

Proceedings

Dynamically Sublime, Vision, and Image in Architecture

The Relationship between 3D Graphics and Physiology of Vision in the Construction of Rendering Images [†]

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† Presented at the International and Interdisciplinary Conference IMMAGINI? Image and Imagination between Representation, Communication, Education and Psychology, Brixen, Italy, 27–28 November 2017.

Published: 4 December 2017

Abstract: The construction of digital images and the role of the CG Artist in communicating architectural projects establishes its origin in pictorial tradition and visual arts. The text focuses on some aspects of this cultural legacy and makes a comparison using biometric instruments, now able to validate and compare the sensibility of the “creator” artist with the perception of sublime of the observer. Understanding the foundations that guide vision and perception of space, whether it is bidimensional or real, is relevant to all disciplines, primarily the architectural one, for the production of computer images.

Keywords: sublime; physiology of vision; computer-generated imagery

1. Introduction

The construction of images in the communication of the architectural project is now attributed to positions external to the design project: it is the *CG Artist* and the *visualization company* that interpret, with tools often far from the skill-set of the architect, the ideas of the designer. The specialist field just mentioned, that to many will remind the position of the draftsman or the professional “perspectivist”, arises and evolves for the necessity to visualize and present with an increasing persuasion and communicative effectiveness the design or architectural project—often overdoing in a certain cinematographic sensationalism—towards an audience that is increasingly prepared and demanding with regards to *visual design*. The necessity to amaze and astonish through *visual storytelling* also becomes a commercial necessity, to compete with architectural firms that employ 3D animations that have nothing to envy to *special effects* from the best cinematic productions (See the 3D animations of the recent *CGArchitect Awards 2017*. Available online: <http://3dawards.cgarchitect.com/categories/2017/image>). The goal of the text is to highlight some aspects in the role of tools and technologies at our disposal, without neglecting the cultural heritage of which the image, and the creators of images, are still custodians.

2. Computer Images and Analog Tradition

Despite the digital environment, the legacy of pictorial and artistic tradition, to which the same *CG Artist* refers, is explicitly stated through the use of *mood-boards* and style references, shared with the same customers to anticipate the aesthetic performance of the image and to agree upon all aspects that will finalize the post-production phases. In such references 3D artists carefully study the use of

color, composition, light, from the masters of the past or from recent works; many refer to author photography, illustration, and cinematographic films. The goal is not imitation or emulation, but it can be understood as a mean for personal and visual repertoire growth: studying other images means incorporating solutions that will be proposed again in similar situations, generating however, intellectual products that are very different from the originals. This is the case of Pedro Fernandez, who studying Velázquez's paintings, and in particular the famous *Las Meninas*, where he has traced various expedients and compositional artifices on the pictorial use of the digital instrument (Pedro Fernandez shows the entire workflow at the base of the construction of his images in the channel dedicated to *Learning*. Available online: <https://www.youtube.com/watch?v=hTlNSoalB-w>). The ability deduced from the painting is to guide the observer's gaze, placing people and the main visual attractants on the strength lines (or attractors) in its architectural illustrations.

With this in mind, to work in the visualization industry, the artistic and expressive competences—in contrast to popular belief—exponentially enrich the ability to generate computer images, having to face in each project, problems of aesthetic and perceptual nature as well as of software nature. While much of the industry literature places maximum emphasis on technical and technological components needed to produce images, few are the texts and studies that try to understand the origin and artistic capabilities needed in the development of *computer-generated imagery* (CGI). To better clarify these aspects, after pointing to Fernandez's work, it is the case to mention the work of other 3D *visualization artists*, as Nicholas O'Leary, Thomas Dubois and Victor Bonafonte, whose "trigger" in the ideation of a visual project is proportional to the ever-living ability in design, painting and even writing. In the first case, Nicholas is originally from New Zealand, graduated in architecture and professional painter who studied in many *ateliers* of renowned artists, among which Odd Nerdrum in Norway. His sensibility, creative ability and careful observation of reality and luminous phenomena, as evidenced by the numerous works of *on site* (*On site* section collects a rich series of *en plein air* paintings. Available online: http://nicholasoleary.com/?portfolio_category=on-site) pictorial realism or *compositions* (Figure 1), are one of the decisive elements within the images produced in the Norwegian Mir (Mir, Norwegian *visualization company*, globally known for the artistic quality of their images. Among their clients international firms as: Snohetta, Bjarke Ingels Group, Zaha Hadid Architects, Cucinella Architects. Available online: <https://www.mir.no>) group, of which Nick is today partner.

