

## Aesthetic Experts\*

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**Abstract:** In the 1990s and early 2000s, researchers in the field of so-called neuroaesthetics recruited research subjects who had been untrained in arts and did not have any pronounced interest in aesthetic matters for their laboratory experiments. The prevalent choice of research subjects has recently changed. Currently, a great number of studies uses subjects who are professionally engaged in the art world. In my paper, I describe, analyze, and critically discuss the two research paradigms regarding the subjects involved in the experiments in neuroaesthetics. I claim that although the more recent one can be generally regarded as an improvement of the research framework, it underestimates the difficulties brought by the notion of expertise in aesthetic perception.

**Keywords:** aesthetic perception, expertise, experimental aesthetics, neuroaesthetics, art appreciation.

**Soc.** What about beautiful and ugly, good and bad?

**Theat.** Yes, these too; in these, above all, I think the soul examines the being they have as compared with one another. Here it seems to be making calculation within itself of past and present in relation to future.

**Soc.** Not so fast, now.

Plato, *Theaetetus*, 186a,b<sup>1</sup>

Does perception come before knowledge, creating its base, giving it an input, so to speak; or is it already a way of knowing? In the last decades, there has been a strong tendency – in various theories of perception that have arisen after a sense-datum theory was so thoroughly discarded<sup>2</sup> – to comply with the latter (although there has been no common theory of what *way of knowing* it is). If the perception of beauty is then regarded as a kind of perception, then, against the backdrop of the prevalent general understanding of the terms in question, it should be classified as a kind of knowledge.<sup>3</sup>

But even for those who would side with the former and say, as Socrates does in *Theaetetus*, that ‘perception and knowledge could never be the same thing,’ (186e) perception of beauty seems to be a clear exception. Perception of beauty is, in fact, one of the arguments that Socrates uses to convince Theaetetus that

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<sup>1</sup> Quoted from M. Burnyeat, 1990, p. 317, according to the translation by M. J. Levett.

<sup>2</sup> On the wide rejection of the sense-datum theory in the second half of the 20<sup>th</sup> century (its reasons, alternatives, and exceptions), see Crane – French, 2017.

<sup>3</sup> One can, of course, argue that whereas, generally speaking, perception is to be categorized as knowledge, it is precisely the perception of beauty (or aesthetic perception, see below) which escapes the requirements that are imposed on experience by the category of knowledge, i. e. that perceiving aesthetically, one does not see objects as objects but as, say, sensations fully present, in all the gamut of their variety. Such a position is usually coupled with a limited view of “normal” perception as, basically, an object recognition. Although it could be ascribed to aestheticians of as different stripes as, for example, Francis Hutcheson, Vincent Tomas, and, arguably, John Dewey, it remains highly controversial. For more details, see Hadravova 2010.

perception and knowledge necessarily split and thus ‘knowledge is to be found not in the experiences but in the process of reasoning about them’ (186d). The so-called *perception* of beauty figures in the passage as an uncontroversial example of *knowledge*, showing that it is the soul that – by examining, comparing, and making calculation within itself – sees beauty, and not the eye. Both Socrates and Theaetetus finally agree that the so-called perception of beauty, contrary to normal perception, is ‘the result of a long and arduous development, involving a good deal of trouble and education’ (186c); and the noticed contrast eventually forces Theaetetus to revise his original thesis, the one that Socrates disagrees with, i.e. that perception and knowledge are the same.

Referring to the text that is approximately 2,388 years old in the essay on current trends in neuroaesthetics might seem to be quite an anachronism. My main reason for using it is to emphasize that both general accounts of perception's relationship to knowledge, namely a perception-equals-to-knowledge account and a perception-is-independent-from-knowledge account, classify the perception of beauty under the rubric of knowledge. In other words, whereas there is tremendous disagreement about a question of whether perception is knowledge, the same question regarding the perception of beauty seems much less contentious. One can, of course, argue against the prevalent answer but then one needs to, precisely, *argue* – the burden of proof lies with her.

