for use in sensory processing. Kosslyn argues that neural representations generated in the primary visual cortex top down from memory function in ordinary vision like low grade retinal inputs to actually fill in missing parts of low grade or incomplete sensory inputs. Kosslyn refers to this aspect of ordinary visual processing as imagery feedback. Paintings, are abstract two-dimensional patterns of pigment on canvas. They are, as a result, degraded images whose formal structure is incomplete. This entails that the depictive content of a painting must be actively filled in, visualized, or constructed in perception. Imagery feedback is a mechanism that can explain how this works. Therefore, there is a sense in which the content of a painting is, as Walton claims, imaginatively perceived.

Consider the following two examples. A two-dimensional stimulus composed of typographic characters can be used to depict a three dimensional, chubby cheeked face (figure 40). The image itself is a jumble of individual typographic characters. However, the italicized capital "L" is diagnostic for a nose and the configuration of parentheses and dashes is diagnostic for a set of jowly cheeks.[60] Kosslyn's model suggests that imagery feedback is used in cases like this to instantiate a neural representation of the contours that define the nose and cheeks in the areas of the visual cortex responsible for form recognition, e.g. the ventral stream. This process, in turn, functions to augment sensory inputs from the picture, and so contributes to the perception of a unified

60. If the L is not italicized the composition is far less convincing. Therefore, consistent with a neoformalist interpretation of the constructivist hypothesis, it is the fact that the L is rendered in a particular way that enables it to embody the form of the nose.

figure in depth.

Figure 41 is a formal study that Frances Bacon made for "Study After Velazquez's Portrait of Pope Innocent X," titled "Head IV." The abstract surface of this painting does not explicitly depict either the top of the Pope's head or his tall "Bishop's mitre."[61] Rather, in the context of appropriate background knowledge, the dark smudge extending upwards from the Pope's open mouth is diagnostic for his head and hat. Educated viewers recognize that "Head IV" is a painting of a Pope. They also know that the Pope wears a miter to symbolize his position in the church and that a bishop's mitre is a tall conical hat. The conjunction of this knowledge and marks on the canvas generate a perceptual hypothesis that augments the contours segregating the dark smudge from its surround. This, in turn, functions to define the shape of the Pope's head and cap. Therefore, the conjunction of art historical knowledge, cultural knowledge, semantic knowledge, and marks on the canvas generate a perceptual hypotheses that prompts a viewer to imaginatively see, or project, an image of the Pope's head and mitre into the picture plane and prescribes the way educated viewers perceive the painting.

This model for form recognition and object identification generates a more detailed explanation of viewers' perceptual interactions with Braque's "Bouteille et Poissons." Knowledge of the aesthetic practices that define Cubism as a style authorizes a game of visual play that prescribes the way viewers interact with the painting. The title is a cue which indicates that the work is a still life. Cubists,

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61. A bishop's mitre is a tall conical fabric hat worn to symbolize the high position in the church of Bishop's, cardinals, and the Pope.

from Cezanne to Boccioni, employed this basic compositional form for their experiments with the spatial properties of ordinary perceptual experience (figures 41 and 42). Knowledge that the work is a Cubist painting indicates that a viewer should search the painting for the objects mentioned in the title, e.g. a bottle and some fish. Knowledge that the work is a still life is a cue to look for natural objects in a pile spilling out towards the viewer from the center foreground of the painting. Therefore, knowledge of Cubism as style, in conjunction with knowledge of the likely depictive content of the painting, functions to guide attention, and shape the way viewers perceive the painting.

The fish in the painting are hard to recognize. Even educated viewers have difficulty finding them. However, if a viewer can find one fish head, he or she often reports that the rest pop into focus almost immediately. Kosslyn's account can explain this phenomena. Recognizing one of the prominently depicted fish in the lower right quadrant of the painting suffices to identify the types of formal features diagnostic for the shapes of the other fish in the painting, e.g. the triangular shape of a fish head. This, in turn, functions to prime the visual system and enables viewers to recover the image features necessary to project the shapes of the other four fish into the picture plane. Therefore, in the context of the game of visual play authorized by a Cubist painting, the conjunction of marks on the canvas, semantic knowledge, and background art historical knowledge functions to generate a set of perceptual hypotheses that prescribe, or determine, the way an educated viewer perceives the painting (see above p. 127 – 128).

4.0 Conclusions: Art, Imagination, and Aesthetic Experience

Paintings are abstract two-dimensional visual stimuli that viewers perceive as three dimensional scenes and spaces, e.g. "Water Taxi" and "Formal Construction #25761-0." In this regard a painting is analogous to a retinal image. It is composed of sets of two-dimensional image features that the visual system interprets as a three dimensional scene or object. Walton and Currie argue that this entails paintings are a type of degraded image into which viewers imaginatively project three dimensional scenes and objects. Therefore, they argue that imaginative perception pervades viewers' perceptual interactions with painting.

The role attributed to imagery feedback in Kosslyn's theory of object recognition provides a mechanism to explain how viewers project depth and form into the picture plane. The conjunction of art historical knowledge, semantic knowledge, marks on the canvas, and a viewer's current understanding of the depictive and narrative content of the painting function to generate perceptual hypotheses about the identity of the image. Perceptual hypotheses are employed to prime the visual system to the expectation of objects and image features at particular locations on the canvas. These processes function to amplify and augment the sensory content of a viewer's perceptual interactions with a painting. Therefore, background knowledge functions to modulate the perceptual content of viewers' perceptual interactions with paintings.

This imagery feedback model for the constructivist hypothesis explains how paintings embody their content. The formal structure of a painting,

conceived as a representation of an object, scene, or abstract space, is a product of the conjunction of the marks on the canvas and the broad range of cognitive influences that contribute to the way a viewer perceives those marks. These cognitive influences include an understanding of the meaning, narrative, and depictive content of the work. Therefore, paintings naturally embody their content by virtue of how they are perceived.

However, one can raise a, by now familiar, objection to this interpretation of the constructivist hypothesis. The influence of imagery feedback on the perception of paintings does not single them out as a unique class of perceptual stimuli. All types of pictures, both aesthetic and non-aesthetic, are two-dimensional perceptual stimuli whose depictive content must be filled in, or constructed, in perception. Furthermore, all sensory inputs to the visual system are ambiguous and incomplete. Therefore, Kosslyn argues that imagery feedback plays an essential role in all form recognition. In this regard, Kosslyn's theory treats viewers' perceptual interactions with paintings as no different in kind than any other type of perceptual event. This entails that explanations of the role played by imagery feedback in the perception of paintings do not suffice to explain how they function to generate aesthetic interest. Therefore, the contribution Kosslyn's imagery feedback model makes to our understanding of Walton's theory of visual imagination does not suffice to establish the constructivist hypothesis as a functional theory of art and aesthetics.[62]

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62. This conclusion is consistent with Walton's own characterization of his theory of visual imagination. He argues that the phenomena of imaginatively seeing is not unique to the experience of artworks (Walton, 1991, p. 7). It is an essential component of the perception of representational stimuli from clouds and natural rock formations to

Nonetheless, a more flexible model for the constructivist hypothesis can be derived from Kosslyn's imagery feedback model for perception that resolves this difficulty. Artworks are categorized relative to properties of their appearances, e.g. what makes something an Impressionist painting is the style in which its content is rendered. Therefore, knowledge of these types of facts functions as a unique category of semantic knowledge that defines artworks in various styles and media as distinct types of objects, e.g. an Impressionist, Hudson River School, or Superrealist landscape painting. Identifying an object as a type of artwork, in turn, triggers sets of semantic associations constitutive of its meaning, e.g. the manner in which Hudson River School artists rendered the landscape of the Catskills symbolizes their beliefs about the relationship between man and nature. These semantic associations function to focus a viewer's attention on sets of image features that embody the work's meaning. It is attention to the influence of these particular semantic associations in viewers' perceptual interactions with artworks that accounts for the aesthetic interest generated by a work of art. Kosslyn's model for object recognition provides a mechanism to mediate these sorts of cognitive influences on perception. I leave discussion the detail of this model for a functional theory of art to chapter 5 below.

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abstract artworks. As a result, he issues his theory with a disclaimer: it is neither a theory of art nor a theory of aesthetics. Rather, it is a theory about how perceptual stimuli in general, e.g. paintings, photographs, and print advertisements, function to generate their depictive and narrative content.

Chapter 5: Cognitive Science and Aesthetics

> In its broadest form, the aim of my research is to bring together two disciplines with a shared intellectual territory – to see what the combined resources of the neurosciences and philosophy can tell us about the nature of mind and its relation to the world...[In] bringing neuroscience to philosophy, my goal is to see what empirical insights the new science can bring to a variety of traditional (and traditionally intransigent) philosophical problems, to the problems of our sensory attachment to the external world...and of mental representation in general (Akins, 2001, p. 77).

Cognitive science and aesthetics, as I have defined it, rests on the observation that perception is an active process. This observation, in conjunction with new research methods in cognitive neuroscience, has inspired a number of philosophers, neuroscientists, and psychologists to study the way works of fine art function to perceptually communicate their content, e.g. painting, sculpture, music, and dance (see Raffman, 1993; Zeki, 1999; McMahon, 2000; Livingstone, 2002; Chatterjee, 2003; Rollins, 2004, and Montero, 2004). The purpose of this rapprochement between philosophy and cognitive neuroscience is not to replace more traditional approaches to aesthetics. Rather, it is to utilize current empirical research in conjunction with theories in philosophy, art history, and art criticism to better understand the nature of artworks and the character of aesthetic experience.

I have identified a general model that unifies this new research into a coherent field of study: the constructivist hypothesis. One of the grounding principles of this model is that the role of cognitive science in philosophy is not reductive. Rather, it is analogous to the role played by neurophysiology in cognitive neuroscience. The function of neurophysiology in cognitive neuroscience is to identify physiological constraints on the possible structure of

cognitive systems. These constraints function to clarify our understanding of the structure of cognitive phenomena and help resolve existing debates between competing theories (see Anderson, 1978, pp. 249 and 271; Farah and Feinberg, 2000, p. 15; Dowling, 2000, pp. XVII - XIX; Ogden, 1996, pp. 4 – 5; and Parkin, 1996, pp. 1 – 4). Likewise, the role of cognitive science in philosophy is to identify psychological constraints on the structure of cognition that help clarify our understanding of the nature of mental events and resolve existing debates in areas like ethics, epistemology, and the philosophy of mind.[63] The constructivist hypothesis is the application of this research strategy to problems in philosophical aesthetics: are there any such constraints on viewers' perceptual interactions with artworks that help resolve debates about the nature of art and aesthetic experience. Therefore, the function of research in cognitive science and aesthetics is to augment, not replace, theories in philosophical aesthetics (Raffman, 1993, p. 2).[64]

There is a general philosophical objection that threatens the validity of this model for cognitive science and aesthetics. Psychologists and neuroscientists are interested in understanding how artworks function as perceptible objects, i.e.

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63. See for instance new research on the interchange between philosophy and moral psychology, e.g. Prinz (forthcoming) Emotional Construction of Morals (Oxford: OUP) and Sripada (forthcoming) "Evolution, Culture and the Irrationality of the Emotions," in D. Evans & P. Cruse, eds., Emotion, Evolution & Rationality, Oxford University Press.

64. There are two general philosophical uses of the term 'reduction'. Some philosophers have argued that a theory A reduces to a theory B when A and B are theories about the same target phenomena and B replaces A in explanations of the target phenomena (Kemeny and Oppenheim, 1956, p. 10; Nagel, 1960, chapter 8; and Churchland, 1981, p. 605). Other philosophers have argued that reductive explanations function to augment theories, not replace them (Kitcher, 1984, p. 556; and Kim, 1992, p. 15). In this context, theory B is used to explain central assumptions of theory A or otherwise clarify the structure of the target behavior to enhance its explanatory power. Cognitive science and aesthetics rests on the latter view.

as perceptual stimuli that trigger complex cognitive events with perceptual, representational, and narrative content. However, explanations of the perceptual, representational, and narrative content of a viewer's interactions with a work of art do not suffice to explain its aesthetic content. This problem is an artifact of the distinction drawn between the contemporary and traditional senses of 'aesthetics' in chapter 1 (see above, p. 7 – 8). Baumgarten introduced the term to refer to the study of sensuous cognition, or perception in general. However, its use in contemporary aesthetics and art criticism denotes that set of properties or practices that differentiate a viewer's interactions with artworks from ordinary perceptual experiences. Research in cognitive science and aesthetics is directed at aesthetics in the former sense, e.g. how do artworks function as perceptual stimuli. Philosophical aesthetics is interested in explanations of aesthetics in the latter sense, e.g. what is it about artworks and aesthetic experiences that mark them off as distinct types of objects and experiences. Therefore, it would appear that one makes a category mistake when one applies results from cognitive science to problems in philosophical aesthetics (see Danto, 2001, p. 3; Carroll 2001, p 15; Dickie, 1962, pp. 291; and Eldridge, 1985, p. 304).[65]

However, contrary to this objection, the constructivist hypothesis can be demonstrated to be part of the basic theoretical framework of philosophical aesthetics. Theories in philosophical aesthetics can be divided into two types: theories of art and theories of aesthetics. Theories of art are theories about the

65. A category mistake is defined as the error of ascribing a property to a thing of one type that is properly attributable only to things of another type, or misrepresenting the category to which something properly belongs (The Oxford Companion to Philosophy, p. 126; Cambridge Dictionary of Philosophy, 2nd Edition, p. 123).

nature of art, e.g. what are the defining features of artworks, what is the nature of the interpretive practices that define a viewer's interactions with artworks, and how do these practices inform a viewer's understanding of the aesthetic features of artworks (see for instance Carroll, 1988; Walton, 1970; and Danto, 1964). Theories of aesthetics are theories about the phenomenal character of aesthetic experience, e.g. what are the defining formal and expressive properties of aesthetic experiences (see for instance Beardsley, 1981; Beardsley, 1983; also Carroll, 1986, p. 57; and Carroll, 1991, pp. 307 - 316). Questions concerning the nature of art are, at least in part, questions about the cognitive processes by which viewers categorize certain artifacts as artworks (see Carroll, 1988; Danto, 2001; and Levinson, 1979).[66] Questions concerning the character of aesthetic experience in art are, by definition, questions about the perceptual and affective properties of viewers' perceptual interactions with certain types of perceptual stimuli, e.g. artworks and beautiful landscapes. Answers to both of these sets of questions fall naturally within the domain of cognitive science. This demonstrates that the use of empirical results from cognitive neuroscience in philosophical aesthetics does not constitute a category mistake. Therefore, the constructivist hypothesis should be conceived as an extension of the domain of philosophical aesthetics to include related research in cognitive science.