Victor Bonafonte is instead the founder of the *Beauty and the Bit* (Spanish company from Madrid, founded by Victor Bonafonte and Lina Garau, that works for international firms in the field of architectural visualization. Available online: <https://www.beautyandthebit.com>) company, and recently author of several *matte paintings* built for personal projects and situated in fictional landscapes (Figure 2). The study of particular environmental and lighting conditions serves as a compositional exercise for a visual approach to solving problems related to the construction of complex images. These achievements are at the basis of the highly pictorial output of many commercial images of the Spanish group. The iconic imaginary employed, has clear roots in *gaming*, illustration and in particular in science fiction sagas for cinema, which have made extensive use of *matte painting* for *visual effects* (VFX), as in the case of *Star Wars* and the beautiful paintings produced by Michael Pangrazio. A trait of the technique is to create scenarios that would be impossible to realize or too difficult and expensive to design. The positive outcome of the procedure depended on the painter's ability to reproduce with extreme competence the backdrops on large glass plates. These plates were placed at a distance from the camera, and in a restricted view, they overlapped to real scenarios, leaving black—today we would define it as alpha channel—the areas intended for actions to be performed by the actors.

The transition from analog processing, until the early 1980s [1] (*Blade Runner* in 1982 can be considered as the last *matte painting* that uses hand painted backdrops), to *digital matte painting*, records the use of *layers* instead of the enormous painted glass windows, along with the possibility of nesting within them other shots or photographic images. The redefinition process of the new tools, in this case, is to be intended as a hybridization and mutation process, as Paolo Granata argues in his "lessons on digital", founded "essentially on prospective rules and principles. A common dimension

is thus discovered in the vision technologies of the present and the past” [2] (p. 167). In a broader sense the tendency of a “Western screen-based representative system [...] lends itself well to representing an up-to-date version of that powerful metaphor of Renaissance origin, that is the frame/painting/window. Today, this metaphor dominates the digital world” [2] (ibid).



Figure 1. Some paintings from *Compositions* by Nicholas O’Leary. On the left: *Blekeveien*, Oil on Canvas (2015); on the right: *Siri’s Place*, Oil on canvas (2016).



Figure 2. *Help Us*. Digital matte painting, personal project of Victor Bonafonte.

In addition to the aforementioned similarity between perspective view and computer screen, nothing excludes that the cultural process of acquiring and reformulating the constituent elements of vision, can take place through the personal process of writing. This is the case of Thomas Dubois,

among the most known and appreciated *digital matte painter* in the online community, who feeds his visual imagery by means of notebooks, ink and pencil drawings, digital sketches and computer preparatory drawings (Figure 3), in continuity with a narrative capacity fueled by writing. Recently awarded among the best artists of the year (*CGArchitects Awards 2017*, non-commissioned images category. Available online: <http://3dawards.cgarchitect.com/categories/2017/image-non-commissioned>) with the visual project *We found something*, Thomas referred his interest towards writing as follows: “I studied literature and I write a lot, there are things that visuals can’t do, they are both necessary. Writing creates stories more easily than images” (Thomas Dubois refers to his passion for writing during the award ceremony of *CGArchitects Awards 2017*, which took place at the *D2 Conference* in Vienna [tr. by the author]. Available online: <http://vienna.d2conferences.com>).

