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Eye Tracking and Art History
Discourse Analysis and Experimental Research

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Visual art cannot exist without the eye, just as music cannot exist without the ear. Art does not happen in the eye, but the creation and reception of artworks pass through the eye. Marcel Duchamp criticized traditional art as purely “retinal”. He wanted to put his works “at the service of the mind”. Nevertheless, they must be seen with the eyes, as must most artworks, including in Concept Art.

Eyes are in constant motion. This is a prerequisite for perception, and it is a twofold phenomenon: conscious and factual eye movements are different. On the one hand, we notice that our gaze, and thus our attention, is focused, shifting from one thing to another within seconds. We intuitively sense whether someone is listening to us or looking at something else. On the other hand, in the late nineteenth century, ophthalmologists discovered that the eyes move extremely quickly in jerkily, making about three stops ("fixations") and three bounces ("saccades") per second. We can notice other people’s fixations and saccades, especially when using a slow-motion camera (I will come back to this in the seminar), but we cannot be aware of our own saccadic movements.

Given the crucial role of the eye in the visual arts and its imperative dynamics, it is not surprising that gaze movements have been ubiquitous throughout the history of art literature, and that since the development of eye-tracking devices, scientists have used them to study art perception. Parallels between art historians discussing eye movements and eye-tracking researchers studying visual art are obvious. However, connections across the divide between Snow's two cultures began to emerge only recently.

The goal of my fellowship is to write a book with the working title *Eye Tracking and Art History* (and I welcome suggestions for catchier titles!). It will be the first book on a topic that most art historians do not yet consider part of the discipline. In the first chapter, I analyze historical discourses on eye movements in

art literature. It is the one I am currently writing. I present a sketch of this work in progress here because it introduces the experimental studies I will share in the seminar. On the other hand, this philological analysis is more suitable for reading.

Different people look differently, but does the perception of artworks change coherently over the centuries? Is there a *history* of art perception? That was the question of my dissertation. I studied how Michelangelo's statues were perceived over almost five centuries, using written descriptions and drawn copies as sources. How did writers and artists see the statues? Did it depend on the medium they used and/or the time they lived in? I collected as many descriptions of the Medici Chapel as possible from the sixteenth century onwards. One surprising finding was that some explicitly focused on the eyes of the viewer, for example:

> As soon as we look up, standing in the middle of the sacristy, our gaze is captivated by a noble male figure sitting in a niche in the simple garb of a Roman warrior. [...] If the eye wants to tire, the gaze lowers as if by itself - we may let it pass through the center of the figure or along its left side to the youthful female figure lying on the left under the warrior, who struggles to stand up in pain. The way to the male figure resting on the other side is more difficult for our eye. While we already, descending from above, bump against its head, the leg set up at right angles against the line of our gaze compels us to turn back.
>
> [Sobald wir, in der Mitte der Sakristei stehend, aufschauen, wird unser Blick gefesselt an eine edle Männergestalt, die im schlichten Gewande eines römischen Kriegers in einer Nische sitzt. [...] Will das Auge ermüden, so senkt der Blick sich wie von selbst   wir mögen ihn durch die Mitte der Gestalt oder längs deren linker Seite gehen lassen   auf die links unter dem Krieger liegende jugendliche Frauengestalt, welche unter Schmerzen sich abmüht aufzustehen. Schwieriger ist für unser Auge der Weg zu der auf der anderen Seite ruhenden Männergestalt. Während wir schon, von oben herabkommend, an deren Kopf anstoßen, nötigt uns das rechtwinkelig gegen die Linie unseres Blickes aufgestellte Bein zur Umkehr. (Vogel, 1878: 55f.)]

At first, I assumed that Vogel was using eye movements to introduce a consistent temporality, a linear sequence necessary to write a text line by line, a temporality that does not occur in painting and sculpture. I also assumed that reflecting on eye movements might be characteristic of Vogel's time when researchers in the physiology and psychology of perception often wrote about the visual arts. Later, in parallel with working on the history of the description of artworks, I systematically collected passages discussing eye movements and found that they were very common—well beyond the nineteenth century. How common is very common? We would need a representative corpus of historical art descriptions to give an accurate answer. Unfortunately, we are far from having one. But art literature is not an infinite field. Thanks to

word-string searches in digitized full texts, and with the help of research assistants, I have systematically combed through almost all texts published in this field before 1700 and a representative number of those from the eighteenth century. After 1800, the number of artworks' descriptions grew exponentially; my collection of references is extensive but rather haphazard.

