Painting methods and visual processing: initial considerations

Métodos de pintura e processamento visual: considerações iniciais

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Abstract. *In recent studies comprising arts and neurosciences focus has been given to artistic objects in their final shape and appearance, generally paintings, and how viewers react to them. In this paper we suggest the artistic methods, with special emphasis in painting methods, as another approach to art in intersectional studies involving both areas of knowledge.*

Keywords. *Art. Painting. Neurobiology of vision.*

Resumo. Recentes estudos reunindo os campos das artes e das neurociências têm focado nos objetos artísticos em suas formas e aparências finalizadas, principalmente pinturas, e a reação do público à eles. Neste artigo sugerimos os métodos artísticos, e em especial os métodos de pintura, como outra forma de abordagem às artes nos estudos de intersecção entre essas duas áreas do conhecimento.

Palavras-chave. Arte. Pintura. Neurobiologia da visão.

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1. Introduction

Paintings have been the primary focus in studies relating arts and neurosciences. Very often, they are used as a tool in studies that try to understand how our brain sees, build and interpret the world around us, and how artworks can induce emotional responses. Scientists acknowledge that the artistic objects offer the viewers a kind of experience that

ordinary objects don't, and therefore they could, in the scope of neuroscientific studies, enlighten the paths that would conduce us to a better understanding of our brain organization and functioning. But the use of artworks in this context can reduce them to visual stimuli comparable to other, non-artistic ones, casting a doubt of its effectiveness and relevance in such studies.

In this article we suggest that another way of interacting the artistic experience with the study of brain functions is to focus on the construction of the artistic object, the methods and personal strategies set in place by the artists in order to build the artistic experience, rather than focusing on the viewer's response or reaction to the artworks.

2. Limitations in the use of artworks

The use of artworks in the neuroscientific research departs from the assumption that the artistic experience, embedded in the artworks, offers a clear differential marker to the neuroscience studies when compared to other visual objects. For example, when staring at an Edgard Degas (1834-1917) painting the observer has a different experience than when staring at a car drawing in a manual. Even though both experiences will be enabled by our visual apparatus and visually processed by the brain, we are talking here about very different kinds of images, each involving expectations, levels of personal interest and knowledge, among other characteristics, that will cast influence not only over the future outcomes of this visual interaction, but also over how the object is perceived *while* it is being perceived.

Researchers from the arts and the neurosciences have pointed out the impact of cultural systems regarding the appreciation and comprehension of images in variable contexts, as well as the symbolic nature of the artwork, which is absent from other visual productions (BUNDGAARD, 2015; GREGORY, GOMBRICH, c1973; ARNHEIM, 1954).

The symbolic nature of the artistic object is, to a large extent, based on cultural context. If we exhibit a painting by Claude Monet (1840-1926) in different countries around the world, reaching people with no prior contact with his work or with Impressionism, they will be able to *see* the painting, but will likely not be able to allocate its meaning in western art history the same way someone with that knowledge would do, impacting the experience as a whole and influencing how the picture will be seen and appreciated, both in perceptual as in cognitive levels.

2.1 Seeing and Perceiving

From a neuroscience perspective, to *see* is a phenomenon that starts from *bottom-up* processes that begin with the sensitization of the cones in the retina. Different wavelengths are converted into signals that are then combined and projected to three main areas of the brain and from those to higher regions of the cortex where they will be processed and assembled with other features. For the *bottom-up* process to start, a visual stimuli is all it takes.

To *perceive*, on the other hand, involves *top-down* processes which use higher areas of the brain, enabling us to give context and meaning to what we are seeing. These *top- down*

processes are concerned with memory, emotions and learning, among many other aspects accumulated in past experiences (KANDEL, 2012), that bestow complexity to the human visual interaction with the world. The *top-down* pathways are connected to the *bottom-up* pathways, updating, adjusting and modifying the former (KANDEL, 2012).

But according to Gregory and Gombrich, the recognition of a represented object in a painting or drawing does not determine that the experience will be equivalent for different subjects, even in cultures rich in visual representation, suggesting that ecological and cultural factors combine to determine how an image is perceived (GREGORY; GOMBRICH, c1973, p.165, p.178).

2.2 Visual cues in reproductions

And that leave us with the problem of the use of artworks as stimuli in neuroscientific research, particularly painting reproductions.

