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Visual imagination and the narrative image. Parallelisms between art history and neuroscience

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ABSTRACT

Understanding visually presented stories requires intense effort from our visual imagination. Artists and theoreticians from the Renaissance onwards suggested various ways to depict stories, either to enhance their understanding and enjoyment, or to help adjust the depictions to the aesthetic ideas of the era. Alberti's concept of istoria, Leonardo's practice of visual stimulation, Lessing's advice on how to choose the most fruitful moment of a story relied both on personal experience and the scientific knowledge of the era. Visual imagination is specially needed in non-figurative and sequential narratives in modern and contemporary art, which are supported by Arnheim's notion of stroboscopic motion. Recent developments in image-making technologies enable some clarification of the processes involved in human perception with regard to the understanding of painted scenes and visually presented stories. The objective of this paper is to find the counterparts of these art theoretical concepts in psychology and neuroscience. Through the phenomena of mirror neurons, scene perception, gist of scene, and face and object recognition, these findings establish parallelisms between art history and neuroscience.

"The more we see, the more we must be able to imagine. And the more we add in our imaginations, the more we must think we see."

Gotthold Ephraim Lessing (1984, 19).

1. Introduction

The experience of any narrative requires the use of imagination. With oral and verbal narratives we have to use our visual imagination to bring both actions and their settings to life. With a visual narrative, such as a panel painting, a fresco cycle, or a film, in which the heroes and their faces are given to us, we see selected actions and settings, but we have to imagine what happened between, before or after the scenes, because the storyline may be less explicit, or even puzzling.

Lessing emphasised the mutually dependent relation between seeing as a physiological act and imagination as a mental process. This relationship had long been established by the art of memory, an ancient mnemonic technique that was passed onto the Middle Ages and the Renaissance (Yates, 1966). This helped orators memorise speeches, monks remember biblical passages, and was also employed in the study and practice of art. The main point of this technique was placing objects and concepts onto imaginary places. Walking through these imaginary locations, for example a building,

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would activate mental images from memory. In the art of memory, visual experiences and inner mental abilities were developed to create sequential order in a visually arranged environment. This makes it similar to visually presented stories, where events and figures are also attached to certain spatial locations in a logical manner. The inseparability of temporal and spatial aspects of storytelling present both in cognition and artistic thought was described by the term *chronotope* in the philosophy of Mikhail Bakhtin (Bakhtin, 1981).

In studying narratives most emphasis was given to philosophical, social, or historical aspects. Storytelling, however, presumes physical engagement as well: "storytelling activity is grounded in the bodies of the participants, including their brains" (Hydén, 2013, p. 228), and is affected not only by everyday or practical experiences but also by active sensory experiences. Visual imagination, understood here as an umbrella term for associative mental visualizations including art of memory, activating the image reservoir in memory, visual reactions to sensory stimulus, learning through images or mental operation of images, will be studied in this paper as an imaginative response to a visually presented story.[1]

Artists and theoreticians from the Renaissance onwards suggested various ways to depict stories, either to enhance their understanding and enjoyment, or to help adjusting the depictions to the aesthetic ideas of the era. The key concepts, like variety, repetition, disposition, the choice of the most suitable moments, the extension of the temporal unit, or sequentiality presumed knowledge of human perception that was only intuitively available at the time. Recent developments in digital image-making technology have revolutionised our ability to collect data and analyse human behaviour. This enables some clarification of the processes involved in human perception with regard to the understanding of painted scenes and visually presented stories. Some of the above mentioned concepts of art theory have found their counterparts in neuroscience, through the phenomena of neuroplasticity and mirror neurons, scene perception, gist of scene, and in face and object recognition. The objective of this paper is to reveal the parallelisms between the art historical concepts associated with visual storytelling and these recent findings in neuroscience.

Let's begin with two contrasting examples, Jacopo del Sellaio's cassone panel *Cupid and Psyche* (c. 1473, tempera and gold on wood, Cambridge, Fitzwilliam Museum, Fig. 1) from the 15th century Florence and a contemporary piece, Barnett Newman's *The Stations of the Cross* (1–14., *Lema Sabachthani*, 1958–1966, oil and acrylic on canvas, Washington, National Gallery of Art, Fig. 2), one that shows everything of a story, and another that shows almost nothing of it. Jacopo del Sellaio's cassone panel leaves little to our imagination. It depicts the classical love story of Cupid and Psyche in fifteen episodes, but reaches only half way, continuing on another panel. The episodes are connected through the figure of Psyche in a sequential narration: she herself appears eleven times on the first panel. From being conceived to falling in love and then losing her love, her journey physically begins in the marital bed of her parents seen on the left and finishes in the bedchamber of her future husband, seen on the right. The other piece, now in a private collection, shows the second half of the story in a similar manner. Their rectangular form suggests that the panels were probably commissioned for a marriage and used as a wardrobe in a marital bedroom. The second example is a series of 14 non-figurative paintings by the abstract expressionist painter Barnett Newman. The panels repeat vertical painted stripes against a grey-white-black coloured background. The title refers to the Passion cycle, and evokes the saddest part of the life of Christ through abstract forms. With the series Barnett Newman intends to awake an emotional response and raise empathy. To some extent both pieces rely on our previous knowledge of the subject and require an intense work from our visual imagination. However, the contrast between the two strategies is striking: Sellaio meticulously paints even the smallest details of the story, including characters, episodes, and different environments, whereas Barnett Newman decisively leaves out all of these elements. He communicates the story by the title, logical order and arrangement of the panels, and by the repeated signs, the life-size vertical stripes, which stand as a metonym of the figure of Christ. Yet, there is a point of view from which these two works of art, in a narrative sense, look very similar.