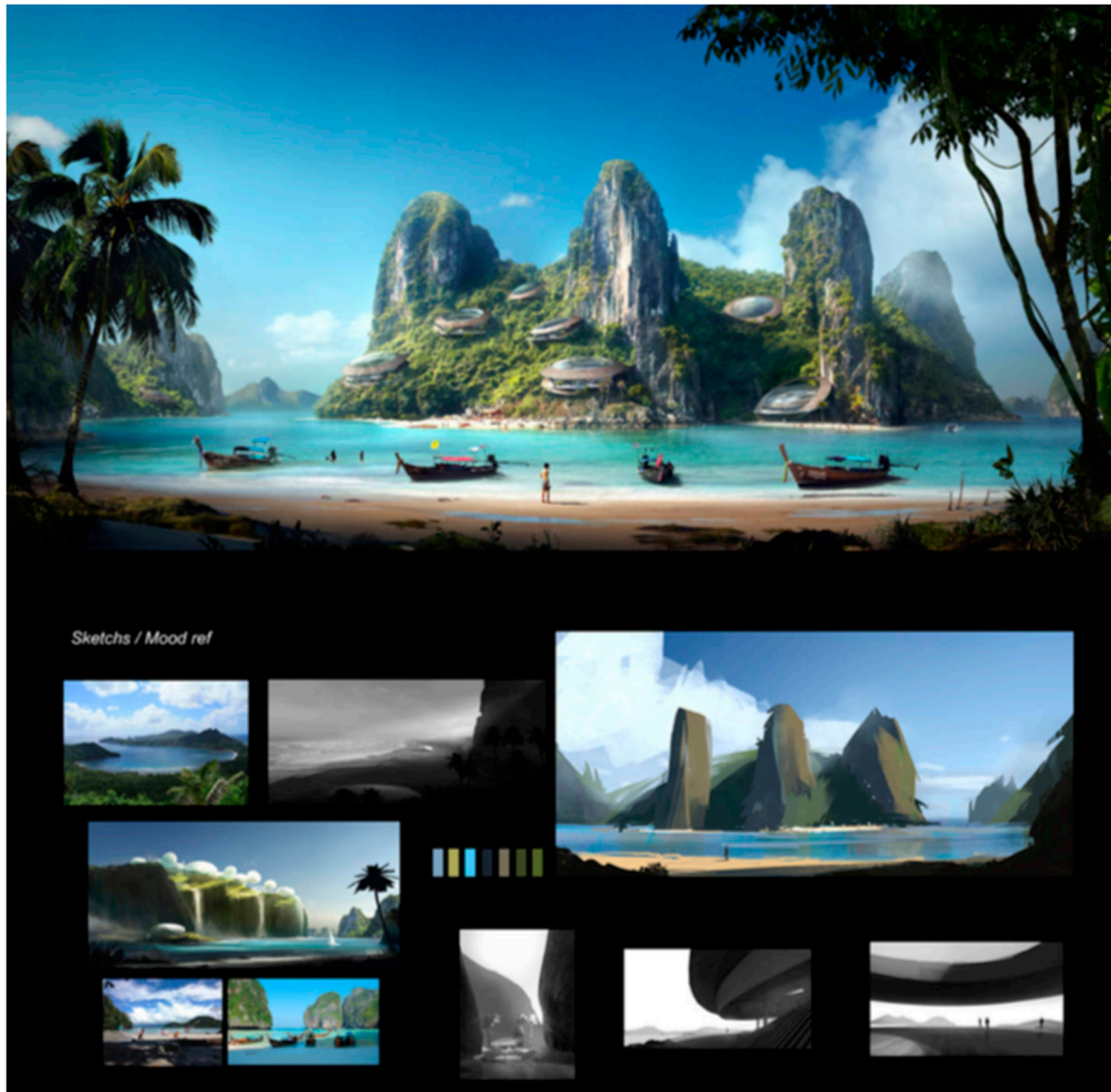


Figure 3. *Island Rings*. Digital matte painting and personal project of Thomas Dubois. Above the final image, also adopted by Chaosgroup to advertise V-Ray for C4d, with which some portions of the image have been rendered. Below a moodboard with the study of landscape, color, and framing.

3. Natural Visualization and the Dynamically Sublime

In *digital imaging*, and more in general in the computer-generated images field, a new trend which we could define as *natural visualization*—which contributes to a phenomenon of visual language uniformity—has recently been set. The term which I propose to give the phenomenon, underlies an attitude that goes far beyond the technical and tooling aspects of the generation of

rendering images and is inspired by a declaration of intent—almost a true manifesto—proclaimed by the Mir group in their *website*: the *Mir way*.

“We aim to produce images that are outside the “3d architectural visualization” category. Our focus is on creating a unique overall feeling in the image, instead of forcefully instructing the viewer in what to think and feel about the project. A Mir image gives space for an individual experience” [3].