It is important to remark that even if used as a strict *bottom-up* stimulus, seeing a painting in lab conditions modifies its appearance to a great extent. This is in large part because most experiments are based on photographic reproductions of the paintings, usually displayed on computer screens. The restrictions suffered by reproductions begin with the fact that paintings are conceived and manufactured as real objects in the world, being thought and produced according to precise choice of scale, texture, accurate and studied combination of colors, and so on. From a viewer's perspective, the local light, the standpoint position regarding the painting, the time given to observation, prior knowledge about the artist (or lack thereof), and even personal preferences are factors that also play a role in how the surface of the painting is scanned by the eyes, which impacts the overall experience of the work on the viewer.

All the physical and material factors mentioned above are of keen importance in the art experience since they very much convey the expression of the artist's emotions and ideas. These physical cues are not present in the screen or photographic reproductions, reducing in large scale the work's reach and scope, flattening most of the features that were programmed to visually render the ideas intended by the artist.

2.3 Artists and visual cues

To some extent, what artists do when they create a painting is a form of selection and curation of visual cues with the purpose of expressing specific ideas. It means that in possession of great knowledge of how these visual cues operate, the artist will seek, individually, how they can be combined and matched for the purpose of individual expressions (MCMAHON, 2003). In order to achieve it, the artist will test materials and combinations in successive attempts and exercises. This results in what is commonly known as an artist's *phase*: when an artist is focused on a set of materials and/or ideas for any given periods of time, testing at length the suitability of a set of tools and materials that precisely convey his idea. This exploration can take days, weeks, even years. It can also be completely abandoned once the artist feels that a concept was achieved or exhausted, making him move on to something else.

In the search for expression, the mechanisms of visualization are used in intentional ways. Shapiro reminds us that even when we talk about random occurrences in the artistic process, the incorporation of a random event is also an artists' choice. (SHAPIRO, 1979) The artist chooses to focus on certain aspects of the visual experience, dives into them, pushing and expanding its limits and boundaries. It's from an intense exploration of physical, emotional and conceptual factors that works of art are born from.

But artists do not use all available elements at their disposal in a composition, they do a selection, and from this selected set of elements, they search for a perfect combination: the only combination able to express what is on his/her mind. This combination has, however, a final recipient: the viewer, the public.

Originated in the artists' mind, first in the form of the original idea then in the form of a practice (method), the artwork will then later become an experience lived by others, in its final shape and appearance. This journey passes through a physical process, orchestrated by the brain. From where it begins (the artist) to where it ends (the viewer), the visual elements present in the painting will carry these ideas, establishing the communication. The intentions and answers may vary, but art is a type of communication known for being effective, compelling and deeply emotional.

So how do artists *do* that? *How* do they build this effective communication? That the work of art can elicit emotions such as joy, anger, revelation, disgust, among other feelings, and foster debate, doubts, or surprises, is a known fact. But can the art practice, as practiced by the artist in the studio, be of interest to the studies in neuroscience? As we will see, studio practices and techniques are, and have always been, an experimental ground for artists to freely test the properties of our visual system, and it's in the methods they used and developed that lies the keys to their achievements. The painting processes describe and register the path from their imagination to the visible form.

3. A neuroscience perspective on painting techniques

The notion that artistic processes are somehow tuned in with our neural processes was already presented by John Willats (WILLATS, 1997), McMahon (MCMAHON, 2003) and others, and in recent years has been explored by contemporary neuroscience researchers (CONWAY; REHDING, 2013; GOLDSTEIN, 2001; MELCHER; CAVANAGH, 2010; CONWAY, 2012; FRÓES, 2015).

We will now argue why the artistic method offers more fertile grounds to the neuroscience research, especially when concerning neurophysiology of vision.

In order to bring their ideas to a visual manifestation, artists have created throughout history, an array of methods along the history of humankind. These methods were sometimes individually developed, while other times collectively achieved. They manifested particular aesthetic outcomes, which were communicated and expressed through the visual marks found in the surface of the paintings. But as Goldstein explains, the marks present in a piece of art are of a special kind:

> When artists talk of creating pictures they often describe the process as one of "making marks." These marks made by artists are not, however, just any marks, there is an intelligence behind them. They are made with the idea of

> creating a response, transmitting information, being seen as something more than mere marks. (GOLDSTEIN, 2001, p. 345)

The use of material characteristics present in works of art, their modes of application, selection, the order in which each pictorial element is reunited or separated from others in the composition, are operations guided by our visual processing system. Therefore, as Melcher and Cavanagh remarked (MELCHER; CAVANAGH, 2010), the techniques employed by the artists expose not only our mastery over the manipulation of these processes but our limitations too. Through individual strategies, artists seek to work around these physical limitations.