2. Pleasing the eye with variety in renaissance painting

Sellaio's story is extraordinarily rich even in terms of 15th century art theory. It fulfills the criteria proposed by Leon Battista Alberti, a theorist and an artist himself, who was the first to write extensively on narrative scenes in his pioneering treatise, *De Pictura* (1435) and revived the ancient term *istoria* filling it with new content.[2] The new model, which was applied to altarpieces, panel paintings, and the individual sections of fresco cycles, was introduced at the beginning of the quattrocento in Italy and can be characterised by less dependence of the written source and by more carefully constructed pictorial scenes. These pictorial spaces house active bodies, of which all should have their own attitudes, gestures, movements and positions. Alberti envisioned quite large dimensions for an istoria, as he advised that the number of figures in such individual scene is to be limited to not more than ten. He prescribed "plentiful variety" for rich painted visual scenarios, and this concerned both the characters and elements of the stage (a "properly arranged mixture of old men, youths, boys, matrons, maidens, children, domestic animals, dogs, birds, horse, sheep, buildings and provinces", Alberti, II. 40., 1991, 74), and also body movements. In quattrocento painting, painted scenes carried various narratives: religious topics, war scenes, historical and mythological stories. Variety was looked at as an element that served to

[1] Visual imagination is a highly personal activity (see Chan, 1997; Kaufmann & Helstrup, 1993). Not everyone has it in full, though. Aphantasia describes the condition of people who live without visual imagery, see for example Zeman, Dewar, and Della Sala (2015).

[2] The Albertian term istoria was studied in detail by Greenstein (1992, Chapter 2).

Fig. 1 – Jacopo del Sellaio: *The Story of Cupid and Psyche*: Part I., c. 1473, tempera and gold on panel, 58.6 × 178.8 cm. Cambridge, Fitzwilliam Museum. Reproduction by permission of the Syndics of The Fitzwilliam Museum, Cambridge.

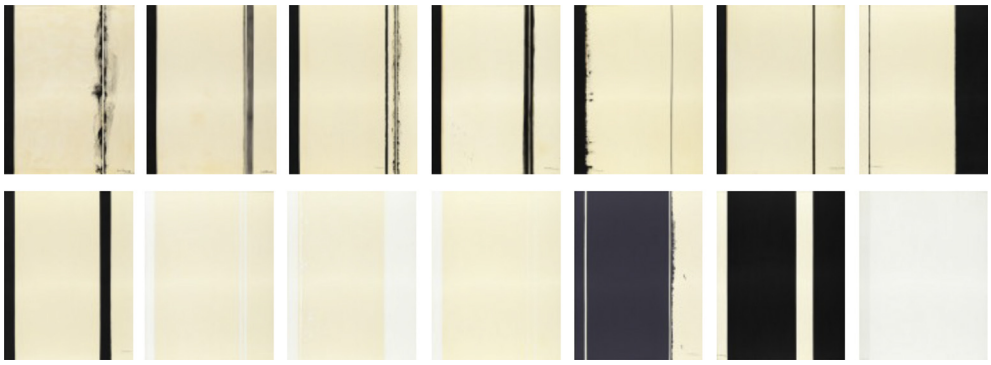

Fig. 2 – Barnett Newman: *The Stations of the Cross*, 1–14., Lema Sabachthani, 1958–1966, oil and acrylic on canvas, each panel approximately 197–199 × 152–154 cm. Washington, National Gallery of Art.

keep alive the attention of the beholder, enhance imagination and evoke the proper emotional condition of the onlooker.

Sellaio applied this "plentiful variety" in a literal sense. Following Alberti's suggestions, the various postures of Psyche, such as standing, walking, floating in the air, or sleeping, help our imagination to understand her different moods and reactions, like being curious, determined, tired, desperate, or disobedient. The variety of body movements, attitudes, gestures, emotions and glances ensure that Psyche and the characters both perform actions and show reactions. Sellaio's way of depicting the ancient narrative was not unique. Indeed, the fifteenth century experienced a huge peak in the production of images showing continuous narration, a narrative mode that, in its present definition, denotes visual tales told by the repetition of figures.[3] Sellaio himself turned to this method in other cassone paintings (for example the *Diana and Actaeon*, c. 1485, tempera on panel, Yale University Art Gallery) where the rectangular format also urges the use of continuous narration. Leonardo da Vinci too regarded diversity as a key to effectiveness in painted stories. As he wrote, a battle scene should show the many stages of the fight; soldiers should be depicted as combatants, conquerors, injured or beaten figures, with shields or disarmed, and with different emotional conditions; the scene is to be filled with riderless or runaway horses, or with horses dragging dead bodies, and apart from animated beings, elements of nature and the effects of light and shadow may also reflect heterogeneity (Leonardo, 2008, pp. 174–176). The *Battle scene between Scipio and Hannibal* shows similar diversity (Cornelis Cort after Giulio Romano, 1550–1578, engraving, New York, The Metropolitan Museum of Art, Fig. 3). This description helps us to visualise Leonardo's lost wall paintings of the *Battle of Anghiari*, which he produced for the Council Hall of the Palazzo Vecchio in Florence

Fig. 3 – Cornelis Cort after Giulio Romano, *The Battle Between Scipio and Hannibal at Zama*, 1550–1578, engraving, 41.4 × 53.9 cm. New York, The Metropolitan Museum of Art. © The Metropolitan Museum of Art, New York.