This is a radical rethinking of the construction of a rendering image, considering the combinatorial capacity of *tasks, step by step, making of, visualization breakdown and workflow*, to mention some of the most searched terms on search engines in the field of *ArchViz* (*ArchViz* is the abbreviation of *Architectural Visualization*). The possibility that anyone can quickly access to computer technologies, in order to learn and reproduce a replicable and time-scalable work methodology, has misleadingly led to the belief that creating computer images is a fact solely dependant on the technique and software used; which has generated a large number of operators within the industry, but not interpreters. Carrying on reading the “manifesto” it can be learned that an unnatural and heavily manipulated light “can backfire and result in images that feel “disguisive” and unnatural”, and that “camera angle, lighting, colour, and composition are the key ingredients that together make up the foundation of an image. A poor foundation cannot be saved with flares, fog and effects” [3].

Another feature, not explained by Mir, is to redefine the concept of landscape as the essential prerogative of the emotional engagement of the observer. In their images the ratio between natural and artificial context meets a clear superiority of the former on the latter. Framing, in photographic terms and making precise choices in the view’s *aspect ratio*, assumes a partial and irrational role in the communication of the project. The act of revealing, then concealing and finally showing only a part of the elements into play, has become one of their dominant features: mist, fog, sunset, are the environmental and lighting conditions they prefer to adopt in images that are “*portraying unbuilt architecture*”. Often the buildings they represent are entirely covered with fog and unveil a small portion of the visible. However, this is a gimmick where the project is not finished (in the 3D model), or even without detail; a limit transformed into stylistic opportunities with the clear will to innovate within the visualization industry. The *locations* adopted by the Norwegian company are obviously linked to the extraordinary beauty of the landscape of Bergen and the whole of Norway, but they could also be considered as modern interpretations of “Norwegian romantic nationalism” or direct quotes of the artistic work of masters as Hans Gude, Caspar David Friedrich (*Wanderer above a sea of fog*), or William Turner and his stormy scenarios. Despite the numerous references from various visual arts fields, the images produced by Mir set the observer in the condition of reflecting in subjective terms, triggering the same as the aesthetic experience offered by pictorial work rather than a “cold and impersonal” computer generated image.

The techniques employed in this representation genre, adopted and replicated by many companies—so much to almost become plagiarism in many cases—, are of various nature: those of *compositing*, in part of *matte painting*, and to a lesser extent taken from *photographic rendering*.

However, to the detriment of realism, the phenomenon moves within the paradigm of verisimilitude, forcing the perceptual components and the sublimity of reality—the reference is therefore to the feeling of the sublime in the aesthetic thought of the philosopher Immanuel Kant—in a dynamic and romantic relationship with the images of places: man is measured with the spectacle of nature as threatening power over the fragility of human existence. The sentiment of sublime, the result of the long reflection of European culture in the nineteenth century, and collected by Kant in his aesthetic thought, seems to revive a second season within the recent evolution of computer graphics. In the *Critique of judgment* the German philosopher referred to the “dynamically sublime” [4] (pp. 234–238) in ethical terms and starting from the natural feeling of fear. The pleasure that derives from the sight of threatening landscapes “it therefore carries a strong moral significance, allowing to trace the similarity between symbolic experiences, such as those experienced in the contemplation of a natural spectacle, and extreme life experiences, such as those of war” [5]. Steep rocks, arduous landscapes, dense and tangled vegetation, fog and mist, plumbean skies and ever-thundering clouds—in all geographical locations—along with a *color grading* that exacerbates

dramaticness and let prefigure the devastation behind it, are elements widely shared by the current visual language of architectural communication. This return to the apparent omnipotence of nature, even more amplified by the possibility of control in the computer modeler, actualizes the subject of sublime, reducing our “resistance” power to 3D visualizations that use natural elements as a parameter of aesthetic pleasure of the image. Following this scenario the stylistic capabilities, available to the *3D visualizer*, have considerably increased avoiding photorealism as the only performance parameter for the rendering image. The vegetation presence has become a term of “design” comparison, motivating to the aesthetic purpose of any type of project represented. Another connection, which reinvigorates this trend, is between visualization companies and *landscape designers*, often called to intervene at the same stage of ideation of the project, as a guarantee of success from the start and of the highest emotional involvement of the observer. This aesthetic use of green, has brought to handle high number of polygons in the vegetation, with the development of large libraries to use in the modeler. Recently, campaigns for high-definition scans of vegetation or megascans, have been carried out, using IBM (*Image Based Modeling*) acquisition technologies, and computational photography, aimed at achieving a more realistic output with the use of PBR (*Physically-Based Rendering*) materials.

