Aesthetic Science
CONNECTING MINDS, BRAINS, AND EXPERIENCE

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The Philosophy of Art and Aesthetics,
Psychology, and Neuroscience
STUDIES IN LITERATURE, MUSIC, AND VISUAL ARTS
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Introduction

Aesthetics was born as a branch of philosophy in 1735 with Alexander Baumgarten's use of the term "aesthetics" in his Meditationes Philosophicae de Nominis ad Poema Pertinentibus (Philosophical Meditations Pertaining to Some Matters Concerning Poetry). Baumgarten used the phrase episteme aesthetike to mean the science of what is sensed and imagined, in contrast to the science of what is known through rational thought. In his incomplete Aesthetica, Baumgarten further defined the terms as follows: "Aesthetics (the theory of the liberal arts, the logic of the lower capacities of cognition [gnoseologia inferior], the art of thinking beautifully, the art of the analogon rationis) is the science of sensible cognition." Contained in this definition are the roots of many 21st-century topics in the philosophy of art. Indeed, the 18th century is important to the history of aesthetics for introducing a range of enduring questions whose provenance can ultimately be traced back to an interest in the sensory grounds for perceptual knowledge. These topics include the analysis of our judgments of beauty, which involves an account of the faculties of the judging subject and the qualities judged in the object; an explanation of our aesthetic preferences or the standards of taste; the role of the imagination in presenting sensory appearances; our experience of artworks as objects suited for detection of beauty or perfection; as well as the relationship between aesthetic pleasure and the domain of morality. However, it is only with the advent of cognitive science in the late 20th century that Baumgarten's vision of aesthetics as a science of sensory cognition, including the study of our engagement with artworks, has become truly possible.

Aestheticians since Baumgarten have addressed these topics, sometimes in slightly altered form, but typically without any concern for a scientific solution. The relevant judgments about, and responses to, artworks are too subjective, the argument goes, to admit of scientific study. The extreme expression of this view
can be found in the Logical Positivists approach to knowledge in general. The positivists argued that the only genuine candidates for knowledge are those that admit of verification through empirical observations. Rather than seek a scientific account of every domain of human knowledge following an 18th-century model—the projects of Hume and Kant include morality and aesthetics as well as mathematics and natural science—the Positivists preferred to exclude anything that involves subjective feeling from the general domain of knowledge. It was not just that a complete account of aesthetics had to wait for the development of psychology and neuroscience; rather, the Positivists argued that there was a complete divorce between what science could deliver and what aestheticians would ask. Science could not, in principle, have any bearing on questions about the nature of art, beauty, or aesthetic appreciation.

This view has remained influential throughout the 20th and into the 21st century. Thus, despite the historical connections between the study of perception and aesthetics, analytic philosophers have been generally skeptical about the relevance of psychology to the philosophy of art and aesthetics. The types of concerns raised in these contexts fall into three general categories: concerns about the relevance of psychology to our understanding of aesthetic appreciation; concerns about the relevance of psychology to our understanding of aesthetic properties; and general concerns about the possible utility to aesthetics of understanding how artworks function as perceptual stimuli. Concerns about the relevance of psychology to aesthetic appreciation can be traced back to arguments in Ludwig Wittgenstein's Lectures in Aesthetics and George Dickie's "Is Psychology Relevant to Aesthetics." Wittgenstein writes:

7. People have the idea that psychology is one day going to explain all of our aesthetic judgments, and they mean experimental psychology. This is very funny—very funny indeed. There doesn't seem any connection between what psychologists do and any judgment about a work of art. We might examine what sort of thing we would call an explanation of an aesthetic judgment. 

8. . . . The question is whether this is the sort of explanation we should like to have when we are puzzled about aesthetic impressions, e.g., there is a puzzle—"Why do these bars give me such a peculiar impression?"

Wittgenstein is not particularly forthcoming in these lectures about the nature of his reservations. However, a plausible interpretation is that he does not think that psychological studies of beholders' particular subjective responses to artworks will help us understand the general nature of either aesthetic appreciation or aesthetic properties.

Dickie argues that the sorts of questions asked in aesthetics differ in logical form from the sorts of questions asked in psychology, so that when we answer aesthetic questions with data concerning the behavioral responses of participants to particular artworks we are committing a category mistake—we confuse a logical problem for a scientific one. Consider two examples that Dickie offers: studies that involve adjective matching and studies that involve preference orderings. In the first case, participants are asked to match musical compositions to a range of adjectives (e.g., stately, sprightly, wistful, etc.) that expert judges have identified as appropriate to the works. Dickie argues that these data—agreement among subjects—are beside the point. Just as agreement among children about the meaning of a nonsense word is not evidence that a word is meaningful, what matters in the case of our responses to music is whether the formal composition of the work—in this case, the syntactic features of compositions that constitute a musical language—is adequate for the attribution of the aesthetic feature in question. And this, Dickie argues, is a matter of convention rather than psychological causation—a matter of the rules of the particular language game appropriate to the production and appreciation of the category of music used as the stimulus.

Dickie's second case is analogous to the first. In preference-ordering studies participants are asked to rank a set of works from best to worst. Again, Dickie argues that these data are not logically appropriate to the question. What matters is the criteria that determine what constitutes good compositional structure, and agreement among novices is not appropriate evidence in this context. Rather, what is important are the rules of the appropriate language games—conventions that are embedded in our common linguistic practice and revealed in the a priori judgments of experts. Again, questions of psychological causation are said to be irrelevant to the investigation of these conventions. Thus, Dickie argues that psychology is not relevant to aesthetics.

Neither the claims of Wittgenstein nor the arguments of Dickie strike us as ultimately compelling. Wittgenstein's position represents an extremely narrow conception of the domain of philosophical aesthetics. He appears to have presupposed that all questions of aesthetics are connected to rendering aesthetic judgments (a.k.a. appreciating an art work) from the inside (of a language game). But there is a larger view of the philosophy of art and aesthetics—one that regards germane to the field any and all questions about the construction and reception of artworks and other aesthetic objects. Questions about the origins as well as the nature of aesthetic experience belong to this broader conception of the philosophy of art. Likewise, confronting the theoretical problems provoked by our standing language games with respect to art also belongs to the philosophy of art, properly construed (e.g., as we shall see in the next section, certain psychological conceptions of the emotions may help us dissolve longstanding issues such as the paradox of fiction).

But it may also be the case that psychology—by elucidating the dynamics of the audience's response to artworks—can help readers, viewers, and listeners sharpen those responses to greater effect. In other words, by understanding the psychology that underpins our appreciative responses, we can self-consciously hone in on the pertinent variables, and thereby enhance our understanding and appreciation of artworks by making those responses more focused than they would be without a
sense of the psychology of appreciation—that is, by understanding how the psychology of appreciation works, we can help it along. In the next section, we will see how Jenifer Robinson’s account of our emotional response to certain kinds of literature encourages us to monitor our reactions in ways that make appreciation more complete and more vivid. Thus, pace Wittgenstein, psychology need not be denied a role in the philosophy of art and aesthetics.

Turning from Wittgenstein’s arguments to Dickie’s, we note that recent imaging studies involving adjective matching and preference orderings support Dickie’s observations but challenge his assessment of the relevance of psychology to aesthetics. Calvo-Merino compared ratings of discrete dance movements along five aesthetic dimensions (simple—complex, dull—interesting, tense—relaxed, weak—powerful, and like—dislike) with fMRI recordings collected while participants watched the same dance movements in a separate session. Individual differences among preference ratings generally preclude projecting aesthetic preferences back to common features of the stimulus space (e.g., formal and compositional features of the works) in these types of studies. Therefore, there is an underlying assumption that the behavioral results do not generalize to the perceived features of artworks. However, correlations among Calvo-Merino’s imaging results revealed common cortical networks subserving participants’ aesthetic judgments. Discussions of the functions of these cortical networks suggest that aesthetic judgments within a medium are realized by a unique set of psychological processes. This, in turn, demonstrates that psychological studies can contribute to our understanding of the underlying structure of aesthetic judgments. Therefore, although adjective-matching and preference-ordering studies do not, as Dickie argues, contribute to our understanding of the nature of artworks, they do contribute to aesthetics, broadly construed.

