Cognitive Science, Aesthetics, and the Development of Taste

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Abstract

Aesthetics and the arts have garnered more attention within cognitive science in recent years. Despite this increasing interest, "scientists of art" often focus on one of two areas: the formal properties of artworks themselves, or the mental processes involved in perceiving these works in an isolated, one-on-one encounter. In this paper, I review some representative examples of such work before suggesting some alternative ways that cognitive science might approach aesthetics and the arts—ways that would complement the isolationist approaches that have predominated to this point. In doing so, I draw on the observations and arguments of various philosophers of art, highlighting some of the socially and culturally situated factors that are important in shaping the development of our taste and sensibilities.

Keywords: Aesthetics; Culture; Social Cognition; Art.

Introduction

What can cognitive science tell us about aesthetic experience? Given the putative aims of cognitive science—roughly, "to provide a cogent scientific account of how human beings achieve their most remarkable symbolic products" (Gardner, 1987, p. 391)—artistic and aesthetic phenomena fit within the scope of the field. While they have long been fringe topics within the field, they have been garnering increasing attention in recent years. This work ranges from so-called neuroaesthetics (Ramachandran & Hirstein, 1999), which seeks to uncover the evolved neural underpinnings of our aesthetic responses, to computational aesthetics (Hoenig 2005), which employs sophisticated mathematical tools to analyze the formal properties of various aesthetic objects. Meanwhile, others have focused more on the representational and/or computational processes involved in perceiving and appreciating works of art

Despite this recent interest, there remains a deep-seated tension between the aims of science, which prizes generality, laws, and quantification; and the arts, which we experience qualitatively through encounters with particular works (songs, paintings, films, etc.). Furthermore, these experiences take place amid a complex background of social, cultural, and historical influences. Thus, one could argue that the goals of science are simply incompatible with the kind of understanding we seek when it comes to aesthetics and the arts. Such misgivings have been voiced by many philosophers (Dickie, 1962; Morgan, 1950; Wittgenstein, 1967) and even some psychologists (e.g., Arnheim, 1991). Others view these misgivings as stubbornly anti-science, insisting that the problems faced by "scientists of art" are merely very difficult, not fundamentally intractable or ill-conceived. If the results of their efforts have been meager, they argue, it is because of this difficulty, together with the fact that it's still early—and after all, one must start somewhere (cf. Berlyne, 1971; Birkhoff, 1932; Meyer, 1957; Rigau, Feixas & Spert, 2008).

Instead of trying to resolve this longstanding debate, I want to focus on the *picture* of aesthetic experience that has tended to emerge from cognitive science's encounters with the arts. According to this picture, the artwork (or other aesthetic object) is treated as an isolated stimulus, while the viewer or listener is treated as a sort of idealized receiver of the information encoded in the work. With this picture in mind, researchers typically either focus on (a) the intrinsic properties of artworks (or other aesthetic objects), as with much of computational aesthetics; or (b) on the mental processing involved in perceiving and appreciating art (Kintsch, 2012; Leder, Belke, Oeberst & Augustin, 2004).

In this paper, I want to look more closely at some of this research, with the dual aim of showing what we can learn from it as well as what its limitations are. In keeping with the theme of the conference ("Cooperative Minds: Social Interaction and Group Dynamics"), I also want to suggest some alternative ways of approaching aesthetics and the arts—ways that would complement the isolationist approaches that have predominated to this point. In doing so, I draw on the observations and arguments of various philosophers of art and aesthetics, highlighting some of the socially and culturally situated factors that are important in shaping the development of our taste and sensibilities.

There are three main sections in this paper. The first looks at research (both recent and not-so-recent) on the perception, appreciation, and value of visual art; the second looks at some parallel work on music (in particular, on musical meaning); and the third focuses on outstanding questions and possible future directions for research.

Order, Complexity, and Value in Visual Art

The scientific study of aesthetics date back to at least the 1870s and Gustav Fechner (cf. Arnheim 1985). However, the work of mathematician George Birkhoff's *Aesthetic Measure* (1933) remains an important landmark in this pursuit. Birkhoff's quest to formalize beauty yielded a succinct mathematical equation, $M = O/C$, where M is the aesthetic measure (or value) of the stimulus in question, O is the order, and C is the complexity. This equation was thought to crystallize Fechner's notion of "unity in variety" while providing a "logical tool in order to answer aesthetic

questions by purely mathematical (logical) reasoning" (p. 46). Birkhoff asked, and sought to answer, questions such as, "Which is the most beautiful of all polygonal forms?"