4. Vision, Image, and Biometric Instruments

To investigate the strengths between vision and CGI, in its scientific dimension, one can refer to studies conducted through biometric instruments, which are of interest to the “image creator” *CG Artist* as much as the “spaces creator” architect. As argued by Ann Sussman (Ann Sussman is coauthor of *Cognitive Architecture, Designing for How We Respond to the Built Environment* and writer of the blog *GeneticsofDesign.com* with Janice Ward, where many experiments and analysis on eye tracking are reported.), author of numerous studies on the use of biometric instruments in architecture and urban planning: “With affordable new tools, we can track subconscious predispositions and use metrics to explain the human response to an existing development or predict responses to a new development. Planning will become trackable and quantifiable in ways unimaginable in the 20th century” [6].

Among the current tools, eye tracking technologies extend the understanding of sensitive data, giving evidence of the saccadic movements and fixation points studied, from the 1950s, by Russian physiologist Alfred Yarbus. In the book *Eye Movements and Vision* Yarbus proved experimentally that vision is an active process consisting of ocular movements and points of interest (fixation points). The eyes observe the scene moving two or three times per second; these ocular movements, called saccades, alternate with fixation points where the eye pauses for a few moments (Figure 4).



Figure 4. Reproduction from I.E. Repin’s picture “An Unexpected Visitor” and records of the eye movements of seven different subjects. Image from *Eye Movements and Vision* by Alfred Yanus [7].

It is interesting to notice that, despite the variables linked to the social extraction and cultural background of the observers, there are many invariants that can be taken into account in the consumption of an image. Some of them are related to facial recognition: in all experiments faces are recognized through a few fixation points on eyes, nose, mouth, and a few significant details of hair.

In recent applications, *eye-tracking*, which is based on computer technologies, has played a decisive role with its cost-effectiveness and ease-of-use: “A biometric tool that marketers, web designers, and others frequently use to determine how customers actually see things. Eye tracking measures subconscious eye movements (as many as five per second) as people experience their surroundings. It then creates an image of where people look, what they focus on first, and where their eyes repeatedly return. One benefit of this technology is that it is relatively inexpensive, portable, and easy to interpret versus other biometric tools like facial expression analysis and EEG (which measures our changing brain waves), which require more time and expertise to interpret” [6].

The results are, among other things, perfectly compatible with the viewing of static images (typical use of an architectural rendering on screen), while it is more complex and expensive to perform eye tracking with subjects moving in a real environment; difficulty not so much tied to the weight or size of the equipment (which are extremely small) as the numerous and unpredictable variables in the perception of a three-dimensional space. Understanding the mechanisms of vision is also a matter of extreme utility, as the physiologist Yarbus reported, for “students and reserchers in the fields of bio-physics, physiology, medicine, psychology, and branches of technology such as television, motion pictures, and apparatus construction” [7]. The most numerous applications were then conducted on the perception of the observer inside the city, by means of street photographs. In these recordings, more visual attention points (fixations) are concentrated on subsystems such as: light signs, shop windows, signage and electrical cables rather than built-in architecture. This kind of analysis allows a radically different approach to the one used until now, providing opportunities for change in urban planning: “arguably, most planning history has not even been human centered, but in recent decades, there’s been a growing interest in designing places through the lens of the human experience” [6].