Finally, Dickie concedes that psychology can help unpack art critical judgments about the way particular artworks work to produce artistically salient effects and therefore might be useful in art criticism. However, he argues that these types of results cannot contribute to the sorts of conceptual, or definitional, questions traditionally asked in the philosophy of art. Questions about the nature of art and the character of aesthetic experience are prior logical questions about the use of a language (e.g., What do we mean when we use terms like ‘dynamic’, ‘stately’, ‘wistful’, or ‘beautiful’ to refer to the perceived attributes of aesthetic features of artworks? What are the syntactic characteristics of musical compositions that enable them to represent emotions and events? What do we mean when we call the experience involved in engaging with an artwork an ‘aesthetic experience’?). Questions about our engagement with artworks, so the argument goes, are questions about the way particular artworks and experiences exemplify aesthetic concepts embedded in our ordinary discourse about art, but they do not elucidate our understanding of either the structure of these concepts or the properties they refer to. If sound, this objection would challenge the utility of psychology to philosophical questions about art.

However, one can argue against Dickie that our use of aesthetic concepts in ordinary language draws on, reflects, or perhaps even itself constitutes an underlying tacit theory about the nature of art and the character of aesthetic experience. This “theory” is grounded in a range of conventions that we bring to bear in aesthetic judgments, conceptual biases about the nature of art and aesthetic experience whose validity depends on facts about the way viewers actually engage with artworks. In this regard, our systematic use of aesthetic terms in ordinary language should yield testable predictions about the nature of art and the character of aesthetic experience. These predictions can, in turn, be explored and evaluated either experimentally or through case study approaches analogous to the method of counterexample employed in the philosophy of art. Therefore, even if, as Dickie suggests, the philosopher of art is concerned with language games, a language game can be studied empirically.

Dickie’s reservations stem from a philosophical view, by now controversial, that takes the boundary between philosophy and science to be stark. But philosophers are no longer so convinced of such a sharp division between philosophy and empirical science. They are, as a result, increasingly turning to psychology and neuroscience as a resource. In the remainder of this essay, we explore significant interactions between philosophy and psychology with special regard to the arts of literature, music, and visual art.

**Literature**

Philosophers of literature have paid scant attention to developments in psychology and neuroscience. One exception to this tendency is Jenifer Robinson’s *Deeper than Reason: The Emotions and their Role in Literature, Music and Art.* This is recognized as an important book and, for this reason, is likely to change the attitude of many philosophers of literature with regard to the relevance of psychology and neuroscience to their research. In this section, we will discuss Robinson’s treatment of literature, the art form with which she opens her discussion of aesthetics proper and the art form to which she devotes (marginally) the most space.

Throughout her book, Robinson is at pains to simultaneously align her position with cutting-edge empirical work in psychology and neuroscience and solve longstanding problems in the philosophy of art. Her embrace of contemporary psychology is perhaps most evident in the view of the emotions that she takes on board. It is roughly a form of non-cognitivism that we can call neo-Jamesianism (in honor of William James). This is a very distinctive stance. Philosophers have, until recently, tended to shun James’s approach to the emotions in favor of various types of cognitive accounts. On James’s view, it is physiological change that is essential to an emotion. When we perceive something that causes fear, for example, that perception directly causes bodily changes. In James’s words, “our feeling of the same changes as they occur is the emotion.” Where philosophers of art have been
explicit about their conception of the emotions, they generally appear to buy into one or another cognitive theory of the emotions rather than adopting a Jamesian view (e.g., Noël Carroll and Berys Gaut).\cite{Carroll2002, Gaut2010}

The cognitive theory of the emotions to which Robinson is most opposed is what she labels judgmentalism. This is the view that an emotional state is essentially a judgment. To be afraid of the puff adder to steal an example from Darwin, one must judge the snake to be dangerous to oneself. If I realize that the glass between myself and the snake is sufficient to protect me from it and, in consequence, I judge that the snake is not dangerous, then I will feel no fear. According to Robinson, judgmentalists, such as the late Robert Solomon, will count a mental state as an emotion even if the pertinent judgment is not accompanied by any feelings (whether phenomenological or physiological).\cite{Solomon1993, Robinson2013} Judgmentalists maintain that one of the strengths of their view is that it solves the problem of how to finely individuate emotional states. In other words, putatively many emotional states are indistinguishable from each other in terms of the way in which they feel. The feeling qualities (or qualia) of certain forms of fear are not all that different, it is said, than certain forms of anger. Likewise, it may be difficult to feel the difference between joy and admiration, on the one hand, and indignation and contempt, on the other. So, how do we differentiate between emotional states if not on the basis of qualia? The judgmentalist answers: in terms of their animating judgments.

Robinson argues that most philosophers of literature buy into judgmentalism, or something very like it. This is especially apparent when one contemplates one of the leading problems in the philosophy of literature, namely the paradox of fiction. This paradox raises the question of how it is possible for us to respond emotionally to fictions. The quandary here is that emotional responses allegedly require a belief in the existence of whatever engenders the emotional state in us; but we do not believe in the existence of Godzilla or Tess of the D’Urbervilles; so how can we fear Godzilla or feel sorrow for Tess? The crux of this paradox is also the leading tenet of judgmentalism. A judgment is an assertion and an assertion entails that we believe its propositional content. Therefore, the judgmentalist holds that in order for an emotion to take hold, it is necessary that we have certain beliefs.

Robinson rejects judgmentalism. Her rejection is based upon a combination of considerations—some philosophical, some psychological, and some neuroscientific. The philosophical argumentation takes the form of a series of thought experiments. Robinson invites us to imagine certain kinds of states of affairs—for instance, to entertain the thought that I am accidentally slicing my finger in half lengthwise. In such cases, we notice that one can make herself shudder as a result of merely contemplating this prospect. We need not believe it is transpiring in the here and now. Imagining it—entertaining it as a proposition or situation type held before the mind as unasserted—is sufficient for emotional uptake. Therefore, emotions can, contrary to the claims of judgmentalism, erupt sans beliefs. Consideration of additional thought experiments indicates that emotions can be ignited by states

that are even less cognitively contentful, including ones involving aspect perception and attention to patterns of salience.

Robinson supports her philosophical arguments with psychological research from Robert Zajonc and Paul Ekman. Zajonc has demonstrated that, at least in primitive episodes of emotional response such as the startle reaction, affect can obtain without being caused by any cognitive state. Further, Zajonc and his colleagues have established that people form preferences for stimuli to which they had been previously exposed, but that were presented to them at rates too fast to allow conscious recognition.\cite{Zajonc1965} Thus, affective appraisals were marshaled where there were no previous cognitions. In a similar experiment, happy and angry faces projected too quickly for conscious recognition nevertheless primed the subjects' affective appraisals of a sequence of Chinese ideographs.\cite{Ekman1992} Zajonc also re-interpreted the earlier "subception" experiments of Richard Lazarus and Robert McCleary in which subjects registered greater affective reactions to words, again projected too quickly for conscious recognition, that had been accompanied on earlier exposure with the administration of electrical shocks.\cite{Lazarus1968} This reaction occurred even though no such shocks were applied during the experiment in question. Finally, Paul Ekman's studies of facial communication demonstrate that exposure to a happy face can make me happy. Your smile disposes me to smile, and the alteration in my facial musculature causes the sort of changes in my autonomic nervous system that are characteristic of joy. There need be no thought here, merely changing facial expressions. Therefore, your facial expressions can directly induce converging affective states in me without cognitive intervention (a phenomena known as emotional contagion). This latter phenomenon also gives us some reason to think that some emotions may be differentiated in light of the distinctive ways in which they feel, as opposed to the way we cognitively appraise them.