[3] The phenomenon of continuous narration in Renaissance painting was examined in Andrews (1995).

between 1503 and 1506, and which is today known only from preparatory drawings and copies.[4]

The reason why the concept of variety earned such a high prestige in the writings of Alberti is probably because of his personal experiences, which made him neurologically sensitive to diversity. Unusually for the time, he was exposed to various environments throughout his life. Growing up, studying, and working in the different environments of cities such as Venice, Florence, Padua, Bologna, Ferrara, Mantua or Rome, made him flexible in adapting changing circumstances.[5] As a consequence, he appreciated variety in visual forms: variety in different landscapes and cityscapes, in depicted human figures, and in their emotions. His neurological inspirations and his sensitivity to the problems of vision have previously been recognised and linked to his ideas on the origin of sculpture. As John Onians has argued, "Alberti is concerned with the way in which the artist can improve his performance by taking artificial control of the process of vision". His advice on how to enhance artistic creativity and pleasure in seeing art is connected to a recognition of empathy. For Onians this resonates with the function of mirror neurons (Onians, 2007, pp. 44–45).

Alberti apparently agreed with the finding of modern neuroscience that boredom hurts. Understimulation and monotony are acknowledged to be negative factors, causing unpleasant, depriving or disappointing feelings. Boredom is connected with feeling of sadness, emptiness, or displeasure. Richard I. Thackeray has stated that "boredom and monotony can, through effecting increases in neuroendocrine activity, produce the syndrome of stress" (Thackeray, 1980, p. 9). With neuroscience, we now know how this happens. During boredom the brain switches to high stress level mode which produces detrimental effects. As Judy Willis has described: "Whenever the amygdalae are highly activated by stressors, including sustained boredom, the PFC [prefrontal cortex] loses communication with the rest of the brain. The output from these upper reflective control networks – such as judgement, goal-directed planning, risk assessment, attention focus, distraction suppression, and intentional control over emotional responses – can no longer reach the lower brain networks that produce behavioural responses. When the reflective PFC does not supervise the lower brain, responses become involuntary" (Willis, 2014, p. 29). Because of these effects, diversity is a way to keep our attention and imagination alive, in real life or during the time we are looking at pictures.

3. Visual stimulation and empathy in Leonardo's writings

Leonardo linked variety to empathy and visual learning. Although he used the mirror as a metaphor of the mind, for him the mind, or better to say, the brain, was not perfected in physiological sense. It was a living and absorbing organ that could be and must be stimulated in order to develop and become a visually sensitive surface. "The mind of a painter should be like a mirror, which always takes the colour of the object it reflects and is filled by the images of as many objects as are in front of it. Therefore you must know that you cannot be a good painter unless you are universal master to represent by your art every kind of form produced by nature. And this you will not know how to do unless you see them and retain them in your mind" (Leonardo, 2008, p. 206). He recommended that painters search the rich textures created by nature for inspiration, because it helps achieving close resemblance and enhances visual imagination: "Look at walls splashed with a number of stains, or stones of various mixed colours. If you have to invent some scene, you can see there resemblances to a number of landscapes, adorned with mountains, rivers, rocks, trees, great plains, valleys and hills, in various ways (…). Do not despise my opinion, when I remind you that it should not be hard for you to stop sometimes and look into the stains of walls, or ashes of a fire, or clouds, or mud or like places, in which, if you consider them well, you may find really marvellous ideas. The mind of the painter is stimulated to new discoveries" (Leonardo, 2008, pp. 173–174). The Renaissance brought an increased awareness of nature, which was recommended to be used as a model for painting. Leonardo himself was a great observer of nature: he examined falling water and clouds among other things, and closely analysed the flight of birds. He, who also knew more about the human body than any other artist of his time, appears to be aware of the effect of neuroplasticity. By looking at surfaces, textures, ornaments, he says, painters enhance their own visual imagination; they could thus strengthen their existing neural connections and set up new ones. Leonardo thinks that observation is a mental process and he suggests a correlation between visual inputs and the quality of the painter's work. In order to develop expertise, the brain indeed must decode to understand and interpret new sensory stimuli from the close environment.

