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The Interchangeability of VFX and Live Action and Its Implications for Realism

GABRIEL F. GIRALT

FOR THE LAST COUPLE OF DECADES, the distinction between a photo-realistic digital visual effect and a live-action plate has become increasingly difficult to discern. The reason for this phenomenon is that many digital visual effects (VFXs) are used to simulate or imitate ordinary reality, and the present technology is refined enough to hide the artifice. This prompts certain skepticism among scholars and others involved in the industry about the use of the term "realism." The skepticism is based on the fact that the industry has developed new venues of entertainment using the latest digital technology to bring about an ultra-realistic visual representation where "live-action" and "VFX" as well as "true" and "false" are interchangeable terms. This is of singular importance when we consider that a realistic visual representation may not be a complement to the fundamental objective reality but instead may become its substitute. Reality here is defined as that which "exists" and that to which the artist has access through the senses and intellect. For example, in a forest winter landscape, the physical aspects of the landscape are grasped through the faculty of sight and revealed to the eye by daylight. What transcends the senses is grasped through the intellect. The cinematographer sees vegetative life, now dormant because it is winter. This intellectual grasp is not reachable by any technological means.

Consequently, the idea that the cinematographer's encounter with reality and the framing of it (i.e., subjectivity) "contributes something to [the embellishment of] the order of natural creation instead of providing a substitute for it" (Bazin 15) is totally irrelevant given today's digital environment standards. That is, the computer graphic artist, like the cinematographer, establishes reality as the basis for realism; however, the former remains distant from it. This remoteness from reality may not be readily apparent.

Let's take Alejandro González Iñárritu's *The Revenant* (2015). Although the film intends to make the audience believe that the visuals were captured exclusively by the camera, a great portion of them—630 shots—were digitally created or altered by VFX production houses such as Industrial Light Magic, Motion Picture Company (MPC), and Cinesite. The final result is a compendium of computer-generated imagery (animals, trees) and hidden VFXs such as particle effects simulation, lighting, stitching, cleaning, and compositing that make up 122 minutes of the 156 minutes of the entire film's length (Wolf). The intention of all these hidden visual effects is to enhance the visuals of the story as well as present visually a dramatic action that otherwise would

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be impossible to manage (the elk, the buffalo herd, the wolves, the bear, etc.).

Another example is Alfonso Cuaròn's *Gravity* (2013). The impossibility of obtaining outer-space live action with actors forced the production team to create a totally realistic digital VFX environment. A blend of studio live action, CGI, animation, and VFX made the visual trickery invisible and credible and thus difficult for the viewer's eye to detect.

What is relevant here is that the veracity of the visuals in *The Revenant* and *Gravity* has no other authentic connection with the objective reality than competing with reality itself. The created realistic temporal and visual spectacle is completed, enclosed, and rooted in technology.

With this in mind, it is the intent of this article to reflect on the consequences of such interchangeability between the "natural" (that which reflects the spontaneous) and the "artificial" (that which mimics the spontaneous). In other words, the present technology has the potential to replace a recorded natural event in the same manner that an artificial flower, in all its perfect imitation of a natural one, replaces the natural one to the point that the regular bystander cannot tell the difference.

A General Definition of Realism

In order to better discern and reflect upon some of the repercussions brought by digital technology and the consequences of interchangeability between live action and computer-generated imagery, we must formulate a general definition of "realism."

A foundational aspect to consider in speaking of "realism" in narrative fiction is its relation to what is "true." In that respect, one film can claim to be more truthful than another in speaking of life's reality. For example, the "European art/auteur cinema has always defined itself against Hollywood on the basis of its greater realism" (Elsaesser 3). As David Bordwell points out, "[European art cinema's] 'realism' is multifaceted. [It] deals with 'real' subject matter," predicated upon themes that pertain to the human condition (206). In terms of style, whether European or not, realism is not reduced to one exclusive film technique or stylistic approach. If we contrast German expressionism with Italian neorealism, it is obvious that we are confronting not just two distinct styles but also two different artistic expressions that speak of life's reality.

In this regard, it is important to emphasize the fact that the so-called realism presented through visuals of highly detailed "perceptually realistic" digital composite images, which contain "light, color, texture, movement, and sound in ways that correspond with the viewer's own understanding of these phenomena in daily life," is not a guarantee of "realism" (Prince 277). In the same way, photographic indexicality favoring realism aided by well-established stylistic devices of realism, such as the long take, deep-focus cinematography, and natural lighting, is not a guarantee of "realism" either (e.g., see Iñárritu's *The Revenant*, the bear sequence). As Josef Pieper points out, there is always "the possibility that something could well be superbly crafted . . . strikingly written, performed, staged, or put on the screen and at the same time in its entire thrust and essence, be false" (19).

So where can we draw the line if what is displayed is fictional? The answer lies unequivocally in the fact that in realism, the stylistic devices must support a fiction that points to what is true and most authentic. In other words, the fiction must reconcile with reality. Realism in fiction narratives requires a fiction to explain the fact and a fact to support the fiction. It deals with historicity that is fictional and factual at the same time. In other words, every fact requires a fiction to explain it, and every fiction requires a fact to support it. For example, consider De Sica's *Bicycle Thief* (1948) story, a fiction that addresses a factual historical context, the Italy of post–World War II, and at the same time deals with a person's internal battle as the characters wrestle with the weaknesses and the strengths present in human nature. The fiction aspect is inevitable because of the interpretation involved in dealing with the events taking place in life. The other aspect

is that in historical reconstruction, there is a multiplicity of points of view interpreting the facts. That is, historicity interprets and explains synthetically a series of events and in doing so presents events from a particular point of view. Here, historicity is largely fictional, although based on factual evidence. Fiction without facts remains fiction and therefore is outside of the domain of realism.

On the other hand, "futuristic" realism is more factual than fictional. For example, consider the following statement: the proliferation of atomic weaponry can lead to fatal confrontation. That is a fact. What will happen twenty-five years from now is a prediction, which can be expressed only in fictional terms, since the future is not a fact yet. Consequently, facts and fictions in dealing with historicity are mental constructions. It is impossible to keep track of the "past" or "future" without those mental calculations that derive from the teller's point of view. Here, it is important to keep in mind that the filmmaker's point of view (i.e., the teller's subjectivity) reveals more about the filmmaker's frame of mind than it does about anything else. And at the very same time, it is the filmmaker's mindset, creatively expressed, that complements the captured objective reality.

