Window to the Soul: The Application of Visual Heuristics in Art

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Introduction to Cognitive Science

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“Art is a lie that makes us realize truth, at least the truth that is given us to understand.” Pablo Picasso once proclaimed. “The artist must know the manner whereby to convince others of the truthfulness of his lies.” The potent transaction between artist and audience rests upon a mutual language of deception and acquiescence – a language founded upon understandings of visual processing mechanisms painstakingly discovered through the experimentation of cognitive scientists. In comprehending how the visual system operates, the artist is capable of great psychological influence. He produces images to exploit the mind’s natural functioning in order to elicit a particular response. Specifically, notable techniques and movements in artistic history seem to utilize the visual system’s abilities and fallibilities in order to invoke a poignant truth, and are thus fundamentally dependent upon the operations of visual heuristics. Thus, the endeavors of cognitive scientists are pertinent to the artist, who seeks to broadcast “the truthfulness of his lies”, and to the viewer, who, with a deeper understanding of how he perceives the image, may also attain a deeper understanding of the image itself.

The study of visual perception and processing occupy a unique pedestal in cognitive science research. This interest, or perhaps obsession, with visualization is derived from several factors. Firstly, perception is foremost among humanity’s pragmatic abilities in utility and consequence: as humans, we absorb and process optical data in order to construct a coherent grasp of reality from a continuous flow of external information. The immense significance of this function is crystallized by a glimpse from the neurological perspective – a disproportionately large sector of the brain’s cortex is devoted to visual perception. Secondly, seeing occurs so rapidly and unconsciously in our daily existence that it arises as a prime example of instinct blindness. Since vision comes absolutely naturally, without deliberate exertion of effort or will, we tend to underestimate the intricacy and ingenuity of the underlying processes, which operate in the literal blink of an eye. The function of the eyes in conjunction with the visual cortex, taken so much for granted, is a miraculous feat when
scientifically considered. Through the coordination of optical muscles, specialized photoreceptors, neurons, stored memory, and other higher-order functions, the electromagnetic signals produced by a vibrant and hectic environment become encapsulated within what is fundamentally a conglomeration of meat, in a way that is articulate and available for immediate use.

These two qualities of visual processing – its prevalence in daily life and its deceptive efficiency – converge to produce an avid fascination among cognitive experimenters. In order to dissect the mind’s mechanisms for vision, scientists can engage with any one of Marr’s levels of analysis. The computational, the question of what problems are to be solved; the algorithmic, the question of how the system solves these problems; the implementational, the question of how these processes are ingrained in and supported by the underlying hardware of the ocular system. In pursuing analysis at the algorithmic level, experimenters stumble upon the apparent challenge posed by the inverse problem: for any particular perceived image, an infinite assortment of physical arrangements could be responsible. Through careful experimentation, cognitive research has extracted a solution: natural constraints and visual heuristics.

A heuristic is, in essence, a shortcut to the most probable reality. As applied to vision, this manifests as two predominant unconscious principles – coincidence avoidance and pattern-seeking. The former refers to the notion that the mind will make assumptions in order to avoid an unlikely accident: for example, co-terminus line segments will be perceived as angles rather than distinct entities that happen to coincide. This visual heuristic gives rise to many unusual but crucial optical phenomena, including stereopsis and motion-induced blindness. The latter of the two principles encompasses a set of basic suppositions that lend efficacy to the processing of stimuli in the environment; for example, we presume that objects are rigid, that straight lines in the image correspond with straight lines in the world, that light comes from a single source, and that ambiguous angles are perpendicular. Thus, by applying these heuristics among others, the visual
system is not faithfully relaying information but rather assembling, through the conduit of these shortcuts, a filtered rendition of perceived truth. An artist exposed to this body of scientific and technical knowledge can more cogently infiltrate the mindset of his audience, deftly manipulating both what the viewer sees and how he sees it. This, then, is the “lie” an artist crafts – a lie which, by accessing, exploiting, and violating the underlying principles of human cognition, can provoke unsettling and profound revelations.

Visual artists take advantage of the coincidence avoidance heuristic primarily in a constructive manner, formulating and unifying the key elements of an image. The artist surpasses the constraints of a two-dimensional surface by instigating the audience’s mind to generate particular associations and assumptions.