If, however, one has no intention to depart from the standard position and is happy with saying that the perception of beauty is, generally speaking, knowledge – as I am here –, it seems reasonable to ask: what are the consequences? One of them has already been pointed to in the above quotation: Knowing goes hand in hand with learning: it involves ‘a good deal of trouble and education.’ If one acknowledges that the aesthetic perception<sup>4</sup> falls under the rubric of knowledge, one subscribes to the idea of acquiring it and supposes there is a process that spans between not-knowing-yet and an accomplished mastery. There are concepts that one needs to be able to understand and apply, *expertise* being one of them.<sup>5</sup>

The main topic of my essay is the concept of aesthetic expertise which I will study in the framework of current visual neuroaesthetics. Do experiments and their interpretations – i.e. the main methodological tool to build theories in this area – allow for aesthetic expertise and if so, how do they conceive it? Who is the aesthetic expert, what aesthetic mastery consists in, and how does one recognize experts – according to researchers working in the area of neuroaesthetics? In a way, this enquiry may seem to be a continuation of David Hume's list of ‘embarrassing questions’ (as he calls them): ‘*But where are such critics to be found? By what marks are they to be known? How to distinguish them from pretenders?*’ (Hume 1757, p. 147-8 [§ 24]).’

Hume (with a palpable relief) reassigns these questions to the realm of facts – and where else to get any closer to facts, you may think, than with neuroaestheticians? Not so fast, though, as Socrates remarks in the opening quote; we should, first, look at whether the experts are being searched by neuroaestheticians at all.

This paper has two main objectives. First, I wish to make a case against the idea that aesthetic perception is not knowledge that I found prevalent in the early days of neuroaesthetics, i.e. in the period spanning

<sup>4</sup> The expression ‘aesthetic perception’ as it is used here, includes (although does not equal) the perception of beauty. In my terminology, the perception of ugliness belongs under the heading of aesthetic perception as well.

<sup>5</sup> This line of thought seems to imply that there are ‘the knowledgeable’ – i.e. a privileged group of experts – whose members see the beauty whenever they encounter it, which could be read as unwelcomingly traditionalist and prescriptive approach. However, such a conclusion does not necessarily hold for there might be many different beauties and many kinds and levels of expertise in the aesthetic field. For a nice example of a pluralist approach to aesthetic expertise (see Lopes 2015).

roughly ten years beginning in the mid-1990's. The structure of the argument I use to support this claim has already been outlined: it is based on the need to justify such a claim by explicit arguments – and the lack of them. My second objective is to describe and assess a recent shift in methodology to what I regard as a more hopeful direction in research in neuroaesthetics.

The paper composes of four sections. In the following one, I am adumbrating the framework of the discussion, i.e. the field of visual neuroaesthetics, and limiting the scope of my current interest. Then I focus on how experiment subjects were described in research papers resulting from the experiments undertaken in the early 2000s and, in the third section of the paper, I compare this description to the one based on more recent lines of research in the field. In the final section, I draw some consequences and suggest improvements of the prevalent research paradigm.

## I.

Most of the philosophical reflections of experimental aesthetics have generalized from a few selected examples of neuroscientific studies (commonly, Zeki [1999] and Ramachandran [1999]) and criticized (or, more sporadically, defended) the usefulness of the neuroaesthetic project as such for philosophical aesthetics.<sup>6</sup> More nuanced and extensive history of the field and the effort to see an inner development in the research methodologies and interests have been scarcely undertaken (see for example Lopes – Bergeron 2018). This article aims at discussing one particular topic which is precisely located.

The experimental aesthetics, as I consider it, is a subset of empirical aesthetics. Beside experimental aesthetics, empirical aesthetics involves approaches based on other possible ways of collecting data, e.g. statistical methods or field research. In this article, I will limit experiments to neuroscientific laboratory experiments.<sup>7</sup> More specifically, I am going to focus on the field of visual neuroaesthetics. Most of visual neuroaesthetics belongs to the experimental subset of empirical aesthetics, i.e. it involves an experiment which is performed in an artificial setting of a neuroscientific laboratory.<sup>8</sup>

A lab is characteristically equipped with some apparati, i.e. a brain scanner and computers that compute, translate into visual or digital terms, and show the results of the scanning. A machine is being operated by a scientist and his or her team. They give a subject some general instructions about the process and required behavior as well as specific instructions about the task which she is supposed to perform inside a scanner (if any). They also ask subjects to fill in questionnaires (before and /or after the scanning) and to sign necessary forms of consent. They start and finish the scanning process and choose and control a visual stimulus set that is being presented to a subject lying inside a scanner. Finally, they analyze and interpret the data they collected at the experiment. Each of the mentioned components and stages of the research paradigm can be discussed and evaluated separately; in what follows, I am going to focus on one of them only – experiment subjects.