Robinson believes that changes in the facial musculature and the corresponding alterations of the autonomic nervous system provide some grounds for discriminating between the so-called basic emotions (e.g., anger, disgust, fear, joy, sadness, and surprise). However, she also maintains, as do the judgmentalists, that it is primarily the cognitive processing that attends the emotion that fixes the identity of the affective state. The way in which Robinson differs from the judgmentalists in this regard lies in where and when she locates the cognitive interlude. On the judgmentalist picture, the emotional state begins with a conscious judgment—an evaluation or appraisal of the stimuli in terms of whether it abets or impedes my interests. This causes a feeling state in me that puts me on the lookout for more relevant information and primes my behavioral response. For Robinson, in contrast, our initial appraisal of the stimuli is non-cognitive; it is of the nature of a perception—the system signals "Danger" or "Look out" before we have even identified the nature of the potential threat. This triggers the physiological response that gears us up for action. Nevertheless, cognition kicks in at this point in the process, monitoring the earlier stages of the process and either endorsing them.
activates the amygdala directly, but then that system is checked by processes operating in the frontal cortex. The former processes, of course, correspond to Robinson's non-cognitive appraisals, while the latter are the neural basis for what she calls cognitive monitoring.

Robinson applies this model of the emotions to literature in a fairly straightforward manner. Reading a fiction prompts our memory system to recall event types like the ones in the story that provoke immediate, non-cognitive, affective appraisals, and thereby activate physiological and behavioral tendencies; this then is cognitively monitored, leading to an adjustment of our appraisal of the situation, refining our understanding of it. For instance, Robinson cites an exchange in Henry James's *The Ambassadors* in which we chuckle at Lambert Strether. That chuckle signals our initial appraisal of Strether as a faintly comic character, which causes a feeling of levity and inclines us toward sympathy for Strether. When we cognitively monitor our responses to this incident, we are able to clarify our conception of Strether, finding that faint amusement to be grounded in our perception of his incongruous combination of good-naturedness and priggishness.

Robinson's account of our emotional response to literature enables her to resolve several longstanding questions in the philosophy of literature. One is the issue that we have already encountered—the paradox of fiction. In other words, how can it be that we respond emotionally to fictions, given that emotional responses require a belief in the existence of their objects, and we don't believe in the existence of Scarlett O'Hara, Rhett Butler, Ashley Wilkes, Tara, etc.? Robinson answers: Emotions are essentially non-cognitive appraisals that provoke physiological changes and behavioral tendencies. Emotions do not require beliefs (cognitions) in order to explode; so the paradox dissolves.

A second recurring question that Robinson addresses is: How can we learn from fictional literature? Many philosophers are skeptical of the longstanding belief that we can learn from fictions. How, for example, could we learn general propositions from fictions? Fictions typically involve only one or two cases of whatever problem they explore and, to make matters worse, the cases are rigged to support the thesis they advance. Robinson outflanks this sort of objection by arguing that it is not, first and foremost, propositions that we learn from fictions. The learning is emotional, what she calls a sentimental education. She conjectures that we respond to fictional characters as we do to people in everyday life. Thus, by responding emotionally to fictional characters, we learn how to respond to people who inhabit the world outside fiction. Emotional learning is prompted in the sense that we may acquire a broader emotional repertoire by encountering events and individuals outside our daily experience. Further, as we cognitively monitor our responses to fictional characters, we may gain insight into what features make our responses to fictional characters appropriate ones, thereby refining our emotional sensitivity. This entails that by monitoring our emotional responses to literary characters, we may also gain insight into ourselves. Therefore, the case of emotional
learning dodges longstanding skeptical arguments about the impossibility of learning general propositions from fiction.

Robinson also believes that our emotional responses to literature can help us understand many literary works, especially the ones she calls realist. She makes this claim with varying degrees of strength. Sometimes she suggests that understanding the works in question, like Anna Karenina, requires an emotional response, but, at most other times, she claims only that it can help our understanding. For example, by reflecting on our response to Strether—by cognitively monitoring the chuckle—we become aware of important features of Strether's character. We come to understand Strether better. Our emotional response to Strether enables us to interpret him better. Indeed, for Robinson, cognitively monitoring our emotional responses to characters is a crucial part of what it is to interpret them. So, Robinson concludes, cognitively monitoring our emotional responses to literature can provide the foundation of our interpretive response.

These arguments provide a way of meeting the objection, sketched in the last section, that psychology doesn't guide us in our understanding of how to appreciate art. In clarifying the psychological processes that subserve our emotional responses to literature, and articulating the ways these processes contribute to interpretation and narrative appreciation, Robinson implicitly points out the importance of cognitive monitoring to a successful engagement with a type of realistic literature. In effect, she is advising readers about the way in which understanding and reflecting on our emotions will help us realize our aesthetic aims. Her account of the psychology of literature helps us to become more sensitive readers by educating us about the nature of our emotional responses to literature and their relation to emotional understanding. Therefore, psychology is anything but irrelevant to the philosophy of art; it both contributes to our understanding of and enhances our capacity for narrative appreciation.

Robinson has advanced our grasp of the emotional understanding of literature appreciably. However, before concluding this section, certain reservations need to be voiced. In particular, we wish to question the thoroughgoing non-cognitivism of her account. As stressed, she thinks of the response to literature as rather like that of a startle response. She appears to deny that deliberation and reflection can give rise to the physiological changes that appear to mark emotional episodes. She deals with apparent counterexamples—cases where protracted thinking (as might occur in response to a complex fiction) give rise to emotions—by asserting that their contribution is only indirect. They call forth memory types that prompt a non-cognitive appraisal, and that is where the emotion process begins. However, this strikes us as exceedingly ad hoc. What, apart from a commitment to complete non-cognitivism, warrants the addition of this epicycle—the mobilization of the memory type—to the emotional process?

Perhaps Robinson feels that she is entitled to this move on the basis of her earlier objections to William Lyons’s theory of the emotions. Lyons holds a cognitive theory of the emotions, although he is not a judgmentalist. On his account, an emotional state involves an initial cognitive state—an evaluation or appraisal—that causes a bodily alteration that is generally connected to some behavioral tendency. This sort of theory would fit with what many suppose our ordinary experience of literature to be. We read, we contemplate, we form appraisals of the various characters and events, and this causes physiological changes in us. But Robinson objects to this sort of account because she maintains that Lyons fails to account for situations where we make a certain cognitive evaluation—so-and-so has wronged me—but do not suffer the physiological perturbations that are a necessary constituent of the emotion of anger. She says, “The trouble with this suggestion [Lyons’s] is that it does not explain why sometimes an evaluative judgment leads to physiological change and hence emotions, while at other times what appears to be the same evaluative judgment fails to lead to physiological change and emotion.” Thus, she seems to surmise that it is never viable to suppose that the first stage of an emotion process can be a cognition, such as reflecting upon a character.

But if this is Robinson’s argument, it does not seem consistent with the rest of her theory. One problem is that she maintains that cognitive monitoring can affect and modify the earlier stages of the emotional process. So, if it has that causal power at one stage of the process, why doesn’t it have that power at an earlier stage? Surely, we are owed an explanation of this. Second, Robinson conceives that even on her account of the emotions, I may sometimes render negative appraisals of a person or a situation but not be thrown in physiological consternation, whereas at other times, given a comparable situation, I will be. Robinson has various explanations of this, including that I may not take the situation as seriously relevant to my interests, I may be distracted, I may not be in a state of bodily readiness, and I may not be in a suitable mood. These, of course, all seem like plausible explanations. But the problem is that they are equally available to people like Lyons for meeting Robinson’s challenge to them. Consequently, Robinson has not thoroughly defeated every version of the cognitive theory of the emotions, especially as a rival account to the question of our emotional response to literature. Perhaps with respect to this matter, a hybrid combination of a neo-Jamesianism approach with some version of a cognitive theory of the emotions may provide the most comprehensive model for our emotional responses to literature. Nonetheless, Robinson’s use of psychology to clarify the nature of our emotional engagement with literature offers promising solutions to both the paradox of fiction and difficult questions about the issue of learning from literature, while also affording a model for how readers understand, interpret, and appreciate.