In what follows, I evaluate the plausibility of this model as a theory of aesthetics. The constructivist hypothesis is a functional theory of art. Functional

66. The scope of theories of aesthetics is not limited to artworks. It also includes viewers aesthetic responses to the natural world, e.g. beautiful landscapes, sublime stormy seascapes, and majestic mountain vistas. I have limited the discussion of theories of aesthetics in this dissertation to their role in our understanding of art.

theories of art define artworks as perceptual stimuli designed to trigger aesthetic experiences, i.e. generate aesthetic interest (see above, p. 115). The difficulty for neuroaesthetics, McMahon's neoformalism, and theories of visual imagination is that they fail to explain how artworks function to generate aesthetic interest. A solution to this problem emerges from a discussion of the productive roles of interpretation and perception in aesthetic experience. Philosophers like Noël Carroll and Arthur Danto argue that attention to the way the formal structure of an artwork functions to trigger its interpretive content, or meaning, is a source of interest in the experience of art. However, they argue that these types of interactions with artworks are non-perceptual cognitive events. Therefore, they argue that viewers' interpretive and aesthetic responses to artworks are distinct. They conclude that the scope of aesthetic theories of art is limited to works that generate aesthetic interest simply by virtue of how they appear, e.g. beautiful landscapes and some types of geometric abstraction.

In what follows, I evaluate this argument. In section 1 I introduce Carroll and Danto's positions and argue that their descriptions of the relationships between artists' and viewers' aesthetic practices demonstrate that interpretation and perception are integrated in aesthetic experience, not distinct. In section 2 I argue that Kosslyn's model for visual recognition confirms this interpretation of Carroll and Danto's theory. This demonstrates that aesthetic theories of art can explain viewer's interpretative interactions with artworks, and that the constructivist hypothesis can explain how a broad range of artworks function to trigger aesthetic interest. Therefore, I argue in section 3 that Carroll and Danto's

arguments against aesthetic theories of art are not sound. In section 4 I evaluate the scope of the constructivist hypothesis as an aesthetic theory of art. In section 5 I conclude with a short description of the limitations of this model for the integration of cognitive science and aesthetics.

1.0 Aesthetic Practice, Semantic Knowledge, and Aesthetic Interest

The strength of the constructivist hypothesis is that it explains viewers' interactions with artworks in terms of the ordinary operation of perceptual systems. The ensuing model for a theory of aesthetics rests on the following assumptions: visual artworks are perceptual stimuli designed to trigger complex mental events with aesthetic content; aesthetic content is a species of perceptual content; and, as a result, explanations of aesthetic content rest on, and so are no more or less problematic than, explanations of the neuropsychological processes underlying ordinary perceptual experience. Perceptual systems are, in principle, transparent to empirical investigation. Therefore, the aesthetic content of a viewer's interaction with an artwork is hypothesized to be fully explainable in terms of the cognitive neuroscience of perception.

However, this strength is also the source of a general objection. The constructivist hypothesis rests on explanations of how artworks function as perceptual stimuli. The functional success of a work of visual art depends on the successful manipulation of visual systems. Artists' formal methods, their sketches, color studies, and maquettes, are epistemic tools for discovering sets of visual cues sufficient to trigger the content of their artworks in the perceptual

experiences of viewers. However, the visual cues embedded in the formal structure of a work of visual art are the very same cues that ground ordinary visual experience, e.g. the receptive field properties of neurons in the early visual system and the form primitives that ground the construction of the global form of visual images (Zeki 1999, pp. 9 – 10 and chapter 2 p. 61; McMahon 2001, pp. 235 – 236 and chapter 3, p. 100 – 101). There is no difference between the way these cues function in aesthetic and non-aesthetic perceptual stimuli, e.g. Abstract Expressionist paintings, billboard advertisements, and stimuli used in vision science experiments (Cavanaugh, 1999, p. 648). This suggests that explanations of how artworks function as perceptual stimuli do not suffice to explain how they function as aesthetic stimuli (Danto, 2001, p. 2; and Carroll, 2001, p. 15).[67] Therefore, if there is something phenomenally unique about aesthetic experience, it appears that the constructivist hypothesis can not succeed in explaining it.

A solution to this problem can be can be derived from contemporary debates between contextualist and aesthetic theories of art. The constructivist hypothesis is an aesthetic theory of art. Aesthetic theories of art are functional theories of art that define artworks as artifacts designed to trigger aesthetic experiences. Aesthetic experience is, on this account, defined relative to the perceptual and expressive properties of viewers interactions with artworks:

> The use of aesthetic terminology in [theories of aesthetics] is, most essentially, "experiential" or "perceptual" where those terms are generally understood by contrast to responses mediated by the application of

67. This type of observation has prompted philosophers, artists, and art critics from Marcel Duchamp to Noël Carroll to argue that our interest in art is a product of how viewers think about artworks, not how they perceive them.

concepts or reasoning (Carroll, 1986, p. 57).

Contextualists argue to the contrary that the interest generated by artworks does not lie in how viewers perceive them. Rather it is a product of the way viewers categorize what they have already perceived relative to background art historical knowledge. This is not to deny that some artworks are perceptually striking. Rather, contextualists argue that the interest generated by an artwork is, more often than not, the product of non-perceptual interpretive events that determine its meaning. Contextualists argue further that aesthetic theories of art cannot, given the perceptual bias of their definition of aesthetic experience, accommodate these sorts of cognitive practices. If sound, this argument entails that theories of aesthetics provide an anemic view of art in which artworks are identified as a narrow category of objects that trigger formal aesthetic responses, e.g. beautiful landscapes and some types of geometric abstraction.

The contextualist claim is clearly articulated in the following two arguments from Noël Carroll and Arthur Danto. Carroll asserts that one must distinguish between "seeing and noticing" in aesthetic contexts:

> "Seeing," in this context, refers to what the faculty of visual perception does automatically; "noticing" refers to the way we organize what we see, often as the result of learning. "Noticing," for my purposes, is a matter of focusing on details of what we see, of finding certain objects or structures salient... Whereas I see what the experienced tracker sees, he or she notices the telltale signs that an animal has been this way. In the best of cases, I can learn to do this as well. It does not require a change in my faculty of perception however. It involves a way of organizing what I literally [already] see (Carroll, 2001, p. 15).

Aesthetic responses are, by definition, perceptual responses to artworks. Carroll argues that interpretation involves focusing one's attention on what is perceived

relative to the way one categorizes the work, e.g. as an Impressionist, Cubist, or German Expressionist painting (Carroll, 1986, p. 60 – 61). However, Carroll argues that learning to attend to something in a novel way does not involve learning to perceive it differently. Rather, he defines interpretation as a cognitive act that involves attending differently to what one has already perceived. One may, for instance, take an interest in how the latent formal structure of a work functions to generate perceptual effects (Carroll, 1986, p. 60 – 61). This may cause one to focus one's attention on its formal features in a novel way, e.g. one may ignore the representational content of the work and fix instead on the way the artist uses contrastive colors to enhance the vividness of the composition. However, Carroll argues that this does not alter how one perceives the work. Therefore, he argues that an interest in how the formal structure of an artwork works is an interpretive act that is distinct from viewers' aesthetic interactions with artworks.

Arthur Danto argues analogously that one must distinguish between "seeing" and "showing" in viewer's interactions with artworks, or between "shape" and "symbol." 'Shape' refers to what the faculty of visual perception does naturally and automatically. It denotes what, in Carroll's language, we literally see. However, viewers do not see a work as simply resembling what it depicts. Rather, viewers see the work as showing what that scene, object, or construction stands for, or symbolizes, within a particular art historical context (Danto, 2001, p. 9):

> Thus we can imagine a pair of indiscernible pictures from different notational systems that mean quite different things, between which the

> eye of course cannot discriminate. We can all identify the pictures in terms of their congruity with what they resemble and denote, but this will carry us only to the level of shape recognition, which is in no interesting sense historical. To understand the meanings requires an archeology of how pictures were used to mean when not used simply to denote their resemblata (Danto, 2001, p. 3).

The visual cues used to depict scenes, objects, and abstract spaces in visual artworks are derived from a careful examination of the visual cues that enable the artists themselves to perceive scenes and objects in ordinary contexts. As a result, the capacity to recognize objects perceptually is ordinarily sufficient to determine the depictive content of artworks (Danto, 2001, p. 6; see also Rollins, 2004; Lopes, 2004; and Carroll, 2001). Danto argues that this capacity is "biological and ahistorical" in the sense that it is grounded in psychological processes that are the product of the basic developmental processes responsible for the structure of the visual system. However, this capacity does not enable viewers to determine what a symbol means. The ability to recover the meaning of a symbol rests on learned conventions, on knowledge of the history of a particular culture or community. Therefore, the capacity to determine what a work shows is not biological in Danto's sense.

Consider a familiar example. Despite obvious physical differences, aesthetically "uneducated," or naïve, perceivers have no trouble perceptually identifying Warhol's "Brillo Boxes" as variants of the ordinary commercial objects they resemble. However, interpreting the art critical meaning of Warhol's boxes is something viewers must learn to do. The significance of Warhol's work is that it "fails to drip" (Danto, 2000, pp. 133 – 137).[68] Although one can clearly see that

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68. Danto argues that this fact about the formal structure of Warhol's work

the paint on the boxes fails to drip, the art critical importance of this fact is not transparent in the visible surface of the work. In fact, ordinary viewers probably never even consciously register the driplessness of these objects. After all, it is a commonplace and unexceptional fact about cartons of cleaning supplies that they are machine printed, and so do not drip. One must learn the history of Abstract Expressionism, and understand the content of debates about its art critical significance, in order to understand why it is meaningful that the surface of Warhol's "Brillo Boxes" fail to drip. Therefore, Danto argues that there is a sharp distinction between the way viewers perceive an artwork and the way they determine its meaning.

Stephen Kosslyn's discussion of the role of memory and attention in visual search and object identification demonstrates that this characterization of the distinction between interpreting and perceiving is not valid (see above, pp. 140 – 142). Semantic hypotheses about the identity of a visual image function to direct visual attention and augment the structure of sensory inputs. Therefore, attention and meaning play a role in determining how viewers "see" artworks and natural scenes.

However, this observation does not, in itself, resolve the problem raised for aesthetic theories of art by interpretation. Carroll and Danto's characterizations of the distinction between interpretive and aesthetic practices suggest that there is an equivocation between two senses of 'interpretation' in constructivist discussions of art and perception. Constructivists argue that all

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symbolizes the shift in aesthetic paradigm Warhol is credited with instigating from Abstract Expressionism to Pop Art.

perception involves a form of interpretation. In order to identify the depictive content of a visual image, one must match the visual cues embedded in its surface to background knowledge of the ordinary shapes and functions of object types. This is equally true of artworks, illustrations, and retinal images. This categorization process has a reciprocal effect on the perceptual content of visual images in that it, at minimum, influences the way the visual system groups image features.[69] Therefore, attributing meaning to a visual image plays a role in structuring its spatial content.

However, conceived as an artistic practice, interpretation involves contextualizing artworks relative to salient art historical and cultural knowledge. This knowledge is not transparently knowledge of the typical shapes and functions of artworks. As a result, although attention and meaning do play a role in perception, it is not clear that the role they play is synonymous with, or even relevantly analogous to, the role played by interpretation in aesthetic contexts. In fact, Carroll and Danto define the act of attributing meaning to an artwork as a higher order cognitive process in which one either focuses attention on, or assigns meaning to, fixed perceptual content that one has previously identified (Carroll, 1986, p. 61; Carroll, 2001, p. 15; Danto, 2001, p. 9). Therefore, the artistic sense of interpretation should be defined as a higher order cognitive event distinct from the categorization processes responsible for the influence of background knowledge on perception.

69. See Kasimir Malevich's "Self Portrait in Two-dimensions," p. 23 below.

1.1 Art, Interpretation, and Aesthetic Practice

Paradoxically, Carroll's own definition of aesthetic practice provides the means to dissolve this apparent equivocation. Carroll defines art as a public practice involving two types of participants: makers and receivers (Carroll, 1988, p. 144). Artists' viewing strategies are tools for discovering salient visual cues in ordinary perceptual experience. These strategies are developed in the service of, and so constrained by, the depictive strategies that define artists' formal vocabularies. There are, in turn, psychological constraints that determine which types of image features are necessary to successfully depict a scene, object, or abstract geometric space in a particular aesthetic medium, e.g. oil paint, acrylics, dry point, intaglio, or bas relief. Therefore, artists' depictive strategies are psychologically constrained by the structure of perception itself. The perceptual and interpretive strategies employed by viewers to recover the meaning and representational content of artworks are, likewise, developed relative to, and so constrained by, knowledge of the depictive and stylistic conventions that define the aesthetic practices and formal vocabularies of particular artists and general artistic movements. Carroll argues, as a result, that the success of art as a public means of communication requires a shared framework that integrates the psychologically grounded practices of makers with the art historically grounded practices of receivers (Carroll, 1988, p. 144).

The communicative exchange between artists and viewers is grounded in the fact that artists treat themselves as their own first audience. Artists must understand the perceptual and interpretive practices of ordinary viewers in order

to assess the practical success of their works as a means for conveying content. This entails that artists internalize the art historical constraints governing viewers aesthetic practices (Carroll, 1988, p. 145). Viewers must have a rudimentary understanding of the productive practices of artists in order to understand which features of an artwork's latent structure are operative in determining its meaning. Therefore, Carroll argues that artworks are the product of the integration of the perceptual practices of artists and the interpretive practices of viewers.