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<sup>6</sup> Philosophers who have reflected on neuroaesthetics include, for example, Weed 2008, Zuska 2009, Hyman 2010, Seeley 2013.

<sup>7</sup> This limitation means that I will not consider an important area of experimental philosophical aesthetics, in whose scope the experiment usually takes place outside the laboratory, in a more or less natural situation and without necessary involvement of technology (See, for example, Meskin – Liao 2017).

<sup>8</sup> An example of neuroaesthetic research conducted outside a neuroscientific laboratory would be eMotion project in Kunstmuseum St. Gallen, Switzerland (see Kirchberg – Trondle, 2015).

## II.

In the late 1990s and early 2000s, most of researchers in the field of visual neuroaesthetics intentionally recruited research subjects who had been untrained in arts and did not have any pronounced interest in aesthetic matters for their laboratory experiments. For example, researchers focused on those who had ‘*no special experience in painting or art theory*’ (Kawabata – Zeki, 2004), who received no ‘*professional training in the fine arts*’ (Jacobsen, 2006), subjects ‘*with no previous training in art or history of art*’ (Cela-Conde et al., 2004), or those who had ‘*no special experience in painting or art theory*’ (Tommaso et al., 2008).

Let us have a closer look at one of the studies just mentioned. Cela-Conde et al. (2004), who define the perception of beauty as ‘*the capacity of assigning different degrees of beauty to certain forms, colors, or movements*,’ ask their subjects to ‘*perform aesthetic judgment task (they should decide whether each picture was beautiful or not beautiful)*’, while presenting them with the set of 320 preselected pictures made in different styles and depicting various subjects (but roughly similar in their complexity, color spectrum, and luminosity). Using magnetoencephalograph (MEG), the research team took neuroimages of the subjects' brain areas, aiming at locating those that were ‘*activated during the visual perception of aesthetic objects*’ (p. 6321).

Whereas the set of stimuli is described in a relatively detailed way (the images the team used had been selected in a special testing that predated the experiment itself, and they were then carefully homogenized), the experiment subjects are introduced very briefly:

*‘Eight female subjects (average age 20 years) were tested. All were neurobiology students at the Universidad Complutense (Madrid) with no previous training in art or the history of art. All subjects had normal or corrected vision and normal color vision. All were right-handed. The experiment was approved by the Ethical Committee of the Comunitat Autonoma de les Illes Balears (Spain), and all subjects participating in the study gave informed consent (p. 6321)’.*

The researchers do not explain or justify the subject selection, although in the concluding discussion they remark that ‘*several studies have confirmed the presence of a “basic knowledge” of art in participants with little or no formal training in the arts or aesthetics. Human beings seem to share “a common denominator” underlying all artistic experience*’ (p. 6324). In the final paragraph, they add that the result of their experiment, i.e. that the aesthetic perception is intrinsically related to the activation of the prefrontal dorsolateral area, deserves further study – in particular, they say, ‘*it is necessary to understand how variables like artistic training modify the aesthetic perception*’ (p. 6324).

These remarks indicate that researchers believed that aesthetic reactions of naive subjects to visual stimuli remained pure and unified in their crude form, that is at least as long as the subjects had not been exposed to any ‘*training in art or the history of art*’. More strongly, any education in arts would, in their terms, impair the scientific results since for the educated subjects aesthetic preferences are ‘*modified*’ or biased, i.e. they no longer exhibit the pure aesthetic reaction. From this reason, I suppose, they did not think it necessary to explore what actually research subjects were doing in the MEG scanner while using their right-hand thumbs do indicate that they were, supposedly, undergoing the ‘*aesthetic perception*’.