We can identify in the artistic processes different brain operations that can be in use according to specific styles or artistic practices.

Let's start by saying that in western European art painting, and drawing, have for centuries incorporated a single, primordial objective: realism. An objective that persisted across uncountable schools and movements and was present in the development and application of techniques regardless of any other feature or characteristic. Realism was an objective in itself, accounted for in the elaboration of paintings from beginning to end. The reproduction of the world as we see it, on canvas or paper, prompted the Renaissance artists to discover mechanisms capable of deceiving our visual apparatus, approximating the vision we have of the world to an illusion of this same world, applied to a two-dimensional surface (HOFFMAN, 2010).

3.1 Traditional realistic painting method

Traditional methods of portrait and landscape composition in painting and drawing, techniques pioneered in the Renaissance by artists, became established as a solid method and would be adopted by the academies of art across Europe in the subsequent centuries (FRASCINA *et al*., 1993). It respected a rigid order of events in the picture making and was developed to give on canvas an impression of the world that resembles the experience we have of it in real life, that could be similarly read by our visual apparatus.

The first task in realistic representation in European classic and neo classic painting was the mastering of drawing, usually in black and white. To achieve the high standards demanded by the schools, students would practice for years before a proper initiation in the use of paint, canvas and colors. The main task for aspiring artists was to achieve and control form, and this task was entangled with the observation of how light and shade operate on objects and sceneries, for they are the features that render objects' volume. It was through years of constant exercise that artists would first master their skills in drawing, without the use of any color, learning to capture what was deemed relevant to the expression of shape. Since drawing is also essentially a mechanical task (the hand must be trained to achieve precision), in the classic method time of practice mattered, both the hand and the eyes had to be trained to obtain a convincing representation of the world through lines and shadows. In this method, color was a later addition (OSBORNE, 1987).

When it comes to painting, the classic painting technique also began with the demarcation of light and dark areas on the canvas, a technique called *ébauche*, which consisted of staining the canvas background with a monochromatic dark color, usually in earth tones,

where the darker areas marked the main shadow regions, therefore giving the first spatial demarcations and thus indicating the initial distribution of the elements on the scene, establishing cues for perspective (DUNSTAN, 1976).

3.2 Classic method and neural processing

We have mentioned above that perception aggregates the context of our lives, our memories, the accumulated experiences in affective, behavioral and mental dimensions. Perception thus holds a significant individual, subjective component. On the other hand, the biological grounds for coupling ourselves to the environmental stimuli we had selected throughout evolution are the very same for each individual of our species, establishing the way sensory stimuli are processed bottom up (MATURANA, 2002).

Parallels may be suggested from analysis of painting techniques. The traditional technique starts from where visual processing also begins: by extracting from the visual scene areas of light and shadow, the main task carried by the cones in the retina, the first step the brain takes to create a coherent vision of the world. Using a word borrowed from the art practice, the most essential job performed by the cones is to define onto neural correlates different areas of *chiaroscuro* in the scene in front of us. As, primarily, the product of a binary cone system which responds or not to light differences, contrast is considered a *low-level* feature conveyed from the retina to V1 , where it features as a relatively coarse information (KANDEL, 2012).

Color instead, just like in the classic painting method, is a feature processed later by the brain, involving non primary and associative cortices, being integrated to other features, occupying a further position in the visual processing order of events (KANDEL, 2012). In classic painting, color was a late addition, a feature taught to be parsimoniously used as to not *disturb* the perception of form (FIELD, 1997). This practice persists to this day in many industrial design schools, where students are taught to first work on the objects' shapes in black and white to only later, when the form is resolved, add color to it.

Color processing in the brain begins in V1, the first target in the cortex concerned with vision, and is subsequently processed in V2, V4 and IT (inferior temporal cortex). It is believed that V4 can be an area more concerned with color processing (CONWAY *et al*., 2018).

As of now, neuroscience has not yet fully comprehended how color is coded in the brain and many questions remain unresolved. The seek for putative parallels between processes of paintings conception and production might shed clues for better alternative approaches and interpretations concerning the neurobiology of colour vision.