E. H. Gombrich's description of artist's methods can be used to cash out Carroll's claims about the aesthetic practices of artists and viewers. The central claim of Gombrich's theory is that there are both psychological and historical constraints on artists' techniques and methods (Gombrich, 1960, p. 291). He argues, following Fry and Ruskin, that conceptions of the shapes and functions of objects influence the way individuals perceive them. This entails that artists cannot perceive the structure of appearances independent of cognitive influence, e.g. the dinner plate demonstration and Picasso's "Baboon and Young" (see above, pp. 2 – 3; see also below, pp. 169 and 177 – 178). As a result, artists do not simply copy what they see. Rather, through experimentation with the effects of different sets of marks on their own visual experience, they learn to manipulate the relationship between their medium and human perceptual systems. The net result is that artists learn to approximate the visual cues necessary to trigger desired perceptual responses in viewers. Therefore, artists' methods and formal vocabularies are a means to harness the operations of the visual system, e.g. to isolate sets of visual cues that function to amplify the resonance between an

artwork and the use of form primitives in object recognition.

Artists traditionally learned their trade by apprenticing with, and so internalizing the methods of, a contemporary master. Contemporary art schools codify this practice by teaching students the techniques constitutive of disparate historical styles. In this vein, Gombrich argues that, as artists learn to paint, they learn to see the styles of their predecessors in familiar scenes and objects (Gombrich, 1960, pp. 315 – 320). For instance, Constable's first works were copies of paintings by earlier artists, e.g. Gainsborough (Gombrich 1960, p. 317). The trace of these copied styles can be seen in his more mature works, e.g. the drawing "Motif in Wivenhoe Park" (Gombrich, 1960, pp. 317). Further, he wrote of his home in Suffolk that, "It is a most delightful landscape for a painter. I fancy I see Gainsborough in every hedge and tree" (Gombrich, 1960, pp. 316), and of an early painting of the Barrowdale landscape: "...tone very mellow, like the mildest of Gaspar Poussin and Sir George Beaumont, on the whole deeper toned than his drawing" (Gombrich 1960, p. 315). Gombrich takes this to demonstrate that an artist's style is a product of experimentation with, and sets of corrections made to, the formal motifs of his or her precursors (Gombrich, 1960, pp. 317 – 320). Carroll argues similarly that artists develop their own style by either repeating, amplifying, or repudiating the styles and aesthetic practices they have inherited from their predecessors (Carroll, 1988, pp. 67 – 69). These observations demonstrate that the styles and formal vocabularies of artists reflect their relationship to their precursors.

Carroll's discussion of the relationship between the practices of artists and

viewers demonstrates that an artist's style and formal vocabulary embodies the aesthetic practices of his or her community, e.g. the beliefs of a community about the appropriate relationship between realism and abstraction in the depiction of scenes and objects (see above, p. 158 – 159). The formal structure of an artwork is the embodiment of an artist's style. Therefore, the formal structure of an artwork embodies the aesthetic practices of a community.[70] For instance, Bierstadt exaggerated the scale of mountains in his paintings of the American West in order to more realistically depict their grandeur. This formal strategy reflects a mid-nineteenth century romanticized view of the vastness of the North American Wilderness which culminates 40 years later in myths about the wild west.

Viewers' practices are linked to artists' practices via knowledge of how to treat a particular artwork's perceptible surface. Knowledge of the particular aesthetic practices of an artist or community indicates how to attend to the features of a painting's visible surface in order to recover its aesthetically salient features, e.g. how to attend to the blurry contours of Monet's "Cathedral of Rouen," the flatness of Matisse's "The Music Lesson," or the fractured surface of Braque's "Bouteille et Poissons." This entails that educated viewers are, in a sense, like anthropologists. Their goal is to use what they antecedently know to uncover hidden meanings embedded in the structure of works of art. Therefore, consistent with Carroll's characterization, the success of art as a public means of communication does rest on the integration of the practices of artists and viewers.

Carroll introduces the concept of a narrative to elucidate this connection.

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70. See also Gombrich, pp. 314; and Carroll, 1988, pp. 72 – 73.

An art historical narrative is a rational reconstruction of the history of an aesthetic practice that is designed to "integrate its past and present into a coherent and unified whole" (Carroll, 1988, p. 144 – 145 and 151). Importantly, the application of a narrative to an artwork does not require viewers to be able to recover the particular intentions of individual artists. Rather, cues within the visible surface of an artwork function as diagnostic clues that enable viewers to categorize it relative to their own understanding of the history of aesthetic practices (see below pp. 178). This, in turn, reveals sets of stylistic conventions that influence the way viewers attend to the formal structure of a work, recognize its aesthetically salient formal features, and determine its meaning.[71]

1.2 Two Case Studies

Art historical narratives can, contrary to Carroll's claim, be demonstrated to have an effect on what one perceives. Consider Figure 46.[72] At first glance the image appears to be a reproduction of an abstract ink drawing, perhaps European Modernist or Abstract Expressionist. In this context, one might perceive it as a geometric construction in ambiguous, but shallow, depth. Alternatively, the belief that it is rendered in a loosely described Japanese Sumi-e style, a style that is often used to depict mountain landscapes, might cause one to identify the drawing as an abstract depiction of a lone farmhouse in a valley at the base of a mountain. In this case explicit knowledge of facts about the use of Sumi-e style, e.g. the use of vertical placement as a convention for

71. Rollins 2003 and 2004 proposes a similar view that leans less heavily the role of semantic knowledge in perception.

72. Reproduced from Hyman, 1997, p. 266.

depicting depth, alters the way one perceives the rough broad brushstroke. Its sharp lower edge now depicts the ridge line of a mountain in the foreground, and the brushstroke itself depicts the lush, and partially occluded, slope of a peak in the distance (Hyman, 1997, p. 267). Therefore, identifying the work as a Sumi-e drawing alters the way one projects depth into the picture plane.

John Hyman describes the intended depictive content of the drawing differently: "One example might be this: in order to make a picture of Hitler, sketch a closely packed series of diagonal lines in the form of a trapezium above a closely packed series of vertical lines in the form of a square..." (Hyman, 1997, p. 266). Reading this description identifies the work as a caricature. Knowledge of the aesthetic practices associated with the depictive style of caricature, in conjunction with knowledge of the defining features of Hitler's appearance, again alters the spatial dimension of the image. The mountain slope is now perceived as a shock of hair and the cabin is perceived as one of history's most despicably notorious moustaches. The act of identifying the image as a caricature of Hitler enables viewers to imaginatively perceive the contour of his face and place missing features in relation to one another in the picture plane, e.g. his ears, nose, cheekbones, and mouth. This semantic association is so strong that viewers may now have a great deal of difficulty perceiving the work as anything but a caricature.

This example is designed to illustrate how one's explicit beliefs about the aesthetic practices of the artist, not as a particular individual, but generally, as an art historically conceived agent, informs one's conception of the work. This act,

in a manner consistent with a constructivist theory of vision, alters how one categorizes the drawing as an aesthetic object. How one categorizes the object, in turn, alters how one perceives its surface properties. This demonstrates that contextualizing the object relative to salient art historical and cultural knowledge, i.e. categorizing the work as either an abstract modernist work, a traditional Sumi-e ink drawing, or a caricature, affects how one perceives the spatial dimension of its visible surface. Therefore, contrary to Carroll's claims, interpreting a work by integrating it into a coherent art historical narrative effects how one perceives it.

Kasimir Malevich's "Self Portrait in 2 Dimensions" can be used to demonstrate further that an understanding of what a work symbolizes or shows can effect one perceives it (figure 47). One might interpret this painting as Malevich's self-critical commentary of his own position as an artist in the emerging Russian communist society. Art is the province of the bourgeoisie. In this regard, Soviet communists interpreted much of the contemporary art of their time as a decadent form of intellectual entertainment open only to wealthy patrons who had both the time and money to participate. However, Malevich also believed that his new abstract style of clean geometric forms and dynamic compositions was ideally suited to represent the ideas of the Bolshevik Revolution. In the context of these two claims, one can interpret the compositional structure of the painting as a loose, representational collage. The black square at the top of the composition is a black felt top hat, the circle is a monocle indicating his eye, and the small

brown square is his bulbous, bourgeois nose. The blue trapezoid and black rectangle represent his calf and dress shoe outstretched in the act of marching. The painting therefore symbolizes the cooption of a bourgeoisie form for the promotion of the revolution.

Whether this interpretation is accurate or not is, in an important sense, beside the point. It is an art historical narrative that I have read off of the visible surface of the work relative to my own beliefs about Malevich's role as an early Soviet artist. The act of identifying the figure in the painting as a man marching in a top hat and monocle adds depth and dynamics to an otherwise static formal composition. Therefore, it significantly alters the way one perceives the spatial structure of the painting. It does so because, relative to my beliefs about the meaning of the painting, its formal structure embodies the idea of a marching 19th century bourgeoisie businessman (see below, p. 164 - 165). This demonstrates that, contrary to Danto's claim, interpreting what an image symbolizes, or determining its meaning, can alter how one perceives it. This, in turn, entails that the equivocation in the constructivist discussion of art between the depictive content and meaning of a work of art does not threaten the constructivist hypothesis.

2.0 The Model

> ...this example and others I have cited illustrate how perceptual strategies in picture recognition might take on added dimensions when the picture is a work of art. They reveal the special aesthetic significance that a [diagnostic] account of picture perception might have. In brief, an artist can give a picture the capacity to engage selectively in the viewer certain perceptual strategies in particularly powerful and effective forms. He does

> this by virtue of the emphasis and enhancements he gives to features, or to the picture's overall composition and design (Rollins, 2003, p. 626).

Kosslyn's hypothesis testing model for visual search and object identification provides a mechanism for integrating interpretation and perception in aesthetic experience. Kosslyn argues that object recognition is driven by perceptual hypotheses that function both to guide attention and augment the structure of sensory inputs (see above, pp. 138 – 140). On this account attention functions as a filter both to select formal image features that are salient to a particular perceptual hypothesis and discard sensory information that is not. This suggests that, contrary to Carroll's claims, how one attends to a stimulus influences the way one perceives it.

The saliency of image features in any given perceptual context depends on the particular perceptual hypothesis guiding attention and object identification. Kosslyn argues that the semantic knowledge that contributes to perceptual hypotheses includes knowledge of the task at hand, e.g. identifying the depictive content of a drawing or recognizing the formal image features necessary to render a scene or object accurately. For instance, subjects ordinarily perceive the central figure in the dinner plate demonstration as a round, three dimensional object presented in depth (figure 51). In this context recognition is mediated by attention to "external" spatial relations between the central figure in the drawing and image features that are salient to its identity as a plate, e.g. the image features that depict the fork, the glass, and the edge of the table. However, relative to the task demands of drawing, artists learn to attend to the salient internal relationships that define the two dimensional elliptical shape of the figure

itself, e.g. the fact that its width and height are unequal. Attention to the latter set of spatial relations is what enables the trained artists to copy the drawing accurately.[73] Observations like this one demonstrate that the visual system can be tuned to organize image features relative to their relevance to a particular context (Kosslyn and Koenig, 1995, p. 77; see also Biederman and Shiffrar, 1987). It is in this sense that Gombrich argued that trained viewers learn to see the world as an artwork. Artists and educated viewers learn to categorize artworks as perceptual stimuli. They thereby learn to perceive them as sets of abstract visual cues as opposed to depictions of scenes, objects, and abstract spaces.

Kosslyn argues that the sensitivity of visual processing to semantic knowledge and task demands demonstrates that the visual system is a cooperative system (see above, p. 137). Cooperative systems are constructed of interconnected subprocesses which share information and so function as larger distributed systems (Kosslyn, 1996, pp. 32, 51, 121, 148). Cooperation is a property of what Kosslyn refers to as opportunistic processing systems (Kosslyn and Koenig, 1995, pp. 76 – 77). The visual system is opportunistic in the sense that it exploits any and all resources available to it in order to promote fast and efficient recognition of the attributes necessary for cognition and action. This principle has two key correlates. First, coarse grained image features that indicate the general shape of an object are ordinarily sufficient for object

73 . Although this may seem like a trivial task, naïve subjects with no formal training in art fail miserably at it (see Cohen and Bennett, 1997). In fact, Gombrich reports that even trained draughstmen have difficulty accurately recognizing the two dimensional shape of this feature of the drawing (Gombrich, 1960, p. 302; see also above, p. 5)

identification, e.g. recovering the outline of the baboon's head is sufficient to identify it as a baboon. Second, once an adequate match has been discovered between a visual pattern and a stored record of an object's shape or function, information not needed for the continued operation of the system in that context is discarded as spurious. Therefore, Kosslyn argues that visual images are constructed piecemeal, beginning with coarse grained image features. Fine grained detail is "filled in" only as it is needed for a given task, e.g. pointing to the baboon's nose or discriminating Picasso's sculpture from a more realistic rendering of a baboon family.

There are four critical stages in Kosslyn's model for object identification.[74] First, sensory inputs are recorded in a short term holding area Kosslyn refers to as a visual buffer. Second, a pattern recognition subsystem extracts the basic formal structure of the image from the sensory inputs in the visual buffer. Third, the output of the pattern recognition system is matched to prior knowledge of the general shapes of objects stored in associative memory. Fourth, if there is no good match between the output of the pattern recognition subsystem and stored records of the shapes of object types, the best match is used to generate a perceptual hypothesis about the form and identity of the scene or object represented by in the current visual image. This perceptual hypothesis is maintained online in spatial working memory for use in further processing (see above, p. 138, fn. 56). At this stage, further information extracted from memory concerning possible object properties is employed to shift attention and prime the pattern recognition system to the expectation of specific image features at

74. See above pp. 140 – 147 for a detailed discussion of Kosslyn's model.

particular locations that are diagnostic for the identity of the image.[75] The net result of these attentional processes is that priming augments and amplifies obscure contours that were previously unnoticed, and so unperceived. This entails that the ascription of meaning to a visual image, i.e. generating a perceptual hypothesis about its identity, is one of the mechanism that drives attentional processing, and that how one attends to the visual field determines what one perceives and how one perceives it (Kosslyn, 1995, pp. 121 – 127; chapter 4, pp. 145 – 146; see also, Schyns, 1998, p. 149; Archambault et al, 1999, p. 254; and Bonnar et al, 2002, p. 683).