Leonardo well recognised the role of mirroring in the perception of narrative images. As he phrased it: "That which is included in narrative paintings ought to move those who behold and admire them in the same way as the protagonist of the narrative is moved" (Leonardo, 2008, xxvii). The modern term describing the sensation of being sensitive to another person's feelings, adopting his or her posture, or "matching the neural responses of an observed", as C. Daniel Batson phrased it (Batson, 2009, pp. 4–5), is empathy. Obviously, Leonardo was not aware of the existence of the mirror neurons that are activated when someone sees an action or reads about an action, but he was able to properly formulate the benefits of their existence. Whether Sellaio followed Leonardo's advice and looked at ashes of fire, we do not know. But his *Cupid and Psyche* panel proves that he looked at trees, clouds and stones, both natural and carved, even gilded, looked at colourful textiles, and understood the language of human gestures. The painted cassone thus offers the variety of natural and man-made elements and human emotions that would help its beholders to learn through seeing.

[4] On the theoretical and practical aspects of Leonardo's *Battle of Anghiari*, see Farago (1994). Martin Kemp discusses the application of Alberti's concept of istoria in Leonardo's *Last Supper* (Kemp, 2006, especially pages 176–180).

[5] More on the relation of Alberti's life, self and personality can be found in Baxandall (1991) and Schneider (1990).

4. Momentary expression and momentary perception

Soon, however, the imagination of viewers was disturbed by the repetition of figures and the quattrocento ways of depicting narratives, such as we find on Sellaio's panel, and it was no longer deemed acceptable. Baroque aesthetics considered narrative painting in relation to a newly rediscovered phenomenon, time. The Renaissance idea of time had been cosmic, symbolic and allegorical, or was related to man's finite existence.[6] By the 17th century time became an abstract measurable phenomenon, and changed its conceptual character. The new aesthetic laws were influenced a great deal by new technologies developed within clock making, which for the first time in history, enabled measuring the minute and its fractions.

The new experience of the momentary was reflected in painting. Many stories were depicted by only a single, short action, giving emphasis to the presentation of the transient and momentary. In Caravaggio's *Boy bitten by a Lizard* (1594–1595, oil on canvas, London, National Gallery, Fig. 4) the young boy cries out in pain. His sudden reaction and strange position are the signs of a sharp physical pain. Chardin's boy, who blows a bubble, is an allegory of vanitas. But his concentrated look intensifies the transiency of the moment (Jean Siméon Chardin: *Soap Bubbles*, 1734–1735, oil on canvas, New York, Metropolitan Museum of Art, Fig. 5). The *Beggar Boys Eating Grapes and Melon* (Bartolomé Esteban Murillo, 1645–1646, oil on canvas, München, Alte Pinakothek) is a realistic image of two boys, one is putting a grape into his mouth, and the other has already taken a bite that protrudes from his face. Murillo emphasised the momentary effect of a bite and the volatility of taste.

The requirement for an instantaneous painterly expression seen in Baroque painting was developed later in aesthetics. It is generally treated as an idea originating from Lessing's *Laocoön* (*An Essay on the Limits of Painting and Poetry*, 1766). The key device for achieving this demand was the concept of the significant moment (Dowley, 1976). The idea of the *punctum temporis* or *pregnant moment* now came with restrictions. Painting should focus on one moment, and it is the viewer who creates the full story with her imagination: "If the artist can never make use of more than a single moment in ever-changing nature, and if the painter in particular can use this moment only with reference to a single vantage point (…) then it is evident that this single moment and the point from which it is viewed cannot be chosen with too great a regard for its effect. But only that which gives free rein to the imagination is effective" (Lessing, 1984, p. 19). Lessing propagated media purity in the era of the Encyclopédistes, so he emphasised the difference between visual and verbal comprehension: "That which the eye takes in at a single glance he [the poet] counts out to us with perceptible slowness" (Lessing, 1984, p. 86). His ideas remained alive, albeit in simplified form and today it is generally assumed that images can only show one moment of a story like a photographic

[6] For the Renaissance notions of time in art see Cohen (2000).

Fig. 4 – Michelangelo Merisi da Caravaggio, *Boy bitten by a Lizard*, 1594–1595, oil on canvas, 66 × 49.5 cm. London, The National Gallery. © The National Gallery, London.

Fig. 5 – Jean Siméon Chardin, *Soap Bubbles*, 1734–1735, oil on canvas, 61 × 63.2 cm. New York, The Metropolitan Museum of Art. © The Metropolitan Museum of Art, New York.

snapshot and that images can be perceived in an instant, with a single glance.

Modern art history set out to disprove this idea of the pregnant moment and confronted it with technical and psychological findings. Ernst H. Gombrich in his study, *Moment and Movement in Art* (1964), brought forward examples to show that the instantaneous moment in photography or in film stills might seem unnatural. He also referred to a number of fascinating psychological experiments, which support the idea that humans do not perceive instants but some kind of interval, a brief temporal span that operates as a unit. This lasts and includes not only the immediate past but the immediate future moments enabling our visual imagination to construct a narrative.