So realism is a dialogue between fiction and facts but also a dialogue between two orders of reality: "fundamental" (objective reality with its own dynamism and vitality) and "complemental" (a subjective reality). In the latter case, when a subjective reality complements the fundamental reality, that means the filmmaker's subjectivity interacts with reality and in doing so adds a greater depth to reality. An example of this can be appreciated in Philip Groning's documentary *Into the Great Silence* (2007).

Groning spent a considerable amount of time with the Carthusian monks at Chartreuse in the French Alps, following their daily life of prayer and study. In one of the sequences, the camera is inside of a monk's cell, discreetly recording—in intervals of long single takes—the young monk as he engages in contemplative prayer and moves about executing other common chores such as studying and maintaining the heat of the woodstove. The camera faithfully captured the events subject to time, but it could not capture the reality of the monk in prayer or that with which the monk was engaged in prayer. That reality transcends objective reality. Only the human eyes of the filmmaker and later the viewer endowed with intelligence are able to distinguish between the metaphysical engagement and the physical engagement with reality. In this regard, the camera lens remains merely a mechanism that captures a succession of happenings, the fleeting appearance of things that end when the camera stops recording.[1] What is left is a testimony of the artist's personalized encounter with reality—the image, an image that no matter how realistic it may appear, gives away the fact that there is no candid camera. That is, the camera lens "sees" candidly what "is" in front of it, but the transposition of light—the light bounced from the concrete reality, captured, and placed on a photographic emulsion or imaging by the lens—is not a natural and passive eventuation, but rather a forceful premeditated action. The inherent optical attributes of a lens, such as focal length, focus, and depth of field, are modifiers in one way or another of the captured reality. In fact, the optical attributes embedded in the image itself create a visual narration that reflects the filmmaker's preferences and perspective.

In this regard, Groning's subjectivity provides dual criteria for our engagement with the image through our faculty of seeing, one that is merely descriptive and another that transcends the mere description. These criteria, in Pieper's view, presuppose on the one hand that there are "those who see things hastily, they have seen enough, that is, those who are satisfied with the outward appearance of things." On the other hand, there are "those who even in the delight of their beholding eyes . . . ultimately will not and cannot be fulfilled" (76); seeing a subject of preference is never enough. The latter is the type of seeing that Jacques Maritain calls an encounter with aesthetical beauty—"[a]n object that pleases the intellect through the means of sensible experience" (Trapani 125)—such as the experience of a winter landscape.

Realism Is Obvious, Not Devious

Fiction in realism, then, must be committed to presenting what is real and consequently obvious. Simply put, what is true is obvious and does not require proof. It is what it is. It is a fact. Now, for Pieper, to represent reality with other than what is obvious requires some caution. For example, we tend to represent the grass as green and the strawberry as red. Describing the grass and the strawberry, generally speaking, with colors other than those just mentioned, is not obvious; it is devious. The color red is an obvious generic fact that describes the strawberry. Description of the strawberry as green, as it may be when it is not yet ripe, is a reality, but it would be unusual if the color green were used to generalize the obvious description of the strawberry and not a particular state of growth of the strawberry as a fruit. Pieper, in his work *Abuse of Language, Abuse of Power*, sees that when any word or image is removed from the reality it represents, it is invested with a particular interest. In other words, any deviation from the "obvious" is "devious," and it is a tailored reality designed to accomplish some "ulterior motive" (20).

The Dogme95 group, regarded as an experimental collective effort of postmodern revival of realism in the 1990s, failed for this very reason. Their obvious, casual, and simplistic approach to realism was a facade to assault the audience with their transgressive deviousness. They reversed the classic approach in which the shocking effect remains confined to the off-screen space. Instead they displayed the shocking object, directly challenging the audience's moral and social codes. In Vinterberg's *Festen* (1998), which omits the display of child abuse, the central causal factor in the narrative, the filmmaker does not spare the audience a series of forceful confrontational scenes in which the head of a well-to-do family, during a celebration of his sixtieth birthday, is accused by the oldest son of having sexually abused the younger sister to the point that she committed suicide. Vinterberg's deviousness lies in transforming the institution of the family into a caricature (i.e., what is honorable is presented as dysfunctional, and what can be seen as an exception is presented as the norm). Vinterberg's "hidden agenda" is to storm the audience by surprise. His crafted spontaneity implicates the viewer with unconventional and unexpected sordid events. For example, the viewer is not spared abusive confrontations between the youngest son with his wife and one of the waitresses. The viewer is manipulated and instigated to become a voyeur by way of participating in what he or she is furtively viewing and observing.

The Lens and the Digital Production Workflow

Another aspect for consideration in realism is the one supporting the belief that any image perceived as created by a camera lens is a representation of the reality in front of the lens at the time the subject was captured. Such strong belief is shared in the court of law, with captured images taken as obvious evidence of what is true.

In contrast, photo-realistic VFX, no matter how realistic, are made to hide what is obvious; the fact remains that audiences are watching a visual effect. Such is the case with the opening sequence in Ron Howard's *Angels and Demons* (2009). The entire sequence consists of one single shot (a digitally indiscernible rendition created by MPC, the Moving Picture Company) of a glimmering golden "papal ring," a contrived depiction pretending to be the reality that it is not. The illusion is enhanced with a virtual camera movement that tracks across the space, catching in the simulated precious metal of the ring the irregular reflections of human forms, supposedly of those standing off-screen (behind the virtual lens), looking at the precious object.

This kind of punctilious photo-realistic realism, no matter the genre, has turned into a new standard for measuring success. Anything less is taken as underachievement. To some extent this practice has marginalized the optical image. It has caused the cinematographer to take into account the virtual world, that which is not present to the lens. In recent years,

the Academy of Motion Picture Arts and Sciences has acknowledged and recognized such cinematographic practice by bestowing the Academy Award for Best Cinematography on works that are predominantly green-screened or whose images compete with visuals that are not created by a camera. A few recent examples are Emmanuel Lubezki for *The Revenant* (2015), *Birdman* (2014), and *Gravity* (2013); Claudio Miranda for *Life of Pi* (2012); Robert Richardson for *Hugo* (2011); Wally Pfister for *Inception* (2010); and Mauro Fiore for *Avatar* (2009).