One consequence of this type of model is that visual recognition does not depend on a full representation of the global form of a scene or object (Kosslyn, 1996, p. 51; Archambault et al, 1999, p. 249). Rather, incomplete spatial information from each coherent glimpse of the visual field is shunted forward to associative memory and used to generate a perceptual hypothesis about the identity of the image. The only spatial information maintained online in spatial working memory over iterations of the hypothesis testing process is information salient to a particular hypothesis. This increases the efficiency of the system. The visual system collects a vast amount of sensory information with each saccade. It would require immense cognitive resources to store all of this information in working memory across iterations of the hypothesis testing process. Kosslyn's model minimizes this cognitive cost by ensuring that, in ordinary perceptual contexts, the visual system generates and maintains only the

75. Image feature that are diagnostic are features that would suffice to confirm a particular perceptual hypothesis about the identity of the image (see above, pp. 146).

minimal set of image features necessary for recognition and action in a particular context. For instance, the text on my t-shirt is not necessary for either the task of identifying me as Bill Seeley or reaching out to shake my hand. Sensory information defining the particular shapes of each of these letters can therefore be discarded as spurious to these tasks without any loss to the function of cognition.

This feature of Kosslyn's model can be used to explain the discrepancy between the visual experiences triggered by Picasso's "Baboon and Young" in naïve and educated viewers. Naïve and educated viewers categorize the sculpture differently, and in so doing assign it different functions. The naïve viewer is concerned with the identity of the work as a representational statue that depicts a particular object. The general shape of an object ordinarily indicates, or is diagnostic for, its identity. The occlusion boundary of an object, its silhouette, is ordinarily sufficient to enable the visual system to reconstruct, or recognize, its general shape. This entails that, the outline of the baboon's head is sufficient for the recognition of its identity as a statue. Therefore, naïve viewers fail to attend to the detail of the baboon's face, and so do not perceive it.

However, educated viewers conceive their perceptual interactions with the sculpture as a game of perceptual play in which they are supposed to recover visual cues that indicate its meaning as well as its depictive content. They know that there are often significant perceptual cues to the meaning of Picasso's work encoded in the way he distorts the features of a subject's face. Further, they know that Picasso is associated with Primitivism in modern art. Primitivists were

fascinated with the types of rough geometric abstractions found in tribal masks. Therefore, categorizing the work as one of Picasso's sculptures causes educated viewers to focus their attention on, and thereby perceive, details in the figure's face that are not attended to, and so are not perceived, by naïve viewers.[76] This demonstrates that how viewers contextualize, or categorize an object as a type of artwork influences the way they focus attention on its perceptible surface, which, in turn, influences the way they perceive it. Therefore, contrary to Carroll and Danto's claim, how one art historically contextualizes a work of art influences how one perceives it.

3.0 Contextualism Reconsidered: A Constructive Dilemma

The contextualist objection to aesthetic theories of art stems from a traditional interpretation of aesthetic experience as a species of phenomenal experience which does not involve the influence of concepts and reasoning (Carroll, 1986, p. 62; Carroll, 1991, p. 327 – 330) Carroll and Danto argue that interpreting the meaning of an artwork involves contextualizing the representational content of a work relative to prior art historical knowledge. Contextualizing the content of a work is defined as a non-perceptual cognitive event that involves concepts and reasoning (Carroll, 1986, p. 57; and Danto, 2000, pp. 134). Therefore, Carroll and Danto argue that interpretive and aesthetic interactions with artworks are distinct.

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76. Notice that the general shape and placement of the windshield, front wheel wells, and front bumper are adequate to stand in for the baboon's eyes, brow, nostrils, and mouth respectively. These are strong, redundant, coarse grained cues consistent with the diagnosticity of the occlusion boundary of the baboon's "head."

However, given the role of perceptual hypotheses and semantic knowledge in perception, this type of objection to aesthetic theories of art is problematic. This leaves philosophers like Carroll and Danto on the horns of a dilemma. Either they can concede that interpretation plays a role in the perception of artworks, or they can argue that it does not. The trouble is that, if understanding the meaning of a work of art contributes to how one perceives it, then viewers aesthetic and interpretative interactions with artworks are integrated not distinct. If viewers aesthetic and interpretive interactions with artworks are integrated then aesthetic theories of art can explain viewers' interpretive interactions with artworks, e.g. by understanding how a work embodies its meaning (see above, p. 111 – 114). Understanding the meaning of an artwork does influence the way one perceives it. Therefore, if Carroll and Danto adopt the first strategy, their objections to aesthetic theories of art are not sound. However, if they deny a role for interpretation in perception, it would appear that their theories contradict good empirical evidence.

There are two strategies the contextualist can adopt in response to this difficulty. First, one could argue that the problem is not due to a flaw in the contextualist's argument. Rather, aesthetic theories of art are mistaken: given the role of semantic knowledge and perceptual hypotheses in viewers' perceptual interactions with artworks, concepts and reasoning do play a role in the generation of aesthetic experience. Once one corrects the traditional conception of aesthetic experience to accommodate the role of background knowledge in perception the problem falls away as spurious. However, this strategy concedes

a role for interpretation, i.e. meaning and art historical knowledge, in viewers' perceptual interactions with artworks. Carroll and Danto both argue that viewers' perceptual and interpretive interactions with artworks are psychologically distinct (see above, pp. 156 – 159; see also Carroll 1986, Carroll 2001, and Danto 2001). Therefore, this strategy is not available to them.

Alternatively, the contextualist could concede that interpretation plays a role in perception, but argue that the role it plays is not aesthetically interesting (Danto, 2001, p. 6; Carroll, 2001, p. 15; see also above p. 159 – 156). Knowledge of stylistic conventions does affect the way the visual system parses, matches, and attends to the elements of the formal structure of a painting. This in turn plays a role in determining how viewers identify the depictive content of painting. However, aesthetic interest is not a product of the fact that we can identify that a painting depicts an X. It is a product of our capacity to understand what X symbolizes in that context. This is the force of Danto's distinction between seeing and showing. Seeing is the ability to recognize that a painting depicts X. Showing is a matter of determining what the fact that the painting depicts an X means in that particular context. The latter, it is argued, cannot be read off of the visible surface of the painting alone. One needs background knowledge to determine what Warhol's "Brillo Boxes" show.

Carroll argues similarly that focusing one's attention on the way the content of a work has been rendered, e.g. attending to the formal image features responsible for its depictive content, representational content, and meaning, is a source of interest or value in the fine arts. However, he denies that this interest

is aesthetic in the sense the term is usually used. He argues instead that these processes function to assign cognitive salience to features of scenes and objects that have already been perceived. Further, he argues that the cognitive salience of image features is determined by the way viewers categorize the identity of scenes and objects, e.g. as a depiction of a scene, object, or individual or as an artwork, not how they perceive it. Therefore, on Carroll's account, the acts of focused attention that drive viewers' games of perceptual play with artworks are interpretive events that are distinct from the types of perceptual events subserving aesthetic experience.

However, this line of reasoning depends on the sharp distinction Carroll and Danto draw between perception and interpretation. The discussions of paintings like "Christina's World" (figure 7) and Malevich's "Self-Portrait in Two Dimensions" (figure 47) demonstrate that understanding what a work symbolizes in a context does effect how one perceives it (see above p. 165 – 168; and below pp. 177 – 178). Further, Kosslyn's model for object recognition demonstrates that the salience of particular image features determines how, and in some cases even whether, one perceives objects in the visual field. The salience, or diagnosticity, of an image feature is determined by perceptual hypotheses that function to categorize the content of incomplete initial representations of scenes and objects in the visual field. In the case of artworks perceptual hypotheses are, in part, the product of background art historical knowledge. Therefore, Carroll and Danto's own descriptions of viewer's interactions with artworks demonstrate that interpretation, in their sense, is integrated with perception in aesthetic

experience.

Consider Wyeth's "Christina's World" again (figure 7). Christina Olsen was 55 years old in 1942 when Wyeth painted "Christina's World." She had contracted polio as a child during an outbreak of the disease that killed her parents and crippled her brother. Each day that the weather permitted she dragged herself from the house across this field to visit the graves of her parents. She described these excursions as the most beautiful times in her life, relishing the vibrant feeling of the dried grass as she passed across it. This biographical and art historical knowledge about Christina Olsen alters how one categorizes the painting. For instance, naïve viewers' are distracted by Christina's pink dress and full head of hair. Consequently, they identify Christina as a normal, healthy young woman and categorize the work as a depiction of a poor depression era farm. Educated viewers categorize the work alternatively as a mid-twentieth century realist painting that symbolizes the bittersweet joy and hope of someone who, despite the tragedies that had beset her, embraced life as an opportunity. These viewers, in turn, interpret the painting to covertly symbolize the enduring strength of the human spirit for a generation that had lived through a world depression and was in the midst of a world war.

The discrepancy between these interpretations is in part a product of the fact that Wyeth used his healthy, 30 year old wife as the model for Christina in the painting. The coarse grained image features that define the shape of Christina's head and torso, e.g. the silhouette of the figure and her full head of hair, are diagnostic for a healthy young woman's body. Since coarse grained

image features are sufficient to categorize the identity of a figure, naïve viewers ordinarily identify Christina as a healthy young woman. The fine grained image features depicting her sickly arms, hands, and ankles are spurious to this hypothesis. Therefore, on a diagnostic account like Kosslyn's, short disconfirming sensory information, these image features are discarded. However, educated viewers recognize the discrepancy between Christina's appearance and her actual identity. Knowledge of what the painting symbolizes generates a perceptual hypothesis that assigns salience to previously unnoticed, and so unperceived, fine grained image features, e.g. the formal features that depict Christina's emaciated arms and gnarled hands. Priming, in turn, amplifies the perception of these object features and causes them to "pop-out" of the image (see above, p. 138 – 142; see also Archambault et al 1999, p. 255; and Moore and Cavanaugh, 1998, p. 67). This alters the way a viewer perceives the painting. Therefore, art historical and cultural knowledge germane to the way viewers categorize a work of art can be demonstrated to influence the way viewers perceive artworks.

The title of Malevich's painting suggests an autobiographical interpretation. This interpretation effects how a viewer categorizes the work, e.g. as a representational work that symbolizes Malevich's views of the social role of art as opposed to a form of geometric abstraction. Categorizing the painting as an early representational work, in turn, affects how a viewer groups formal features of the painting, e.g. three objects as opposed to six formally distinct abstract geometric shapes. Therefore, categorizing the work as an early modernist self-

portrait enables viewers to recognize a marching bourgeoisie painter in the geometry of its visible surface. This alters how one projects depth into the picture plane and gives form to the meaning of the work, e.g. it indicates that one should interpret the painting to embody an art critical commentary. In this regard, the latent structure of the work is a product of a reciprocal relationship between the way viewers interpret its meaning and assign form to its compositional structure. Therefore, attention to the productive role of interpretation in viewers' perceptual interaction with the artwork function as a source of aesthetic interest. These two examples demonstrate that a viewer's understanding of the meaning and representational content of a work of fine art influences the way he or she attends to the features of its formal structure, and that how one attends to formal structure of a painting affects the way one perceives it. Therefore, Carroll and Danto's objections to aesthetic theories of art are not sound.

4.0 Conclusions

I argued at the end of Chapter 2 that Zeki's interpretation of the constructivist hypothesis as an aesthetic hypothesis rests on the claim that an interest in the way artworks work is a valid source of aesthetic interest. The insight of the Carroll-Danto position is that an understanding of art historical context is one of the variables that contributes to a viewer's understanding of how an artwork works, i.e. aesthetic interest is a product of how one categorizes the content of an artwork relative to background art historical knowledge. Identifying X as an artwork involves categorizing it relative to one's prior knowledge of the

defining formal features of types of artworks, e.g. the works of different artists, artistic schools, or eras. One's knowledge of the defining formal features of a type of artwork includes knowledge of the way artists have used features of their formal vocabularies to convey the meanings of their works. This knowledge influences how a viewer interprets a particular work of art and, as a result, determines which image features he or she identifies as salient to its meaning and representational content. Contrary to Carroll and Danto's position, these processes influence how one perceives the work. Therefore, one can define aesthetic experience as the product of a unique form of perceptual play that integrates viewers' interpretive and perceptual practices (see above pp. 113, and 165 – 166). This, in turn, demonstrates that an interest in how an artwork works, how its formal structure functions to convey its content, is a valid source of aesthetic interest.

This is not a novel view of aesthetic experience. Alan Goldman argues that the aesthetic features of viewers' interactions with artworks are the formal properties one encounters when one is <u>fully engaged</u> by the work:

> To be fully engaged is not simply to pay close perceptual attention to formal detail and complex internal relations in the object's structure, but also to bring to bear one's cognitive grasp of those external and historical relations that inform one's own aesthetic experience...Knowledge that <u>can</u> inform one's experience of a work includes that of the artist's intentions, techniques, attitudes, problems overcome, and so on. Such knowledge is important only when it does inform one's experience of the work (Goldman, 2001, p. 191).

The ensuing model for the constructivist hypothesis is a neoformalist theory of aesthetics which defines aesthetic interest, consistent with Baumgarten's framework, as a sense of cognitive consonance associated with the act of

clarifying image structure (see above, pp. 23 – 24; and 106). The process of clarifying image structure in viewers' perceptual interactions with artworks is, in turn, interpreted as a form of perceptual play that reveals the way the formal features of a work of art embody their meaning. Artworks embody their meaning by virtue of the influence of background knowledge, the knowledge viewers bring to bear when fully engaged in a work, in perception. Therefore, research in cognitive science clarifies our understanding of how artworks function as perceptual stimuli to generate aesthetic interest, and, consequently, contributes to the debate between contextualist and aesthetic theories of art. Therefore, there is no category mistake in the application of empirical results from cognitive science to debates and problems in philosophical aesthetics.

