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# From Remediation to Digital Plenitude and Back Again

*An Interview with Jay David Bolter*

Jay David Bolter is Wesley Chair of New Media and Co-director of the Augmented Media Lab at Georgia Institute of Technology. He became widely known in the field of media studies in 1998, when he co-published the book *Remediation. Understanding New Media* with Richard Grusin. Bolter and Grusin described remediation as the principle of mutual relations between new and old media. According to this theory, each new medium builds on some old media and reshapes and updates aspects of it. At the same time, Bolter and Grusin distinguished between the processes of immediation, i.e. the tendency of the media to reflect reality and create an impression of presence and move towards experience without mediation, and hypermediation, which in turn shows the process of mediation and leads the viewer or user to perceive their experience as mediated.

However, *Remediation* was the third book in Jay David Bolter's work, building on his earlier interest in media-technology relations. In the 1980s, inspired by the history of ideas, Bolter wrote a book tracing the idea of the computer in Western culture in the 20th century, *Turing's Man: Western Culture in the Computer Age* (1984). In his second book, *Writing Space* (1990), Bolter addressed the nascent phenomenon of hypertext. In his latest book, *The Digital Penitude* (2019), he traces the rise of digital technologies in the context of the disintegration of cultural hierarchies in the second half of the 20th century. During his career, Bolter, in addition to historical-theoretical reflection on emerging media forms and technologies, has long been involved in the development of new technologies and media forms, whether they are used in entertainment, education or care for cultural heritage.

This interview took place in early November 2019 following the Interface Symposium, organized to mark the 30th anniversary of *Iluminace*, in which Jay David Bolter participated as one of the keynote speakers.

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*It's been 20 years since your defining work, the book* Remediation*, was written. When you look at the book in hindsight, how do its main theses stand today?*

To be honest, I think it holds up well. So many things have happened in digital technology and in our culture's use of technologies since 1999 — in particular, of course, the entire social media revolution. What was originally by Tim O'Reilly called *Web 2.0*, which has transformed the way we think about the world of digital technology in our culture, was totally absent from our book. We understood digital technologies and their impact in terms of *Web 1.0* — the World Wide Web — in terms of video games and a few other kinds of digital manifestations at the time, but we couldn't have anticipated, nor did anyone, I think, anticipate a social media revolution: Twitter, Facebook, YouTube. And yet, when I look at these technologies today, and the role that they play, it seems to me that *Remediation* still is, in one way, one lens in which we can understand what's happening in each of them individually, and in the whole digital revolution collectively. What I have toyed with several times is updating *Remediation*; to, essentially, look at the whole new set of examples and the ways in which the media forms such as YouTube, for example, may resonate with earlier technologies of representation. And I think it would be quite instructive to do so. Having said that, we never thought of *Remediation* as a universal theory that explained all of media, and so in the interim there have been lots of interesting and important ways to understand digital media that we didn't take into account.

*At the beginning of the book, you mention the double logic between immediacy and hypermediacy. I was thinking about to what extent one principle can take over the other: Is there a balance between immediacy and hypermediacy today, or do some kinds of immediacy, especially in the context of VR, take over hypermediacy?*

I think we'd have to look at the situation case by case, as to say, looking at each of these new media forms, and, even more specifically, their relationship to the way they're used by certain groups or for certain purposes. I would say that the way we tried to present it is that immediacy and hypermediacy are always present in any media economy, deep within any media form, and that in a certain sense they penetrate one another, so they're both dichotomies, end points — they enter a kind of dialogue with each other at the same time. And I think that would still be true today.

Now, let's begin with the first example you've mentioned, virtual reality. As I was trying to suggest at the Interface symposium, virtual reality has pursued immediacy for its representational strategy which we call transparency. Strongly, since its inception, and we can date the inception to 1965–1970, alternatively later to the 1980s, but in either case, the rhetoric that virtual reality makes the media disappear and essentially transports us to another world, that it is seamless, has been very strong since the beginning and is just as strong today. Nevertheless, even within virtual reality, we can see the alternate strategy of hypermediacy playing at least a minor role, and in particular because our concept or notion of virtual reality and the technological platforms that support it have become more sophisticated and more varied over the years. Originally, we only thought of virtual reality as a leverage technology that required you to wear a headset which completely covered your view, really blacked out all other access to media, and in that context it was easy to see the goal of virtual reality as transparent immediacy. However, as it's evolved, the term

"virtual reality" and the practices associated with virtual reality have come to include screen-based video games in the 1990s and in the 2000s, and, more recently, on smartphones and tablets the possibilities of hypermediacy or multiple media forms intersecting with one another or interacting with one another become more real. And then, on the other hand, within the last five years or so, the rise of inexpensive and fairly effective, fairly high-quality headsets from Oculus and Vive and other manufacturers, has made it possible for us to return, in a certain sense, to that golden era, to a notion of virtual reality as immediate. So even in VR we could argue that hypermediacy has a role.