After analyzing hundreds of texts from nearly two millennia, I realized that there are four (and only four) distinct discourses on eye movements in art literature. I will discuss them one by one, in the chronological order of their beginnings.

a) Eye movements mirror attention

The direction of the gaze is related to attention. Pietro Aretino phrased this nicely in 1537, referring to a painting by Titian: *fermati gli occhi del viso e le luci de l'intelletto in cotal opra* ("stop the eyes of the face and the lights of the intellect on this work"). Disruptions in this relationship were addressed early on in art literature. In 553 CE, Procopius of Caesarea wrote about the Hagia Sophia. It is arguably the oldest detailed description of an existing building. Referring to the dome of the church, he first lists its parts and then describes the viewer's gaze:

> each detail attracts the eye and draws it on irresistibly to itself. So the vision constantly shifts suddenly, for the beholder is utterly unable to select which particular detail he should admire more than all the others. But even so, though they turn their attention to every side and look with contracted brows upon every detail, observers are still unable to understand the skillful craftsmanship but they always depart from there overwhelmed by the bewildering sight. (Procopius, 1940: I, i, 48-49)

Procopius uses the confusion of the beholder's eye to express an essential element of the Hagia Sophia. From the inside, the colossal dome appears to be supported by thin walls pierced by arcades and windows. The architects must have wanted the visitors to wonder how this was physically possible—the buttresses are only visible from the outside.

b) Eye movements are the source of aesthetic pleasure

Antonio di Pietro Averlino, known as Filarete, was one of the first artists to export the revolutionary approaches that we now call 'Renaissance' out of his native Florence—to Rome and Milan. The experience in explaining and advocating for innovative forms is reflected in his *Libro architettonico*, the

first architectural treatise written in Italian (*volgare*) in the 1460s. A major theme of this highly diverse book is the superiority of ancient (Roman) over modern (Gothic) architecture. Filarete knew that the Gothic pointed arch was advantageous from a constructive point of view. Instead, he argues on an aesthetic level, invoking something that seems universal: the physiology of the eye:

> The reason why the round ones are more beautiful than the pointed ones, there is no doubt about that, is that nothing that impedes the sight in any way is as beautiful as the one that leads the eye rather than restraining it. Such is the round arch. As you have noticed, your eye is not arrested when you look at a half-circle arch. […] The pointed is not so, for the eye, or sight, pauses a little at the pointed part and does not run along as it does on the half circle.
>
> [La ragione perché sono più begli e' tondi che gli acuti, questo non è dubbio, ché ogni cosa che impedisce o tanto o quanto la vista non è sì bella come quella che seguita e da l'occhio non ha niuna cosa che la ritenga. E così è l'arco tondo, come tu vedi. Quando tu vedi uno arco mezzo tondo, l'occhio tuo non è impedito niente quando tu lo risguardi […]. Non è così l'acuto, perché l'occhio, o vuoi dire la vista, si ponta un poco in quella parte dove è acuto e non trascorre come quello che va a mezzo tondo (Filarete, 1972: VIII, 230f.)]

To the best of my knowledge, Filarete's paragraph presents a completely original idea and is the beginning of a long discourse. He created a new *aesthetic theory of eye movement* by combining two simple concepts. The first is the assumption that the eyes follow shapes, i.e., they reproduce the course of the arch when looking at it. The second is that beauty results from the pleasure caused by the movement of the eye. He asserts that generous curves, over which the eye can glide unhindered are more beautiful because they make a more pleasing course than angles and turns. The *Libro architettonico* never found a large readership and was only printed in the context of modern scholarship. Nevertheless, the aesthetic theory of eye movements developed a life of its own that continues to this day. However, this discourse was very slow to get going. I found only four sporadic examples from before the mid-seventeenth century: in Lodovico Dolce's *Dialogo della Pittura* of 1557, Francesco Sansovino's Guide to Venice of 1581, Monsignore Agucchi's description of the Villa Aldobrandini of 1611, Giulio Mancini's *Considerazioni sulla pittura*, written around 1620.

