

OPTICAL ILLUSION: A PERSPECTIVE ON THE SENSE OF SIGHT IN EARLY MODERN PHILOSOPHICAL THINKING

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Abstract: On account of the 17th century optics, the Scholastic theory of the unity of senses has been viewed in a critical manner. A true revolution was engaged by the new theory of vision initiated by Johannes Kepler who had a great influence on the philosophical thinking of that time, especially on Descartes' and Hobbes' works. Being the first who applied the *camera obscura* principle to reveal the mechanisms of sight, Kepler emphasized the importance of the subject in the process of imaging, ultimately leading to the idea of an external reality that subjectivized itself. The new theory of vision has been speculated by Early Modern philosophers in support of the idea that the senses are deceptive. From science and philosophy, the idea of deceiving senses penetrated into Baroque painting and architecture, performing the illusory effect of *trompe l'oeil* in which two-dimensional images would be perceived as three-dimensional ones. Thus, science, philosophy and especially art developed a vision centered on the subject, on its freedom in creating and especially interpreting the idea of reality. For early Modern thinkers, reality is no longer a single one, and the subject ceases to be a passive reproducer of it, but rather an artisan, a demiurge of his own world. This new quality of the free subject recalled a new interpretation of the relationship with the Creator in the 18th century.

Keywords: subjectivity, *camera obscura*, *trompe l'oeil*, Early Modern philosophical thinking

INTRODUCTION

During the 16th century, optics came into the attention of Western European scholars along with the translation and printing of treatises written by Arab scholars at the beginning of the first millennium. In the same period, new anatomical data about the structure of the eye came to light.

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In 1583 the Swiss doctor Felix Platter published his own exhaustive description of ocular morphology defining this small organ as *primarium visus instrumentum*; but the mechanism of vision was still unknown. However, a long debate on this issue persisted among the scholars of those times.

THE SIGHT IS NOTHING MORE THAN A “PAINTING” OF NATURE

At the dawn of 17th century, the astronomer and imperial mathematician Johannes Kepler collected the scientific data from his contemporary opticians and anatomists and made his own researches and calculus, and he published *Astronomiae pars optica* (1604).

As an astronomer, Kepler was familiar with the *obscura camera* operating mode, a dark room completely empty of light except for a small pinhole. The principle of *camera obscura* was known since antiquity, but only in 13th century the astronomers observed that, when the solar rays passes through the small pinhole, it creates an illuminated spot on a screen. However, in 16th century *camera obscura* used all the achievements obtained in optics and in lens manufacturing.

Even though the dark room with a small hole on one side was already knew by astronomers and artist, the term *camera obscura* was used for the first time in optics by Kepler, in his *Astronomiae Pars optica*. By the geometric analysis, he discovered that the human eye works just like a *camera obscura*¹, the pupil being the pinhole. The eye lens is a lens that refracts light rays and retina is a screen that receives a two dimensional painting of the external visual hemisphere:

I say that the sight occurs when the image (*idolum*) of the entire hemisphere of the world in front of the eye, and even more, is formed on the white-pink concave surface of the retina (*ad album subrusum retinae cavæ superficiei parietem*)².

As such, “vision is based on the painting of visible things on the white-pink concave surface of the retina (*visio igitur sit per picturam rei visibilis ad albam retinae et cavuum parietem*)”³. There is a clear and distinct vision only in the retina and nowhere else (*distinctissima et*

¹ Johannes Kepler (1604). *Ad Vitellionem Paralipomena, quibus astronomiae pars optica traditur*. Frankfurt: Claudium Marnium et Hæredes Ioannis Aubrii, p.197.

² *Ibidem*, p.168.

³ *Ibidem*, p.170.

evidentissima visio).⁴ From an epistemological point of view, these statements were great contributions that made modern optical studies possible, but the most important significance of this treaty was the first theory of reversed retinal image. The bright rays, coming from the luminous objects located outside the eye, were passing through the refractive environments of the eyeball, forming a smaller, inverted image on the surface of the retina.

A few years later, Johannes Kepler published *Dioptrice* (1611), where he renewed the discussion about the formation of visual images. Appealing again to the analogy between eye and *camera obscura*, he mathematically demonstrated that each rays emitted from each point of a visible body reach a single point on the retina. Kepler was the first natural philosopher who geometrically demonstrated that the light rays emitted from a point of a luminous object are lines in the form of cones with the same base on the eye lens. When these rays pass through the eye lens, they refract and restore the cones, which have the same base on the lens, and the peaks are on the retina. This is the double cone model, later taken over in their works by the Jesuit Father Christoph Scheiner and the French philosopher René Descartes.