The cinematographic practices seen in these major works employ sophisticated software designed to simulate the natural world with the exclusion of the "unexpected" or "unplanned" found in live-action footage. Traditionally, these latter elements are part of an earlier cinematographic approach, where all the formal elements that constitute the image merge in unison in the lens as the cinematographer searches for an intimate encounter with the spontaneous.[2] That said, it is not surprising that in spite of the latest developments in optical technology, paired with the latest camera sensors able to display images with clarity greater than the human eye can resolve, fascination with seeing nature's spontaneity through the lens is in decline. For example, *The Revenant* prides itself in its breathtaking photography shot with natural light, yet the VFX are part of the visual representation, supporting more than two-thirds of the film's narrative.

Such decline parallels the declining process leading to the partial demise of photo-chemical technology,[3] which has given way to digital technology and the emergence of the digital visual-effects artist as its flag bearer. In some instances, the digital VFX artist has come to occupy a prominent place in the production workflow, where the optical image no longer plays the primary role in the creation of a sequence but instead is just one option along with other options that the digital technology has to offer. Yet the digital VFX artist, like the cinematographer, looks at "reality" with keen fascination. As Joseph Pieper indicates, "[n]obody has to observe and study the visible [reality] more than the one who sets out to sculpt it in a tangible medium" (*Only the Lovers Sing* 35). In this particular sense, the eye of the visual digital artist resembles that of a cinematographer. He or she seeks to peer deeply into nature's spontaneity in order to discern the intricacies of color variations in relation to light and movement as well as the movement of things through space, so that layer upon layer of visual data can digitally emulate and simulate in some relevant measure the reality as seen through a lens. The result is a digital photo-realistic computer-generated image that mimics a live-action plate. How is that so? The computer-generated image draws its value mainly from technology. Reality and any other visual acknowledgment of it are used only as referential models. The image's photo-realistic accomplishment is to be mistaken for a genuine and authentic photographic visual representation, a live-action plate.

Unavoidably, on the one hand, the VFX artist's common interest with the cinematographer in realism sets a potential for image interchangeability (i.e., a photo-realistic VFX replacing a live-action plate). On the other hand, the VFX artist challenges the role and place of the cinematographer in the production pipeline. Let us consider, for example, *Life of Pi*. This film was praised for its visuals even though much of what we see on the screen was not created through a camera lens (Chagollan). This prompted the board of the American Society of Cinematographers (ASC) and its president Richard Crudo (in his 2013–14 term) to acknowledge openly the situation and the need to readapt to the present condition. "Nothing stays the same very long anymore," said Crudo. "And it's not like the old days where you shot on film and the process was very simple, very direct and very easy to control—where you could take what you learned on one job and move it right into the next. Every time out now, we're reinventing the wheel, so to speak. And cameras and work flows change every six months" (as qtd. in Chagollan).

All of this is at the core of the digital workflow that is set to compete with the order of nature. That is, the digital workflow is a platform on

which artists compete in their quest to surpass the realism of their predecessors. This artistic competitive "will" has already been explored by Norman Bryson in his *Vision and Painting*, where he examines realism in painting as a product of "a rivalry between technicians for the production of a replica so perfect that art will take the palm from nature" (1). In a broader sense, this competitive creative attitude toward realism/realistic representation is replicated in today's field of digital visual effects. "One hallmark of visual effects is the notion of producing something no one has seen before" (qtd. in Seymour).

If we compare Kubrick's *2001: Space Odyssey* (1968) with Cuaròn's *Gravity*, with plenty of authorial signatures from Kubrick's work (e.g., the floating pen), the relevant factor is that both compete for a totally realistic, outer-space visual representation. However, *Gravity* comes across with greater realistic refinement and technical innovation. It has raised the bar in terms of realism and technical means in constructing the VFX. Kubrick's *2001: Space Odyssey*, on the other hand, has become by default a record of time. Looking at the film in today's time, "the film [now] has the added frisson of historicity attached to it" (Doane 103–04).

The Cinematographer versus the VFX Artist in the Hybrid Model

As suggested earlier, a naturalistic approach to image making has become less common, as seen, for example, in the cinematographic work of Nestor Almendros (awarded best cinematography for *Days of Heaven* [1978]).[4] Instead, frequent usage of green and blue screens, virtual cinematography, and digital visual effects, including extended use of digital intermediate, digital grading, and other picture-manipulation software and hardware in the production pipeline, indicates that the industry and other professionals have moved away from interest in the real to fascination with the digital quasi-real and controlled virtual environments.

This technology has forced cinematographers to adapt to a production landscape in which digital VFX designers and artists take center stage more and more often. The VFX designer now shares responsibilities with the cinematographer or director of photography, who once was solely responsible for the final visual look of the project. Films such as *Titanic* (1998), *The Lord of the Rings* (2002), *Avatar*, *Inception*, *Hugo*, *Life of Pi*, and *Gravity* are just a few examples of such complicity. All these films were recognized by the Academy of Motion Pictures for both best cinematography and best visual effects at the same time. In contrast, *Birdman* and *The Revenant* were recognized only for their cinematography. It should be noted that *Birdman*'s use of VFX did not go unnoticed, though. The film was awarded in the 13th Annual Visual Effects Society Awards for Outstanding Supporting Visual Effect in a Photoreal/Live-Action Feature. On the other hand, *The Revenant* was in the list of films nominated for Best VFX by the Academy and the Visual Effects Society (VES). The VES granted those involved in *The Revenant*'s visual effects awards for Outstanding Supporting Visual Effects in Photoreal Feature, Outstanding Animated Performance in a Photoreal Feature (for the Bear), and Outstanding Compositing Performance in a Photoreal Feature (for the Bear attack).

Curiously enough, such films compete with other works that adhere to more traditional methods of cinematography. One example of this is Payne's *Nebraska* (2013); this film was traditionally photographed with an Arri Alexa by Phedon Papamichael, yet it was nominated by the Academy in 2014 for best cinematography together with *Gravity*, a hybrid in which most of the lighting, camera movement, and so on was done with the aid of digital VFX artists. These two distinct approaches to how digital technology is employed explain why many "people from all segments of the industry [wonder] when the Society will create a new awards category to recognize hybrids, motion pictures that feature a prominent mix of live-action photography and CGI" (Crudo 2). In this particular sense *Nebraska* stands out for the finesse of its photographic qualities; director of photography Papamichael's traditional approach went so far as to use film stock to set exposure latitude,

as well as contrast and grain benchmarks to be matched by the digital footage.