A particularly salient mode by which artists utilize the coincidence avoidance heuristic is the creation of the illusion of depth. Although the surface of the medium is flat, the skilled painter can produce an extremely convincing rendition of space. Specifically, many monocular cues for depth perception translate cogently to artistic representation, including relative size, relative texture, interposition, and linear perspective. In a depiction of a landscape, for example, the artist may reiterate a motif, such as a tree, throughout the piece in varying sizes or degrees of clarity. Rather than indulge the improbable notion that the specimens truly display such drastic physical differences, the viewer’s visual heuristic forces him to perceive depth where none exists. Likewise when one structure is partially obscured by another: the viewer does not understand this as tessellated buildings of distorted form, but rather as one object lying in front of the second. Finally, the familiar arrangement of entities along converging lines is parsed in the mind as a representation of recession into the distance, not of an inherently triangular road or path. Through the work of cognitive research, the artist is fully cognizant of the audience’s heuristics: he can be certain his viewer will assume objects within a shared environment are not intrinsically different from each
other or from physical reality, but rather manifest unique properties as a function of their orientation within the captured space.

The same theory applies to the interplay of positive and negative space. The artist, by keeping in mind these perceptual reflexes, can operate not only in arranged forms but also by the illusions of structures created in the unoccupied regions. This particular application of the coincidence heuristic is comparable to the Kanizsa triangle illusion\(^1\), in which a white equilateral triangle arises from the precise arrangement of acute angles and Pacman figures. Another clear, albeit simplified, manifestation of this principle is in the familiar kiss and candlestick illusion\(^2\). The positive space in this image, rendered in black, consists of two faces in profile. However, an image of a candlestick emerges concurrently from the negative space, rendered in white. Since the two figures are both equally probable, the mind resolves the coincidence by perceiving both simultaneously or alternating between the two. Likewise in visual art, the artist exploits his understanding of this cognitive tendency to seek a unified whole to produce complex images in both the foreground and the background. Thus, the boundaries of elements in a piece may give rise to, in addition to their individual identities, an equally coherent figure in the negative space when perceived together.

More generally, artists exploit research into the intrinsic mechanism for producing logical unity and avoiding improbable arrangements in order to create associations between elements of their compositions. For example, the artist essentially forces the viewer to perceive perceptual lines of movement, dictating how the viewer’s attention shifts to different points on the piece, through the repetition of similar elements. The viewer’s visual system repudiates the coincidence of these similarities by perceiving the entities as unified. In other words, the conscientious artist with an understanding of the coincidence avoidance heuristic can craft the illusion of an intricate balance, vibrancy, and animacy in his static creation. The Impressionist and Post-Impressionist painters in
particular serve as examples of this operation of the coincidence avoidance heuristic. In Vincent van Gogh’s oeuvres, his vivacious streaks of hue create the false impression of motion, notably in the swirls of his skies and other landscapes. In this instance, the similarity in color and direction of the brushstrokes causes them to be associated and gives rise to apparent patterns through the reconstruction in the viewer’s visual system. The artistic movement of Pointillism too serves as a powerful exemplar of this technique. Through their understanding of coincidence avoidance, these painters arrange discrete dots of color in ways which are interpreted as coherent depictions. The heuristics of the viewer’s visual system automatically reconcile the pinpoints into a unified whole based on proximity and similarity in hue. Thus, through the shared medium of visual heuristics, the artist and viewer can distill a collective experience and meaning from the limited physical framework of the painting.

An awareness of the coincidence avoidance heuristic can be exploited not only to construct impressions enhancing what is physically present, but also to challenge the viewer. Much of contemporary art disturbs the viewer with the absence of any superior cohesion. Such works achieve their impact through the entropic chaos of images, upon which the viewer’s visual system struggles futilely to impose order. Thus, by grasping and working against the natural tendency of humans to seek coherence in turmoil, abstract artists can create tension and perturb their audience.

Artists frequently strive to unsettle the norm in various manners in order to provoke a thoughtful, emotional, or visceral response. To do so, they must first understand how a cognitive process operates, then systematically destabilize its function. When a painting violates our heuristic that presumes certain principles about the world, we are forced to reevaluate our perceptions of reality. A myriad of artistic movements and techniques are based upon this theme of disruption of ingrained visual suppositions.
A stunning illustration of this method is painters Georges Braque and Pablo Picasso’s innovation in the artistic movement of Cubism\(^5\), a style of painting that targets the human mind’s propensity for taking straight lines and right angles at face value. In Cubist works, the objects are depicted not from one stable viewpoint, but rather from an amalgam of different perspectives. Consequently, the lines in such a painting do not correspond directly to what the viewer would see if he observed its subject in the real world. Likewise, the angles cannot be assimilated as depth cues as in traditional realist paintings, so the imposition of multiple standpoints prevents an accurate construction of the object’s form from its vertices. In employing such techniques, the Cubist painters agitate the visual system’s heuristic for parsing input because the viewer cannot develop a conception of reality in the normal fashion. The result is a seemingly hectic and discordant image, difficult not only to comprehend, but simply to decode optically. In this case, the artist perverts the visual heuristic to produce a profound visual and psychological impact on his audience.