Music

There is a longstanding connection between the psychology of music and philosophical theories of musical understanding and appreciation. The very earliest
philosophical discussion of music in Plato's *Republic* draws on the Aristotelean theory that music in different modes affects our mental states in different ways (e.g., the Lydian mode has a calming, softening effect, while the Dorian instills the courage and self-control befitting a warrior).46 Plato stresses the way "rhythm and harmony permeate the inner part of the soul" and likens hearing music to "pouring those sweet, soft, and plaintive tunes . . . through his ear, as through a funnel." The assumption behind Plato's tactile physiological metaphors is that music is something we make direct physical contact with: the emotional and aesthetic effects of music are directly caused by the physical properties of musical sounds.47 Therefore, even as early as Plato, there is an implicit appeal to speculative psychology in philosophical discussions of music. The following section will review some of the connections between the philosophy and psychology of music, and then discuss musical imagery as a case study of the way in which results from psychology and neuroscience can shed light on the way we understand music.

Music aesthetics has explored questions involving our psychological response to music in the centuries since Plato, despite, and in large part without any concern for, a lack of empirical grounding in knowledge of the mind's inner workings. The most often discussed problem has been our emotional responses to music, followed closely by the question of whether music can or should represent non-musical ideas. These issues gained new prominence with the publication of Eduard Hanslick's *The Beautiful in Music.*48 Hanslick argued that our affective responses to music could not involve genuine emotions, for an emotional response is not possible unless its object has some semantic content. This issue is closely related to the theory of judgmentalism with respect to emotions in fiction discussed earlier. However, Hanslick makes a weaker claim than the judgmentalists: whether or not an emotion is a judgment, an emotion must take an object, and if music is to represent that object, it must do so in terms of a concept.

For Hanslick, in order for us to be saddened by music, the music would have to depict some particular thing that we recognize and react to in a canonical way. But music does not have the semantic resources of a language. Therefore, Hanslick argued that it could not depict the appropriate objects of genuine emotional responses. Peter Kivy has likewise argued that those who believe music arouses or expresses genuine emotions are confused.49 People often say either that the slow movement of Beethoven's Symphony No. 3 "Eroica" is sad, or that it makes them sad, but, according to Kivy, neither the music nor the listener is actually sad. Instead, the music has certain melodic and harmonic features that make it expressive of sadness. It is not literally sad; nor is what we feel genuine sadness. If we are aroused by music, what we feel is better described as a kind of awe in response to the music itself.50

The inability of music to express emotion literally is a conceptual claim for Kivy—it ultimately rests on our definition of the nature of emotion and the nature of music. At issue in these cases, as in the discussion of Dickie's claims about the relevance of psychology to art, is whether, and if so how, empirical studies can help to elucidate our understanding of the nature of our affective responses to music. This question is not limited to the relationship between music and the emotions, of course; it also bears generally on questions about musical understanding and appreciation. Empirical data are relevant to several points related to these questions. First, music is something we normally have access to only through the perceptual modality of hearing. Music is, as Edgar Varèse has asserted, organized sound.51 It is the science of acoustics that studies the physics of sounds. Therefore, the science of acoustics is relevant to an analysis of the musical object. Furthermore, the study of how we perceive sounds involves both auditory perception and psychoacoustics. Therefore, perceptual psychology will contribute important data as well. More concretely, questions about musical emotions are also questions about our emotions in general. In these contexts, psychology and affective neuroscience will be relevant. Finally, claims about musical understanding often involve explicit or implicit comparisons with other types of understanding (e.g., understanding sentences or pictures). In these contexts, the study of music will draw on data from the study of cognition in general. In sum, both musical understanding and appreciation involve a relation between a perceiving subject and a physical object. The sciences that study the listening subject as well as the musical object may have quite a bit to tell us about the interaction between subject and object. Philosophers would do well to recognize that although questions about the nature of music or emotions may be partly conceptual questions, they are also empirical questions. Indeed, even where they are conceptual questions, our concepts continue to evolve as they are influenced by scientific developments.

The relevance of music cognition to both the philosophy of music and aesthetics is exemplified in the study of musical imagery and its relation to the variety of faculties and processes that have been termed "the imagination" over the centuries. Imagination is related to music in a number of respects: we often imagine music silently in our minds, just as we imagine visual scenes. We refer to composers, especially the most highly regarded ones, as extraordinarily imaginative. We claim that composers are able to be imaginative in virtue of imagining music internally. However, philosophers have resisted an imagistic, or experiential, account of musical imagination. It was an anathema to speak of any entities existing inside the mind, whether pictures or sounds, for many 20th-century philosophers—notably Wittgenstein, Ryle, and Scruton.52 Instead, imagining is simply an attitude we take. Rather than believing that we hear a melody when there is no actual sound present, we merely imagine the sound. For instance, Scruton argues that in imagination we conceptualize, or entertain the idea of particular sounds; however, doing so does not involve commitment to the existence of any actual internal perceptual representation or experience of these sounds.

The difficulty with Scruton's account is that it does little to explain the phenomenology of our experiences of musical imagery. We would like a theory of the musical imagination that does justice to the fact that the experience of imagining sound feels like an experience of actual sounds in important respects. The term
"imagination" is currently used to refer to any one of several related concepts: imagination as the production of mental imagery; imagination as a faculty that organizes percepts for coherent cognition (the constructive imagination); imagination in the sense of being imaginative or creative; and imagination as a propositional attitude taken towards fictional or imaginary propositions. The neurophysiological processes that underwrite our experience of musical imagery can be said to be a kind of imagination in several of these senses. Certainly, there is an explanation of imagination as the capacity for musical imagery, and this can easily be linked to the capacity for creativity. Furthermore, an explanation of the experience of musical imagery also involves the constructive imagination in the sense discussed below (i.e., the general capacity to organize and manipulate percepts in the service of cognition). It turns out, therefore, that any coherent experience of music at all must draw on imagination in this sense.

It is necessary to review a bit of history in order to see how the different senses of imagination are related and have come to be at the heart of aesthetics. The 18th century's contribution to the conceptual development of the imagination takes the form of a complicated synthesis of three senses of imagination. In Hume's A Treatise of Human Nature, the imagination is a storehouse of ideas derived from past perceptions. Cognition is a capacity that always involves the imagination, since it involves the comparison of present perceptions to past perceptions, or the application of general concepts, which are formed by the imagination. Having an image of something not present also involves the imagination, since this involves either the recall of a past idea from the imagination, or the construction of a new idea out of past ideas. To be imaginative in the sense of being creative, then, is to be especially innovative in constructing new ideas, whether these ideas are imaginative (i.e., sensory) or abstract. Artistic creation is a product of this type of imaginative activity. Kant argues that the imagination is responsible for shaping sensory information from perception so that it is available to our understanding, or coherent to us. In the case of music, we are able to hear music as an ordered succession of sounds through time precisely because the imagination structures auditory sensory input so that this is possible. Further, Kant argues that visual aesthetic judgments arise from the harmony between the imagination and the understanding as they work together in the perception of a beautiful landscape or painting. Kant's definition of the imagination as the grounds for the possibility of sensory cognition in general is, therefore, also the root of his theory of aesthetic experience. So, the idea that the imagination is a productive, creative capacity that also constructs coherent sensory cognition and grounds our aesthetic judgments was present in, and has been inherited from, 18th-century theories of aesthetics.