4.1 Art, Interpretation and Intention

Carroll and Danto's discussions of interpretation suggest that prior knowledge of artists' productive practices influences the way viewers perceive artworks. Educated viewers identify artworks as the works of different artists, schools, and epochs by virtue of distinctive features of their formal structure. Both Carroll and Gombrich's descriptions of artists' methods, and Carroll and Danto's descriptions of interpretation, suggest that these distinctive image features embody information about the aesthetic practices of the artist. However, this information is not transparently visible in the surface of an artwork. Rather, it is information that viewers learn to recognize relative to their own prior knowledge of the history of aesthetic practice. This entails that features of the

formal structure of an artwork are identified as distinctive only relative to prior knowledge of the formal vocabularies that define artworks as the works of a particular artist or school, i.e. knowledge of the shapes and functions of the unique systems of marks used by an artist or school. Therefore, educated viewers employ a novel class of semantic knowledge to identify artworks: knowledge of the unique shapes and functions of the formal vocabularies of different types of artworks within a medium, e.g. Impressionism, Cubism, and Surrealism.

Diagnostic processing models like Kosslyn's imagery feedback model for object identification suggest that the role of semantic knowledge in perception extends to the recovery of basic image features, e.g. figure ground segregation and the recovery of obscure contours salient to the identity of the image as a type of artwork. These features, in turn, function to trigger the semantic associations constitutive of viewers' interpretations of particular artworks. Therefore, in the context of the task demands of aesthetic practice, educated viewers are able to use their knowledge of the history of art to recover the distinctive features of artworks.[77] In the absence of this knowledge the visual system may not tag those particular features as salient to the identity of the object. The perceptual information germane to interpretation would, in these contexts, be discarded as spurious to recognition. Therefore naive viewers do not just fail to notice the distinctive features of an artwork. They fail to perceive

77. Recall that the aesthetic practices of a community are defined as the conjunction of the productive, perceptual, and interpretive practices of artists and educated viewers (see above pp. 20 – 21).

them at all, e.g. Picasso's baboon.[78]

One might object that too much hangs on art historical knowledge and artists' intentions for this model to be successful. The power of art seems to be the ability of artworks to convey their content independent of any knowledge of the intentions of artists. If the work strikes us, we may investigate its history in order to flesh out our understanding of its content. However, we don't study for our initial visit to a work of art. Rather, we treat each new artwork as a novel discovery. Therefore, it would appear that knowledge of factors like artists' intentions are superfluous to our standard interactions with artworks.[79]

The solution to this difficulty lies in Carroll's description of viewers' aesthetic practices. Carroll argues that, despite appearances, one never approaches a work of art blind. Rather, viewers learn from an early age to treat artworks as vehicles for hidden meanings. The goal of the viewer is, on this account, to apply what he or she knows about art in general to the task of uncovering the obscure themes and latent structures hidden in artworks. The subsequent interpretation of a work of art must adhere to a criteria of rationality in that it must cohere with what one knows about the history of art (Carroll, 1988, p. 149). However, this practice does not require one to know the particular intentions of any artist. In fact it does not even require an accurate

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78. This effect is not limited to knowledge of the task demands of interpretation. Even if one understands the aesthetic practices underlying interpretation, if one lacks prior knowledge of the diagnostic formal attributes of a particular style they may be too obscure to recover. The identity of the depictive content of the work may, in such cases, override one's perception of its critical formal features, e.g. Primitivism and Picasso's Baboon. Therefore, the features diagnostic for the work's interpretive content may be discarded as spurious to the identity of the work and so not perceived.

79. McMahon, in correspondence.

understanding of the aesthetic practices of an artists' time. It suffices that one is able to integrate the work into a coherent art historical narrative, regardless of whether that narrative is historically accurate. Therefore, all one needs is a coherent conception of aesthetic practices that, in the context of one's beliefs, makes rational sense of the artwork. It is in this regard that it is unimportant whether my interpretation of Malevich's "Self-Portrait" is correct or not. It suffices that I can incorporate this interpretation into a coherent art historical narrative. Therefore, concerns about viewers' abilities to recover the actual intentions of artists do not effect my model for the constructivist hypothesis.

4.2 Generalizing the Model

The arguments and case studies used in this dissertation are drawn almost exclusively from painting. However, the explanatory power of the constructivist hypothesis is not limited to either painting or the visual arts. A work of fine art is an artifact designed to selectively control for those features of viewers' perceptual experiences that generate its aesthetic and interpretive content. This entails that, successful artistic production requires that an artist have at least an intuitive understanding of the functional relationship between his or her media and the structure of appearances. The structure of appearances in any sensory modality is a construct of perceptual processing. Artists' knowledge of the relationship between their media and the structure of appearances will, as a result, always encode an intuitive understanding of the operation of perceptual systems. Therefore, the constructivist hypothesis can be generalized to other

media in the fine arts. For instance, proprioception plays a role in the perception and understanding of the movements and actions of others. The content of a dance is conveyed to spectators via the perception and understanding of the movements of the dancers. Barbara Montero has suggested that, as a result, an understanding of the role played by proprioception in the perception of the movements and actions of others can contribute to our understanding of the aesthetics of dance (Montero, forthcoming 2006).[80]

There is a virtue to this description of the constructivist hypothesis. The general consensus in the philosophy of art is that, given the diversity of perceptual media in the fine arts, and the range of artifacts that count as artworks, it is unlikely that there is a single universal theory that can account for all of our interactions with artworks. Rather, one should ask for any given artistic style, school, or media, e.g. Impressionist paintings, classical ballet, or avant garde jazz: "What are the general formal features that define this type of artwork, what is the nature of viewers interactions with this type of artwork, and what role do the defining formal features of individual artworks in this style, school or medium play in these interactions?"

The function of perceptual systems, on the constructivist account, is to recover and interpret perceptual cues embedded in structurally ambiguous sensory inputs. However, despite neurophysiological similarities among perceptual systems, the way this function is realized differs relative to structural differences among sensory modalities, e.g. the tonal space of Western classical

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80. See also Langer (1953), chapter 11, pp. 169 – 187; and Beardsley (1982), pp. 34 - 36.

and popular music and the color space of painting.[81] Therefore, the psychological processes involved in recovering the content of a work of art will differ for different perceptual media. These processes may even differ for different types of artworks within a sensory modality. For instance, recovering the content of a painting requires one to project depth into a two-dimensional picture plane. Sculptures are three dimensional perceptual stimuli. No such process is required in recovering the content of a sculpture. This entails that the detail of explanations of the aesthetics of painting will differ in some ways from explanations of the aesthetics of sculpture, and both should differ from explanations of the aesthetics of music. Therefore the constructivist hypothesis predicts that explanations of art and aesthetic experience will differ relative to differences among the psychological processes, form primitives, and computational principles involved in perceiving artworks in diverse media across different sensory modalities.

5.0 Epilogue: A Caveat

I would like to conclude with a caveat. There are limitations to the application of this model to our understanding of art. Consider the case of conceptual art: identifying the distinctive features of Duchamp's "Readymades" and Warhol's "Brillo Boxes" does not appear to alter the way one perceives them. This entails that the interest these works generate is not associated with the

81. See (Dowling, 2001, p. 418; Goldstein, 2005, pp. 361 – 365) for a discussion of neurophysiological and computational similarities between early auditory, somatosensory, and visual processing (Janata et al, 2002, pp. 2168) for a discussion of neurophysiological and computational similarities between higher level auditory and visual processing.

phenomenal characteristics of viewers perceptual interactions with them. Aesthetic theories of art explain the interest generated by works of art in terms the perceptual and expressive properties of viewers' phenomenal experience. Aesthetic theories of art can, as a result, only explain viewers' interpretative interactions with artworks to the degree that these cognitive events influence the perceptual and expressive properties of aesthetic experience. The constructivist hypothesis is an aesthetic theory of art. Therefore, the constructivist hypothesis cannot explain the interest generated by conceptual artworks.[82]

This appears to be an insurmountable problem. Nonetheless, its does not threaten the model. Theories of art and theories of aesthetics represent overlapping but not coextensive fields of study. The division of labor within philosophical aesthetics rests on the basic assumption that artworks need not be aesthetically engaging objects. Therefore, the constructivist can simply concede that the scope of aesthetic theories of art is not universal. For instance, the mundane visual appearance of the LED displays in Jenny Holzer's "Truisms" series is important to the meaning of the works. However, these works do not engage us in the form of visual play constitutive of an aesthetic experience.[83]

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82. A diagnostic recognition model for aesthetic experience can be constructed that disputes this claim. For instance, Danto argues that the curvy lines on Brillo boxes were designed to depict waves and the stripes on the American Flag in order to symbolize one's pride in, and duty to, cleanliness (Danto, 2001, p. xxvi). However, this information is not transparent on the visible surface of the boxes. Independent of knowledge of the details of this ad campaign viewer's do not group these image features together, do not perceive them as depictions of waves or flags, and so do not recognize what that boxes symbolize. Therefore, even in the case of conceptual art, knowledge of the meaning of an image affects how one categorizes it, which in turn affects the diagnosticity of image features and the way viewers perceive it. Nonetheless, conceptual art does pose a problem for the constructivist hypothesis.

83. This series of works consisted of LED signboards that displayed thousands of platitudes like "A man can't know what it is to be a mother," "A lot of professionals are

Therefore, these works would seem to be beyond the purview of the constructivist hypothesis.

This observation suggests that the constructivist treatment of the integration of interpretation and perception in aesthetic experience needs qualification. The constructivist hypothesis rests on the claim that the distinction between perception and interpretation in viewers' interactions with art should be conceived as a graded continuum, not a sharp divide. Some cognitive interactions with artworks carry no information about their formal features. e.g. the act of determining the moral message of a work of art. These types of interpretations do not influence the way one perceives the work. Therefore, they are beyond the purview of the constructivist hypothesis. However, to the degree that the knowledge employed in interpretation does carry information about the work's potential formal structure, the ascription of meaning to the image will engage the viewer in a form of visual play that influences the way he or she attends to its visible surface. This type of interpretation-driven visual play alters the way a viewer perceives a work of art. This, in turn, entails that interpretation does influence the structure and content of aesthetic experience. Therefore, the scope of aesthetic theories of art can be extended to encompasses the role of interpretation in viewers perceptual interactions with artworks, and so is broader than traditionally conceived.

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crackpots," "A relaxed man is not necessarily a better man," "A single event can have infinitely many interpretations," or "One must be aware of the fact that viewers are volunteers."

Bibliography

Abell, Catherine and Gregory Currie (1999). "Internal and External Pictures," ed. Mark Rollins, Philosophical Psychology: Special Symposium: Aesthetics and Cognitive Science, Volume 12, Number 4, December, pp. 429 – 446.

Acton, Mary (1997). Learning to Look at Paintings (New York: Routledge).

Adolphs, Ralph (2003). "Amygdala," Encyclopedia of Cognitive Science (New York: MacMillen Press), pp. 98 – 105.

Aguirre, G. K. and M. J. Farah (1998). "Human Visual Object Recognition: What Have We Learned from Neuroimaging?" Psychobiology, 26:4, pp. 322 – 332.

Akins, Kathleen A. (1996). "Of Sensory Systems and the 'Aboutness' of Mental States," Journal of Philosophy, Volume 93, Number 7, July, pp. 337 – 372.

Akins, Kathleen A. (2001). "More than Mere Coloring: A Dialogue Between Philosophy and Neuroscience on the Nature of Spectral Vision," in eds. S. Fitzpatrick and J. T. Breuer, Carving Our Destiny, (Washington, D.C: Joseph Henry Press).

Anderson, John R. (1978). "Arguments Concerning Representations for Mental Imagery," Psychological Review, Volume 85, Number 4, July, pp. 249 – 277.

Ashcraft, Mark H. (1994). Human Memory and Cognition (New York: Harper Collins College Publishers).

Ashcraft, Mark H. (1998). Fundamentals of Cognition (New York: Addison Wesley Longman, Inc).

Atkinson, Rita L., Richard C. Atkinson, Edward E. Smith, and Ernest R. Hilgard (1985). Introduction to Psychology. Ninth Edition (New York: Harcourt Brace Jovanovich, Publishers).

Barnouw, Jeffrey (1993). "The Beginnings of Aesthetics and the Leibnizian Conception of Sensation," in Eighteenth-Century Aesthetics and the Reconstruction of Art, ed. Paul Mattick, Jr. (New York: Cambridge University Press, 1993).

Bartels, A. and S. Zeki (1998). "The Theory of Multistage Integration in the Visual Brain," Proceedings of the Royal Society of London, Series B, Volume 265, pp. 2327 – 2333.

Basso, Anna, Edoardo Bisiach, and Claudio Luzzatti (1980). "Loss of Mental Imagery: A Case Study," Neuropsychologia, Volume 18, pp. 435 – 442.

Baumgarten, Alexander (1734). Reflections on Poetry, trans. Karl Aschenbrenner and William B. Holther (Berkeley: University of California Press, 1954).

Beardsley, Monroe C. (1978). "The Aesthetic Point of View," in ed. J. Margolis, Philosophy Looks at the Arts (Temple University Press, Philadelphia).

Beardsley, Monroe C. (1981). Aesthetics, (Indianapolis: Hackett).

Beardsley, Monroe C. (1983). "An Aesthetic Definition of Art," reprinted in ed. Thomas E. Wartenberg, The Nature of Art (New York: Harcourt College Publishers), 2001, pp. 234 – 246.

Bechtel, William and Jennifer Mundale (1999). "Multiple Realizability Revisted: Linking Cognitive and Neural States," Philosophy of Science, 66, June, pp. 175 – 207.

Bechtel, William, Pete Mandik, and Jennifer Mundale (2001). Philosophy and the Neurosciences (Malden, Massachusetts: Blackwell Publishers).

Beck, Lewis White (1993). "The Age of German Idealism: From Leibniz to Kant," in eds. Robert C. Soloman and Kathleen M. Higgins, The Age of German Idealism (New York: Routledge), pp. 5 – 40).