Significantly more examples follow in the 1660s. The culmination of this theory was a bestseller of aesthetic theory: William Hogarth's *The Analysis of Beauty*, published in 1753. Hogarth put forward a thesis that was revolutionary in its abstraction for the time, and which we might now accuse of being reductionist: he claimed that the source of all beauty was the serpentine line. Any object, person, or move-

ment that resembles a serpentine line is beautiful, while the more it deviates from it, the uglier it becomes. Two tables with dozens of examples illustrate his simple principle, from chair legs to corsets (Fig. 1):

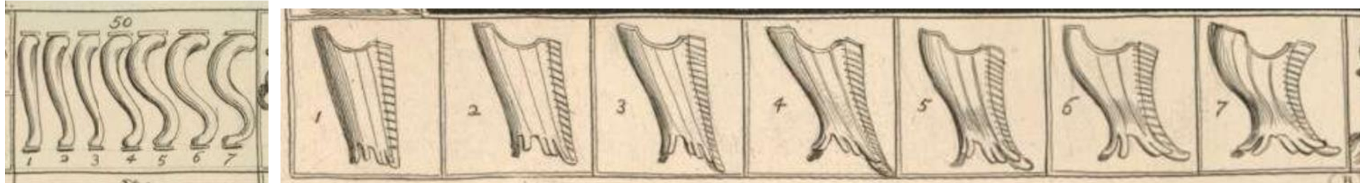

Fig. 1, William Hogarth, *The Analysis of Beauty*, 1753, Pl I, Etching, Two details

Hogarth does not quote Filarete and may not have read the *Libro architettonico*, but his theory, like Filarete's, is firmly grounded in an aesthetic of eye movement:

> The eye hath this sort of enjoyment in winding walks, and serpentine rivers, and all sorts of objects, whose forms, as we shall see hereafter, are composed principally of what, I call, the *waving* and *serpentine* lines. […] It is to be observed […] that the serpentine line, by its waving and winding at the same time different ways, leads the eye in a pleasing manner along the continuity of its variety […]. (Hogarth, 1753: 25, 38f.)

Filarete and Hogarth used eye movements to justify a normative aesthetic position on the round arch or the serpentine line. While the discourse on eye movements has become broader and more sophisticated since the seventeenth century, it is worth noting that the idea of a preference for curves reappeared in empirical aesthetics, where dozens of experimental studies attempted to prove a universal preference for curves (Chuquichambi et al., 2022).

c) Eye movements follow the composition of artworks

The coordinates of European art theory and art literature changed fundamentally in the seventeenth century. Marc (Fumaroli, 1994) describes this change as the entry of the spectator onto the stage: People who were neither artists, nor patrons, nor educated clergymen who might design programs for artists emerged in the art system and determined it from now on. Fumaroli suggests that Rome was the starting point of this change and that the involvement of the spectator was the premise for the birth of aesthetics in the eighteenth century. Were the changes in discourse caused by social changes? Distinguishing causes and consequences is beyond the scope of my project, but it is clear that the seventeenth century saw a radical paradigm shift in European art discourse: from the theory of mimesis, used since Aristotle to define and evaluate the arts, to an aesthetics of effects; from a focus on how art copied nature to an

attention to how artworks affect the viewer. Also, the circle of writers and readers grew, and the number of published texts increased rapidly.

With the focus on the viewer, there has also been a marked increase in reports on how the artwork guides the eye. It is no coincidence that in the previous section, I mentioned texts by two of the authors Fumaroli discusses most extensively as examples of the new viewer: Monsignor Agucchi and Giulio Mancini. The change was not only quantitative but also qualitative. Statements about eye movements became differentiated and specific. In addition to justifying aesthetic pleasure, eye movements were used to explain some properties of artworks. An early example is a letter from Nicolas Poussin to his patron, Paul Fréart de Chantelou, dated April 28, 1639. The letter accompanies the canvas *The Jews Gathering the Manna* from Rome to Paris. For the sake of the viewer's eye, Poussin recommends that the recipient place the painting in a matte gold frame: “so that when you look at it in all its parts, the eye's rays are retained and do not spread out”.