Birkhoff's approach was grounded in two key assumptions. First, it is assumed that the *formal* properties of the aesthetic object (e.g., symmetry, equilibrium, number of components, etc.) can be isolated from its *connotative* (i.e., referential or associative) properties. Second, he believed that the same kinds of methods employed in simplified domains (e.g., geometric forms) could be applied to other, more complex domains such as visual art, poetry, and music. The difference between the two was thought to be merely one of degree, not of kind.

Optimal Complexity, Pleasure, and Arousal

Birkhoff's conception of aesthetic measure influenced subsequent efforts by psychologists (e.g., Eysenck 1942) and information theorists (e.g., Moles 1966). The latter would recast Birkhoff's order and complexity as *redundancy* and *entropy*, respectively. The informational and psychological approaches were brought together by Berlyne (1971). Berlyne conceptualized the link between the two in terms of the Wundt curve (Fig. 1). The idea was that people prefer stimuli of moderate—but not excessive—novelty and complexity. The greater the stimulus complexity, the greater the arousal potential, which in turn correlated with a more pleasurable aesthetic experience, so long as the subject was not overwhelmed by the stimulus. Berlyne acknowledged that "what constituted novelty and complexity would vary from person to person" (Margulis & Beatty, 2008, p. 66), but maintained "that his adapted Wundt curve could apply to both of them; it would simply shift along the x-axis to reflect the experience level" of the perceiver (ibid.).

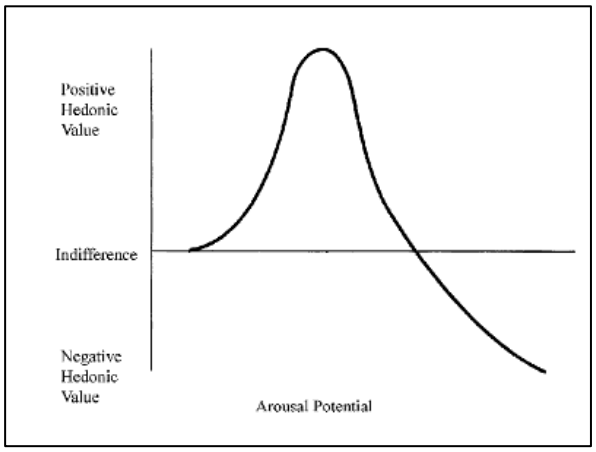

Figure 1: The Wundt curve. From Margulis and Beatty (2008); adapted from Berlyne (1971).

Surely, there is some truth to this sort of "Goldilocks theory" of complexity and optimal arousal. However, there is also a clear tradeoff between (1) the level of generality sought in such a theory and (2) the degree of fidelity one would hope for in a genuinely enlightening account of musical experience. In order to achieve the latter, it becomes necessary to reincorporate just those factors—listener background, experience, personality, mood, et cetera—that must be subtracted out in order for the information-theoretic approach to get off the ground. What I want to suggest is that the factors influencing this "shift along the x-axis" are where much of the interest lies. (I will return to this point below.)

From Aesthetic Measure to Computational Aesthetics

Computational aesthetics (Hoenig, 2005) is the most recent offspring of Birkhoff's aesthetic measure and its subsequent reformulations in terms of information theory. Various researchers have picked up on these threads, including Koshelev, Kreinovich, and Yam (1998), who recast aesthetic measure as a joint function of (a) the length of the shortest program required to generate a given visual design and (b) the running time of this program; and Machado and Cardoso (1998), who recast it as0020the ratio between image complexity and processing complexity.

More recently, Rigau, Feixas, and Sbert (2008) created several reformulations of Birkhoff's aesthetic measure—most notably, as the ratio between algorithmic reduction of uncertainty and initial information content, which correspond, respectively, to order and complexity. Essentially, this ratio measures "the degree of order created from a given palette" (2008, p. 131), with the "palette" construed as "the range of colors selected by the artist with a given probability distribution" (p. 128). This and other measures are applied to paintings by Mondrian, Pollock, and van Gogh, resulting in is a series of rank-orderings that, not surprisingly, show Mondrian's works to possess a higher degree of order than those of the other two painters.