Visual imagery has dominated mental imagery research in the late 20th century. These studies have demonstrated that imagery preserves key metrical properties of perceptual representations in a target modality, that it draws on the same neurophysiological processes as perception in a target modality, and that the capacity for imagery is disrupted by both focal damage and the application of repetitive transcranial magnetic stimulation (rTMS) to the discrete brain regions that realize these perceptual processes. For instance, Kosslyn, Ball, and Reiser demonstrated that differences in the time it takes to answer questions about the presence of targets on a memorized map are proportional to the distances one would have to scan to locate them on the original. This suggests that visual images are things that can be scanned, or have constituent spatial properties that can be explored and evaluated. Similarly, Shepard and Metzler demonstrated that differences in the time it takes for participants to evaluate whether an object is identical to a target in mental rotation studies are proportional to the distance the former would have to be rotated to match the latter. This suggests that mental images are things that can be rotated, or that the constituent spatial properties of visual images can be mentally manipulated. Further, imaging studies demonstrate that visual imagery tasks employ the same areas of the cerebral cortex that are involved in ordinary perception and derive their modality-specific metric properties from the functional organization of these brain regions. Behavioral evidence from studies of patients with focal lesions that affect perceptual systems supports these conclusions. For instance, Bisiach and Luzzatti demonstrated that the perceptual effects of hemifield neglect, a syndrome in which selective damage to one side of the cerebral cortex causes patients to fail to perceive objects in associated areas of the visual field (i.e., the right or left side of the visual field), generalize to visual imagery. Patients asked to visualize that they were in a familiar location and report what they could see consistently omitted familiar objects and locations in the "blind" hemifield, regardless of which spatial perspective they adopted. Finally, Kosslyn and his colleagues have demonstrated that the use of rTMS to disrupt activity in areas of the cerebral cortex involved in the encoding of sensory information in visual experience also disrupts the capacity in normal perceivers to use imagery and visualization to make spatial comparisons among the parts of recollected visual stimuli.

These observations about visual imagery generalize to auditory imagery. The perceptual features of auditory experience occur along three dimensions: pitch, meter (or rhythm), and timbre. Auditory imagery experiments confirm that these metric properties of auditory perception are preserved in auditory imagery, that auditory imagery draws on the same neurophysiological processes in the auditory cortex as ordinary hearing, and that focal damage to these areas disrupts auditory imagery. For instance, Halpern asked participants to identify whether a lyric was part of a song or not. Those asked to mentally play through the song took longer to respond than those who were not, and differences in their response times were proportional to the musical time between the target lyrics. Typically, participants reported that they needed to "play through" the song from the beginning. In a second experiment, Halpern asked participants to identify whether a note corresponding to a lyric was higher or lower in pitch than the starting note. Some subjects could not do this at all. However, those with musical training were better than non-musicians, and differences in response times were more pronounced than in
the previous experiment. These data provide further evidence to suggest that participants use a modality-specific representation of the musical elements of pitch and tempo rather than conceptual knowledge of a tune in musical imagery tasks.

Halpern’s claims are modest: she states that her results show that auditory imagery is a “strong subjective experience” and at least partly quantifiable. “People indeed behave as if they were running songs through their heads. That is, the evidence seems to point towards a representation that codes extension in time, that unfolds in real time, that has strong links between adjacent elements, and that is unidirectionally ordered.”25 This isn’t to say that we don’t also encode melodies in other ways (e.g., to know that a piece starts on F requires conceptual encoding of the music-theoretical category “F”), but it is to insist that the metric qualities of musical imagery that are unique to the modality of hearing must be represented in ways that are sensitive to just these qualities. Nonetheless, Halpern’s results support our phenomenological intuitions about musical imagery as a productive capacity to generate auditory images. We experience “inner tunes” not merely as having some pitch, but as having particular identifiable pitches. Furthermore, we can scan melodies by playing them in our heads, demonstrating that these representations encode temporal features of their targets. Finally, lesion studies of focal brain damage and imaging studies of normal subjects demonstrate that auditory imagery exploits the same sets of neurophysiological processes as ordinary auditory experience.26 Overall, these studies in psychology and neuroscience support the hypothesis that “parts of the cortex specialized for processing actual sound are also recruited to process imagined sound.”27 This, in turn, lends support for the phenomenological intuition that the experience of imagery is importantly like the experience of perception. Halpern describes musical imagery as follows:

the “tune inside the head” is in some ways an apt description of the representation of familiar tunes. These tunes seem to be stored with much exact or analogue information... [Moreover], real time passes while auditory images are activated, and the representations apparently include the fairly absolute perceptual information of tempo and pitch, in addition to the relative information of note and harmony relationships.28

What philosophical purpose does a discussion of these results from the cognitive neuroscience of music serve? It supports the intuition that experiences of musical imagery have a perceptual basis, and thus contributes to debates about the nature of musical understanding. Musical sounds, especially pitches of instrumental sounds, are not the sorts of thing that we can comprehend through multiple sense modalities. If we are to imagine musical sounds, and not just imagine that there are musical sounds, or that something is true of a musical sound, this imagination must be, contrary to Scruton’s claims, perceptual, and it must be specifically auditory.29 This opens the way for specifically perceptual cognition, and demonstrates that the propositional imagination cannot coherently explain imagined content that has a perceptual, as opposed to propositional, structure. Thus, shedding light on the neural underpinnings of auditory imagery provides support for the claim that there is something that performs the functions of the musical imagination, and elucidates an important component of the musical listening experience. Auditory memories seem to be stored as past auditory percepts, and can be recalled in a way that reproduces the pitch and temporal details of the original auditory experience. Zatorre and Halpern review evidence that suggests that it is plausible to think that composers who report “hearing” their compositions internally are drawing on the same capacity for auditory imagery used to rehearse a remembered piece of music.30 In addition, gifted composers are likely to have this capacity developed to a high degree—a link between one sort of imagination and creativity. Musicians who “rehearse” pieces internally are also reporting vivid imagery experiences. Hearing a piece that one already knows involves reviving an auditory image of that piece, drawing upon memory stores that function as a kind of constructive imagination.31 All of these are functions of the imagination as that concept developed in the 18th century.

Finally, these studies can contribute to our understanding of musical appreciation. Cognitive neuroscience demonstrates that musical capacities are highly variable, and that both listening to and performing music seems to alter the very structure of the brain.32 Arguably, what is happening is the formation of aural/musical categories for the components of music as well as for entire compositions. As a result, it may not be advisable to give a univocal philosophical account of musical understanding. This variability in musical imagery capacities might explain why non-experts tend to understand music through various non-musical aids, while highly trained musicians and musical formalists insist that it is improper to summon visual pictures to accompany one’s experience of purely instrumental music. Further, if it is the case that the musical ability relevant to music listening can be developed later in life, then those who insist on formalist listening are not asking the impossible. If, however, there are limits to what listening capacities many people can develop, whether or not audiences appreciate complex, abstract, atonal music is not merely a matter of conservative or progressive tastes. Rather, most people simply have not developed the musical categories needed in order to hear this music as coherent, let alone enjoyable.33 The studies and results discussed in this section demonstrate that cognitive neuroscience can help determine whether philosophical paradigms of music listening are consistent with physiological facts about the psychological processes that underwrite our engagement with performances of musical compositions, and, as a result, contribute to aesthetic issues related to musical understanding and appreciation.