Recent research in neuroscience, however, has revealed, that Lessing was actually right: momentary perception is an existing and measurable phenomenon and images can, to a certain extent, be perceived in a glance. Experiments in quick scene perception have proved that humans very rapidly perceive the overall meaning (the gist of a scene, as neuroscience calls it) of complex, visually rich scenes even in a fraction of a second. An experiment from 1976 showed that observers could, with almost 100% accuracy determine the type of a scene after seeing the image only for a quarter of a second (experiment by Mary Potter, Goldstein, 2010, p. 114). The type of images used in this research consisted of an office, a street view, a family photo, or an outdoor scene with a mountain, but this can be easily translated to genres of painting, like landscape, interior scene, group portrait, or narrative scene. Li Fei-Fei and colleagues in another experiment in 2007 showed that this fraction of a second can even be iterated further. In this experiment, images were shown with four different presentation times (27 msec, 40 msec, 67 msec and 500 msec). In terms of our own concerns it is most useful to consider the free-recall responses, in which the observers described three images: a coastline with birds, an interior of a room with paintings on the wall, and another interior with two men sharing an activity. At short presentation time (27 msec and 40 msec) observers could recognise only dark and bright patches, lines, and basic shapes. At 67 msec they were able to distinguish indoor and outdoor scenes, recognise basic spatial relations, identify some objects (for example furniture), and landscape elements (water or rock). When the presentation time was raised to 500 msec, they all gave a short but proper description of the image identifying the details of the objects, recognizing human activities and even human relations (Fei-Fei, Iyer, Koch, & Perona, 2007, pp. 15–16). At short presentation time (27 msec and 40 msec), shape- and low-level sensory-feature-related terminology predominated the responses, but as the display time increased, conceptual and semantic terms appeared in the description (Fei-Fei et al., 2007, p. 15). As the authors summarised, "evidence suggests that, on average, less information is needed to access some level of nonsemantic, sensory-related information in a scene compared to semantically meaningful, object- or scene-related information" (Fei-Fei et al., 2007, pp. 16–17).

This speed of perception (200–500 msec/image) in real life corresponds to looking at images during a quick walk. Imagine a 16th century bishop hurrying through the Stanzas in the Vatican to attend an audience with the pope, a 17th century ambassador walking through the Private Gallery of Maria de' Medici to visit the queen in the Luxembourg Palace in Paris, or a 21st century art historian having only three hours for the entire Metropolitan Museum in New York. They would only be able to recognise the genre of Raphael's or Rubens' cycles but not its details. This speed is enough for rapid scene categorization and detecting objects, but not adequate to identify the object details and object relations, such as are essential to the fabrication of a story in a narrative image. In the case of our previous examples, the reflection on the glass vase in the foreground of Caravaggio's *Boy Beaten by a Lizard*, or Chardin's signature on the stone parapet where the boy leans over in *Soap Bubbles* would surely go unnoticed.

We recognise scenes and comprehend their gist using skills developed by real experiences. We humans are taught from an early age to understand our constantly changing environment, both physically and mentally, because it is crucial for our survival. Images in the visual arts, such as narrative frescoes and panel paintings are similar to real life situations in the way that they are also inhabited by acting humans, and are surrounded by objects, architectural or landscape elements. The above mentioned experiments used photos of real life scenes. Quick scene perception of real life situations, however, might be slightly different. The observers then are embedded in the scene, which implies different spatial relations. This might be similar to experiencing a chapel with painted stories on the walls. During a quick first glance, when we try to figure out the general meaning of a scene, we focus on the global features of images. This perception, however, is superficial, rather schematic, quickly lost from visual memory, and is blind to details. Helen Intraub, a leading researcher on scene perception, confirms these contradictory aspects of rapid scene perception, saying that: "Visual information exists all around us, but physiological constraints prevent us from seeing it all at once (…). The visual system has evolved in such a way as to maximise comprehension of discrete views at the expense of unnecessary detail, but through the action of attention allows the viewer to access detail when the need arises" (Intraub, 1997, pp. 217, 220).

5. Taking a longer look: stories to be contemplated

Obsession with the momentary changed the representation of complex stories as well: painters experimented with solutions that maintained temporal and spatial coherence but at the same time enabled them to show several moments of a story. The key to this was sequentiality. An early Italian example of this rendering is Domenichino's *Diana and her Nymphs* (1616–1617, oil on canvas, Rome, Galleria Borghese) that demonstrates how variety can be achieved without doubling: the act of shooting an arrow is divided into several successive phases and is allocated to different persons. The phases follow each other from left to right in a curve, from pulling out the bow to the dogs eager to catch the bird shot. By the use of their imaginations observers link these moments, and by iteration they assemble the correct movement. Another

strategy is to distribute different episodes among different characters, thus elongating the activities in order to include moments both before and after the climax. An important example is Poussin's famous *The Israelites Gathering the Manna in the Desert* (1639, oil on canvas, Paris, Louvre), which provoked passionate debates at the French Royal Academy of Painting and Sculpture. These debates, which were initiated by Charles Le Brun's lecture in the Academy in 1667, focused on the choice of the right moments.[7] The starving family in the foreground would be interpreted as a preceding phase, which is overcome by the miracle and used to contrast with the depicted later stages, the display of joy, relief, and thanksgiving.