By appealing again to analogies, Kepler resembles these geometrical constructions with the pencils of an artist and concludes that the sight is nothing more than a “painting” of nature through the direct action of light on our retina. A vertical, smaller, inverted retinal paint is obtained⁵. So, the act of vision involves the “portrayal” of an inverted image on the retina, the mechanism being similar to that of the painting that appears on the screen inside the *camera obscura* when the light of Sun or Moon light penetrated through its narrow aperture.

The old *imago* that the subject perceived when looking at an object was the result of a tradition reminiscent of Aristotle’s “substance theory”. In *Peri psychēs* he considered that the basic feeling was touching, since all the senses had nothing but to take over the elements of nature as faithfully as possible, without any alteration of their essence by the subject. Thus, the data of the senses merely gave the intellect some substantial forms such as weight, taste-related elements (sweet, bitter, sour, salty), and colors. All these data were regarded as real things, and not as elements holding on to our subjectivity.

⁴ *Ibidem*, p.205.

⁵ Johannes Kepler (1611). *Dioptrice seu Demonstratio eorum quæ visui et visibilibus proptet Conspicilla non ita pridem inventa accident*. Augsburg: Davidis Franci., p.17.

Aristotle made no distinction between perception and reality. The sight was a kind of touch. To him, light had little significance in the act of visual perception:

The vision is of course the sense of the visible. The color is first visible [...]. Each color is a factor that moves transparency into action, and that is the very nature of it. That is why there is no visible without light, but any color pertaining to an object is seen only in light.⁶

Aristotle conducted this realism to the point where some substantial forms, some patterns of reality perceived through vision, such as colors could be taken into consideration.

On the contrary, in his new theory of vision, Kepler gave light a role in the mediation of knowledge⁷, distancing himself from the old Aristotelian conception that considered light to be merely a “transparency”⁸, with some role in the mechanism of vision. For the German optician, vision was a process of illumination, as light was seen as an active agent that painted nature on the tool of sight as if it were some tips of small paintbrushes (*apices penicillorum*)⁹.

Like the scholars of the 16th and 17th centuries, Kepler was closer to Plato’s philosophy, which, through the myth of the cave, in the dialogue *Republic*, greatly valued the metaphor of the Sun and of the Light in the process of authentic knowledge. Aristotelian knowledge began from physics, from material, unlike the Platonic one, which recognized the active role of the subject in knowledge, both by the anamnesis, *a priori* character of mathematics, and by the ideas that were the expression of a pure light coming from within the soul.

The German natural philosopher introduced the distinction between the small, vertical, and inverted retinal *pictura*, seen as a projection of a real image, and the old *imago*, defined as an image directly perceived by the subject, that would represent external objects in a direct way. Kepler’s new theory of vision removed the old conception of substantial forms or the “sensitive species” of ancient theories as he gave up all their epistemological implications. In his conception, sight was based on “shadows and lights” and retinal painting using the

⁶ Aristotle, *Peri psychēs*, 418a-419b.

⁷ Ofer Gal, Raz Chen-Morris (2013). *Baroque Science*. Chicago: The University of Chicago Press, p.123.

⁸ Aristotle, *op. cit.*, 429a.

⁹ Johannes Kepler (1611). *Dioptrice*, *op.cit.*, p.54.

camera obscura principle offered images that were in many ways distinct from the external objects producing them because these images were smaller and overturned.

Even though Kepler mentioned that the retinal painting would be perceived somewhere in the brain, he declared that the real mechanism of “mental” sight was not a concern for him but for other philosophers of nature. And indeed Descartes and Hobbes were among those who took over and developed Keplerian ideas in searching the “mental” mechanism of sight.

THE SIGHT COULD DECEIVE US

The metaphor of *camera obscura* played an important role in *La Dioptrique* (1637) where René Descartes confirmed and added precision to the Keplerian statements. In his youth, the French philosopher went to the city of Prague, the imperial capital, in order to find not only Brahe’s and Kepler’s astronomical instruments, but also to find Kepler’s treatises as from the contact with his *Dioptrice* resulted the Cartesian *La Dioptrique*. Descartes did not hesitate to use many Keplerian ideas, including the title of the treatise. Also, he used the word *la peinture*¹⁰ to describe the action of light in forming the retinal image.