André Félibien was a friend and biographer of Poussin who may have inspired him to think about eye movements. He was one of the most prolific and influential writers on art and played an important role in promoting gaze movements in the art discourse. Louis XIV appointed Félibien 1666 as Historiographer of Royal Buildings, Paintings, Sculptures, Arts, and Manufactures (*Historiographe des bastiments, peintures, sculptures, arts et manufactures royales*), arguably the first professional, i.e., paid art historian. Félibien wrote numerous detailed descriptions of artworks and was the first to print such descriptions. They are divided into sections discussing different aspects of each artwork. In the description of Lebrun’s *The Queens of Persia at the Feet of Alexander* (1663), he, for example, discusses one after the other the iconography (*sujet*), the composition (*disposition*), the expression of the figures (*expression*), the light and shadows (*lumière*), the coloring (*couleur*), and the drawing (*dessein*). This very analytical approach was innovative, and Félibien had to find appropriate terms. Eye movement was one of them. For instance, to explain Lebrun’s masterful distribution of color, he wrote:

> But to judge this beautiful conduct and effect of colors, we must only consider how they are so judiciously placed in this painting, that the eye passes imperceptibly from one to the other, without finding anything that offends it by too much disproportion or hardness.

> [Mais pour bien juger de cette belle conduite & de l'effet des couleurs, il ne faut que considerer comment elles sont si judicieusement placées dans ce Tableau, que l'œil passe insensiblement de l'une à l'autre, sans trouver rien qui l'offense par trop de disproportion ou de dureté. (Félibien, 1663: 27)]

On the one hand, like Filarete, Félibien argues that beauty comes from the smooth path of the eye. But his goal is more far-reaching. He wants to explain what we now call the composition of a picture, a dimension of painting that was not properly theorized until his time. Félibien explains that pictures are composed of different parts and on different levels—figures in groups, colors, lights and shadows, and that the purpose of composition is to guide the eye in a pleasant way through the picture:

> the arrangement of the figures [of a painting], must be composed of parts, groups and contrasts. […the] parts, are all the figures separated in various places of this painting, which share the view, give it the means to somehow walk around these figures, and to consider the various planes and different situations of all the bodies [...] the groups […] serve […] to arrest the view; so that it is not always wandering in a great expanse of country.

> [la disposition des figures […], doit être composée de parties, de groupes et de contrastes. […les] parties, sont toutes les figures separées en divers endroits de ce Tableau, lesquelles partagent la veuë, luy donnent moyen en quelque façon de se promener autour de ces figures, & de considerer les divers plans & les differentes situations de tous les corps […] les groupes […] qui servent à le lier & à arrester la veuë; En sorte qu'elle n'est pas toûjours errante dans une grande étenduë de pais. (Félibien, 1668: 79 and 83)]

Félibien's texts became a model for art literature in general, and his reflections on eye movements in particular. From the 1660s to the end of the eighteenth century, statements about eye movements, often related to the composition of paintings, were extremely common in art literature. We find them in every other author in the field; a higher frequency than ever before or since.

In 1767, Denis Diderot, the French philosopher who was also one of the founding fathers of art criticism, went beyond Félibien in one crucial respect: he suggested that a good composition offers the eye a path to follow through the whole artwork—a clear line, which he described in reference to an altarpiece by Joseph-Marie Vien (to make this clear I have drawn Diderot's line in Fig. 2):

> Such is the path followed in perusing this composition, Religion, the angel, the saint, the women at his feet, the listeners in the background, and those in the left background, the two tall standing female figures, the elderly man leaning forward at their feet, and the two figures, one a man and the other a woman, seen from the back and placed squarely in the foreground, this path descending gently and meandering [...]. In every composition there's a path, a line that passes through the center of its masses and groups, traverses the various levels of depth, here penetrating into the painting, there advancing towards the foreground. […] A well ordered composition will always have but one true line of liaison; and it will serve as guide to anyone looking at it as well as to anyone attempting to describe it. (Diderot, 1995: 29, 152)

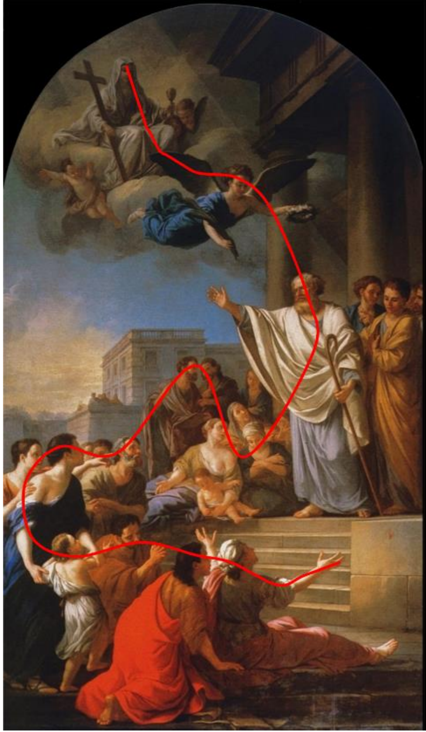

Fig. 2, Joseph-Marie Vien, *Saint Denis Preaching the Faith in Gaul*, 1767

Diderot's approach is important for the history of art, as it has been often used in university courses since the middle of the nineteenth century. Describing the path of the eye through the artwork is still popular today (perhaps more in French and German than in English and Italian classes and texts).