3.3 Impressionist Painting Methods

Now let's take a look in the painting methods practiced by a group of painters from the XIX century that became known as the Impressionists, regarding exclusively the two practices mentioned before: preparatory drawings and painting techniques.

The Impressionists became famous for portraying the variation of light over the landscapes. They were breaking with the classic conception of the traditional European institutes of art and the rigid drawing and painting methods they taught.

Regarding drawing, the first important change they brought to the painting method was to diminish, and sometimes even remove, the importance of preparatory drawings. It is not to say that they abandoned drawing altogether, but drawing, as it was previously conceived, seemed to them as an impediment to achieve their new goal: to be faithful to the light they had in front of them, and for this, they had to paint directly on the scene. In order to do this, they studied the landscapes in advance, also through drawing, but not in such detailed manner anymore. Drawing no longer had the objective of extracting a general colorless impression of contrasted areas from the scenery. Now the direct encounter with the landscape before their eyes that guided the entire production of the picture, reducing also the time devoted to painting it. Claude Monet, the most famous of all Impressionists, eliminated the drawing studies almost completely, to the point that some of his preparatory drawings were comprised of just a few thin lines, squarely indicating the main areas of the scene and nothing more. Drawing, for the Impressionist painters, is made with paint, directly on the canvas, without intermediary steps.

The suppression of accurate black and white drawing studies was substituted with the merge of coloring and shaping into one single act, as opposed to the separation of tasks found in the traditional technique. It means, from a neuroscience perspective, that color was now thought concomitantly with shape, and no longer as an addition to it. Color, in their groundbreaking technique, *is* shape, a component that is now present in the painting process simultaneously with form and perspective, right from the beginning. It becomes a way of thinking and understanding the objects, as well as space too. From that point on a variety of art movements would work out the color element in their own terms, finding new ways and techniques to use it as an expression and as a tool to gather knowledge of other visual features.

Regarding the canvas, Impressionist painters still used the *ébauche* technique, but with two significant modifications: first, they began to cover the canvas background with white or another light, pale color, such as light grey; and secondly, they began to use lighter and vibrant colors to apply the *ébauche*. Cézanne and Monet used to stain the canvas with shades of blue (CALLEN, 2000), Renoir with red. (DUNSTAN, c1976) This practice came from their fierce observation of nature: they realized that shadows were colored too, that the shadow of a tree on the ground wasn't necessarily brown or simply a darker shade of the ground tone (DUNSTAN, c1976), it could be blue, or pink, depending on other elements composing the scene, including sunlight in that hour of the day (FRASCINA *et al*., c1993). For them, the *ébauche* was no longer a matter of demarcating areas of *chiaroscuro*, as before, but a step towards the final color composition of the painting. These changes in the elaboration of the first layer in the painting guided all next paint additions and modified the perception and consequently elaboration of all color dynamics that followed from it.

In the brain, considering the *bottom-up* process, color is coded *after* shape (PINNA, 2011). They are features processed in anatomically separated areas of the brain, making use of different pathways that will be later integrated, and both involve V4 (VIVIANI, AYMOZ, 2001; BARTELS, ZEKI, 2006), and many other areas thereafter. Just as it happens in the *bottom-up* processing of visual stimuli, in the traditional painting method color was also a later step in the construction of the image. The neuroscience knowledge we have today offers then maybe a possible biological explanation for the separation of these tasks in the classic method.

As mentioned, nevertheless, top down commands concur to shape bottom up visual processing. According to Changeaux and Goldhammer (1996) the artistic creation is made by sequential and concurrent processes. In the classic painting practice, color was explored in further phases of the work, separated from the study of shape, whereas the Impressionist artists turned color into a concomitant process with shape, condensing both tasks in the same thought and gesture, integrated to the canvas at the same time.

The artistic method shows here a clear distinction on how features of the visual experience are treated and operated by artists of different times and style and that the expression of an artist's vision privileges certain pathways more than others, depending on how each technique is conceived.

4. Conclusions

The objective of this paper was to point out the richness of the artistic methods for the neuroscience research. A closer look on the ability of artists to create new ways of conceiving pictorial images can lead to other interesting questions in the field, with a focus on how art is created, instead of how it is appreciated. The observation of painting methods' structures and organization can be revealing of aspects of our brain systems, especially for the neurobiology of vision.

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