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The unit of vision: the concept of *opsieme*

Topic: art and science
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References:
[1] Münch TA, Azeredo da Silveira R, Siegert S, Viney TJ, Awatramani GB, Roska B. "Approach sensitivity in the retina processed by a multifunctional neural circuit". Nature Neuroscience 2009.
[2] Mc Conkie GW, Rayner K. The span of the effective stimulus during a fixation in reding, Perception and Psychophysics, (1975)
[3] Dehaene S. Les neurones de la lecture. Odile Jacob. 2007

Originating from the embryological neuroectoderm layer, the retina acts like a real extension of the central nervous system (1), selecting and processing information that it will later transmit to the cerebral cortex. The eye centers the fovea, (1.5 mm diameter in the retina), on a desired and specific target. The fovea is exclusively composed of cones, which makes it the region of the eye with maximum acuity. This way the eye achieves a fixation (200-300 ms). Then the eye displaces the fovea to another target, thereby completing what is called a saccade. At a normal reading pace, one perceives 3-4 letters to the left side and 7-8 letters to the right side of the eye's anchor point (2). According to cognitive neuroscientist S. Dehaene (3), recognizing letters and their combinations (graphemes) and then creating an interface between what's written and what's articulated (phonological awareness) is the way to gain access to the lexicon that we use to communicate. If we indeed pay attention to the basic elements that compose the written sentence, we find letters, syllables and words. However, the smallest significant element of the sentence is probably the grapheme, since the whole understanding process derives from it. The grapheme is the written equivalent of the oral phoneme. It is comprised of the smallest group of letters making a phoneme. Does this same concept apply to a painting ? Just like in the reading process, the image undergoes several mutations between the retina and the sensory areas of the cerebral cortex, whereby the basic components of the image (forms, colors, orientation of the lines) are dissected first and then transmitted to the visual areas. Dismantling, reassembly and identification are the three steps in the process of the visual representation, whether artistic or natural. The time spent in front of a work of art is known to be very short (10-45 sec); the spectator leaving the art piece stores in his neurons a permanent image made of sharp zones and less sharp ones. It is based on these foveal and peri-foveal elements solely that the spectator will understand the meaning of the message that the artist wants to convey, not only at a purely semantic level, but also at an esthetic and emotional level. Thus the reading of a sentence and the « reading » of an art piece seem to be similar processes. We would thus like to equate visual units and graphemes. This basic element can be explicit, but still has a polysemantic potential at this stage. It must be linked to other basic elements or visual units in order for the image or the art to be understood as a whole and make « one » sense only. We suggest opsieme as a designation for the smallest significant visual unit: « opsie » – from the Greek ops, opsis, which means eye, vision and « eme », suffix which signifies basic unit. The education of the eye movements evolves, according to the substrata that are presented to us. The classic or figurative painting, is read as we read in a book and the modern painting is read in the style of our information's researches on the Internet?

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Thanks to vision, one can discover and relate to one's surrounding world. The eye is much more than a simple photographic tool which gathers information in order to present it to the brain. Originating from the embryological neuroectoderm layer, the retina acts like a real extension of the central nervous system (1), selecting and processing information that it will later transmit to the cerebral cortex. The study of ocular movements helps us understand how the eye indeed analyzes the surrounding world. The first principle is that visual acuity is not homogeneous in the visual field. First, the eye centers the fovea, a tiny dimple of 1.5 mm diameter in the retina, on a desired and specific target. The fovea is exclusively composed of cones, which makes it the region of the eye with maximum acuity. This way the eye achieves a fixation ; with each fixation usually lasting between 200 and 300 ms. Then the eye displaces the fovea to another target, thereby completing what is called a saccade. Vision is thus a succession of fixations and saccades, rather than a single global input. If only foveal vision can generate a sharp vision, the peri-foveal vision is indeed blurred. That is, when one reads a written page, only certain letters are simultaneously perceived acutely, while the rest of the page is blurred (2). At a normal reading pace, one perceives 3-4 letters to the left side and 7-8 letters to the right side of the eye's anchor point (3). Thus, reading consists in fixating onto micro-areas of only a few letters length in the midst of a multitude of letters. According to cognitive neuroscientist Stanislas Dehaene (4), recognizing letters and their combinations -- called graphemes -- and then creating an interface between what's written and what's articulated (phonological awareness) is the way to gain access to the lexicon that we use to communicate. If we indeed pay attention to the basic elements that compose the written sentence, we find letters, syllables

and words. However, the smallest significant element of the sentence is probably the grapheme, since the whole understanding process derives from it. The grapheme is the written equivalent of the oral phoneme. It is comprised of the smallest group of letters making a phoneme. For example, in French, the phoneme [o] has several graphemes : o, au, and eau. Unlike a letter, a grapheme represents better the phonology of a language, or what a language sounds like. The French language counts 130 graphemes.