And then, if we think about augmented reality, it should be the hypermediated technology par excellence, in a sense that it is about putting various media forms in front, making them available to the user, as he/she walks through his/her everyday environment. So, in a sense, augmented reality simply "realifies" immediate condition that we already experience every day. I was just walking through Prague and everyone had a phone out — to take a picture or to use a map, or to consult a website about some historic building. Then we have screens in our bars, in our airports, in our hotel rooms, in our homes, in our offices… So, augmented reality, in a certain sense, just takes all of the screens and puts them into one application. It should be the apotheosis of hypermediacy. And in some sense, it is. On the other hand, there is even there an attempt to think about augmented reality as a kind of immediate experience in which the 3D graphics that you see in front of you are so perfectly integrated into your environment that you can't tell the difference between that and the physical world. That's a dream, or a dystopia, depending on your point of view, that we're nowhere near reaching, but it sits there as a kind of vision that is a counterpart to the immediacy of virtual reality.

*In your lecture you also talked about VR as a* reality medium*, or medium which is, according to some authors (for example Chris Milk), even the last medium. To what extent do you subscribe, for example, to this idea of the VR as the last medium, or are you critical towards such a stance?*

I am critical. The notion that virtual reality is the medium to end all media is something that we were talking about in the late 1990s with regard to the film *Strange Days* by Kathryn Bigelow. We already saw a filmic representation of that notion of virtual reality, where people would wear a headset that had the ability to record our sensations from our brains, in such a way that if another user put on the headset, they effectively inhabited the other person's perceptual world. So that, as Ralph Fiennes says in the movie, virtual reality is not a medium anymore at all, it is real life. And the notion that virtual reality can give us the experience of life is still present in Chris Milk's Ted Talk that I was referring to at the conference.[1] Chris Milk is a 360° video filmmaker who has argued that virtual reality could be the last medium, or the first medium that gives us the experience of the world as if it were unmediated. We were critical of that vision in the 1990s and we remain so today, in the sense that it's always only half of the story. In fact, this argument contains the seeds of its own inadequacy: when people like Chris Milk, or like the characters in *Strange Days*

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1)  Online:  <https://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ultimate_empathy_machine/discussion>, [accessed 24 June 2020].

20 years ago, talk about this medium that ends all media, they end up talking about it in terms of other media. That was our notion of remediation. Thus, the awareness of other media is always present as part of our understanding of how a medium functions, even when that medium is purporting to be real life.

*It seems like this notion also relates to the way some cinema scholars — such as Laurent Bazin and Oliver Grau — imagine VR as something like 'a cinema of all senses': the total immersion which started with the screen in the cinema and ends up with a headset.*[2] *In this respect, I wonder whether there is some limitation to how we can think about digital media through the lenses of film studies? Or, shouldn't there also be some alternative genealogies of digital media, not relying on the parallels or analogies taken from the cinema context?*

I think that both approaches to digital media make sense. In other words, I think that film studies have a lot to contribute to our understanding of digital media. Not least of which, because, as I was just suggesting, cinema as one of the dominant media forms of the 20th century has been formative in the way we think about virtual reality — even when the creators of virtual reality are not consciously aware of it, they are still caught in the logic of remediation, still thinking in cinematic terms. And we have to be fair and say that many of the makers of 3D graphics and even VR artefacts are actually aware of the relationship to cinema. They talk about the camera, lighting, and techniques of representation that come from cinema and photography. As I was suggesting at the conference, I think that film studies can contribute to our notions of digital media mainly because they have such a rich, long and varied tradition of thinking about the relationship of technology to the processes of representation. In *Remediation* and continuing on from there, I've always argued that it's valuable to take a historical view of the evolution of digital media, and that historical view has sometimes been ignored by the makers and even the theorists of digital media because they've been caught in a kind of logic of "the new", which is really a modernist notion, a logic of revolution. So, they argue that digital media is something completely new, and we can't think of it in terms of earlier media forms, and, ironically, they end up doing just that. On the other hand, to get back to your original point, I don't think we should think of film as the only genealogy of digital theory. There are other ways to think about it that could be equally productive.