Being not only a mathematician but also a philosopher, Descartes wondered about the way in which the images appearing on the retina became fantasies of the mind. The French philosopher produced a general mechanistic model for living things and asserted that humans are working like an organic machine. He described the material influences on the sense organs, including the physical impressions of light on sight organ and believed that image is interpreted in the pineal gland, which is a small gland situated in the center of the human brain. This anatomical structure is the place where the retinal information is transformed into a fantasy, and this fact means that the gland is the seat of sight and reason or common sense.

Descartes describes the formation of images on the retina taking over the *camera obscura* principle that he also applies to the eye¹¹. Making optical experiments, including those on an ox eye, he demonstrated, just like Kepler, that *la peinture* on the retina is reversed, smaller or larger depending on the distance from the object to

¹⁰ *Œuvres de Descartes* (1824). Tome cinquième: *La Dioptrique*. Published by Victor Cousin. Paris, p.43.

¹¹ *Ibidem*, p.41.

the eye, but it is not homogeneously distinct in the periphery as it is in its center.¹² Kepler's *Dioptrice* convinced Descartes that, once the light and motion of the planets could be mathematized, the instrument of Knowledge is not the sensation, but the mathematical order. And through mathematics we can make the transition from the two-dimensional plane to the three-dimensional space.

LIGHT IS NOTHING BUT A FANCY

Thomas Hobbes also initiated a revolutionary change in the theory of optics, being in line with his mechanistic view of natural philosophy, which reduced all natural effects to motion. He considered that the action of light on the eye is determined by a motion of the medium caused by the light source.

The manuscript of *A Minute or first Draught of the Optiques* (1646) represents Hobbes's unpublished tract on optics, dedicated to William Cavendish, marquis of Newcastle. The English philosopher recognized the inversion of retinal image and depicted an eye with a lens as an active agent for focusing light on the retinal screen. In the first part of this manuscript, the English philosopher presented the organ of sight, the eye, using anatomical diagrams that bonded the eye with the brain through the optic nerve and thus distancing himself from Descartes who located the center of vision in the pineal gland. Hobbes declared:

So that light is nothing but a fancie, made by the lucid object by ... pressure ... but this pressure is really and actually a local motion of the parts, both of the lucid object that comes a little forward every way, and also of the organ [...] and of parts of the braine and of the optique nerve (though said motion is imperceptible)¹³.

This statement is reiterated in his *Leviathan*. From the beginning, he delimited himself from the "universities of Christendom", where a doctrine based on "certain texts of Aristotle" was taught, according to which the sight was the result of taking over the representations of things without any contribution of subject's unconscious fantasy; in other words, the representations were believed to be the reproduction of the sensitive things from the outside. So, Hobbes stated that vision

¹² *Ibidem*, pp.47-49.

¹³ Thomas Hobbes (1646). *A Minute or First Draught of the Optiques. In two parts. The first of Illumination and the second of Vision*. Paris, f.7v. http://www.bl.uk/manuscripts/Viewer.aspx?ref=harley_ms_3360_fs001r [accessed 29.07.2017]

has more to do with the fantasy than with the image formed within the physical eye itself. He wrote: “the object is one thing, the image or fancy another. So that sense in all cases, is nothing else but original fancy, caused ... by the pressure, that is, by the motion, of external things upon our eyes”.¹⁴ So, Vision is just “Fancy” caused by motion. Even if this motion has its origin in the “motion” of external objects upon the eye, the motion in the brain do not directly correspond to phenomenal reality. Instead, phenomenal reality is constructed by the Fancy from the motions of the brain and optic nerve.

Thus, the flat plane of the retinal screen becomes a three-dimensional and focused on the construction of the image of interest. The mind tends to prefer the illusion of a deep and wide space rather than a small and pressing space. The eye deceives when this deformation provides thinking some time to react to certain situations such as those involved in a hunt or placing a maximum of information in a small space, as in the case of the effect of *trompe l’oeil*.

Perhaps due to Hobbes, who had brought Kepler’s innovative ideas in his native country, the first *camera obscura* that examined not Heaven but the Earth was built in the United Kingdom of Great Britain in the 18th century.

The dark chamber was placed under the roof of a tall building and the small aperture through which the light came inside was made at the very top of the roof. A mirror that could rotate and reflect the light inside the dark room on a table whose concave-shaped surface mimics the retina, could take pictures from the ground along 360 degrees, thus covering a wide surface, from the focusing point to the horizon.