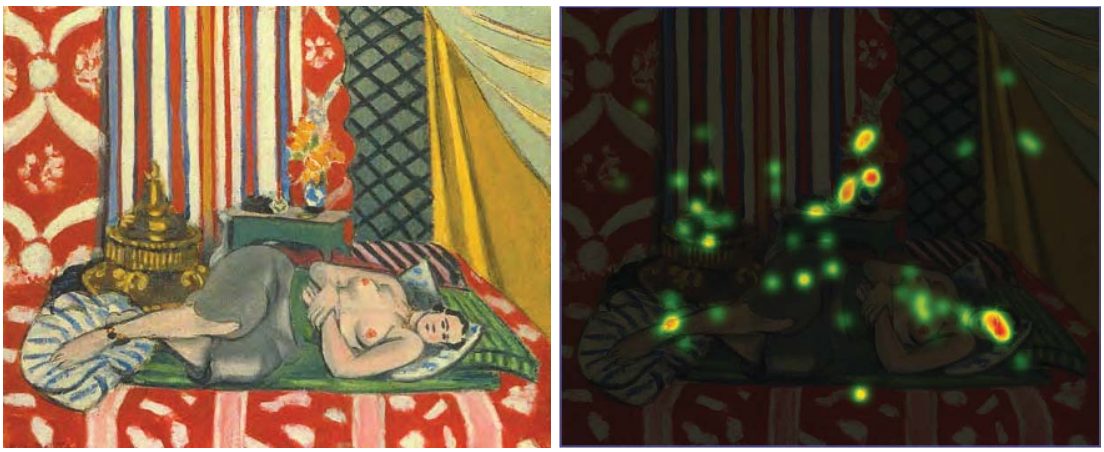
Does this same concept apply to a painting or an image ? Just like in the reading process, the image undergoes several mutations between the retina and the sensory areas of the cerebral cortex, whereby the basic components of the image (forms, colors, orientation of the lines) are dissected first and then transmitted to the visual areas. It is only then that the image is reconstructed, and that it will be confronted against other known representations that are stored in our memory for an identification of the present image. Dismantling, reassembly and identification are the three steps in the process of the visual representation, whether artistic or natural.

The time spent in front of a work of art is known to be very short (10-45 sec) ; in this time lapse, the spectator leaving the art piece stores in his neurons a permanent image made of sharp zones and less sharp ones. Using Matisse's *Odalisque a la culotte grise* as an example, figure 1a points to the areas of interest of the painting, and figure 1b represents the painting as seen by the fovea with a few sharp areas standing out from a fuzzy background (5). It is based on these foveal and peri-foveal elements solely that the spectator will understand the meaning of the message that the artist wants to convey, not only at a purely semantic level, but also at an esthetic and emotional level. The painter Avigdor Arikha defines this process : « Similarly to the function of grammar in a string of words, the pictorial constituents operate the picture – dot, line, form and colour in a state of tension – that underlie depiction. It is analogous to a succession of segmental phonemes that constitute a sentence» (6). Thus the reading of a sentence and the « reading » of an art piece seem to be similar processes.

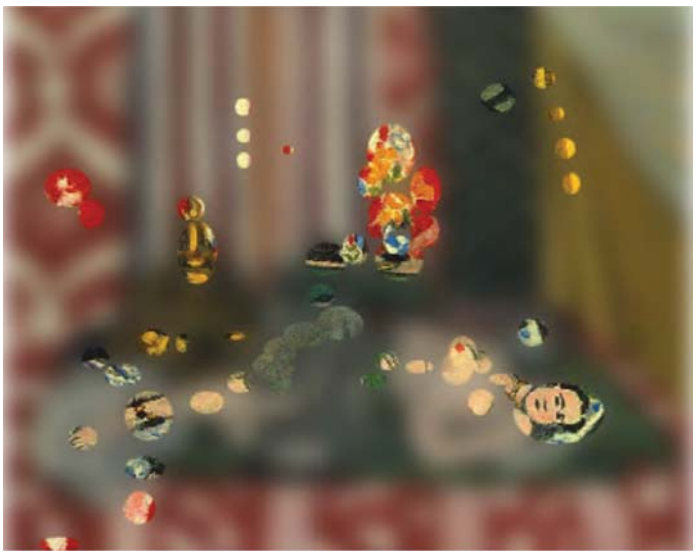
We would thus like to equate visual units and graphemes. Like in reading, the basic visual element in the work of art carries an information that once integrated within the rest of the visual « sentence » will make sense. This basic element can be explicit, but still has a polysemantic potential at this stage. It must be linked to other basic elements or visual units in order for the image or the art to be understood as a whole and make « one » sense only. Can one infer that the understanding of the image is dependent upon the number of fixations? Does the number of fixations correspond to the number of fixations necessary to transition from a polysemantic vision to a homonymous vision ?

Fixation can be equated with the time necessary to identify the smallest significant visual unit in an image. Just as a phoneme is the smallest articulated unit, and a grapheme is the smallest written unit, we suggest opsieme as a designation for the smallest significant visual unit : « opsie » – from the Greek ops, opsis, which means eye, vision and « eme », suffix which signifies basic unit.

Figure 1 : *Odalisque a la culotte grise* (Matisse)



a b



c

a - the original

b - areas of interest

c - foveal and perifoveal visions

References

(1) Münch TA, Azeredo da Silveira R, Siegert S, Viney TJ, Awatramani GB, Roska B. “Approach sensitivity in the retina processed by a multifunctional neural circuit”. *Nature Neuroscience* (d.o.i. 10.1038/nn.2389), September 2009.

(2) Sere B, Marendaz C, Herault J (2000). Nonhomogeneous resolution of images of natural scenes. *Perception*, volume 29, pages 1403 - 1412.

(3) Mc Conkie GW, Rayner K. (1975) The span of the effective stimulus during a fixation in reding, Perception and Psychophysics, 17, 578-586.

(4) Dehaene S. Les neurones de la lecture. Odile Jacob. 2007.

(5) Courchia JP, Courchia B. “What do we see?” A study on the variability of the visual strategy over time to explore a work of art. CogSci 2005 XXVII Annual Conference Cognitive Science Society, Stresa, 21-23 July (Italy).

(6) Lévy-Eisenberg D .On Art and credibility Avigdor Arikha’s phenomenological practice of art. Tel Aviv University. http://arts.tau.ac.il/departments/images/stories/journals/arthistory/Assaph5/12eisenberg.pdf. Accessed January 22nd, 2012.