Visual Art

Current research in the cognitive neuroscience of visual art lies at the confluence of two broad research strategies: empirical aesthetics and aesthetic experimentalism.34
Empirical aesthetics is a field of research that traces its roots to the beginnings of experimental psychology in the late 19th century. The central claim of the field is that we can learn about the nature of art and associated aesthetic experiences by using the methods of psychology and related fields to examine behavioral responses to artworks. Aesthetic experimentalism is the view that visual artists develop formal and compositional vocabularies by trial and error, or through a systematic exploration of the perceptual effects of different sets of marks, color schemes, and compositional arrangements. The central claim of aesthetic experimentalism is that we can learn about the operations of perceptual systems by examining the productive strategies of artists (e.g., the way visual artists develop and use formal techniques to convey information in their works). A general model for the cognitive neuroscience of visual art emerges from the rapprochement between these two research strategies. Cognitive science, in the broadest sense, is the study of the way organisms acquire, recognize, manipulate, and use information in the production of behavior. Visual artworks are stimuli intentionally designed to trigger ordinary perceptual, affective, and cognitive responses in spectators. Questions about the understanding and appreciation of visual artworks are, as a result, questions about the way viewers acquire, represent, and manipulate information embedded in the formal and compositional structure of artworks in order to recognize and evaluate their content. Cognitive neuroscience is a tool that can be used to investigate and model these processes. Therefore, cognitive neuroscience is a tool that can be used to investigate and model the cognitive and perceptual processes subserving our engagement with artworks. Data collected in these types of studies can be used to confirm art critical judgments about particular paintings and, as discussed above in the cases of narrative fiction and music, adjudicate between competing theories in philosophical debates about the nature of art and the defining characteristics of aesthetic experience.

This model for the cognitive neuroscience of visual art rests on the assumption that correlations between the formal features of artworks and basic neurophysiological mechanisms in the visual system can be used to explain how visual artworks work as perceptual stimuli. This assumption is, in turn, grounded in the following argument. The input to the visual system is replete with information about the local environment. However, only a small fraction of this information is diagnostic for the identity of an object, action, or event at any given time. In this regard one can think of the visual system as a set of evolved biological mechanisms whose function is to select information from sensory inputs that is sufficient for visual recognition and action. Artists’ formal methods and vocabularies are tools for culling features sufficient for object, action, and event recognition (or in the case of abstract visual art features sufficient for figure-ground segregation and form recognition) from ordinary perceptual experience and rendering them in a medium. These productive strategies work because artists’ formal strategies and vocabularies are directed at just those sets of environmental features that trigger the ordinary operations of perceptual systems. Therefore, the success of a visual artwork, its capacity to convey its content to viewers, depends on productive relationships between its formal features and the operations of the visual system.

A good deal of research in the cognitive neuroscience of visual art is dedicated to searching out and explaining these relationships between the formal strategies employed by artists and the operations of the visual system. Philosophers have been generally skeptical whether these types of perceptual explanations of artworks can contribute to our understanding of the nature of art or the character of aesthetic experience. What one needs in order to answer these skeptics is an argument that ties explanations of the way artworks work as perceptual stimuli to explanations of their artistically salient features (e.g., perceptual features responsible for the aesthetic effects and semantic associations constitutive of their status as artworks). A first pass at such an argument is forthcoming in the analysis of artists’ productive practices. Consider the case of realistic landscape painting. Painters engage in formal studies (e.g., drawing studies) in order to recover sets of environmental features sufficient for naturalistic depiction. However, there is no single, ideal set of formal cues necessary for rendering these environmental features. Even in the case of highly realistic portraits and landscape paintings, any of a broad range of formal vocabularies and compositional strategies will suffice. This suggests that artists choose the formal and compositional strategies they use relative to the aesthetic effects and semantic associations they intend a particular work to produce. Artworks can, in this context, be thought of as artifacts intentionally designed to direct attention to their artistically salient features. Cognitive neuroscience can contribute to explanations of the ways particular artworks work to direct attention and produce perceptual, expressive, and cognitive effects. These explanations can, in turn, provide data to clarify whether our best theories of art are consistent with the psychological processes that underlie our engagement with artworks. Therefore, explanations of how visual artworks work as perceptual stimuli can contribute to our understanding of how they work as artistic stimuli. In what follows we discuss three case studies that illustrate this model for the cognitive neuroscience of visual art: Richard Latté’s discussion of the use of irradiation in Georges Seurat’s Bathers at Asnières, Margaret Livingston’s discussion of Mona Lisa’s elusive smile, and Lizann Bonnar, Frédéric Gosselin, and Phillipe Schyns’s discussion of Salvador Dalí’s disappearing portrait of Voltaire.

Georges Seurat used a formal technique called irradiation to enhance edges and amplify figure–ground segregation in Bathers at Asnières (Fig. 2.1). Irradiation is derived from the observation of Mach bands in ordinary perception. Mach bands are perceived light and dark stripes that occur at luminance boundaries in the visual field. However, these image features do not correspond to any objective features of the distal environment. They are instead artifacts of the way the visual system initially encodes the information contained in the light that impinges on the retina. Interestingly, although the scientific discovery of Mach bands is attributed to Ernst Mach in the mid-19th century, painters have copied this feature of...
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enhances luminance contrast along these edges. Therefore, one function of lateral inhibition is to amplify the intensity of a feature of the sensory input that defines the boundaries between objects in perception. This in turn contributes to form recognition by enhancing the contrast between figure and ground.\textsuperscript{29} Irradiation involves copying Mach bands onto the canvas at critical object boundaries in order to amplify the effects of lateral inhibition in our perceptual interactions with a painting. The resultant glowing, irradiated edges draw attention to object boundaries, amplify the luminance contrast between a figure and its surround, and so sharpen the perception of depth in the picture plane (e.g., the contour defining the back of the seated figure in the center foreground in Bathers at Asnières.\textsuperscript{21}) Therefore, irradiation is an explicit feature of artists’ formal vocabularies whose utility in paintings is explained by its resonance, or close coupling, with discrete neurophysiological mechanisms in the visual system.

Lotto argues that irradiated edges are aesthetic primitives or features of a work that viewers experience as aesthetically pleasing because of their resonance with the basic operations of the visual system. However, there is a difficulty for this interpretation. Stimuli like the luminance ramps used to illustrate Mach bands are intentionally designed to optimally stimulate these basic neurophysiological mechanisms.\textsuperscript{22} Further, Mach bands, as artifacts of the way lateral inhibition contributes to figure-ground segregation in all ordinary perceptual contexts, are ubiquitous in the visual environment (e.g., we see Mach bands at shadow boundaries because lateral inhibition is finely tuned to this type of environmental feature).

If Lotto’s model were correct we should find luminance ramps and shadow boundaries to be deeply compelling aesthetic stimuli—but we do not. Therefore, although this case study demonstrates that cognitive neuroscience can contribute to our understanding of the way paintings work as perceptual stimuli, it does not establish irradiated edges as artistically salient features of Bathers at Asnières. This objection reflects a common problem for any theory that proposes to explain art in terms of ordinary cognitive processes: if the nature of art can be explained in terms of ordinary psychological processes subserving our engagement with artworks, one needs an additional explanation to determine what, if anything, differentiates artworks from ordinary artifacts.

It has been argued that the artistic value of Leonardo’s Mona Lisa emerges from the way he used sfumato to render the dynamics of the figure’s facial expression.\textsuperscript{23} Sfumato is a formal technique in which artists blur the sharp edges that define object features in a painting so that these boundaries disappear into soft, “smoky” shadows. Leonardo used this technique to render the critical facial features that define Mona Lisa’s expression, the corners of her mouth and eyes. Gombrich argues that these sfumato contours introduce a degree of ambiguity into the painting that forces viewers to use their imagination to interpret an expression that cannot ever be discretely resolved. The dynamics of the composition, on his account, emerge from these imaginative events, and are enhanced by spatial inconsistencies in the background landscape that alter the way viewers perceive the

ordinary appearances into their paintings since at least Robert Campin (1406–1444)\textsuperscript{47} and Leonardo (1452–1519) described the utility of this technique in his writings on artists’ formal methods.\textsuperscript{48} The presence of Mach bands in the visual field is explained by lateral inhibition in the retina, an architectural feature of neural networks that enables cells to modulate the outputs of their nearest neighbors.\textsuperscript{49} A ganglion cell in the retina receives excitatory signals from photoreceptors and inhibitory signals from other ganglion cells that surround it. The outputs of retinal ganglion cells are determined by the sum of their excitatory and inhibitory inputs. Ganglion cells that respond to discrete regions of a homogenous light field receive identical excitatory and inhibitory inputs. Therefore, the outputs of these cells are identical. However, imagine a border between two homogenous fields of different luminance. Ganglion cells along the bright side of the border between these regions receive less inhibition from their neighbors on the dark side. The overall response of these cells will therefore be higher than their neighbors in the “bright” field. The converse is true for the cell along the dark side of the border. As a result, lateral inhibition generates illusory light and dark stripes along the boundaries between regions of different luminance that do not match the intensity of light received from the environment.