These proposed metrics are intended to "help us … quantify the aesthetic experience" (p. 124), but it is questionable what we are to make of them. Are these formulas being proposed as measures of aesthetic value (in which case Mondrian trumps van Gogh and Pollock)? Would these metrics be able to discern the difference between a genuine Pollock and an imitation, or between a Mondrian painting and some generic arrangement of primary-colored geometric forms? Do the authors themselves draw a distinction between artistic value and mere pleasantness? It is not quite clear what lessons we are to take from this work.

Meaning, Information, and Entropy in Music

The quest to formalize aesthetic value in the visual arts has parallels in the attempt to quantify meaning in music. The work of Leonard Meyer (1957) is a touchstone here. Meyer linked musical meaning to expectation, uncertainty, probability, observing that "the rules of musical grammar and syntax found in textbooks on harmony, counterpoint, and theory in general" are "almost invariably stated in terms of probability" (p. 414). Conceived of in this light, the

"meaning" of a musical event—a note, a chord, or a phrase—is inversely proportional to its probability: low probability events (such as the sounding of a D ♭ in the key of C) are more surprising and thus more meaningful. Meyer summarized, "Both meaning and information are thus related through probability to uncertainty" (p. 416). The greater the probability, the lower the information, or entropy.

By operationalizing musical meaning in terms of information theory, Meyer lent the former a newfound precision. However, the tradeoff is that this precise characterization does not intuitively capture what we typically mean when we talk about "meaning," whether in music or in more general terms. "So much for intuitions," one might reply—except that Shannon and Weaver themselves warned against conflating information (in the information-theoretic sense of the term) with meaning. For example, Weaver (1949) stressed that "the rather strange way in which, in this theory, the word 'information' is used … must not be confused at all with meaning" (p. 12). He added, "It is surprising but true that, from the present viewpoint, two messages, one heavily loaded with meaning and the other pure nonsense, can be equivalent as regards information" (ibid.).

Similar objections were raised by Vermazen (1971) and Sherburne (1966) in direct response to Meyer. One objection, later referred to as the "Information Theory Paradox" (cf. Titchener & Broyles, 1973), holds that if meaning were tied to uncertainty, then repeated listening to the same piece would yield less and less "meaning" each time—which surely runs counter to experience. The second objection is that the most meaningful music would be that in which all of the musical events within the piece were equally likely to occur at any moment.

Cultural Noise and Distance

Meyer anticipated some of the aforementioned objections in his 1957 paper. In order to circumvent them, he appealed to the related notions of *cultural distance* and *cultural noise*. Writing during the heyday of serialism, Meyer acknowledged the general public's disdain for modern classical music: "Here 'noise' is the result of a time-lag between the habit responses which the audience actually possesses and those which the more adventurous composer envisages for it" (p. 420). He added that "in their zeal to 'pack' music full of meaning some contemporary composers have perhaps so over-loaded the channel capacity of the audience that one meaning obscures another in the ensuing overflow" (p. 420). Thus, too much meaning (in the information-theoretic sense) can essentially render a work meaningless (in the pre-theoretic sense), at least to lay audiences.

Cultural noise and distance are also invoked to explain why audiences struggle to make sense of music from unfamiliar cultures. In a nutshell, "[T]he more distant a culture is from our present set of habit responses, the greater the amount of cultural noise involved in communication" (p. 420). While there is truth to this statement, it overlooks that (a) the listener always brings something to the table, even if it is simply a lack of familiarity with the musical style in question; and (b) there is always some degree of distance between listener and work. Meyer's way of factoring out this distance was to take for granted the notion of an "Ideal Auditor"—that is, someone who "knows the style of the piece and the styles of the period and thus has an experiential basis for the expectations which Meyer's theory requires" (Titchener & Broyles 1973, p. 17). But how do we come to know the style of a piece or the style of a period? As with the confounding factors that caused Berlyne's modified Wundt curve to shift along the x-axis, these factors are worthy of exploration in their own right.

Meyer Rehabilitated? Huron's *Sweet Anticipation*

The most thorough and ambitious attempt to bring Meyer's work up to date can be found in Huron (2006). Huron maintains Meyer's emphasis on listener expectations—and the ways in which they are "exploited" by composers—as the key to a systematic understanding of how music works on the mind/brain. One could debate the "composer as manipulator" characterization that emerges throughout this work, along with the idea that the chief aim of music is to evoke specific emotions in listeners. However, I will instead look briefly at Huron's effort to incorporate cultural context into an account that is otherwise rooted in evolutionary psychology, statistical learning, and information theory.