What the individual subjects were doing, and for what reasons, is, however, quite an open question. First of all, it is highly improbable that the subjects have not been educated in arts at all since education takes many different forms, ranging from formal to a wide spectrum of the informal ones. All of the subjects

had been exposed to culture and aesthetic norms prevalent in their social contexts.<sup>9</sup> Put differently, their past experience with pictures (or, more broadly, visual designs) significantly influences the expectations they use to be able to appreciate the picture they are presented with in a particular moment – they are, as Plato said, ‘*making calculation within itself of past and present in relation to future*’ (*Theaetetus*, 186b). Moreover, there are various competing aesthetic norms present in the society and there is no guarantee that all of the subjects (not even that each one of them) have been consistently applying the same one in the scanner. It seems quite reasonable to expect that while color or composition was the key appreciative factor for some of them, the other ones were more inclined to focus their judgement on the presence of a specific topic (a female human body or a landscape, for example) or the way of depiction (its realism, for example) etc. It is also highly probable that different styles and different themes of pictures invited one subject to use different criteria across the testing.

But what if one claims that the neurobiology students at the Universidad Complutense were so exceptionally ignorant about the visual arts and their appreciation that they just lacked any standards, norms, and criteria they would use to answer the researchers question? Would their aesthetic reaction be pure, unbiased, and – supposedly – homogenized then? Even if possible, this move will, however, hardly help us to get on a safer ground, since it is an open question – one that is strikingly similar to the famous Molyneux question – how such subjects understand the researchers’ request to perform aesthetic judgements in the scanner. Moreover, their aesthetic judgements were subjugated to some kind of training directly in the scanner; with more than 300 pictures being shown to them, they necessarily compared one to the other, while their discerning abilities might become more and more acute (or go more and more numb). If they lacked the aesthetic criteria before they entered the scanner, they surely had some at the end of the scanning session.

The neuroscientists in question have not gone so far, though, since, as is clear from one of their remarks quoted above, they believe that people in general share an ‘aesthetic denominator’ and ‘basic artistic knowledge’. They must have been worried, then, that it is specifically formal artistic education which distorts one’s natural and shared ability to judge visual stimuli aesthetically: the researchers must have suspected that if one was educated in arts, that is, supposedly, trained in some artistic standards and knowledgeable about some aesthetic norms, one does no longer report what she really likes but rather what she is supposed to like.

The problem is real but, contrary to what neuroscientists supposedly fear, I think it turns up more intense at places where aesthetically naive subjects are being used. Subjects who have had only little or weak contact with the arts, might be aware of their own limitations and, as a result, feel uncertain in basing their preferences in their feeling intuitions. If they are asked to make a judgement or express their preferences, they tend to turn to where they feel the safest ground under their feet – tradition, canons, rules, and pre-established meanings. From the extensive literature on heuristics in judgements, written and inspired by Tversky and Kahneman’s studies from the 1970’s on, one learns how unreliable and subjected to various biases people’s normal reasoning, i.e. reasoning under uncertainty, is. I suggest that *feeling under uncertainty* can display similar patterns of distortions. When one is not confident enough, he or she tends to discard her feelings and base her preferences on some easily available rule, such as, for example, ‘*more variety is better*’ or ‘*pick up the same thing as someone you admire*’<sup>10</sup>.

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<sup>9</sup> Various psychological studies since Zajonc (1968) indicate that the so-called mere exposure has an important share in the way people develop their value systems across different dimensions, the aesthetic one included.

<sup>10</sup> Adapted from Mercier – Sperber, 2011, p. 71.

This is highly relevant for experimental research done with students, especially those whose aesthetic attitudes are uncrystallized or ‘under construction’. For example, in a famous study called ‘College Sophomores in the Laboratory: Influences of a Narrow Data Base on Social Psychology's View of Human Nature’ (published as long ago as in 1986, but still relevant today), David O. Sears argues that exploring opinions, attitudes or preferences of adolescents or young adults faces generalization problems since these subjects ‘*tend to have a less than fully formulated sense of self, manifested variously in [...] identity confusion and diffusion, [and] inadequate integration of past, present, and future selves...* [They also have] *a stronger need for peer approval, manifested in dependency, conformity, and overidentification with peers*’ (Sears, 1986, p. 521). In other words, far from being clear or natural, liking or preferences of aesthetically naive research subjects are ambiguous, subjected to variety of influences, and inclined to follow an *ad hoc* rule rather than a robust feeling intuition.

To sum up: I assumed that aesthetically naive subjects were recruited for the experiments in neuroaesthetics because of the worry that aesthetic reactions of artistically educated people are corrupted by their knowing too much about art. I argued that people who are not familiar with art are not safe from this worry – for what gets in a way of experiencing the artwork is not knowledge as such, but a certain way of using knowledge – as a shortcut, so to speak, to a judgement.