The visual system interprets sharp variations in luminance to indicate boundaries between discrete surfaces that define objects in the visual field. Lateral inhibition
posture and relative size of the figure as they scan the painting. The net result is an elusive, lifelike expression that is indicative of the ebb and flow of an ordinary individual’s mental states and enhances the qualitative character of our imaginative engagement with the subject of the painting.

Livingstone has demonstrated that differences between the spatial resolution of peripheral and foveal vision explain how sfumato works to generate the dynamics of Mona Lisa’s expression. We are able to discern remarkably fine-grained visual detail in the central, or foveal, region of the visual field. However, foveal vision is nearly blind to visual features defined by coarse-grained image information. Conversely, peripheral vision is tuned to coarse-grained image features at the expense of fine-grained visual detail. Livingstone filtered a reproduction of Leonardo’s painting in order to separate out the low-, middle-, and high-spatial-frequency information used to depict Mona Lisa’s face (Fig. 2.2). The difference between low/middle- (coarse-grained) and high (fine-grained) spatial-frequency information is roughly analogous to the difference between the use of shading or discrete narrow lines to depict object boundaries in a drawing. The sfumato contours that define Mona Lisa’s smile were more apparent in the images representing low- and middle-spatial-frequency information in the painting than the sharp lines of the high-spatial-frequency image. For instance, the slight upturn of the corner of her mouth, which is extended and exaggerated into the hollows of her cheek by the coarse-grained image features in the low- and middle-frequency images, is nearly invisible in the fine detail of the high-frequency image. Therefore, critical formal features defining Mona Lisa’s smile are depicted only in low- and middle-spatial-frequency information.

The spatial resolution of human vision decreases dramatically as one moves from the center of the visual field towards the periphery. For instance, Livingstone reports that the spatial resolution of normal vision diminishes by a factor of 10 just 7 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. The 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, like contours rendered in sfumato, that carry low- and medium-spatial-frequency information. 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. As a result, when one foveates on, or directs one’s attention to, Mona Lisa’s smile it disappears. However, the smile reappears in a viewer’s peripheral field when he or she looks away. Therefore, the dynamics of Mona Lisa’s expression emerge from the differential sensitivity of foveal and peripheral vision to low-spatial-frequency information in the painting.

Livingstone’s discussion of the Mona Lisa provides another example of the close coupling between the operations of the visual system and the formal strategies of artists. Further, the identification of a mechanism that underwrites the dynamics of the depicted expression both clarifies and improves upon Gombrich’s discussion of the painting. If sound, Gombrich’s account would entail that a viewer’s interpretation of Mona Lisa’s expression should vary with his or her state of mind, or with the qualitative character of his or her imaginative engagement with the painting. In this sense, the depicted expression need not necessarily be dynamic at all. If Mona Lisa’s mental state remains stable in a viewer’s imaginative engagement with the painting, so will her expression. Livingstone’s explanation, to the contrary, demonstrates that the depicted expression varies systematically with the eccentricity, or distance, of one’s focus of attention from the center of Mona Lisa’s face. This explanation accounts for the robustness and elusiveness of Mona Lisa’s expression. It also attributes a more explicit directive role to the sorts of compositional choices Leonardo made in constructing the background landscape: spatial discrepancies in the landscape draw viewers’ attention away from the figure (e.g., the discrepancy between the position of the horizon on the left and right side of the painting); the depicted expression is revealed as one looks away to explore these spatial discrepancies: it changes systematically as one scans the painting; and it disappears as one returns his or her attention to the face to resolve it.

It is important to note, however, that this case study does not itself establish that the elusiveness of Mona Lisa’s smile is an artistically salient aesthetic effect of the painting. Sfumato works to produce the effects it does in the painting because it yields the same types of facial cues that the visual system uses to recognize and interpret facial expressions in ordinary, non-aesthetic perceptual contexts. Nonetheless, the case study does confirm the art critical claim that Mona Lisa has a dynamic expression and explains the sorts of formal choices that Leonardo used to guide viewers’ attention and produce this central feature of the work. In this
regard, Livingstone’s discussion contributes evidence in support of a particular hypothesis about the aesthetic quality of the painting. This in turn demonstrates that these types of case studies can contribute to art critical discussions about particular artworks. Further, theories about the nature of art and aesthetic experience rest ultimately on their consistency with facts about the way we engage with particular artworks. Therefore, case studies like Livingstone’s, case studies that are focused on understanding the way we acquire, represent, manipulate, and use artistically salient information carried by a painting, can potentially provide data to help adjudicate among competing positions in theoretical debates about difficult aesthetic problems.

Bonmar, Gosselin, and Schyns’ discussion of Salvador Dalí’s Slave Market with the Disappearing Bust of Voltaire demonstrates that the differential use of low- and high-spatial-frequency information to convey information in a painting generalizes to other cases. Dalí’s painting is a bistable ambiguous image (e.g., a Necker cube or the duck/rabbit image) whose central feature is perceived as either two figures walking arm in arm or a large marble bust of Voltaire (Fig. 2.3). The bistability of the image is an artistically salient feature of the painting that generates both the perceptual ambiguity and the range of semantic associations that are constitutive of its identity as an artwork. Bonmar and her colleagues used a technique called frequency-specific adaptation to demonstrate that this high- and low-spatial-frequency information was selectively used to drive the perception of either the nuns or the bust of Voltaire in the painting. They first filtered a cropped reproduction of the work into six different spatial scales in order to separate out low- and high-spatial-frequency information diagnostic for the perception of either the two figures or the bust of Voltaire. Although there was some overlap, the nuns were more apparent in the high-spatial-frequency images and the bust of Voltaire was more apparent in the low-spatial-frequency images. Frequency-specific adaptation can be used to desensitize the visual system to the particular spatial-frequency information presented in a stimulus. Bonmar and her colleagues predicted that if high- and low-spatial-frequency information is used selectively in the Dalí painting to drive the perception of either the nuns or the bust of Voltaire, then participants adapted to high-spatial-frequency information should see the bust of Voltaire and participants adapted to low-spatial-frequency information should see the two nuns. Participants viewed an animation constructed of either high- or low-spatial-frequency dynamic noise, after which they were shown a hybrid image composed of just the high- and low-spatial-frequency information diagnostic for the nuns and the bust of Voltaire. The results of the experiment confirm this prediction.

These results demonstrate that Dalí used different types of spatial-frequency information to carry different artistically salient information in Slave Market with Disappearing Bust of Voltaire. The background under the arch behind the two nuns is colored brown as if filled in with a wall. However, the cut-out windows resemble the shapes of clouds, which is consistent with the open-sit arch to its left. In the latter context the occlusion boundary that defines the top of Voltaire’s head has the appearance of a rough-hewn open arched doorway through which the nuns have entered the market. These ambiguities in the identity of the background draw viewers’ attention to the top of the doorway and the cloud/windows, and, in the process of doing so, reveal the coarse-grained visual information diagnostic for the bust of Voltaire (i.e., the heads of the nuns become his eyes, their interlocked arms his nose, and their aprons his chin). The play of these two discrete perceptual resolutions of the work, in turn, generates the contrasting interpretations that are constitutive of its artistic salience.