A specific example comes from a study that compared Balinese and American musicians' predictions of successive notes in a melodic line. The melody was composed in a 10-tone Balinese scale but was unfamiliar to participants in each group. Huron and his associates found that while the Americans performed better than chance, they were outpaced by their Balinese counterparts in terms of both predictive accuracy and confidence (as opposed to uncertainty) in their guesses.

Thus, in contrast to Meyer, Huron does try to account for "cultural noise," or at least one aspect of it. However, we should keep in mind that cultural background plays a more significant role in musical understanding and experience than merely imparting a set of statistical expectations for melodic or harmonic development. For example, what does it really mean to be an "American musician" (or "American listener")? Of course, there are certain melodic, harmonic, and rhythmic norms that most American (and, more generally, Western) listeners are accustomed to. However, underneath the broad umbrella of "Western music," there is a vast array of musical subcultures—pop, jazz, punk, classical, rap, electronic, noise, drone, Tin Pan Alley—most of which can be further subdivided into sub-subcultures. Each subculture (or subgenre) has its own norms, its own aesthetic values. To know a genre (or subgenre, or artist) extends far beyond possessing a matrix of transition probabilities of the sort used to model melodic expectation.

Another way to put it is this: Huron's emphasis on generalities—transition probability matrices, statistical

learning tendencies, and our (mostly) shared evolutionary heritage as human beings—lends itself to a study of what is universal about music cognition (or at least "universal" within a particular culture). This is fine as far as it goes, but this sort of account is not going to supplant the kind of understanding that comes from engaging with particular works and understanding them in particular contexts—whether that's the context of a genre, a historical period, an individual artist's work, or whatever else. There is value in the sort of research documented in Huron's book. It's just that the gains made in understanding the psychology of expectation through the study of music are likely to far exceed the gains made in understanding music via the psychology of expectation.

Sketching an Alternative Approach

In this section, I highlight some important points and arguments from philosophers of art and aesthetics, with the goal of suggesting alternative ways for cognitive science to engage with aesthetics and the art.

Aesthetic sensibility and personal development

Despite David Hume's (1757) ingenious arguments to the contrary, the notion of a fixed "standard of taste" is unrealistic. This is true whether we seek this standard in the form of a group of ideal critics or judges, as Hume suggested, or whether we follow the Birkhoffs of the world in searching for quantifiable measures of aesthetic value. Regardless, the lack of a fixed or objective standard doesn't stop us from seeking to improve our taste and encounter more rewarding aesthetic experiences. The development of taste and aesthetic sensibility is an ongoing process. But how do we know where to look for these more rewarding experiences as we undertake this process of developing our taste? Herwitz (2008) offers some useful suggestions, arguing that "taste is a circular and constructivist enterprise. We are led by others because they elevate our taste to their level, and this because we already have taste" (p. 52). Even so, we are left to ask how we are able to gain an initial foothold in this process.

One suggestion comes from neuroaesthetics (Ramachandran & Hirstein, 1999), which seeks to uncover the evolutionarily hardwired tendencies that shape our preferences. Certainly, our preferences and tastes are constrained by our biological makeup, but they are not rigidly determined by them. What we know about an artwork or other aesthetic object affects our appreciation of it. This seems like a truism, but it poses problems for nativist accounts of aesthetic preference.

A vivid example comes from Saito (2010), in which the author discusses the example of a lavishly kept green lawn in Arizona. Superficially, the lawn might be visually appealing—the kind of lawn that would make any suburban homeowner jealous. Yet once we come to understand what goes into maintaining such a lawn in the middle of the desert—in particular, the burden it places on the local environment—it is likely to lose some of its appeal. It might even be perceived as garish or tacky, in much the same way that a previously admired painting loses its luster when it turns out to be a forgery. In other words, we do not just respond automatically and passively to aesthetic stimuli. Furthermore, our differential responses to artworks and other aesthetic objects cannot be simply a matter of differences in processing fluency (think back to Berlyne's modified Wundt curve). How can we better understand the effects of such background knowledge on our aesthetic responses? This is another underexplored question for cognitive science to consider.