This was not a new form of expression, but it was one that had not been especially praised earlier. Poussin's composition was regarded as "an example of dramatic sequence", where the arrangement of the groups and their different reactions allow the beholder to use her imagination and construct a sequence of causal moments in the narrative (Dowley, 1997, p. 336). The expansion of the narrative moment raised the more general question of the best possible choice for such a moment when illustrating a written story. Lord Shaftesbury's advice was to choose the most significant point, a "single instant", the real climax of the narrative, and also to anticipate the next moment and refer backwards to earlier stages, just as Poussin did (Dowley, 1976, pp. 321–324). Shaftesbury turned to human biology to explain those complex movements that call to mind both past and future moments: since the body may move slower than the mind, "more sprightly parts of the Body (such as the Eyes and Muscles about the Mouth and Forehead) taking the alarm, and moving in an instant, may leave the heavier and more distant parts to adjust themselves, and change their Attitude some moments after" (Gombrich, 1964, p. 294).

Perceiving details in images, however, takes time. The nuances in the elaboration of the storyline, which was praised by Charles Le Brun at Poussin, and was pointed out by Lord Shaftesbury, requires certain duration to be recognised. Over time, paintings were made to please the eye, evoke feelings, convey knowledge, and be contemplated, repeatedly, and in length. To return to our previous example, Sellaio's panels were designed to be part of a domestic setting. The story of Psyche and Cupid did not just entertain its viewers but offered a parable on the morals of love and marriage and was an exemplar on the standards of gender roles in the society. As Caroline Campbell has noted, painted chests "embodied family identity, memory and history", and such stories were also able to address people on different levels, as "They were required to fulfil the primary function of history – that of instruction – in this case for a diverse audience in a single space" (Campbell, 2009, p. 32).

How long do we need to look at artworks to understand them? There is no universal answer. Scanning an image is a dynamic and time-consuming process during which beholders not only distinguish figures from objects and background elements, but use their imagination to comprehend the movements, gestures and facial expressions of the characters, feel their emotions, and predict their reactions, so as to get the coherence of a story. One study examined the average time general visitors spent looking at paintings at The Metropolitan Museum of Art and found that it was 27.2 s (Smith & Smith, 2001). When the experiment was repeated 15 years later, a very similar result, 28.63 s came out for the average viewing time (Smith, Smith, & Pablo, 2017). Although this seems rather short, this duration of time is approximately 50 times more than observers need to give a fairly good description of a scene. People of the past, or today's experts may, however, spend long minutes or even hours contemplating paintings in order to experience the aesthetic and other qualities of art.

Eye-tracking helps us understand what happens during contemplation. Based on previous experiments, it is generally accepted that in figurative paintings, certain areas attract more interest than others and this hierarchy can be detected by higher densities of fixations. A recent research, carried out at the Laboratory for Cognitive Research in Art History at the University of Vienna monitored eye-movements for several minutes while looking at narrative altarpieces (Klein & Rosenberg, 2015). The heat diagrams of these eye-movements show that during fixation periods beholders focus primarily on the areas of heads and faces, and saccades (jumps in focus of concentration) establish connections between the figures (Klein & Rosenberg, 2015, Fig 5.4.). Most often jumps follow head-to-head or head-to-hand routes. According to the research, these routes are very similar for the same painting, that is as long as the observers look at the painting for longer stretches of time. The most frequently repeated saccades follow clear paths (Klein & Rosenberg, 2015, Fig. 5.6). These routes are so markedly clear that experts with a little routine in practicing the method of iconography of old masters are eventually able to construct the composition of an altarpiece from these diagrams. This was suggested in the conclusion of the experiment: "the eyes of beholders do indeed often reconstruct the structure of painting" (Klein & Rosenberg, 2015, p. 97). Research confirmed that there is a difference in the way artists and non-artists look at paintings (Antes & Kristjanson, 1989), and that extended viewing duration and careful looking bring better understanding and better appreciation to art, even in the case of non-experts (Lachapelle, Douesnard, & Keenlyside, 2009).

Most importantly, eye-tracking experiments prove that our perceptual experience, which appears to be continuous, is in fact built up of alternating fixations and saccades. Our gaze operates in a way that the relatively persistent fixation periods are interrupted by saccadic jumps during which the focus changes. Mental updating in our brain is forced by these quick alterations and serves to achieve an illusion of fluency, which is the clearest demonstration of the imagination's ever-present role in our visual perception.

6. Toward abstraction

Modernity, and especially the appearance of new technologies in image-making, such as photography and film, dramatically modified the themes of paintings: classical stories and religious narratives received less attention, while more emphasis

[7] Le Brun's lectures are known through André Félibien's later publications. See Lee (1940, 223–226), and Marin (1988).

was put on sequential movements and on more abstract forms of narration. Sequential movements either supplement traditional narratives based on a written story, as in the case of Domenichino's *Diana and her Nymphs*, or construct a purely motion-based composition, as does Marcel Duchamp's famous *Nude Descending the Staircase* (No. 2, 1912, oil on canvas, Philadelphia, Museum of Art). Our initial example, Barnett Newman's *The Stations of the Cross* belongs to this latter type. It is because of the particular way our perception works that we regard these sequences as narratives.