What emerges from recent debates regarding the "traditional" versus the "hybrid" mode is the need for greater recognition that there are two distinct production modes, as well as two indispensable roles played by the digital VFX artist and the cinematographer in the image creation process. A recent article in the *American Cinematographer* by ASC president Richard Crudo (2014–15 term) recognizes the extensive collaboration between cinematographer and VFX designer in films such as those mentioned previously but maintains that the most viable way, for the sake of efficacy and consistency, is to utilize "a single pair of eyes [to] govern the overall look." That is, the cinematographer should remain the ultimate agent responsible for the final visual look of the work (2–3). Crudo's statements are indicative of the ASC's interest in maintaining the traditional model. However, the hybrid remains a complex issue, with which the ASC will continue to contend for quite some time. Visual effects are part of today's visuals, and they must be recognized as cinematography. For example, according to Ara Khanikian, VFX supervisor for *Rodeo FX*, 90 percent of *Birdman*'s content went through that company's pipeline. This is a substantial amount for a film that focused on invisible effects (Fortheringham)—not to mention the 78 percent in a film such as *The Revenant*, where so much attention is given to the cinematography.

These examples tell us that in spite of the invested effort to keep cinematography and visual effects apart, the symbiotic relation between the cinematographer and the VFX designer will continue.

The Traditional versus the Hybrid

The success of the hybrid model where the VFX and CGI take as much importance as, or greater importance than, live-action plates rests primarily, as Philip Rosen has suggested, in the fact that the digital "picture [is] infinitely manipulable and the possibilities . . . [for tinkering with the image are] limitless" (306–07).

Paradoxically, in spite of today's attraction for image maneuverability, no matter the genre—magic realism, fiction, science fiction, and more—"photo-real" representation remains the central aim for image manipulation and computer-generated imagery. The VFX must appear hidden. In this particular sense, digital VFX designers as well as cinematographers share in common with a select group of artists the aspiration to exceed reality—that is, to accomplish a perfect mimesis. However, the attraction for non-indexical or partly indexical realistic representation has been counterbalanced by "a renewed interest in the Percian concept of indexicality, as that which defined analogue photographic imagery linking representation existentially to the social material world" (Pollock xvii).

With such renewed interest in indexicality, the debate on realism takes a deeper turn in the already established controversy. On the one hand, there are those who contend there is no difference between "realism" based on referential evidence and partly referential or non-referential-based approaches since all of them are visually contrived representations that are the product of technology. On the other hand, there are those who believe that there is an irreconcilable difference. The difference between the two views is marked by the definition given to "realism." At the experiential level this is extremely important since, as Stephen Prince points out in his introductory theory on "perceptual realism," once the image is projected on the screen, there may not be a noticeable difference, whether it is indexical or non-indexical (277). Crudo makes exactly the same point when questioning his interlocutors regarding the difficulty in evaluating a hybrid film: "Looking at the Oscar-winning features *Avatar*, *Hugo*, *Life of Pi* and *Gravity*, can you tell me how much of each was photographed traditionally and how much was originated through computer software? . . . It's impossible to determine unless you were directly involved with each step of these productions."

Paradoxically, the efficacy of this digital non-indexical example is accomplished by usurping

from photography/film its inherent persuasive visual objectivity, which is strengthened by the viewer's belief in the actual existence of the subject, now reflected on the screen with as much detail as if reality were reflected in a mirror. This so-called photographic embodiment on the part of the CGI raises a fundamental question: can the hidden digital VFX, with no dependence on a referent, have its own aesthetic and therefore disengage completely from photography? As far as the industry is concerned, there are too many political issues involved to answer the question. However, according to Crudo, there is a remote possibility that in some unknown future, CGI cinematography may have to disengage from the optical traditional approach of image making for the sake of the latter. The ASC "currently [has] a committee hard at work on deconstructing the issue" (Crudo).

This issue not only has forced the ASC to redefine the standards for excellence in cinematography but also in itself provides some indication that the CGI has reached certain levels of aesthetic recognition by sharing status with traditional models.

Pseudo-Realistic Digital Visual Discourse

To understand the implications of this pseudo-realistic digital visual discourse present in hybrids, as well as other problematic aspects brought about by the digital paradigm, we may have to regress just for a moment and seek an answer to one of D. N. Rodowick's questions: why is it that in spite of the unprecedented technological transformation in the process of image making (i.e., from photography/film to digital), "the aesthetic goal [is] to become perceptually indiscernible from an earlier mode of image production?" (11).

The answer lies, categorically, in the fact that in order for the "invisible digital visual effect" to be effective, the digital illusion must appear hidden. Therefore, in order to subsist as a hidden illusion and achieve total credibility, "the photographic medium of cinema [must be] position[ed] as a key compositional model for the digital image" (Rosen 313). For Rosen, photography and film have an extensive history of well-established realism based on the fact that "a photographic or cinematic image always provides the spectator with absolute, irrefutable brute knowledge that the objects represented in the frame *were at one time* in the spatial 'presence' of the camera" (Margulies 56–57). The latter is an indispensable requirement for a successful hidden illusion of invisible effect. Interestingly enough, digital VFX sneak in unnoticed with a photographic film disguise at a time when "film as a photographic medium is disappearing as every element of cinema production is replaced by digital technology" (Rodowick 11). Consequently, for realism, whether the visual medium is painting (e.g., still life, landscape) or film/video (e.g., fiction, documentary, or journalistic genre), at its best the invisible VFX unquestionably will be taken for true; at its worst, realism will always be questioned. And that is the case with Jean-Claude Van Damme's famous gymnastic split (a real stunt) between two Volvo trucks moving backward. The question posed by the viewer is the inevitable "Is it real?" The Volvo commercial premiered online on November 13, 2013, and reached 60,298,167 hits in the month after it was uploaded (Graser).