Beckers, G. and S. Zeki (Zeki). The Consequences of Inactivating Areas V1 and V5 on Visual Motion Perception," Brain, 118: 1, pp. 49 – 60.

Beckers, G. and V. Homberg (1992). "Cerebral Visual Motion Blindness: Transitory Akinetopsia Induced by Transcranial Magnetic Stimulation of Human Area V5," Proceedings of the Royal Society of London, Biology, 249, pp. 173 – 8.

Bell, Clive (1914). Art (New York: Perigree) 1981.

Biederman, Irving (1987). "Recognition-by-Components: A Theory of Human Image Understanding," Psychological Review, Volume 94, pp. 115 – 147.

Biederman, Irving (1995). "Visual Object Recognition," in Stephen M. Kosslyn and Daniel N. Osherhorn, Visual Cognition (Cambridge Massachusetts: MIT Press) 1995, pp. 121 – 165.

Biederman, Irving and Margaret M. Shiffrar (1987). "Sexing Day-Old Chicks: A Case Study and Expert Systems Analysis of a Difficult Perceptual-

Learning Task," Journal of Experimental Psychology: Learning, Memory, and Cognition, 13:4, pp. 640 – 645.

Bisiach, Edoardo and Claudio Luzzatti (1978). "Unilateral Neglect of Representational Space," Cortex, Volume 14, pp. 129 – 133.

Bloom, Paul (1996). "Intention, History and Artifact concepts," Cognition 60:1, pp. 1 – 29.

Bloom, Paul and Lori Markson (1998). "Intention and Analogy in Children's Naming of Pictorial Representations," Psychological Science 9:3, pp. 200 – 204.

Bywater, William G. (1975). Clive Bell's Eye (Detroit: Wayne State University Press).

Cabeza, Roberto and Alan Kingstone (2001). Handbook of Functional Neuroimaging of Cognition (Cambridge, Massachusetts: MIT Press).

Calder, Alexander (1952). "Alexander Calder," in eds. Alvard, Julien and R.V. Gindertael, Témoignages Pour L'Art Abstrait: 1952 (Bologne (Seine): Editions "Art d'aujourd'hui," 1952), pp. 43 – 44.

Carrier, David (1977). "American-Type Formalism," in ed. David Goldblatt and Lee B. Brown, Aesthetics, Prentice Hall, Upper Saddle River, New Jersey, 1997, pp. 23 – 29.

Carroll, Noël (2002). "Aesthetic Experience Revisited," British Journal of Aesthetics 42:2, pp. 146 – 168.

Carroll, Noël (2001a). Beyond Aesthetics, (New York: Cambridge University Press).

Carroll, Noël (2001b). "Four Concepts of Aesthetic Experience," Beyond Aesthetics, (New York: Cambridge University Press).

Carroll, Noël (2001). "Modernity and the Plasticity of Perception," Journal of Aesthetics and Art Criticism," 59:1, pp. 11 – 17.

Carroll, Noël (2001c). "Formalism," in eds. Berys Gaut and Dominic McIver Lopes, The Routledge Companion to Aesthetics (New York: Routledge), pp. 87 – 96.

Carroll, Noël (2000). "Art and the Domain of the Aesthetic," The British Journal of Aesthetics, Volume 40, Number 2, April, pp. 199 – 208.

Carroll, Noël (1999). The Philosophy of Art (New York: Routledge).

Carroll, Noël (1997). "Danto's New Definition of Art and the Problem of Art Theories," British Journal of Aesthetics, pp. 386 – 392.

Carroll, Noël (1991). "Beauty and the Genealogy of Art Theory," The Philosophical Forum, Volume XXII, Number 4, Summer, pp. 307 – 334.

Carroll, Noël (1989). "Clive Bell's Aesthetic Hypothesis," in ed. George Dickie, Richard Sclafini, and Ronald Roblin, Aesthetics, Second Edition (New York: St. Martin's Press), pp. 84 – 95.

Carroll, Noël (1988). "Art, Practice, Narrative," The Monist, Volume 71, No. 2, (April), pp. 140 – 156, reprinted in Noël Carroll, Beyond Aesthetics, pp, 63 – 75.

Carroll, Noël (1986). "Art and Interaction," Journal of Aesthetics and Art Criticism, Volume 45, Number 1, 1986, pp. 57 – 68.

Cavanaugh, Patrick, (1999). "Pictorial Art and Vision," in eds. Robert A. Wilson and Frank C. Keil, The MIT Encyclopedia of the Cognitive Sciences (Cambridge, Massachusetts: MIT Press) 1995, p. 648 – 650.

Cavanaugh, Patrick (1991). "What's Up in Top Down Processing?" in A. Gorea (ed.) Representations in Vision: Trends and tacit assumptions in vision research, pp. (New York: Cambridge University Press) 295 – 304.

Cavanaugh, Patrick and Yvan G. Leclerc (1989). "Shape from Shadows," Journal of Experimental Psychology: Human Perception and Performance, 15:1, pp. 3 – 27.

Chatterjee, Anjan (2004). "The Neuropsychology of Artistic Production." Neuropsychologia, 42, pp. 1568 – 1583.

Chatterjee, Anjan (2003). "Prospects for a Cognitive Neuroscience of Visual Aesthetics." Bulletin of Psychology and the Arts, 4(2), pp. 55-60.

Chun, Marvin M and René Marois (2002). "The Dark Side of Visual Attention," Current Opinion in Neurobiology, 12, pp. 185 – 198.

Churchland, Paul (1981). "Eliminative Materialism and the Propositional Attitudes," The Journal of Philosophy, 78, pp. 67 – 90, in ed. D. Rosenthal, The Nature of Mind, (New York: Oxford University Press), 1991, pp. 601 – 612.

Collingwood, R. G. (1938). The Principles of Art (New York: Oxford, Clarendon

Press), excerpted in eds. George Dickie, Richard Sclafini, and Ronald Roblin (1989). Aesthetics, Second Edition (New York: St. Martin's Press), pp. 96 - 118.

Constatinidis, Christos, Matthew N. Franowicz, and Patricia S. Goldman-Rakic (2001). "The Sensory Nature of Mnemonic Representation in the Primate Prefrontal Cortex," Nature Neuroscience 4:3, pp. 311 – 316.

Cooper, David (1997). A Companion to Aesthetics, (Malden, Massachusetts: Blackwell Publishers).

Crick, Francis and Christoph Koch (1995). "Are We Aware of Activity in Primary Visual Cortex?" Nature, Volume 375, May 11, pp. 121 – 123.

Crowther, Paul (1985). "Greenberg's Kant and the Problem of Modernist Painting," British Journal of Aesthetics, Volume 25, Number 4, Autumn, pp. 317 – 325.

Currie, Gregory (forthcoming). "Aesthetics and Cognitive Science," in ed. J. Margolis, Aesthetics (New York: Oxford University Press).

Currie, Gregory and Ian Ravenscroft (2002). Recreative Minds (New York: Oxford University Press).

Currie, Gregory (2001). "Imagination and MakeBelieve," ," in ed. Berys Gaut and Dominic McIver Lopes. The Routledge Companion to Aesthetics (New York: Routledge) pp. 253 – 262.

Currie, Gregory (1995a). "Imagination and Simulation: Aesthetics Meets Cognitive Science," in ed. Martin Davies and Tony Stone, Mental Simulation (Malden, Massachusetts: Blackwell Publishers), pp. 151 – 169.

Currie, Gregory (1995b). "Visual Imagery as the Simulation of Vision," Mind and Language Volume 10, Number 1/2, March/June, pp25 – 44.

Currie, Gregory (1995c). Image and Mind (Cambridge: Cambridge University Press).

Currie, Gregory (1993). "Book Review: Mimesis as MakeBelieve," Journal of Philosophy, Volume 90, Issue 7, July, pp. 367 – 370.

Currie, Gregory (1990). The Nature of Fiction (Cambridge: Cambridge University Press), 1990.

Curtin, Deane W. (1982). "Varieties of Aesthetic Formalism," The Journal of

Aesthetics and Art Criticism, Volume XLI, Number 3, Spring.

Damasio, Hannah and Antonio R. Damasio (2000). "The Lesion Method in Cognitive Neuroscience," in Martha J. Farah and Todd E. Feinberg, eds. (2000), Patient-Based Approaches to Cognitive Neuroscience (Cambridge, Massachusetts: MIT Press), pp. 21 – 34.

Danto, Arthur, (2001a). "The Work of Art and the Historical Future," The Madonna of the Future (Berkeley: University of California Press), pp. 416 – 431.

Danto, Arthur, (2001b). "Seeing and Showing," Journal of Aesthetics and Art Criticism," 59:1, pp. 1 – 9.

Danto, Arthur, (2001c). "The Pigeon Within Us All," Journal of Aesthetics and Art Criticism," 59:1, pp. 39 – 44.

Danto, Arthur(2000). "Art and Meaning," in ed. N. Carroll, Theories of Art Today (Madison, Wisconsin: The University of Wisconsin Press), pp. 130 - 140.

Danto, Arthur(1988). "Foreword to Color for Philosophers," (Indianapolis: Hackett), pp. ix – xii.

Danto, Arthur(1964). "The Artworld," The Journal of Philosophy, volume 61, number 19, pp. 571 – 584.

Davey, Nicholas (1995). "Alexander Baumgarten," in A Companion to Aesthetics, ed. David Cooper (Malden, Massachusetts: Blackwell Publishers, Ltd., 1995).

Dickie, George (1997). Art Circle: A Theory of Art, Chicago: Spectrum Press. Dickie, George Richard Sclafini, and Ronald Roblin (1989). Aesthetics, Second Edition (New York: St. Martin's Press).

Dickie, George (1974). Art and the Aesthetic: An Institutional Analysis, Ithaca: NY: Cornell University Press.

Dickie, George (1965). "Clive Bell and the Method of Principia Ethica," The British Journal of Aesthetics, Volume 5, Number 2, April, pp. 139 – 143.

Dickie, George (1964). "The Myth of the Aesthetic Attitude," American Philosophical Quarterly, 1, No. 1, pp. 56 – 66, in ed. George Dickie, Richard Sclafini, and Ronald Roblin (1989). Aesthetics, Second Edition (New York: St. Martin's Press), pp. 342 – 355.

Dickie, George (1962). "Is Psychology Relevant to Aesthetics," The

Philosophical Review, Volume 71, pp. 285 – 302.

Diesendruck, Gil, Lori Markson, and Paul Bloom (2003). "Children's Reliance on Creator's Intent in Extending Names for Artifacts," Psychological Science 14:2, pp. 164 – 168.

Dowling, John E. (2001). Neurons and Networks (Cambridge, Massachusetts: Harvard University Press).

Driver, Jon and Chris Frith (2000). "Shifting Baselines in Attentional Research," Nature Reviews Neuroscience, 1, pp. 147 – 148.

Ekman, Rosalind, (1970). "The Paradoxes of Formalism," The British Journal of Aesthetics, Volume 10, Number 4, October.

Eldridge, Richard (1985). "Form and Content: An Aesthetic Theory of Art," The British Journal of Aesthetics, pp. 303 – 316.

Farah, Martha (2004). Visual Agnosia, Second Edition (Cambridge, Massachusetts: MIT Press).

Farah, Martha J. (2000). The Cognitive Neuroscience of Vision (Malden, Massachusetts: Blackwell Publishers).

Farah, Martha J. (1992). Visual Agnosia (Cambridge, Massachusetts: MIT Press).

Farah, Martha J. (1988a). "Electrophysiological Evidence for a Shared Representational Medium for Visual Images and Visual Percepts," Journal of Experimental Psychology: General, Volume 117, Number 3, pp. 248 – 257.

Farah, Martha J. (1988b). "Is Visual Imagery Really Visual?: Overlooked Evidence from Neuropsychology," Psychological Review, Volume 95, Number 3, pp. 307 – 317.

Farah, Martha J. (1984). "The Neurological Basis of Mental Imagery: A Componential Analysis," Cognition (18), pp. 245 – 272.

Farah, Martha J. and Todd E. Feinberg, eds. (2000). Patient-Based Approaches to Cognitive Neuroscience (Cambridge, Massachusetts: MIT Press).

Freeland, Cynthia (2001). But Is It Art? (New York: Oxford University Press).

Freese, Jennifer L. and David G. Amaral (2005). "The Organization of Projections from the Amygdala to Visual Cortical Areas TE and V1 in the

Maquaque Monkey," The Journal of Comparative Neurobiology, 486 (4), pp. 295 – 317.

Fry, Roger (1934). Reflections on British Painting, Ayer Company Publishers, London, 1934.

Fry, Roger (1919). "The Artist's Vision," Vision and Design, (repr. Mineola, NY: Dover Publishers, Inc., 1981).

Fry, Roger (1909). "An Essay in Aesthetics," Vision and Design (repr. Mineola, NY: Dover Publishers, Inc., 1981).

Gabo, Naum (1962). Of Diverse Arts (New York: Pantheon Books).

Gaut, Berys and Dominic McIver Lopes (2001). The Routledge Companion to Aesthetics (New York: Routledge).

Goguen, Joseph A. and Erik Myin (2000). Journal of Consciousness Studies: Art and the Brain II, Volume 7, No. 8/9 (2000), (Thiverton, England: Imprint Academic).

Goguen, Joseph A. (1999). Journal of Consciousness Studies: Art and the Brain, Volume 6 (1999): June/July (Thiverton, England: Imprint Academic).

Goldblatt, David and Lee B. Brown (1997). Aesthetics (Upper Saddle River, New Jersey: Prentice Hall).

Goldman, Alan (2001). "The Aesthetic," in ed. Berys Gaut and Dominic McIver Lopes, The Routledge Companion to Aesthetics (New York: Routledge), pp. 181 – 192.

Goldman, Alan (1998). Aesthetic Value (Boulder Colorado: Westview Press).

Goldman, Alan (1997). "Aesthetic Properties," in ed. David Cooper, A Companion to Aesthetics, (Malden Massachusetts: Blackwell Publishers, 1997), pp. 342 – 345.