d) Eye movements reveal changes over time and cultures

In the second half of the nineteenth century, a new idea emerged: that the history of the visual arts is driven by a 'history of the eye', that is, by changes in vision. As early as 1859, Berthold Riehl, professor of cultural history at the University of Munich, wrote:

> One might think that sun, air and clouds, water and mountains and trees and rocks have changed their nature over the centuries, that nature itself has changed its style, if we did not know too well that only the human eye has changed its nature in the meantime, that every generation sees in a different style.
>
> [Man könnte meinen, Sonne, Luft und Wolken, Wasser und Berge und Bäume und Felsen seyen mit den Jahrhunderten anders geartet, die Natur selber habe sich umstylisiert, wenn wir nicht zu genau wüßten, daß nur das Auge des Menschen inzwischen anders geartet ist, daß jede Generation in einem andern Style sieht.] (Riehl, 1859: 74)

The historicity of the eye became popular among German-speaking art historians in the early twentieth century and experienced a European revival in the 1970s. Alois Riegl, Heinrich Wölfflin, and Michael Baxandall have referred to it in various ways, as have Hermann Bahr, Walther Benjamin, John Berger, and Michel Foucault. Not all of them specified whether and to what extent physiological processes were involved in historical changes, but some assumed that cultural differences were intertwined with different eye movement patterns:

> Italians have an architectural-plastic talent accustoming the eye to trace the form of things, to see each individual figure in space and to ascertain the physicality of a thing by scanning it with the eye […]. The Italian vision isolates, the vision of Dutch people and Germans connects; the former is used to the mobility of gaze, the latter to the quiet-looking eye.
>
> [Bei den Italienern spricht die architektonisch-plastische Begabung der Nation mit, die das Auge daran gewöhnt, der Form der Dinge nachzugehen, jede Gestalt einzeln für sich im Raume zu sehen und in abtastenden Blickbewegungen sich der Körperlichkeit eines Dinges zu versichern. [...] Das Sehen des Italieners isoliert, das Sehen der Niederländer und Deutschen verbindet; das erste ist an die Beweglichkeit des Blicks, das zweite an das ruhig schauende Auge gewöhnt. (Waetzoldt, 1912: 211f.)]

As I will explain in more detail in the seminar, eye movements are faster and more jerky than the authors discussed in this chapter acknowledged. Why, then, have people for centuries described something that does not correspond to reality? For one thing, they were not interested in physiology, but in art. They wanted to explain works of art and their effect on the viewer, not the mechanics of vision. On the other hand, most writers were unaware of this contradiction because saccadic eye movements are unconscious, they were not discovered until the late nineteenth century, and this discovery was not considered by the public interested in art.

This leads to a question that is more than linguistic: Did the authors who discussed eye movements in art literature assume that they were describing something that actually happened, or were they merely using metaphors and/or idioms? The line to metaphor is easy to draw when we compare the passages I have quoted above with metaphorical ones—for example, (Dufresnoy and Piles, 1668: 3, 43f., 94f., 105, 131f., 130, 139) who write about things that “please”, “satisfy”, “recreate”, “soothe”, “abhor”, “shock”. “hurt” the eye, “are hard”, “unpleasant” to, and “make it suffer”, or that the colors of a painting are “music

to the eyes”. On the other hand, my analysis shows that eye movements (also) form specific idioms in art literature—idioms that were created, developed in specific contexts, and reused because they were instrumental. Can we tell whether the authors were aware that they were using idioms, or whether they thought that they were describing actual phenomena? Not in retrospect. But I have anecdotal evidence that at least some believed that they were describing actual eye movements. When I was a student at the University of Munich, I had a professor who was passionate about teaching us how to analyze the composition of historical paintings—from left to right, in a very abstract way. He was not aware that this method ultimately goes back to Diderot, but he was explicitly convinced that the eyes of trained viewers would definitely follow the correct path of composition.

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