Camera obscura actually reproduced a gigantic human eye that could reduce the outlook of the outer world to extremely smaller one that could be found on a surface of no more than 1 m². From now on, Plato’s shadows were endowed with light and color and created an instantaneous image of reality that served as a source of fascination and delight for avid enthusiasts of optical curiosities¹⁵.

¹⁴ Thomas Hobbes (1651 / 2014). *Leviathan: The Matter, Forme, & Power of a Common-Wealth Ecclesiastical and Civil (Wordsworth Classics of World Literature)*, with an Introduction by Richard Serjeantson. Hertfordshire: Wordsworth Editions Limited, p.14.

¹⁵ Catherine Elwes (2015). *Installation and the Moving Image*. London & New York: Wallflower Press, p.77.

CONCLUSION

Camera obscura proved that the sight is the sense that offers the widest information of the surrounding world, giving perspectives to distances, but at the same time it implies the subject's attention and effort of interpreting on a certain field of interest. The vision is in fact the gateway to the subject's freedom in his relation with the surrounding space, and by storing phantasms in his memory it ensures, at the level of the internal sense, the subject's entry in time.

Kepler, the one who first applied the *camera obscura* principle on the mechanism of vision, made also a reform in philosophy. Through his conception of image formation, the idea of substantial quality was annihilated because in the retina there is only the light that paints, forming a new, inner reality, different from the outer one, since it is smaller, two-dimensional, inverted and vertical. Starting from here, René Descartes is the one who has the best comprehension of the human understanding of the reality. Our reality is in fact a subjective effort made at the level of the human mind. Thus, the active role of the subject in the formation of the image is revealed, and the process of knowledge is initiated by the contact with the material objects that the intellect describes as faithfully at the mental level. Our world is primarily a construct of consciousness. Reality is a product of our mind in contact with light. So, the subjective era was born.

Kepler's new theory of vision and his new optical instruments allowed human being a new visual experience by creating new worlds, alternatives of the material world. So, the world created by artists has become a "second game" on everything the nature painted on the original screen of the eye, i.e. the retina.

These new universes created by the artists from 17th and 18th centuries which defines the Baroque art were characterized by other scale and resolution parameters, along with spherical and chromatic aberrations, whose role was to amplify the illusions of vision, thus creating the *trompe l'oeil* effects. Baroque art has become a genuine program whose purpose was to demonstrate intuitively that the senses are misleading, confirming the skepticism that characterized the philosophy of those times that sought to free itself from the religious dogmatism that accompanied the Thirty Years' War.

Through their works, the artists supported the anti-scholastic scientific program initiated by Kepler, Descartes and Hobbes, which demonstrated that science cannot be built only on data provided by the senses because these are relative and can be misleading. For instance,

the *trompe l'oeil* effects were used by the Baroque painters in order to create a three-dimensional illusion on a two-dimensional space. This technique was used in many interior spaces, warning about the idea of visual deception in which straight ceilings were seen as lifting themselves into vertical spaces that could be expanded into undefined horizons reaching the sky. Artist illusions have effectively broken the idea of the unity of the senses that the scholastic vision of medieval universities has imposed upon the world, demonstrating that the eye perceives reality differently from what the tactile sense gives us. The authority of the radiant eye theory imposed by Galen to support the supremacy of the sense of touch in relation to the other senses, assuring them and thus guaranteeing their unity, yielded definitively to the great achievements of scientists and especially of the Baroque artists. The new era opened by them has liberated the universe of human imagination and creativity that was centered on discovering subjectivity and assuming it in the creative act.

Kepler's works on optics, especially *Dioptrice*, depicted him not only as a mathematician, but rather as a natural philosopher. Kepler has modernized the anatomy and physiology of the eye, and the philosophers who followed him isolated the mind from objects and grounding knowledge on subjective experience to the detriment of a traditional perspective where this process was pursuing a strict correspondence (*Adaequatio rei et intellectus*) between the inner experience of the subject and the external objects offered to the subject through the senses.

Transformed into a simple screen on which the reversed image of the luminous objects is projected, the eye no longer provides the observer with genuine representations of visible objects. The human mind became an active agent, which built a subjective reality and lead to Baroque art which create a real universe of dream as an expression of subjective freedom.

The human mind has begun to be understood as an active agent whose role was to focus attention on certain sequences of the film that unfolded on the retina. Finally, a subjective, interpretable, and meaningful reality focusing on the subject's point of view was built. Baroque art has understood this fact and created, through a real program, a genuine dreaming universe as an expression of the inner freedom. Adequacy was superseded by the theory of coherence regarding the foundation of truth.

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