Goldman, Alvin I. (1979). "What is Justified Belief," reprinted in ed. Hilray Kornblith, Naturalized Epistemology, second edition (Cambridge, Massachusetts: MIT Press, 1997, pp. 105 - 130.

Gombrich, E. H. (1950). The Story of Art, Sixteenth Edition (New York: Phaidon Press), 2002.

Gombrich, E. H. (1984). "Meditations on a Hobby Horse or the Roots of Artistic Form," Meditations on a Hobby Horse, Fourth Edition (Chicago:

University of Chicago Press), pp. 1 – 11.

Gombrich, E. H. (1960a). Art and Illusion (Princeton, NJ: Princeton University Press).

Gombrich, E. H. (1960b). "The Limits of Likeness," in ed. David Goldblatt and Lee B. Brown, Aesthetics (Upper Saddle River, New Jersey: Prentice Hall), 1997, pp. 35 – 40.

Gould, Carol S. (1994). "Clive Bell on Aesthetic Experience and Aesthetic Truth," The British Journal of Aesthetics, Volume 34, Number 2, April, pp. 124 – 133.

Greenberg, Clement (1995). The Collected Essays and Criticism, Volume 4, ed. John O'Brian (Chicago: University of Chicago Press).

Greenberg, Clement. (1999). "Esthetic Judgment," Homemade Esthetics (New York: Oxford University Press), pp. 10 – 22.

Greenberg, Clement(1973). "Intuition and Esthetic Experience," Homemade Esthetics (New York: Oxford University Press), 1999, pp. 3 – 9.

Greenberg, Clement (1965). "Avant-Garde and Kitsch," Art and Culture (Boston: Beacon Press), pp. 3 – 21.

Greenberg, Clement (1960). "Modernist Painting," in ed. John O'Brian, The Collected Essays and Criticism, Volume 4 (Chicago: University of Chicago Press),1995, pp. 85 – 93.

Gregory, Richard, John Harris, Priscilla Heard, and David Rose (1995). The Artful Eye (New York: Oxford University Press).

Gregory, Richard L. (1977). Eye and Brain, Fifth Edition (Princeton, New Jersey: Princeton University Press).

Grill-Spector, Kalanit and Nancy Kanwisher (2005). "Visual Recognition: As Soon as You Know it is There You Know What It is," Psychological Science, Volume 16, Number 2, February, pp. 152 – 160.

Grossberg, Stephen and Ennio Mingolla (1985). "Neural Dynamics of Form Perception: Boundary Completion, Illusory Figures, and Neon Color Spreading," Psychological Review, Volume 92, Number 2, pp. 173 – 211.

Grossberg, Stephen (1993). "A Solution for the Figure-Ground Problem for Biological Vision," Neural Networks, 6, pp. 463 – 483.

Grossberg, Stephen (1980). "How Does the Brain Build a Cognitive Code?" Psychological Review, Volume 51, Number 1, pp. 1 – 51.

Gutheil, Grant, Paul Bloom, Nohemy Valderrama and Rebecca Freedman (2004). "The Role of Historical Intuitions in Childrens' and Adults' Naming of Artifacts," Cognition, 91:1, pp. 23-42.

Guyer, Paul (2001). "Alexander Gottleib Baumgarten," ed. Robert Audi, The Cambridge Dictionary of Philosophy, 2nd Edition (New York: Cambridge University Press), pp. 73 – 74.

Guyer, Paul (1996). Kant and the Idea of Freedom (Cambridge: Cambridge University Press).

Hammermeister, Kai (2002). The German Aesthetic Tradition (New York: Cambridge University Press).

Harrison, Charles and Paul Wood (2001). Art in Theory: 1825 – 1900 (Malden, Massachusetts: Blackwell Publishers).

Harrison, Charles and Paul Wood (2000). Art in Theory: 1900 – 1990, Art in Theory: 1825 – 1900 (Malden, Massachusetts: Blackwell Publishers).

Hildreth, Ellen (1999). "Computational Vision," in eds. Robert A. Wilson and Frank C. Keil, The MIT Encyclopedia of the Cognitive Sciences (Cambridge, Massachusetts: MIT Press), pp. 172 – 173.

Hofstadter, Albert and Richard Kuhns (1976). Philosophies of Art and Beauty, (Chicago: University of Chicago Press, Chicago).

Hubel, David H. (1995). Eye, Brain, and Vision (New York: Scientific American Library)

Hubel, D. H. and T. N. Wiesel. (1968). "Receptive Fields and Functional Architecture of Monkey Striate Cortex," journal of Physiology, 195, pp. 215 – 143, reprinted in ed. Steven Yantis, Visual Perception, Psychology Press, Philadelphia, 2001, pp. 147 167.

Hume, David (1989). "Of the Standard of Taste," Four Dissertations, in ed. George Dickie, Richard Sclafini, and Ronald Roblin, Aesthetics, Second Edition (New York: St. Martin's Press) 1989, pp. 242 – 253.

Humphreys, Glynn, W. and Dietmar Heincke (1998). "Spatial Representation and Selection in the Brain: Neurophysiological and Computational Constraints," Visual Cognition, Volume 5, Number 1/2, pp. 9 – 47.

Humphreys, Glynn W. and M. Jane Riddoch (1998). To See But Not to See: A Case Study of Visual Agnosia (East Sussex: Psychology Press).

Hutcheson, Francis (1989). Inquiry Concerning Beauty, Order, Harmony, and Design, ed. Peter Kivy (Hague, Netherlands: Matinus Nijhoff .

Hyman, John (1997). "Language and Pictorial Art," in ed. David Cooper, A Companion to Aesthetics (Malden, Massachusetts: Blackwell Publishers, 1997), pp. 261 – 268.

Intons-Peterson, Margaret Jean (1983). "Imagery Paradigms: How Vulnerable Are They to Experimenters' Expectations?" Journal of Experimental Psychology: Human Perception and Performance, Volume 9, Number 3, pp. 394 – 412.

Intraub, Helen and Michael Richardson (1989). "Wide-Angle Memories of Close Up-Scenes," Journal of Experimental Psychology: Learning, Memory, and Cognition, 15:2, pp. 179 – 187.

Kan, Irene P., Lawrence W. Barsalou, Karen O. Solomon, Jeris K. Minor, and Sharon L. Thompson-Schill (2003). The Role of Mental Imagery in a Property Verification Task: fMRI Evidence for Perceptual Representations of Conceptual Knowledge," Cognitive Neuropsychology 20:(3/4/5/6), pp. 525 – 540.

Kandel, E. R., J. H. Schwartz, and T. M. Jessell (2000). Principles of Neural Science, Fourth Edition (New York: McGraw Hill).

Kandel, E. R., J. H. Schwartz, and T. M. Jessell (1995). Essentials of Neural Science and Behavior, Second Edition (New York: McGraw Hill).

Kanwisher, Nancy and Ewa Wojciulik (2000). "Visual Attention: Insights from Brain Imaging," Nature Reviews Neuroscience, 1, pp. 91 – 100.

Kastner Sabine, Ungerleider Leslie G. (2000). "Mechanisms of Visual Attention in the Human," Cortex. Annual Review of Neuroscience, 23, pp. 315 – 341.

Kemeny, J. and P. Oppenheim (1956). "On Reduction," Philosophical Studies, VII, pp. 6-19

Kim, Jaegwon (1992). "Multiple Realization and the Metaphysics of Reduction", Philosophy and Phenomenological Research, 52, pp. 1-26.

Kim, Jaegwon (1988). "What is "Naturalized Epistemology"?" reprinted in ed. Hilray Kornblith, Naturalized Epistemology, second edition (Cambridge,

Massachusetts: MIT Press), pp. 33 – 55.

Kitcher, Paul (1984). "1953 and All That: A Tale of Two Sciences," The Philosophical Review, 93, pp. 335 – 373, reprinted in eds. Richard Boyd, Phillip Gasper, and J. D. Trout, The Philosophy of Science (Cambridge, Massachusetts: MIT Press), 1991.

Klein, Isabelle, Anne-Lise Paradis, Jean-Baptiste Poline, Stephen M. Kosslyn, and Denis Le Bihan (2000). "Transient Activity in the Human Calcarine Cortex During Visual Mental Imagery: An Event Related fMRI Study," Journal of Cognitive Neuroscience 12: Supplement 2, pp. 15 – 23.

Kosslyn, S. M. (1999). "If Neuroimaging is the Answer, What Is the Question?" Philosophical Transactions of the Royal Society, London B, Volume 354, pp. 1283 – 1294.

Kosslyn, S. M. (1996). Image and Brain (Cambridge, Massachusetts: MIT Press).

Kosslyn, S. M. (1995). "Mental Imagery", in ed. Stephen M. Kosslyn, and Daniel N. Osherhorn, Visual Cognition (Cambridge, Massachusetts: MIT Press), pp. 267 – 296.

Kosslyn, Stephen M., Nathaniel M. Alpert, William L. Thompson, Vera Maljkovic, Steven B. Weise, Christopher F. Chabris, Sania E. Hamilton, Scott L. Rauch, and Ferdinand S. Buonnannol (1993). "Visual Mental Imagery Activates Topographically Organized Visual Cortex: PET Investigations," Journal of Cognitive Neuroscience, Volume 5, pp. 263 – 287.

Kosslyn, Stephen and Richard Anderson (1995). Frontiers of Cognitive Neuroscience (Cambridge, Massachusetts: MIT Press).

Kosslyn, Stephen M. and Daniel N. Osherhorn (1995). Visual Cognition (Cambridge Massachusetts: MIT Press)

Kosslyn, Stephen M., A. Pascual-Leone, O. Felician, S. Camposano, J. P. Keenan, W. L. Thompson, G. Ganis, K. E. Sukel, and N. M. Alpert (1999). "The Role of Area 17 in Visual Imagery: Convergent Evidence from PET and rTMS," Science, Volume 284, pp. 167 – 170.

Kosslyn, Stephen M., William L. Thompson, Darren R. Gitelman, and Nathaniel Alpert (1998). "Neural Systems That Encode Categorical Versus Coordinate Spatial Relations: PET Investigations," Psychobiology, Volume 26, Number 4, pp. 333 – 347.

Kostelanitz, Richard (1989). Esthetics Contemporary (Buffalo, New York: Prometheus Books,).

Latto, Richard (1995). "The Brain of the Beholder," in eds. Richard Gregory, John Harris, Priscilla Heard, and David Rose, The Artful Eye (New York: Oxford University Press, New York).

Leibniz, Wilhelm Gottfried (1704). New Essays on Human Understanding (New York: Cambridge University Press), trans. P. Remnant and J. Bennett, 1989.

Leibniz, Wilhelm Gottfried (1702). "Letter to Queen Sophie Charlotte of Prussia, On What Is Independent of Sense and Matter," in trans. Roger Ariew and Daniel Garber, G.W, Leibniz: Philosophical Essays (Indianapolis: Hackett Publishing Company), 1989, pp. 186 – 192.

Leibniz, Wilhelm Gottfried (1634). "Meditations on Knowledge, Truth, and Ideas," reprinted in trans. Leroy E. Loemker, Wilhelm Gottfried Leibniz: Philosophical Papers and Letters (Norwell, Massachusetts: Kluwer Academic Publishers, 1989), pp. 291 – 295.

Lemon, L. T. and M. J. Reis (1965). Russian Formalist Criticism: four essays, Lincoln, Nebraska: University of Nebraska Press).

Levinson, Jerrold (1979). "Defining Art Historically," British Journal of Aesthetics, 19: 3, pp. 232-250.

Livingstone, Margaret S. (2002). Vision and Art: The Biology of Seeing (New York: Henry Abrams and Company).

Livingstone, Margaret S. (2000). "Is It Warm?, Is It Real? Or Just Low Spatial Frequency?" Science, November 17, 290, p. 1299.

Livingstone, Margaret S. (1988). Art, illusion, and the visual system. Scientific American, 258 (1), 78-85.

London, Justin (2004. Hearing in Time (New York: Oxford University Press).

London, Justin (2003). "Hearing Rhythmic Gestures: Moving Bodies and Embodied Minds," Keynote Address at the "Music and Gesture" Conference, August 2003; retrieved July 12, 2005, http://www.people.carleton.edu/~jlondon/Keynote%20Webdocument.htm

Margolis, Joseph (1997). "Interpretation," in ed. David Cooper, A Companion to Aesthetics (Malden, Massachusetts: Blackwell Publishers), pp. 232 – 238.

Marr, David (1982). Vision (New York: W. H. Freeman and Company).

Marr, David (1977). "Analysis of Occluding Contour," Procedings of the Royal Society of London, Series B, Volume 197, pp. 441 – 475.

Marr, David and H. K. Nishihara (1978). "Visual Processing: Artificial Intelligence and the Sensorium of Sight," Technology Review, 81, pp. 2 – 23, reprinted in eds. Stephen M. Kosslyn and Richard A. Anderson, Frontiers in Cognitive Neuroscience (Cambridge, Massachusetts: MIT Press), 1996.

McMahon, Jennifer Anne (2001). "Beauty," in ed. Berys Gaut and Dominic McIver Lopes, The Routledge Companion to Aesthetics (New York: Routledge), pp. 227 – 238.

McMahon, Jennifer Anne (2000a) "Perceptual Beauty As the Basis for Genuine Judgments of Beauty," in ed. Joseph A. Goguenand Erik Myin, Journal of Consciousness Studies: Art and the Brain II, Volume 7, No. 8/9 (Thiverton, England: Imprint Academic), 2000, pp. 29 – 36.

McMahon, Jennifer Anne (2000b). " Book Review: Inner Vision," Leonardo Digital Reviews, September.

McMahon, Jennifer Anne (1999). "Towards a Unified Theory of Beauty," Literature and Aesthetics 9, pp. 7 - 27.

Mellet, E., N. Tzourio-Mazoyer, S. Bricogne, B. Mazoyer, S. M. Kosslyn, and M. Denis (2000). "Functional Anatomy of High Resolution Visual Mental Imagery," Journal of Cognitive Neuroscience, Volume 12, pp. 98 – 109.