The Efficacy of Visual Effects

It is precisely in its disguise where the efficacy of VFX lies. The visual effects provide a technical solution to a visual problem, whether the hidden VFX are subordinated to the cinematography (e.g., the VFX enhancing *Birdman*'s long take) or the cinematography is subordinated to the VFX (e.g., green-screen cinematography supporting a CGI environment). In Ang Lee's *Life of Pi*, the VFX and CGI technology overcame the impossibility of taming nature to allow for adaptation of Yann Martel's novel into a motion picture. In Ron Howard's *Angels and Demons* VFXs provided entrance to specific locations that could not be physically accessed otherwise. Howard was set "to create Rome, recreate the Vatican and take people into that world in a

way that is utterly realistic . . . It [was] important that people who have been into places like the Sistine Chapel, been in St Peter's Square, that it would be absolutely impossible for them to discern an effect shot versus a real plate."[5] In both cases, Ang's and Howard's realism is constructed as a digital visual amalgam made of studio sets, computer-generated imagery, and digital image manipulation, with material recorded at various locations now composited into one seamless, temporally and spatially unified imperceptible illusion.

The created VFX that suggest concreteness, the actual physicality of things, are not sufficient to allow the viewer to enter the world of the narrative. VFX tend to place the viewer at the surface of things, placing the attention on outward appearances. Let us take a look at Ron Howard's adaptation of Dan Brown's historical novel *Angels and Demons*, a film filled with VFX pointing to a historical past. The visual effects and narrative discourse strive for realism with the inclusion of well-known specific locations or sites and some historicity claims. The historicity touches on the tension between science and religion and more specifically the "rift" that took place between the Roman Catholic Church and science in the 1600s. That is, the establishment of the natural sciences (astronomy, physics, etc.) brought scientific methods of inquiry to explain reality. "This led, in not a few sectors of ecclesial life, to a cautious and suspicious view of science as being tainted with atheism" (qtd. in Wojtyla). The film uses this fact as a historical backdrop to propel and unravel a plot in today's twenty-first century.

The role of the mise-en-scène in the film's narrative is extremely important. The architectural locations and some of the art in them (e.g., Bernini's sculptures) are intended to bring the remembered past into the present consciousness. The introduction of the key locations calls for an encounter with Bernini's work. In many respects, those encounters are attenuated since the digital composites are drawn as mere background for the characters (e.g., the simulation or virtual walk of Ewan McGregor as the diseased pope's secretary, Patrick McKenna, and Ayelet Zurer as the scientist Vittoria Vetra inside St. Peter's Basilica as they move toward the crypt beneath the main altar).

Howard's cinematographic simulation is not able to connect with Gian Lorenzo Bernini's architectural space, the massive arches, or the lighting falling in the gigantic bronze baldachin where the main altar is located, right below the basilica's dome. Neither is he able to provide a visual "encounter" with the spiritual, the symbolic, and the historical aspects all coalescing in the space of the basilica. He does not acknowledge the depth of the architectonical reality that surrounds the characters other than for referential purposes (i.e., as a backdrop). There is not camera exploration of the space to bring about the sense of the place as an eyewitness. Howard's idea of "encounter" deviates from the traditional sense of encounter, where it is regarded as the result of an intimate personalized relation between the artist and reality, as if the encountered reality were presenting and reporting itself privately and unexpectedly at the very moment of filming. In cinematic terms, Howard's cinematography differs from Groning's camera lens by not only capturing life's temporal continuum but also preserving another primordial aspect of reality—that is, the "spontaneous." As Mary Ann Doane points out, the shot's temporal continuum is conducive and therefore has "the capacity to represent the unforeseen . . . the ability to represent everything—both the planned and the unplanned" (65). In her comments she goes further, suggesting how the technique of editing brings the "spontaneous" and the "random" under control (137). In a similar way the visual effects do too. Through "perceptually realistic" digitally composed images, the VFX are an alteration of reality as much as editing is, and that alone cannot be reconciled with the "spontaneous."

Something similar takes place in Ang Lee's *Life of Pi* as Lee simulates an ultra-realistic encounter with nature, a storm in the sea of extraordinary proportions. The ocean is presented as incommensurable and unpredictable with an implacable overwhelming might. Lee's presentation of the sea storm is made of CG rain, dark

CG skies, and gigantic CG waves. Here, credibility is not predicated upon a true experience but on a wide range of calculated and constrained visual variables—depth cues, animation, simulation, and so on—that allow Lee and the VFX team to achieve an emotionally convincing level of realism. However, although both Lee's and Groning's are contrived depictions attained though different types of technology, Lee differs from Groning in that he lacks any concrete reference to an autonomous reality with which to measure his realism.

Competing for Realism, an Aesthetical Aim

In spite of the differences found between Groning and Lee, can the visual representation of digital visual effects provide a contemplative dimension? The answer is yes. The sense of "encounter," as it was mentioned earlier, is available to the visual artist. Douglas Trumbull's "organic effects" used in Malick's *Tree of Life* (2011) are one of those beautiful rare examples in which the VFX workflow was exposed to experimentation and open to the unexpected and spontaneous, as opposed to strictly synthetically calculated computer graphics. Trumbull experimented with water and paint running over a sheet of glass and shot at 1,000 frames per second, in addition to employing other extemporaneous methods in his attempt to provide the viewer a visual reencounter with nature, a representation of the beauty of the universe coming into formation:

> For the astrophysical sequences . . . they conducted chemistry experiments: photographing paints and liquids (like fluorescence in dyes and half-and-half) in tanks of water at high speeds, which produced images that could be digitally composited to resemble astronomical phenomena like interstellar clouds. "With computer graphics everything is based on some algorithm and there's often a predictability to it," Mr. Trumbull said. "Terry and I wanted randomness and irregularity that seem truly natural." (Lim)

In spite of the visual abstraction that presupposes dealing with the cosmos and the approach taken in creating the VFX, the aim was to compete with other artists for greater realism. As a result of artistic rivalry, the VFX turn into an imposed enhanced realistic representation where what is "true" and what is "false" become interchangeable. The dynamics of such interchangeability are carefully spelled out in Bryson's study on realism in painting. He bases his theory on Pliny's story about the rivalry between two artists, Zeuxis and Parrhasius. The former painted a still life with grapes so successfully that the birds began to fly down to eat the grapes in the painting. In response, the latter painted a set of curtains so convincing that when Zeuxis asked to have the curtains removed so that he could see the work of his contender, he was shocked at the realization that the curtain set was the painting itself. "With a modesty that did him honour, he yielded up the palm, saying that whereas he had managed to deceive only birds, Parrhasius had deceived an artist" (Bryson 2).