Newman's series and Sellaio's panel find their common denominators in Rudolph Arnheim's notions of stroboscopic motion and the so called "perceptual casuality" as discussed by him in *Art and Visual Perception* (1957). According to Arnheim, stroboscopic motions are created by a series of discrete still images that depict different but successive positions of a movement and give the illusion of a continuous motion. This "occurs between visual objects that are essentially alike in their appearance and function in the whole field, but differ in some perceptual feature – for example, location, size, or shape" (Arnheim, 2002, pp. 434–435). In his examples, a sequence of photographs depicting the mechanics of simple movements can produce this effect. For art lovers, this definition might recall a large number of abstract paintings of Op Art or other minimalist tendencies, paintings of Piet Mondrian, Bridget Riley, Victor Vasarely, or some sculptures of Donald Judd. For instance, Vasarely in his huge canvas repeats regular hexagons in various colours, the embedded forms are reduced in their size (*Sextans*, 1979, acrylic on canvas, Budapest, Museum of Fine Arts, Fig. 6). The definition of stroboscopic motion also calls attention to a feature present in Sellaio's panel: the need to be recognizable; Psyche is always depicted in the same white dress, thus satisfying the criteria of stroboscopic motion in its similarity (the dress) and difference (in posture). Barnett Newman's *Stations* panels, positioned in linear order, can also be seen as relying on stroboscopic elements, in this case vertical stripes. These top to bottom black or white stripes are repeated in front of a simplified background. Two effects described by Gestalt psychology operate here: "similarity grouping", a tendency to see elements together that look alike, and "perceptual wholeness", a tendency to see isolated parts as constituting wholes (Behrens, 1998, pp. 300–301). Stroboscopic effects also lie behind our perception of continuity in cinematic images.

Arnheim argues that through a process of narrativization, humans empower abstract, geometrical forms with certain human characteristics, and perceive their motions in terms of causal relations, even interpreting their interaction as a story. He calls this phenomenon "perceptual causality" and claims that this happens even when physical causality does not occur at all (Arnheim, 2002, p. 395). Returning to Vasarely, Arnheim's argument explains how our visual imagination establishes narrative connections between these purely geometrical shapes. The series of embedded forms can be interpreted as a story of a sparkling hexagon that gets smaller and smaller. The repetition of the abstract shapes not only enhances, but even secures this effect.

The reasons behind such causalities could be assigned to a general human experience: "the mind assumes the connection to be necessary and expects it to be made every time.

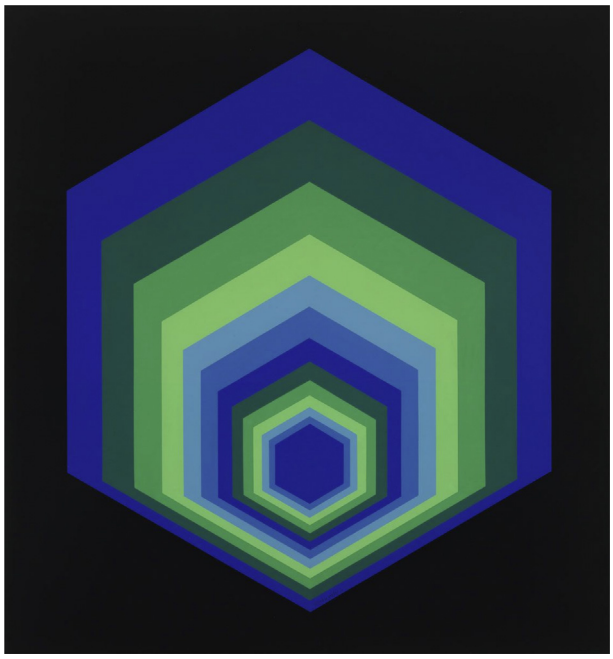

Fig. 6 – Victor Vasarely, *Sextans*, 1979, acrylic on canvas, 192 × 180 cm. Budapest Vasarely Collection, Museum of Fine Arts. © Museum of Fine Arts, Budapest.

The quality of cause and effect is thus added secondarily to the percept by an association formed over a lifetime" (Arnheim, 2002, p. 395). Arnheim refers to Albert Michotte's animation films, which demonstrated that this occurs even on a very simple level. However, perceptual causality also operates in more complex examples as well. This was shown in an experimental short film made by Fritz Heider and Marianne Simmel in 1944, a film that has by today become a well known example in narrative psychology.[8] The film presents geometrical objects, two triangles and a circle moving in and around an enclosed construction (Fig. 7). As experiments have revealed, viewers assign human qualities to geometrical shapes and interpret the film as a story of love, hatred and jealousy in which the big triangle aggressively chases the couple (Arnheim, 2002, p. 403; Bruner, 1986, 18). Abstract animation, a genre in its own right, commonly exploits effects of stroboscopic motion and perceptual causality in stories where geometric objects play roles, as for example in the short films by Hans Richter or Oskar Fischinger (Devlin-Gascard, 1983).

Arnheim thought that perceptual casuality in human visual experience is "formed over a lifetime", however, recent research in cognitive psychology, besides confirming the existence of this phenomenon, claims that the underlying knowledge comes at a very early age. In one experiment participants had to describe events in simplified versions of the Heider-Simmel's silent film that was presenting three different types of movements with abstract shapes: random actions, goal-directed interactions, and mentalising interactions (Abell, Happé, & Frith, 2000). In accuracy, normally developing 8 year old children were almost as successful as adults, and even children with autism and those with

[8] See for example László (2009).