### III.

The effort to keep the aesthetic reaction pure and natural, meaning untrained, unspoilt by knowledge, that I ascribed to neuroaestheticians of the late 1990s and early 2000s, does not have any counterpart in contemporary philosophical aesthetics. To my knowledge, for even those who take aesthetic properties or values to be directly represented in feelings of pleasure, consider, as Jerrold Levinson does, ‘*the sensational model of artistic apprehension, in which artworks become merely pushers of one's buttons, with the result, in favorable cases, of delightful tingles, [as] simply inadequate to what transpires during most of our intercourse with art*’ (Levinson, 1993, p. 297). It also goes almost without saying that the perceivers who can count on their pleasures in delivering aesthetic judgements are supposed to be ‘competent’ and ‘appropriately prepared’ (Levinson, 1993, p. 298), or ‘suitably informed,’ (Goldie, 2007, p. 83), or ‘appropriately primed’ (Davies, 2005, p. 23).

The prevalent choice of research participants in neuroaesthetics has recently changed and some of the above objections have thus lost their point. In more recent papers, the subject description gets more volume and the important part of it consists of the information about the arts-related education of experiment subjects. The comparison of professional or expert reactions or judgements to those of the so-called laypeople has been a wide-spread method used in many, if not most, studies in (visual) neuroaesthetics in the last ten years, regardless of the aims or hypotheses of the research in question. Examples can be found in Kirk et al. (2009), Pihko (2011), Vessel et al. (2012), Bullot – Reber (2013), Pang et al. (2013), Else et al. (2015) and many others. In philosophical terms, what seems to be happening in visual neuroaesthetics now is a shift from what Levinson calls sensational model to what David Davies calls ‘enlightened empiricism’ (Davies, 2005, p. 23).

Let us have a closer look at one of the studies mentioned above. Kirk et al. (2009), who aim at discovering ‘*brain correlates of aesthetic expertise*’, in particular, expertise in architecture, start with an observation that it is quite ‘*likely that art experts use different neural processes for determining aesthetic evaluation than non-experts*’ (p. 306). They focus on brain areas that have been selected by previous neuroimaging studies which explored brain correlates of aesthetic judgement (but have not considered the impact of expertise upon the neural pronouncement of the judgement) – striatum, orbitofrontal cortex, and anterior cingulate cortex. The

subjects, whose neural activity was measured in a functional magnetic resonance imaging scanner (fMRI), were asked to rate (on a scale running from 1 to 5, i.e. from ‘very unappealing’ to ‘very appealing’) more than three hundreds of images belonging to two different subject categories – the images of buildings and of human faces (the latter being a control group since it does not allegedly have any relation to the expertise in question).

Interestingly enough, the results have not shown any significant differences in evaluation – the mean of evaluation was roughly the same for both experts and non-experts as well as for buildings and faces pictures (a sole exception being a ‘neutral value’ that was given to buildings significantly more often by experts than by non-experts). However, the brain scanning results confirmed the researchers' assumption: the images of the selected areas of the expert brains showed significant differences both in the strength of the reaction and in extension across the engaged brain subareas.<sup>11</sup>

The description of the research subjects reads as follows:

*‘24 healthy volunteers (11 experts / 13 non-experts; 6 female experts / 7 female non-experts; experts mean age: 30.8 years; non-experts mean age: 27.2 years; all subjects were right-handed) were scanned. We excluded two subjects (both male non-experts) from the analysis for clinical reasons. The experts were recruited from architectural offices and schools where they were graduate or post-graduate students. Non-experts were all undergraduate or graduate students with no formal education in any art-related field’ (p. 307).*

Similarly to the previous decade, the key factor influencing the subjects' supposed performance is formal education. Expertise is firmly rooted in specialized education: graduate students of architecture as well as architecture professionals are considered as experts. We can see a similar pattern in other above mentioned studies, which also tend to define expertise in formal educational terms solely.<sup>12</sup>

Although I think that the described development makes research in neuroaesthetics more connected with what at least some aestheticians might consider as thematically relevant for philosophical aesthetics, strong doubts remain. In the previous part, I put a pressure on the idea that to avoid the situation in which one's knowledge replaces one's experience, one needs to recruit subjects with no knowledge in arts. I argued that the real problem did not concern knowledge per se but the way knowledge was being used and that the problem seemed most relevant in a ‘feeling under uncertainty’ condition that I allotted to naive appreciators forced to express aesthetic judgements. However, the turn to experts does not by itself guarantee that they will actually perform aesthetic appreciation in a scanner, i.e. use what they know to guide their perception, and not to replace it. The main reason for doubting about the psychology of naive subjects was their lack of confidence and uncertainty. Here one can suspect the opposite problem, i.e. an overdose of confidence, resulting in a quick assessment based on applying the right ‘label’ rather than experiencing the work.