The three case studies discussed here provide a promising model for how to pursue research in the cognitive neuroscience of art more generally. They suggest that we can come to understand the nature of art and aesthetic experience by tracking the relationship between the formal and compositional structure of particular artworks and viewers’ behavioral responses. The model that emerges defines artworks as attentional strategies intentionally designed to direct attention and enhance the perception of features diagnostic for their artistically salient aesthetic (e.g., Mona Lisa’s elusive smile) and semantic (e.g., the bistable ambiguous content of Dalí’s painting) content. These case studies each demonstrate a role for exogenous, stimulus-driven attentional processes in our engagement with artworks. However, attention is also endogenously driven by knowledge and expectations. The influence of knowledge and expectations in perception is mediated by frontoparietal attentional networks that are employed to shift attention and prime
the firing patterns of networks of neurons in the visual system to the presence of expected objects and features at particular locations. These feedback projections influence visual processing as early as the lateral geniculate nucleus. Although there is not space to discuss these processes here, research suggests that artworks are attentional strategies that harness both basic formal features and viewers’ semantic knowledge, including art historical knowledge of the unique sets of formal strategies used to categorize artworks as belonging to artistic types (e.g., the works of particular artists, schools, or epochs), to convey their content.

What, if anything, can all of this contribute to the philosophy of art? First, it suggests that some of the philosophical difficulties associated with the cognitive neuroscience of art can be attributed to the growing pains of an evolving field of interdisciplinary research. The various disciplines involved in interdisciplinary endeavors each bring prior theoretical and practical biases with them to the table, biases that can initially cut at cross-purposes to one another. In the case of cognitive science and aesthetics we see that there is often a difficulty clarifying (and agreeing upon) the appropriate targets for perceptual explanations of artworks, or identifying which exactly are the artistically salient features towards which research in the cognitive science of art ought to be directed. In this regard more work needs to be done to determine how to isolate and model the types of aesthetic and semantic effects used to categorize artifacts as artworks. Second, we often make reference to the formal structure of artworks in explanations of the nature and function of art. In its broadest, most comprehensive sense the term denotes all of the individual parts of an artwork and the relations among them (e.g., the lines, color patches, and shapes, as well as the objects, their parts, and the relations among them in a painting). However, this descriptive sense of artistic form is not particularly useful in explaining art. What one needs is a way to constrain our understanding of formal structure to just those features and relations that contribute to the function of an artifact as an artwork. An account of this functional sense of artistic form is transparent in the definition of visual artworks that emerges from the discussion of the cognitive neuroscience of visual art. Works of visual art are artifacts intentionally designed to direct attention to the features responsible for their artistically salient effects. The formal structure of an artwork can thereby be understood as the sum total of the formal and compositional choices directed towards the production of these effects.

Finally, the account of formal structure that emerges from this discussion can contribute to debates about the role that artists’ intentions play in the determination of the content of a work of art. On the one hand it seems beyond question that the intentions of an artist play a significant role in our determination of the content of an artwork (skeptics need only consider how the meaning and artistic value of a particular work would change with the discovery that it is a forgery, or that the artist intended it as a piece of unappealing political propaganda). Many, if not all, artworks are occasions for communicative events in which artists express ideas and emotions. In this context it seems that our interpretation of the content of an artwork is constrained by the intentions of the artist in ways that are analogous to our interpretation of the use of metaphors in ordinary conversation. However, we rarely, if ever, come to a work of art with explicit knowledge of the actual intentions of the artist. Rather, it would seem that we treat the artist as a hypothetical agent, or infer the most plausible set of intentions from the best available evidence. On the account that we have provided, visual artworks are attentional strategies that carry information sufficient to enable viewers to recover their content from their perceptible surfaces. In this regard the formal choices made by an artist direct attention to the works semantically salient features, and so constrain the set of available, appropriate interpretations. This in turn provides a principled means not only to recover the content of the work without demanding explicit prior knowledge of an artist’s actual intentions, but also to evaluate the adequacy of competing interpretations of those intentions.

Conclusion

In this chapter we have provided counterarguments to philosophical skepticism about the relevance of results of psychology and neuroscience to aesthetics, maintaining that philosophical skeptics who hold this view have an overly narrow conception of the problems of aesthetics. Artworks are, ultimately, artifacts intentionally designed to direct attention to the features responsible for their artistically salient aesthetic and semantic effects. In this regard, questions about the nature of our understanding and appreciation of art are questions about the ways in which we cognitively engage (broadly construed to include perception) with art, questions that ultimately depend on an understanding of our psychological interactions with particular artworks. Therefore, we have claimed that cognitive science has bearing on a variety of topics relevant to aesthetics. We have focused on three sets of examples from different art forms. First, we showed that recent research on the emotions elucidates our responses to fiction. Second, we argued that studies of musical imagery shed light on both the way we hear and understand music and the cognitive and neural processes that account for some of our experiences of sensory imagination. Finally, we argued that explanations of how visual artworks work as perceptual stimuli can contribute to our understanding of how they work as artistic stimuli. These discussions point towards the continuation of the rich and productive rapprochement between aesthetics and psychology originally envisioned in works of 18th-century philosophers like Alexander Baumgarten.

Endnotes


8. One goal of Calvo-Merino and coworkers’ study is to develop a methodology to resolve this difficulty with preference-ordering studies.


employs the same areas of the motor cortex involved in planning and preparation for the imagined types of actions in ordinary contexts. These areas are also activated when expert musicians listen to music, suggesting that motor simulation plays a productive role in musical understanding. See Decety, J., & Grèzes, J. (2006). The power of simulation: imagining one's own and others' behaviour. *Brain Research, 1979,* 4-14.


8. See Zatorre and Halpern, 2005, p. 10-11. This is a claim about the findings of the experiments on musical imagery and understanding, but a skeptical claim about multisensory integration in auditory perception.


60. Diagnostic features are defined as sets of image cues that are sufficient to determine the identity of a stimulus or to perform an action. See Schyns, P. G. (1998). Diagnostic recognition: task constraints, object information, and their interactions. *Cognition, 67,* 1-2.


84. See also Rollins, 2004, pp. 185–186.


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**Aesthetic Theory and Aesthetic Science**

**PROSPECTS FOR INTEGRATION**

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Researchers from different disciplinary backgrounds often propose competing explanations of such phenomena as emotion, consciousness, or aesthetic response. Though sometimes heated, this kind of disagreement is not fundamental. Fundamental disagreement occurs when researchers from different backgrounds have different, even incompatible, conceptions of the phenomenon to be explained. Disagreements about how to explain a phenomenon are not fundamental; disagreements about what is to be explained are fundamental. There is currently a great deal of fundamental disagreement in research into aesthetic response. The remedy is ideally integration, wherein researchers converge on a common conception of what they are trying to explain, even if they continue to disagree about how to explain it. In other words, the remedy is to work towards a theoretical concept of aesthetic response that serves explanations in the different aesthetic sciences and non-scientific studies as well. An integrated concept has potential benefits for all kinds of scholars whose subject is aesthetic response.

**The Aesthetic Sciences**

Quite independently of the need for a theoretical concept of aesthetic response that is common to the sciences and the humanities, there is also a need for integration within the aesthetic sciences themselves. On the one hand, an examination of the recent literature in different sciences on aesthetic responses to visual stimuli indicates that investigators may not be getting at the same phenomenon in their explanations. Aligning the aesthetic sciences with each other may prove beneficial. On the other hand, these investigations range over different levels of analysis, from the neurobiological to the psychological, and a common conception of what is to be explained may be useful to understand how explanations at these various levels of analysis cohere and reinforce each other.

To begin with, different groups of investigators have, over the past few decades, studied what we may think of as different parts of aesthetic responses to visual presentations. It makes sense to expect that any aesthetic response (e.g., when