Getting Outside the Frame

It is a given that scientific research must make certain simplifying assumptions in order to get off the ground. This is especially true when the subject matter is as complex as human aesthetic and artistic experience. That said, many of the assumptions taken for granted by Birkhoff, Berlyne, and their followers have been (indirectly) called into question by the work of philosophers of art, on issues ranging from originality and forgery (Dutton, 1979) to the very distinction between works of art and "mere real things" (Danto, 1992). A unifying thread among these arguments is that neither artistic value nor even an object's status as an artwork can be predicated on mere appearances—that is, by an exclusive concern with what lies "inside the frame." Here we find a basic difference between works of art and psychological stimuli such as Birkhoff's geometric forms. The latter are designed to be context-invariant, perceived and experienced in isolation; the former are not and, in fact, cannot be if they are to be genuinely understood and appreciated. As philosopher Garry Hagberg (2011) recently put it, "Art that we see or hear or read is to a large part constituted by relational interconnections." These connections involve not just other works of art, but the art world itself (Danto, 1992), as well as the broader culture in which art works (and worlds) exist.

Take the case of Mondrian, who has long been a favorite of aesthetic formalists, since his work might initially appear to consist of nothing but pure form. Even here, though, there is more to the story. Kieran (2005) describes a visit to a Mondrian exhibit in which the artist's work was presented in chronological order, allowing for an understanding of the way his style and approach evolved over the years, become increasingly abstract but always "trying to get at the underlying structure of the naturalistic world of appearances" (p. 38). Kieran adds that "unless one is concerned with what Mondrian was striving to capture and express in his artistic development, one will fail to understand and properly appreciate his art" (p. 40). Danto (1992), in his discussion of the work of avant-garde sculptor Eva Hesse, makes a similar point about the role of art-historical (or "art world") context in criticism.

Expertise and the "Feeling for the Rules"

In addition to knowledge *about* artworks, aesthetic appreciation also draws on less explicit, more tacit forms of

knowledge. This tacit knowledge can be likened to the kind of know-how that Dreyfus and Dreyfus (1988) emphasize in their five-stage model of skill acquisition, the last stage of which is expertise. It makes sense to think of the development of aesthetic sensibility within a given field or genre as tracing a similar arc of development.

In discussing Huron's research on melodic expectation, I suggested that there is more to learning a style of music than, say, internalizing a frequency distribution matrix. But I also raised the question of how we come to know a novel genre or style of music in the first place. Yes, listening is important, but trying to grasp a foreign style of music can be as bewildering as trying to learn a new language without so much as a dictionary. Wittgenstein (1967) offers some illuminating, if occasionally cryptic, hints on this process. As he argues, coming to know a style amounts to developing a "feeling for the rules"—rules that are largely social and cultural in character. This feeling for the rules, when fully "internalized," constitutes a kind of expertise. Novitz (2004) helpfully elaborates on Wittgenstein's terse remarks that "to have a 'feeling for the rules' that are embodied or instantiated in a work or a category of art is to understand the role that they play within the 'culture of a period.' It is to understand their cultural or their social significance" (p. 61). Developing this feeling for the rules goes hand in hand with overcoming the barriers Meyer spoke of in his discussion of cultural noise and cultural distance.

But why should we bother trying to overcome such barriers? One kind of argument suggests that we should try because doing so is intrinsically valuable. As Cooper (2010) puts it, "[A]ppreciation of new beauty is educative, for it requires initiation into traditions, practices and cultural contexts that allow for beauty of a certain kind to become visible" (pp. 63–64). He adds, "[T]his appreciation is an achievement or acquirement that, typically, calls for effort, imagination, and intelligence. Finally, the appreciation is, typically, edifying or improving" (p. 64). In other words, aesthetic appreciation—especially when it comes to "new beauty"—is not an automatic, facile accomplishment, but is often the product of much cognitive "work."

If, as Cooper suggests, this sort of achievement is intrinsically valuable, it seems that it is worth trying to understanding it better. What kinds of imagination and intelligence are involved? Why are some people more open to pursuing such experiences than others? What kinds of barriers—social, cultural, biological, or otherwise—prevent those others from pursuing the kind of "initiation" Cooper describes? At this point, there are more questions than answers, but I believe they are worthwhile questions for us to ask, even if doing so is bound to raise further difficult questions about the scope and methods of cognitive science.

Conclusion

The drive to bring aesthetics and the arts under the umbrella of cognitive science is understandable. They are important aspects of our (mental) lives, so to simply ignore them would be to limit the scope of the field to a perhaps depressing extent. On the other hand, it is still unclear how best to go about studying them. However, as I have emphasized in this paper, there are limits to what can be understood via many of the tried-and-true methods of the past. Artworks differ from garden-variety psychological stimuli in important ways, such that many of the "complicating," noise-like factors—social, cultural, and otherwise—that have traditionally been removed from the equation are actually quite important, and possibly even essential to accurately understanding the phenomena in question.

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