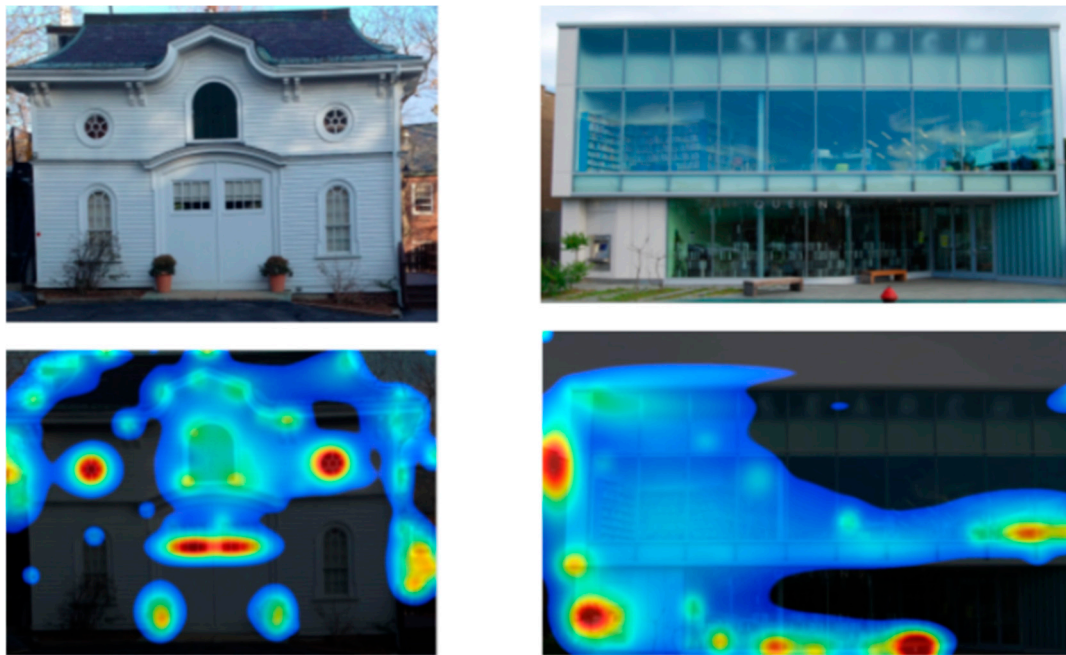


Figure 5. Recordings obtained with a *Visual Attention Software* on the two photographs of a *Carriage House* (Massachusetts) on the left and of the *Queens Library* at Glen Oaks (New York City). The red points are those on which the the observer’s eye stopped for a longer time. Photos and research by Ann Sussman© geneticsofdesign.com [8].

Studies on the urban environment, conducted by Ann Sussman’s workgroup in *The Genetics of Design*, have analyzed both individual buildings (as in the case of Villa Almerico Capra “La rotonda” by Palladio) or compared buildings that differ in the building age and typology. The study case of *Carriage House* (Typical colonial dwelling where on the ground floor were sheltered horses and

carriages.) (building typology now historicized in Massachusetts) was conducted with *Visual Attention Software* (vas.3m.com). The obtained data are of extreme interest if compared with a modern building in glass and reinforced concrete, as the Queens Library at Glen Oaks (New York City). The recordings (Figure 5) show that in the first case the “hot spots” (in red), where the observation time was higher, are in proximity of the openings of the building and along its border; in the case of the modern building (Figure 5) the entire facade is overlooked by the sight, that pauses with more attention on the off-center bench on the right and on the small window reported on the left. Conclusions that can be taken, with the necessary reservations, concern the lack of interest in the transparency of the glazed building and the visual attention to the small openings. Similar cases are reported in numerous studies, where directional centers and glazed towers meet fewer fixation points within the observation field. The anthropological implications would suggest that small openings can represent a greater danger than large windows where everything is fully visible and controllable; our brain, despite the evolutionary history and the sensory stimuli to which is subjected, would tend to rehearse ancestral behavior, characterized by the defense against dangers, as in a hunting situation.

Other studies might fully belong to the definition domain of the *CG Artist*, in particular you can refer to those conducted on the presence—or absence—of people in the images. Observing the image on Figure 6 (architectural rendering of interiors) the recordings of the eyeball show as the fixation points (red areas) are tied to the presence of people. In this case in the left image the interior is empty: the points of greater visual attention (in red) are distributed in varying degrees on the details of the interior; in the right image people are black transparent silhouettes: the fixation points overlook the architectural parts and focus on the people (despite these are transparent silhouettes). The use of silhouettes is a further proof, compared to the previous recordings in which even real people attracted the attention in the same way, of how humans are attracted to themselves. Taking note of this disinterest (in the non-specialized eye or lacking a specific interest in architectural details) this kind of registration would justify “with scientific rigor” the activity of the perspectivist of the past, devoted to covering or distracting with people (positioned ad hoc with foliage, and vegetation) the less successful design parts. Anyhow, the observations, result of the previous experiments, would explain in more rigorous terms the motivations and the commercial success of a stand-alone category of image rendering that abound with distracting elements and people—from the doubtful taste—, as well as the success of many *entourage* sites dedicated to collecting and sharing useful *png files* in photo-insertions.