Mendelssohn, Moses (1771). "On the Main Principles of the Fine Arts and Sciences," Philosophical Writings, (repr. New York: Cambridge University Press), 1997, pp. 169 – 191.

Mendelssohn, Moses (1771). "On Sentiments," Philosophical Writings, (repr. New York: Cambridge University Press), 1997, pp. 7 – 95.

Mendelssohn, Moses (1771). "Rhapsody, or Additions to the Letters on Sentiments" Philosophical Writings, (repr. New York: Cambridge University Press), 1997, pp. 131 – 168.

Mondrian, Piet (1945). Plastic Art and Pure Plastic Art (New York: Wittenborn and Company).

Montero, Barbara (2006). "Proprioception as an Aesthetic Sense," Journal of Aesthetics and Art Criticism, 65:1.

Moore, G. E. (1903). Principia Ethica (New York: Cambridge University Press), 2000.

Moore, Cassandra, and Patrick Cavanaugh (1998). "Recovery of 3D Volume from 2-tone Images of Novel Objects," Cognition 67, pp. 45 – 71.

Moutoussis, K. and S. Zeki (1997a). "A Direct Demonstration of Perceptual Asynchrony in Vision," Procedings of the Royal Society of London, Series B, Volume 26, pp. 393 – 399.

Moutoussis, K. and S. Zeki (1997b). "Functional Segregation and Temporal Hierarchy of the Visual Perceptive Systems," Procedings of the Royal Society of London, Series B, Volume 264, pp. 1407 – 1414.

Nagel, Ernest (1961). The Structure of Science (New York: Harcourt, Brace, and Company).

Ogden, Jenni A. (1993). "Visual Object Agnosia, Prosopagnosia, Achromatopsia, Loss of Visual Imagery, and Autobiographical Amnesia following Recovery from Cortical Blindness: Case M.H.," Neuropsychologia 31/6 pp. 571 – 589.

Ogden, Jenni A. (1996). Fractured Minds (New York: Oxford University Press).

Palmer, Stephen (1999). Vision Science (Cambridge, Massachusetts: MIT Press).

Palmer, Stephen (1974). "Visual Perception and World-Knowledge: Notes on a Model of Sensory-Cognitive Interaction," in eds. Donald A. Norman and David E. Rumelhart, Explorations in Cognition (San Francisco: W. H. Freeman and Company), 1975, pp. 279 – 307.

Parkin, Alan J. (1996). Explorations in Cognitive Neuropsychology (new York: Psychology Press).

Peterson, Mary A. and Bradley S. Gibson (1994). "Must Figure-Ground Organization Precede Object Recognition: An Assumption in Peril," Psychological Science, 5:5, pp. 253 – 259.

Purves, D., G. J. Augustine, D. Fitzpatrick, L. C. Katz, A. LaMantia, J. O. McNamara, S. M. Williams (2001). Neuroscience, Second Edition (Sunderland Massachusetts: Sinauer Associates Inc.).

Pylyshyn, Zenon W. (2003). "Return of the Mental Image: Are There Really Pictures in the Head?" Trends in Cognitive Science, 2003, 7(3), 113-118.

Pylyshyn, Zenon W. (2002). "Mental Imagery: In search of a theory," Behavioral and Brain Sciences, 25(2), 157-237

Pylyshyn, Zenon W. (2001). "Is the "Imagery Debate" Over? If So, What Was It About?" in Cognition: A Critical Look, Advances, questions and controversies in honor of J. Mehler, ed. E. Dupoux, S. Dehane and L. Cohen, (Cambridge, Massachusetts: MIT Press).

Pylyshyn, Zenon W. (1999). "Is Vision Continuous with Cognition: The Case for the Cognitive Impenetrability of Vision," Behavioral and Brain Sciences, Volume 22, 341 – 423.

Quine, W. V. O. (1969). "Epistemology Naturalized," Ontological Relativity and Other Essays New York: Columbia University Press) 1969, pp. 69 – 90.

Raffman, Diana (1993). Language Music and Mind (Cambridge, Massachusetts: MIT Press).

Ramachandran, V. S., and R. L. Gregory (1978). "Does Color Provide an Input to Human Motion Perception?" Nature, Volume 275, September 7, pp. 55 – 56.

Ramachandran, V. S. and William Hirstein (1999). "The Science of Art: A Neurological Theory of Aesthetic Experience," in ed. Joseph A. Goguen, Journal of Consciousness Studies: Art and the Brain, Volume 6 (1999): June/July (Thiverton, England: Imprint Academic), pp. 15 – 51.

Reber, Arthur S. and Emily Reber (2001). The Penguin Dictionary of Psychology, Third Edition (New York: Penguin Books).

Rickey, George W. (1962). "The Morphology of Movement," Art Journal, Volume XXII, Number 4, pp. 220 – 231.

Rollins, Mark (2004). "What Monet Meant: Intention and Attention in Understanding Art," Journal of Aesthetics and Art Criticism, 62:2, Spring, pp. 175 – 188.

Rollins, Mark (2003). "The Mind in Pictures: Perceptual Strategies and the Interpretation of Visual Art," The Monist, 86:4, pp. 608 – 631.

Rollins, Mark (2001). "The Invisible Content of Visual Art," Journal of Aesthetics and Art Criticism," 59:1, pp. 19 – 27.

Rollins, Mark (1999a). (ed.) Special Symposium: Aesthetics and Cognitive Science, Philosophical Psychology, Volume 12, Number 4, December.

Rollins, Mark (1999b). "Introduction," in ed. Mark Rollins, Special Symposium: Aesthetics and Cognitive Science, Philosophical Psychology, Volume 12, Number 4, December, pp. 381 – 386.

Rollins, Mark (1999c). "Pictorial Representations: When Cognitive Science Meets Aesthetics," ed. Mark Rollins, Special Symposium: Aesthetics and Cognitive Science, Philosophical Psychology, Volume 12, Number 4, December, pp. 387 – 414.

Rosch, Eleanor (1975). "The Nature of Mental Codes for Color Categories," Journal of Experimental Psychology: Human Perception and Performance, Volume 1, Number 4, pp. 303 – 322.

Rosch, Eleanor, Carolyn B. Mervis, Wayne D. Gray, David M. Johnson, and Penny Boyes-Braem (1976). "Basic Objects in Natural Categories," Cognitive Psychology 8, pp. 382 – 439.

Ross, John and Ann Ma-Wyatt (2003). Nature Neuroscience, 7, p. 65 – 69.

Ruskin, John (1857). The Elements of Drawing (repr. Mineola, NY: Dover Publishers, Inc, 1981).

Sacks, Oliver and Robert Wasserman (1987). "The Case of the Colorblind Painter," The New York Review of Books, Volume XXXIV, Number 18, November 19, pp. 25 – 34.

Scholl, Brian J. (2005). "Innateness and Bayesian Visual Perception: Reconciling Nativism and Development,: in eds. Peter Carruthers, Stephen Laurence, and Stephen Stich, The Innate Mind: Structure and Contents (New York: Oxford University Press), pp. 34 – 52.

Smith, Murray (1997). "Imagining from the Inside," in eds. Richard Allen and Murray Smith, Film Theory and Philosophy (New York: Oxford University Press, 2003), pp. 412 – 430.

Soslo, Robert L. (2000). "The Cognitive Neuroscience of Art: A Preliminary fMRI Observation," ed. Joseph A. Goguenand Erik Myin, Journal of Consciousness Studies: Art and the Brain II, Volume 7, No. 8/9 (2000), (Thiverton, England: Imprint Academic).

Soslo, Robert L. (1999). Cognition and the Visual Arts (Cambridge, Massachusetts: MIT Press).

Sparing, Roland, Felix M. Mottaghy, Giorgo Ganis, William L. Thompson, Rudolf Topper, Stephen M. Kosslyn, ad Alvaro Pascual-Leone (2002). Brain

Research: Volume 938, pp. 92 – 97.

Stolnitz, Jerome (1961). "On the Origins of 'Aesthetic Disinterestedness," Journal of Aesthetics and Art Criticism, Volume 2, pp. 131 – 143.

Stolnitz, Jerome (1960a). "Beauty: Some Stages in the History of an Idea," Journal of the History of Ideas, Volume 22, Number 2, pp. 185 – 204.

Stolnitz, Jerome (1960b). Art and Criticism (Boston: Houghton Mifflin).

Tanaka, James W., Tim Curran, and David L. Sheinberg (2005). "Training and Transfer of Real World Perceptual Expertise," Psychological Science, 16:2, pp. 145 – 151.

Tarr, Michael J. and Heinrich H. Bultoff (1998). "Image-based Object Recognition in Man, Monkey, and Machine," Cognition 67, pp. 1 – 20.

Tatarkiewicz, Wladyslaw (1974). "The Great Theory of Beauty and Its Decline," The History of Aesthetics, Volumes I & II (The Hague: Mouton).

Thompson, William L. and Stephen M. Kosslyn (2000). "Neural Systems Activated during Visual Mental Imagery, " in ed. Arthur W. Toga and John C. Mazziotta, Brain Mapping: The Systems (New York: Academic Press), pp. 536 – 560.

Thouless, Henri (1931). "Phenomenal Regression to the Real Object," British Journal of Psychology, Volume 21, pp. 339 – 359.

Toga, Arthur W. and John C. Mazziotta (2000). Brain Mapping: The Systems, (New York: Academic Press).

Tse, Peter Ulrich and Patrick Cavanaugh (2000). "Chinese and Americans See Opposite Apparent Motion in Chinese Characters," Cognition 74: 27 – 32.

Tulving, Endel (1972. "Episodic and Semantic Memory," in eds. E. Tulving and W. Donaldson, Organization of Memory (New York: Academic Press), pp. 381 – 403.

Wallis, Brian, (1984). Art After Modernism: Rethinking Representation (New York: The New Museum of Contemporary Art).

Walsh, V., and A. Pascual-Leone (2003). Transcranial Magnetic Stimulation: A Neurochronometrics of the Mind (Cambridge, Massachusetts: MIT Press).

Walton, Kendall (1992). "Mimesis as MakeBelieve," Art Issues 21, pp. 22 – 27, reprinted in ed. David Goldblatt and Lee B. Brown, Aesthetics (Upper

Saddle River, New Jersey: Prentice Hall), 1997, pp. 56 – 62.

Walton, Kendall (1990). Mimesis as Make-Believe (Cambridge, Massachusetts: Harvard University Press).

Warrington, E. K. and A. M. Taylor (1978). "Two Categorical Stages of Object Recognition," Perception, 7, pp. 695 – 705.

Warrington, E. K. and A. M. Taylor (1973). "The Contribution of the Right Parietal Lobe to Object Recognition," Cortex, Volume IX, No. 2, pp. 152 – 164.

Warrington, E. K. and P. Rabin (1972). "Visual Span of Apprehension in Patients with Unilateral Cerebral Lesions," Quarterly Journal of Experimental Psychology, Volume 23, pp. 423 – 431.

Warrington, E. K. and P. Rabin (1970). "Perceptual Matching in Patients with Cerebral Lesions," Neuropsychologia, Volume 8, pp. 475 – 487.

Wessell, Leonard P. Jr. (1972). "Alexander Baumgarten's Contribution to the Development of Aesthetics," Journal of Aesthetics and Art Criticism 30 (1972).

Wessell, Leonard P. Jr. (1972). "Alexander Baumgarten's Contribution to the Development of Aesthetics," Journal of Aesthetics and Art Criticism, Volume 30, Number 3, pp. 333 – 342.

Wilson, Robert A. and Frank C. Keil (1995). The MIT Encyclopedia of the Cognitive Sciences (Cambridge, Massachusetts: MIT Press).

Wimsatt, William. K. and Monroe C. Beardsley (1954). "The Intentional Fallacy," from The Verbal Icon, University Press of Kentucky, Lexington, Kentucky, reprinted in eds. George Dickie, Richard Sclafini, and Ronald Roblin (1989). Aesthetics, Second Edition (New York: St. Martin's Press), pp. 431 – 441.

Yantis, Steven (2001). Visual Perception (Philadelphia: Psychology Press).

Zeki, Semir (2000). "Artistic Creativity and the Brain," Science, July 6, 293, pp. 51 – 52.

Zeki, Semir (1999). Inner Vision, Oxford University Press, New York, 1999.

Zeki, Semir (1999a). "Art and the Brain," Goguen, Joseph A. Journal of Consciousness Studies: Art and the Brain, Volume 6: June/July (Thiverton, England: Imprint Academic), pp. 76 – 96.

Zeki, Semir (1993). A Vision of the Brain (Boston: Blackwell Scientific).

Zeki, S. and A. Bartels (1998). "The Asynchrony of Consciousness," Procedings of the Royal Society of London, Series B, Volume 265, pp. 1583 – 1585.

Zeki, S. and D. H. ffychte (1998). "The Riddoch Syndrome: Insights Into the Neurobiology of Conscious Vision," Brain, 121, pp. 25 – 45.

Zeki, S. and M. Lamb (1994). "The Neurology of Kinetic Art," Brain, 117, pp. 607 – 636.

Zeki, S. and K. Moutoussis (1997). "Temporal Hierarchy of the Visual Perceptive Systems in the Mondrian World," Procedings of the Royal Society of London, Series B, Volume 264, pp. 1415 – 1419.

Zeki, S., J. D. G. Watson, C. J. Lueck, K. J. Friston, C. Kennard, and R. S. J. Frackowiak (1991). "A Direct Demonstration of Functional Specialization in Human Visual Cortex," The Journal of Neuroscience, Volume 11, Number 3, March 1991, pp. 641 – 649.

Zihl, J. , D. Von Cramon, and N. Mai (1983). "Selective Disturbance of Movement Vision After Bilateral Brain Damage," Brain, 106, pp. 313 – 340.

Zihl, J. , D. Von Cramon, N. Mai, and C. H. Schmid (1991). "Disturbance of Movement Vision After Bilateral Posterior Brain Damage," Brain, 114, pp. 2235 – 2252.