Bryson's paradigm based on Pliny's scenification of the competition between Zeuxis and Parrhasius is to portray the innate rivalry that has invigorated realism throughout the ages in painting. Our concern in the digital age is that this paradigm can serve, with great clarity, as a parallel to what has taken place in the digital visual arts. In Bryson's own words, it is the process of assimilating and surpassing one's predecessor's skillful realistic replication that casts the other into eclipse and brings the talent of the newer artist into the forefront for the next challenge (2). And this is how the history of visual effects has developed, from the silent period until today.

Realistic, non-perceivable digital visual effects (invisible VFX) are peculiarly driven by competition among artists, who strive to outwit each other as a new project turns into a technological feat pushing the limits, not only technical limits but limits of verisimilitude and absolute mimesis. This rivalry toward realistic representation in motion pictures is not as

"novel" or "unprecedented" as has been suggested (McClean 270). It reaches as far back as the early days of photography. As McClean points out, many of the present invisible digital VFX simply replace the old photographic effects of the pre-digital era (44). *Citizen Kane* (1943) is one of the early well-known examples of invisible VFX. "The picture was about 50% optically dupe, some reels consisting of 80% to 90% of optically-printed footage. Many normal-looking scenes were optical composites" (Venkatasawmy 75).

This interest in outsmarting "the other" has spread across visual media. It once was said that photographers had outwitted painters, freeing Western art "once and for all, from its obsession with realism" (Bazin 12). In response, the painter has taken up the challenge to emulate and compete with his or her contender. Pictorial hyperrealism can provide extremely detailed images and emulate optical attributes to such a level of finesse that in some cases it is difficult to discern whether the visual representation is a painting or a photograph—for example, the paintings of Spanish artist Pedro Campos, who uses oil paints on canvas to recreate still-life objects that look even better than a photograph (Campos). Here it is important to emphasize that the merit of the pictorial work over photography lies in the viewer's delayed realization that he or she is looking at a painting. It is only because of the delayed awareness that painting can successfully challenge photography's realism. It should be noted that the history of both media—photography and painting—makes them rivals due to the fact that they complement and borrow compositional features from each other. In any event, because of reality's enhancement and because parts of the image may be idealizations drawn from models, hyperrealism can be seen as a visual effect in its own right.

On the other hand, the digital encounter with photography, particularly expressed as an invisible visual effect, has turned photography's exclusive relation with the real upside down. If photography freed painting from its obsession with realism, the digital technology has "freed photography from [a] perpetual constraint, that of having, by definition, to record the reality of things" as they are and as they occur naturally in time (Lister 9). In *Life of Pi*, according to VFX supervisor Westenhofer, 150 computer-generated tiger shots stand successfully unnoticed side by side with 20 shots of the real tiger (Robertson, "VFX Supervisor Bill Westenhofer"). Does this mean that the CG tiger was perfectly and accurately created to simulate the action as it would have happened in real life? "The answer is no," writes Donald Greenberg, "yet the results are [so] appealing because the resulting images are believable," and that is sufficient. However, credibility does not quite equate with realism. Credibility here depends on a wide range of variables, such as depth cues, animation, and simulation. There are other devices that contribute to blurring the very thin line separating realism and realistic representation. For example, anthropomorphism in *The Chronicles of Narnia* (2005) becomes apparent, giving away the "lion's" synthetic nature. Anthropomorphism, or the humanization of animalistic, spontaneous behavior, is one of the typical challenges that CGI artists face. Westenhofer noted that working on the creation of Richard Parker, the CG tiger in *Life of Pi*, presented its own difficulties of staying away from anthropomorphism and in keeping the depiction real:

> The fact that you know what the shot is supposed to mean, it's tempting to hold the tiger's gaze too long. Then you lose some of the animal qualities. What we did was we went through our reference clips on every shot and found something representative of what we wanted to convey. Certainly you'd have some happy accidents with the tiger making a twitch that you might not have thought of, but it kept us honest in the animal quality of the performance. (qtd. in Failes)

It is for the digital visual designer to discern what constitutes the standard for proper animal behavior. There are small nuances to recognize,

as the designer scrutinizes what is proper behavior. For example, Westenhofer tells us the following about OJ the orangutan: "right before she gets dispatched by the hyena she gives a look and that was the one time [they] let a little bit of anthropomorphism kick in as representative of the last look Pi gets [from her]" (qtd. in Failes).

The Greater the Realism, the Greater the Illusion

The more realistic the portrayal of the VFX, the greater their illusory power. The quest toward greater realism has deviated and branched silently away toward a fictitious realism—that is, a "realistic" mode of representation that differs from "realism." As Ortega points out, while speaking of the difference between realism and modern art, "opposites differ in their similarities" (25). Both realism and photo-realistic representation are imitators of nature. They are intermediary media. Both want to reflect in their visual representations what life reflects to the senses, but it is precisely at this particular point that photo-realistic representation departs from realism. If realism is interested in reality as we experience it, the interest in photo-realistic representation is the desire to be convincing to the point of becoming a substitute for the real (e.g., Parker the tiger in *Life of Pi*). In this particular respect, the invisible visual effect turns against nature. "What we have in this idealization of image technologies is the basis of a new utopianism" (Robins 3)—that is, to achieve an absolute computer-generated replica that can substitute for a referential optical image.

Ironically, the enhancement of fantastic and realistic VFX originates from the director of photography or cinematographer, once connected with the real (that which exists) and now part of a competitive process in creating a visual utopia where the only reality to look at is a subject against a blue or green screen. "From this standpoint, the digital technology . . . not only has gotten rid of Bazin's inseparable bond between the image and reality but also has turned Bazin's photographic image into raw material to be processed" (Giralt 8).

Obviously, the trend in this "rivalry" between VFX artists is to achieve the effect of total realism. It should be noted that the concept of realism includes also the representation of fantastic VFX. When VFX supervisor Richard Stammers was asked about the efficacy of the visual effects in *Prometheus* (2012) compared to other similar (science fiction) films, he replied, "Prometheus stands out for the level of realism" (qtd. in Robertson, "VFX Supervisor Richard Stammers")—deceptive realism, that is. Whether it is "photo-realistic realism" (invisible VFX) or "fantastic realism," both are meant to deceive, just like the grapes in Zeuxis's painting deceived the birds and Parrhasius' curtains deceived Zeuxis, a professional artist himself (Bryson 1). In a similar way, Ted Rae, a visual-effects supervisor himself, acknowledges that he has been deceived by his peers many times. "I had no idea that there were 300 visual effects shots in *Cold Mountain*. [And] I can't find the 800 effects in *Master and Commander*, even though I've seen the film five times" (qtd. in Skweres).