#### IV.

Writing about moral experts, Bruce Weinstein coined a useful general distinction: he distinguished between the epistemic and the performative expert. According to him, an epistemic expert is ‘a person who is capable of providing strong justifications for a range of claims in a domain’ and a performative expert is ‘a person who is

<sup>11</sup> This result concerns the images of buildings, not of faces.

<sup>12</sup> An exception would be Vessel et al. (2012) who asked their (supposedly non-professional) subjects to imagine that they are asked to advise a curator who is choosing new acquisitions for the museum of art.

*able to perform a skill well according to the rules and virtues of a practice'* (Weinstein 1993, s. 71). He further argues that the two kinds of expertise are mutually independent, i.e. one is not reducible to the other.

In visual neuroaesthetics since the 1990s, aesthetic experts are understood as, simply, the opposite of laypeople or aesthetically naive subjects, while a demarcation point between them is supposedly indicated by the presence (or absence) of formal education received at an art school. What Weinstein's distinction helps to question is the supposition that there is one scale only – running from aesthetically naive people to (future) artists.

Both types that Weinstein distinguishes seem to have their clear incarnations in the aesthetic realm. An example of an epistemic expert would be an art historian who is able to say that, for instance, the newly discovered da Vinci is, in fact, a forgery arguing that the artist who painted it was right-handed.<sup>13</sup> A performative expert, on the other hand, seems to be a violin player who is capable of closely following the most demanding score with an impression of effortlessness. This difference is ignored in the neuroaesthetic studies and, as a result, both kinds are put on a single scale. While naivety in arts is being mostly described in the epistemic terms (the research subjects do, supposedly, lack knowledge in art history, art theory etc.), the expertise is usually coached in the performative terms (experts are the ones who have been attending art schools, i.e. trained to become professional artists).

Although the distinction Weinstein coined for the realm of ethics seems to be well preserved in aesthetics, “aesthetic appreciation” presents some difficulties. At the beginning of the paper, I subscribed to the view that aesthetic perception belongs to the general category of knowledge. Further on, I said that what matters is not solely the contents of knowledge but also the way one employs it. Although I am well aware of the fact that these remarks are far from being satisfactory, I cannot elaborate on them in the scope of this paper. But even characterized in these crude terms, aesthetic perception clearly escapes classification under one of the general types of expertise distinguished by Bruce Weinstein. As an expert in aesthetic appreciation, one needs both sufficient knowledge of the arts, i.e. some kind of expertise in the epistemic sense, and, at the same time, an ability to perform a certain skill well, namely apply the mentioned knowledge in the right way.<sup>14</sup>

Let us recall the questions Hume famously asked in his essay: ‘But where are such critics to be found? By what marks are they to be known? How to distinguish them from pretenders?’ Neuroaestheticians who have been recruiting “experts” at art schools have implicitly answered the first of them; the two remaining ones have not been even tackled yet. By identifying the collapse of the two categories of expertise, i.e. an epistemic and performative one, in the case of an art appreciator, I attempted at opening the discussion about the second question. As a side effect, the assumption that an art degree will do to find an aesthetic expert has been problematized. That does not mean that neuroaesthetics should give up on aesthetic expertise; to find and correctly instruct the research subjects might, however, prove to be more difficult than expected. And philosophers’ help in the search, Hume’s reservation notwithstanding, is needed.

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<sup>13</sup> Adapted from Charney (2018).

<sup>14</sup> As has been pointed out by the journal’s referee, aesthetic appreciation as it is discussed here seems limited to the appreciation of art only, and does not take into account aesthetic appreciation of nature. Being a cognitivist, that I am, I would assume that the aesthetic appreciation of nature works similarly to that of art. Further discussion of this point has to be, however, postponed to another occasion.

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