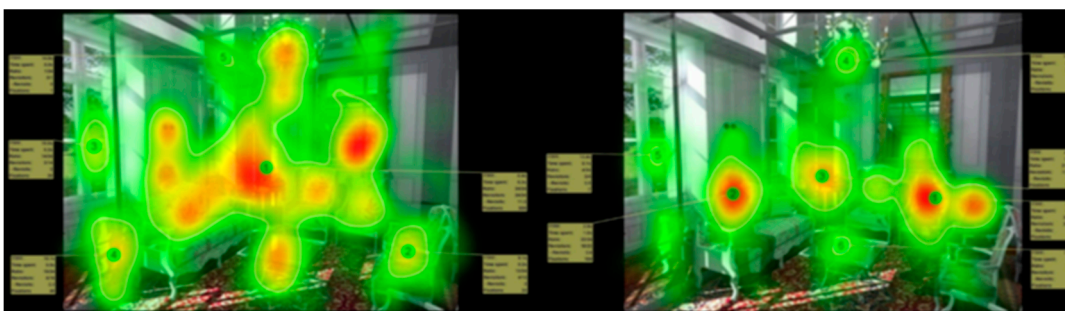


Figure 6. Recordings of the visual attention on interior renderings (designer Charline LeBrun). In the image on the left there are no people: visual attention focuses on details of the interior environment. On the right there are people (black silhouettes): fixation points focus on them. Research by Ann Sussman© geneticsofdesign.com [9].

5. Conclusions

Computer images represent, for the student and then for the professional, a natural evolution of traditional instruments, in which exercise, sensitivity and inventive capacity are still decisive principles for a good outcome. It can be argued that the best visual artists are also great designers, illustrators, painters, photographers, or writers, without all these skills being necessarily combined

together; this intellectual dimension, in the figures that work in architectural visualization, is often overlooked. The text proposes a multidisciplinary investigation methodology, for the purpose of understanding and describing the trends of images generated through a computer. This integrated methodology takes into account the historically critical aspects and the cultural components of the discipline, exploiting highly-specialized technologies in the study of vision (biometric instruments). The literature, today traceable, on architectural visualization is usually expressed solely on technical achievements in computer technology (software or hardware advances), omitting many of the aspects, addressed in the text, which decisively contribute to the construction and formation of the image. Recent developments in the visualization market seem to confirm the ultimate goal of simplifying the user-software interaction, focusing on the hybridization of existing computational models, to re-emphasize the central role of visual expression and visual research freed from intense adjustments phases of the rendering parameters. Following this trend it is no surprise, then, that the dichotomy of hybrid solutions gives the greatest results in terms of performance and speed in *rendering engines*: *biased* and *unbiased* solutions that coexist together, using GPUs for complex calculations integrated with previous CPU technologies, post-effects that act in pre-production before the rendering phase is completed, and a range of *cloud-based* solutions (such as render farms available online) to remotely interface with and increase the actual computational capability of the single node. Such solutions are aimed at simplifying, speeding up, and slimming down the interaction with the software, and they tend to reiterate, with even greater strength, the central role of the artist in the field of architectural communication, affirming the primacy of subjectivity towards the technique.

Author Contributions: The themes and reflections presented in the text are the result of professional experiences in the 3D visualization of the authors and individual researches of both authors in the PhD (currently underway) in History, Design, and Restoration of Architecture, at Sapienza University of Rome. In particular Lorena Greco wrote paragraph 3 (Natural Visualization and the dynamically sublime), while Cristian Farinella wrote paragraph 4 (Vision, image, and biometric instruments). Introduction and conclusions are common work. Experiments and case studies taken by reference are instead by the authors and scholars mentioned in the text and references.

Conflicts of Interest: The authors declare no conflict of interest.

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Sitography

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