Conclusion

Like VFX, the optical image poses a technological dilemma that touches upon the paradoxical tension between the fictional and the factual inherent in cinema. In regard to the optical image, it is assumed that the camera's eye "sees" the physical reality in front of it. This is taken as a fact. However, the very use of a lens is itself an artificial intrusion (i.e., an artificial device); hence, the naturalistic photographic reproduction of any event captures what is spontaneous, but the reproduction remains in itself a contrived and calculated exploitation of what is being captured and depicted. The essence of what is being filmed is always beyond the camera's lens. The camera's eye is merely a mechanism and not a living, animated organism like the human eye. When the human eye sees an object, it sees a substance because its sight is animated with the person's intel-

ligence. When the camera's eye captures the same scenario, it cannot "see" the object or understand what it captures. It merely captures a succession of happenings, an event that ends when we place the lens cup in front of the lens.

On the other hand, the rapid advancement of digital technology and the fascination with image manipulation both reaffirm and challenge any aesthetics of realism. In practical terms, VFX are a misrepresentation of reality. The realistic visual effects (invisible VFX) imitating "likeness" can substitute entirely for the "realism" of the photographic image. Visually, the effect presents itself as the result of the artist's genuine encounter with reality, and therefore the digital effect instigates the viewer to accept the popular belief that seeing is believing. Such propositions *reaffirm* the well-established notion of realism by claiming the obvious: the fact that true "realism" can point only to what is true, to an existing reality that is independent from its visual representation that reflects the artist's mindset.

In Bazin's terms, such a mindset or subjectivity plays a central role in realism. The subjectivity of the photographic image "contributes something to the order of [objectivity or] natural creation instead of providing a substitute for it" (15). For example, Roberto Rossellini, Vittorio De Sica, Federico Fellini, Pier Paolo Pasolini, and Luchino Visconti, all in their own individual ways, gave expression to the historical, socio-economic, and moral realities of the Italy of their time. Personally, with their fictions, their point of view, they did not deal with reality directly, but they toiled with their perception and the ideas they had about it. That is, in realism the subjective or supplemental reality must complement the objective or fundamental reality.

In that regard, realism is the sharing of an experiential "encounter" with reality (i.e., reality is that which exists), and it is from that visual experience that realism draws its value. That is, the inserted subjective point of view adds greater depth to or complements the fundamental reality that remains transcendent and independent from the cinematographer and the digital visual-effects artist/designer. The difference between the subjective or complementary reality and the objective or fundamental reality must remain clearly distinct. It is from this autonomous objective reality that the truthfulness of realism is measured. Anything contrary to that, Josef Pieper reminds us, is just a photo-realistic visual discourse taken over by pseudo-realities tinted with sophism, where true and false are on interchangeable terms (Pieper, *Abuse of Language* 34–35). And it is from this pseudo-realism that the new aesthetic models feed other theories, among them that of perceptual realism, which establishes clearly a new aesthetics of realism based on computer-generated imagery that has no bearings on or connection with nature's spontaneity. However, the digital visual-effects artist must have "encountered" and scrutinized reality in order for the CGI to be photo-realistic. In that respect, perceptual realism can set aside the camera as a tool for image making but cannot bypass reality as a referent, because otherwise the CGI ceases to be photo-realistic. VFX are measured by reality to the extent that they are realistic.

Therefore, there is only one way for realism to be authentic, and that is for it to be based on reality. That is, reality is the touchstone for realism. It is from that reality that one can measure the artist's realism or truthfulness. In the final analysis, the cinematic image is a technical rendition that results in a visual image. The visualization of such an image is the result of the artist's encounter with reality, which is both technological and humanistic. At the technological level, the optical/photographic image and the digital VFX, when projected side by side on the screen, are both contrived depictions of reality. However, there is a significant difference between the two. That difference is that they are products of different technologies. Technologically, the camera lens tends to have the upper hand, so to speak, over the software tools in a computerized environment because of the lens's immediacy with reality's physicality. The lens has an exclusive relation with reality in that it remains in touch with reality even when the cinematographer is not. This cannot take place in the computer environment.

At the humanistic level, both the cinematographer and the digital visual-effects artist have access to reality. This humanistic dimension is intellectual. It captures reality available to the human eye and its intelligence. What is visualized transcends the physical world as well as the image's visual formal attributes (i.e., the lines, the shapes, the contrast, the color). All of these formal elements are intended to convey an intuitively grasped reality (one of the many multifaceted aspects of reality)—for example, the splendor of the sun and its grandeur conveyed by an image of a sunset or the barrenness of nature during the winter season conveyed by a winter landscape. The singularity and authenticity (i.e., existence) of this particular sunset or landscape is the criterion for realism. The visual image is not reality; it is only proof, by way of either a fictional (i.e., hypothetical) premise or a factual (i.e., verifiable) conclusion. However, although both VFX and live-action plates are products of technology and are interchangeable side by side, there exists a subtle difference between the two technical variants of realism. The live-action plate complements what is authentic (i.e., a visual representation with a direct bearing on reality) whereas the photo-realistic CGI remains a misrepresentation even when everybody believes the contrary. It replaces the camera and the reality that the camera lens is in touch with.

NOTES

1. Yet another aspect for consideration concerning realism is that there is a reality that can be apprehended only by a person's intelligence; it transcends the senses. It is known as truth-as-such. For example, the strawberry is red. It is true that it is red, and we can prove it if one looks at a ripe strawberry. The red in the strawberry is not truth-as-such. It is merely a temporary fleeting instance of what is true in reality since the strawberry when it deteriorates will no longer be red; it will blacken. However, if one considers the ontological dimension, the reality of red as truth-as-such transcends time. The color red is not a particular color of red. "Red" contains and represents all shades of the color red (similar to the description of grass as green). Therefore, red-as-such is captured by the human eye and animated with the person's intelligence, but it is out of reach for the camera lens.

2. According to Jacques Maritain, the artist's engagement with nature's spontaneity is the acknowledgment of reality as it is. It is a delightful intimate and private encounter in which heartfelt feelings and intelligence are involved in transcending the perceived reality. See Trapani 120–38.