An equally or perhaps even more radical manifestation of this approach is in the work of Dali and the other Surrealists\(^6\). These painters, by challenging the physical laws of the universe that have been encoded into our cognition as heuristics, create deeply unsettling images. For example, many pieces contain a suspension or distortion of time, with objects hanging precariously or oozing gelatinously rather than moving in their typical fashion. Here, solidity and scale are called into question and the viewer’s visual system struggles to reconcile this information with the preset assumptions about physicality such as the rigidity of objects and the relationship between an object and its boundaries and environment. Since visual heuristics are evolutionarily engineered to help the perceiver understand the real world, in which movements and behaviors are dictated by physical laws, the painter can produce counterintuitive renditions of reality and thereby shock and agitate his viewers.
This assault upon physical constraints is adopted by M.C. Escher in his iconic drawings and woodcuts. These images merge the multi-perspective method of the Cubists with the Surrealists’ disruption of rigidity and gravitational logic, ultimately producing what are commonly termed “impossible worlds”. Escher’s structures are amalgamations of many segments of logical depiction, which when combined produce an illogical representation. The mind, however, responds defiantly to this violation of physical law, and struggles ceaselessly to parse and resolve these perplexing images using the suppositions of the visual heuristic system.

Although many artists seek to perturb their audience through infringement upon the logic and regularity of optical processing, they often also work within these constraints, cooperating with the viewer’s mind, to arouse certain impressions. For example, one of the four basic heuristic assumptions is that scenes are subject to only a single lighting source. Artists understand how to create the illusion of depth by carefully manipulating the intensity of light and shadow. To do so, they must take into consideration the effects of reflectance (an inherent quality of the object), lighting (a quality produced by the environment), and the effects that arise from the mutual interplay of elements within the composition. Specifically, good artists are aware of the difference between an X-junction, in which contrasts in color result from reflectance, and a Y-junction, in which contrasts arise instead from lighting.

To supplement the manipulation of light and shadow, appeals to the heuristic assumption of perceiving ambiguous angles as right angles can also give rise to convincing impressions of depth. The visual system prefers to consider variations in edge length and angle side as products of recession into or protrusion from space, not intrinsic qualities of the object. This heuristic is exemplified by the Ames window, where a trapezoidal frame is perceived not as such, but rather as a rectangular window possessing visual indications of depth. Visual artists can take advantage of
research into such cognitive tendencies in order to portray three dimensional entities convincingly by carefully manipulating angles and relative lengths of edges.

Thus, cues that the visual heuristic system automatically and rapidly processes must be carefully constructed by the artist. This is a particularly compelling example of the importance of visual research, because the process by which the mind perceives depth is of crucial significance to the artist who seeks to recreate the illusion of dimensionality. Without a clear understanding of these heuristics, the artist cannot compellingly relay information about the physical world with its multifaceted layers of beauty.

Extrapolated to the larger picture, it is evident that artists and art appreciators alike benefit from the discoveries made by cognitive scientists studying visual processing. Our decoding of the optical system is the essential impetus for propelling advancements in creative expression, as well as facilitating a meta-analysis of art appreciation that will catalyze more productive discussion of artistic work. The purpose of such research, then, is not solely to understand how we perceive the world, but also how we interact with and are indelibly affected by art. Understanding of these heuristics can help a viewer discern and justify his reaction to a work of art, as well as engage in more eloquent and self-aware discourse regarding the piece.

For the artist, these advances are akin to accruing more weapons for an ever-expanding arsenal. The more precise his conception of visual cognition, the more potential impact he may exert on his audience. Thus, if scientists make advancements into exposing a new visual heuristic, artists can either utilize or subvert it in the same ways they have assimilated other such knowledge. The common ground between artist and audience rests entirely upon the regularities and assumptions of human visual cognition. They, in the most concrete sense, rely upon cognitive research to communicate through this evocative and beautifully creative language.
Reference Figures (taken from Google images):

1. Kanizsa Triangle
2. Kiss and candlestick illusion
3. Vincent van Gogh’s Country Road in Provence by Night
4. Georges Seurat’s The Seine and la Grande Jatte
Pablo Picasso’s The Weeping Woman

Salvador Dali’s The Persistence of Memory

M.C. Escher’s Waterfall

Ames Window