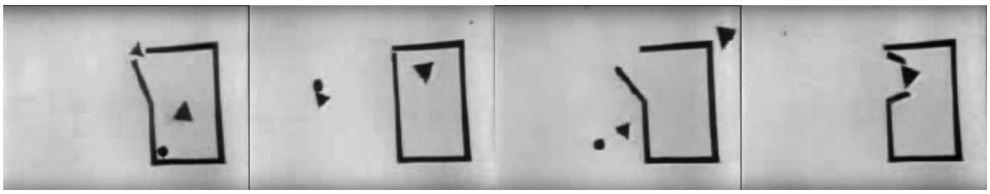

Fig. 7 – Four Stills taken from Fritz Heider and Marianne Simmel animation film, 1944.

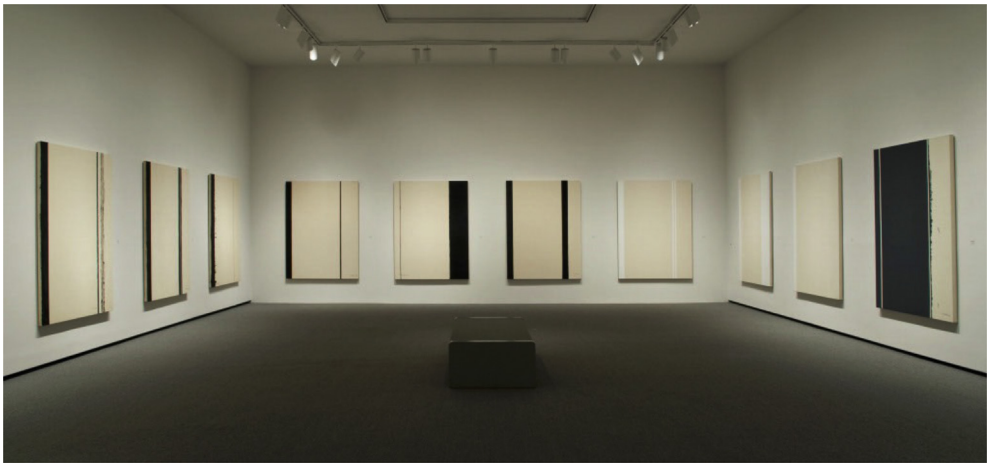

Fig. 8 – Barnett Newman, *the stations of the cross*, 2008, photograph by Rob Shelley, National Gallery of art, Washington, D.C., Gallery Archives. 26A5_98095_003.

intellectual impairment achieved rather high scores. Although visual abstraction allows a high degree of freedom in interpretation, the experiment concluded that these films "elicited remarkably consistent interpretations in the normal and learning disabled individuals" (Abell et al., 2000, p. 11). Another experiment suggested that children become capable of recognising intentional activities through physical movements of abstract geometric shapes by age 3. The roots of this ability are apparently present during infancy and precede the formation of verbal concepts (Montgomery & Montgomery, 1999).

Barnett Newman's *The Stations of the Cross* as an abstract artwork is equally puzzling. In spite of the fact that Newman himself called the subject "antianecdotal" (Newman, 1992, p. 250), it possesses several elements that evoke perceptual casuality and intentional activity, so suggesting a narrative interpretation. The panels are life-size, and repeat vertical stripes in front of various backgrounds; so they can easily be associated with a repeated human figure in a changing environment (Fig. 8). What Arnheim said about experimental films can be applied to them: "under favorable structural conditions, objects appearing at successive moments in time at different locations will be perceived as two states of one identical object" (Arnheim, 2002, p. 390). Newman admitted that each of the panels in the sequence corresponded to a "meaningful stage" in his own life (Walker, 2013, p. 187), which creates a clear link between his story and the narrative of the series. Indeed, the work's title *Stations of the Cross*, implies a narrative understanding. In the Abell–Happé–Frith's experiment animation was facilitated if abstract shapes were given character roles (Abell et al., 2000, p. 12), and humanising Newman's shapes also advances understanding. The sequence offers a clear direction: each of the 14 scenes can be paired with a corresponding stage of the Passion. The process culminates in the darkest panels Nr. 12. and 13. associated with Death and Deposition in traditional Passion cycles. In the art of memory, mentioned in the introduction, Newman's paintings would suit to serve as locations and would attract the imagination to place events upon them. Even imposing an extreme reduction of non-figurativity on his viewers, Newman inevitably relies on the story of Christ to evoke an emotional response. He thus invites us to use our visual imagination to achieve a full effect of the narrative.

Sellaio's *Cupid and Psyche* cassone and Barnett Newman's *Stations* both rely on cultural references in their presentation of visual information. However, independently of any cultural content, their repetitive shapes have the power to activate our neural responses. Neuroscience says that the probable source of our ability to make inferences about other people's intentions is our experience of observing human actions and their outcomes (Castelli, Happé, Frith, & Frith, 2000). This is because the primary function of our neural networks is to help us understanding and dealing with other human beings. They predispose us to treat abstract shapes as we would treat humans, either by their behaviour, as in

the case of Sellaio's panel, or their form, as in the case of Newman's verticals.

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