3. In 2013, Fujifilm Corp announced that it had stopped making motion picture film stock. The company "blamed the shutdown on the proliferation of digital filmmaking and decreased demand for film" (Kaufman). This rapid digitalization of the cinema industry has already affected the three major motion-picture camera brands in the United States: "ARRI, Panavision, and Aaton who have [already] quietly ceased production of film cameras . . . to focus exclusively on design and manufacture of digital cameras" (Kaufman).

Kodak's sudden announcement in 2014 that it was ending its manufacturing of 35 mm negative stock ended "signing agreements with the six largest Hollywood studios that will keep all parties in the celluloid business for at least a few more years" (Frazer).

4. Cinematographer Nestor Almendros captured live action in the midst of an awesome Canadian landscape with majestic skies and natural weather formations. His sublime natural lighting compositions, many of them drawn from natural twilights and sunsets, made him the recipient of an Oscar for best cinematography. See Almendros 167–86.

5. Quoted from an interview with Ron Howard about the making of *Angels and Demons*. This interview can be found in the DVD's "special selections."

REFERENCES

Almendros, Nestor. *A Man with a Camera*. Toronto: Collins, 1984. Print.

Bazin, Andre. *What Is Cinema? Vol. I*. Trans. Hugh Gray. Berkeley: U of Cal P, 1967. Print.

Bordwell, David. *Narration in the Fiction Film*. Madison: U of Wisconsin P, 1985. Print.

Bryson, Norman. *Vision and Painting: The Logic of the Gaze*. New Haven: Yale UP, 1983. Print.

Campos, Pedro. *pedrocampos.net*. N.p., n.d. Web. 21 June 2013.

Chagollan, Steve. "Richard Crudo Named ASC President for Fourth Term." *Variety* 5 June 2013. Web. 5 July 2013.

Crudo, Richard. "President's Desk." *American Cinematographer* (June 2014): 2. Print.

Doane, Mary Ann. *The Emergence of Cinematic Time*. Cambridge: Harvard UP, 2002. Print.

Elsaesser, Thomas. "World Cinema: Realism, Evidence, Presence." *Realism and the Audiovisual Medi*. Ed. Lucia Nagib and Cecilia Mello. Palgrave: MacMillan, 2009. Print.

Failes, Ian. "*Life of Pi*: A Tiger's Tale." *Fxguide*. 26 Nov. 2012. Web. 20 Apr. 2013.

Fortheringham, Scott. "The Use of VFX to Stitch *Birdman* Together." *Below the Line RSS*. 2 Feb. 2015. Web. 5 Feb. 2015.
Frazer, Bryant. "It's Official: Six Major Studios Will Help Kodak Keep Film Alive." *Studio Daily*. Feb. 2015. Web. 7 Feb. 2015.
Giralt, Gabriel F. "Realism and Realistic Representation in the Digital Age." *Journal of Film and Video* 62.3 (2010): 3–16. Print.
Graser, Marc. "Why a Volvo Stunt Is Jean-Claude Van Damme's Biggest Hit in Years." *Variety* 20 Nov. 2013. Web. 17 Mar. 2014.
Greenberg, Donald P. "A Framework for Realistic Image Synthesis." *Program of Computer Graphics*. Cornell U. 29 Sept. 2010. Web. 19 Mar. 2012.
Kaufman, Debra. "Film Fading to Black." *CreativeCOW.net*. N.d. Web. 19 July 2016.
Lim, Dennis. "Pursuing Imperfection in Malick's Eden." *New York Times* 22 May 2011. Web. 20 Jan. 2014.
Lister, Martin. *The Photographic Image in Digital Culture*. London: Routledge, 1995. Print.
Margulies, Ivone. *Rites of Realism: Essays on Corporeal Cinema*. Durham: Duke UP, 2002. Print.
McClean, Shilo. *Digital Storytelling*. Cambridge: MIT P, 2007. Print.
Ortega y Gasset, Jose. *La Deshumanizacion del Arte*. Madrid: Alianza Editorial, 1984. Print.
Pieper, Josef. *Abuse of Language, Abuse of Power*. San Francisco: Ignatius, 1992. Print.
———. *Only the Lovers Sing: Art and Contemplation*. San Francisco: Ignatius, 1990. Print.
Pollock, Griselda. *Digital and Other Virtualities: Renegotiating the Image*. Ed. Anthony Bryant and Griselda Pollock. London: I. B. Tauris, 2010. Print.
Prince, Stephen. *Digital Virtual Effects in Cinema: The Seduction of Reality*. New Brunswick: Rutgers UP, 2012. Print.
———. "True Lies: Perceptual Realism, Digital Images, and Film Theory." *Film Theory and Criticism*. Ed. Leo Braudy and Marshall Cohen. New York: Oxford UP, 2004. Print.
Robertson, Barbara. "VFX Supervisor Bill Westenhofer on 'Life of Pi.'" *Studio Daily* 15 Feb. 2013. Web. 20 Apr. 2013.
———. "VFX Supervisor Richard Stammers on 'Prometheus.'" *Studio Daily* 8 June 2012. Web. 16 June 2013.
Robins, Keith. *Into the Image*. Oxfordshire: Taylor & Francis, 1996. Print.
Rodowick, D. N. *The Virtual Life of Film*. Cambridge: Harvard UP, 2007. Print.
Rosen, Philip. *Change Mummified, Cinema, Historicity, Theory*. Minneapolis: U of Minnesota P, 2001. Print.
Seymour, Mike. "A Way Forward for the VFX industry." *Fxguide*. 1 Dec. 2014. Web. 14 Dec. 2014.
Skweres, Mary Ann. "Getting Respect for Invisible VFX." *Awn.com*. 28 Dec. 2004. Web. 21 Apr. 2013.
Trapani, John. *Poetry Beauty and Contemplation: The Complete Aesthetics of Jacques Maritain*. Washington: Catholic University of America P, 2011. Print.
Venkatasawmy, Rama. *Digitation of Cinematic Visual Effects*. Lanham: Lexington, 2013. Print.
Wojtyla, Karol. "Address of His Holiness John Paul II to the Participants of a Conference." Sponsored by The Vatican Observatory, Vatican. 27 Sept. 1991. Web. 19 Mar. 2013.
Wolf, Jennifer. "Cinesite Delivers Invisible Effects for *The Revenant*." *Awn.com*. 28 Jan. 2016. Web. 20 Feb. 2016.