*An alternative genealogy I have in mind is, for example, to think about VR from the position of video games. That would be a kind of genealogy that approaches VR more as an environmental or architectural medium rather than a medium that presents a motion, or a speed — i.e. a spatial medium rather than a temporal one.*

Video games, and games in general, are, obviously, important to think about virtual reality. And that's borne out not only culturally, but even economically. If you look at what's happening today with VR, you'll see that it is videogames that constitute the most important route to the popularization of these VR headsets. When they project who's going to be buying VR headsets and why, it's the gaming community first and foremost. And then, other users are hopefully going to catch up. So, yes, indeed, video games are an important

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2)    Online: <http://sensesofcinema.com/2019/feature-articles/total-cinema-or-what-is-vr/>, [accessed 24 June 2020].

place to look for our understanding of VR. Yet, with all that I've said, one of these trends, but only one of these trends in terms of understanding video games, is cinema, after all. Video games, or at least some genres, depend very heavily on cinematic conventions while other genres reject cinematic conventions altogether.

*Last question related to VR: one of the effects of VR is what you call the proliferation of un-canny doubles. The double might be a copy of the world itself, as OASIS from* Ready Player One*, or it can be just a copy of a person (e.g. an avatar). Could you please elaborate a bit on where these uncanny doubles, or uncanny bodies we encounter in the VR, might lead to and how to unpack them?*

That's an interesting question. What got me thinking about it is that I didn't coin the term "uncanny" in the context of virtual reality or computer graphics. In fact, the idea of the "uncanny valley" is something that computer graphics specialists and people interested in what we could call the aesthetics of computer graphics have been talking about for quite some time. The term uncanny valley goes back to the roboticist Masahiro Mori, who coined that term as early as in 1970 in relation to robots that were being fashioned to look more like humans. The majority opinion was that if you made robots look more human, they would integrate better with human workers, while he claimed that this wasn't always the case. If the robots looked too much like humans, but were not convincing replicas of the human, they would end up in an interim space, an uncomfortable space which he called the uncanny valley, creating a kind of eerie feeling that it was better to keep the robot looking more mechanical. So, that concept was taken up by computer graphics experts as they were trying to pursue the goal of photorealism to make computer graphic images look more and more like photographs and animations look more and more like live action films. We're still in the midst of that experiment, particularly in video games, and also in certain kinds of movies the computer graphics experimentations are becoming more and more realistic. So, again, the uncanny valley in the context of computer graphics is a valley which you want to get through, you want to get to the other side, get up the mountain as it were, of a perfect photorealism.

That got me thinking about the term "uncanny" which, of course, has a long and interesting theoretical history that goes back, in particular, to the early part of the 20th century, with the essays by Ernst Jentsch and then, of course, Sigmund Freud.[3] Both of whom talk about the 19th century literature of horror in which the uncanny double appears as a figure of menace, a figure that's rejected by the human society, so Mary Shelley's *Frank-enstein* or E. T. Hoffmann's *The Sandman* become cardinal examples. And the tradition of the double as something horrible takes us right up into the present with Jordan Peele's recent film *Us*, in which doubles who live underground come back and attack their above-ground counterparts. The connection to Sigmund Freud's theory is itself uncanny in the sense that Freud postulated that the feeling of the uncanny comes from the return of the repressed, and in Jordan Peele's film the repressed figures are, in fact, returning — they're in fact coming up from the unconscious, from the underground world.

3)   Ernst Jentsch, 'On the Psychology of the Uncanny (1906)', *Angelaki*, vol. 2, no. 1 (1995), pp. 7–16. Sigmund Freud, 'The "Uncanny"', in James Strachey et al. (ed.), *The Standard Edition of the Complete Psychological Works of Sigmund Freud*, vol. 17 (London: Hogarth, 1955), pp. 217–56.

That whole tradition of the uncanny as horrible and eerie would seem to be in concert with the computer graphic notion of the uncanny valley. But my point was that the uncanny double is, in fact, something that can even have a certain appeal to us, as much for the flaws and differences that we see between the double and the real as for the similarities. So, if we think of it that way, we see that computer graphics is, in fact, in the position of producing a whole world of uncanny doubles, but in a certain sense, what virtual reality is always doing is creating these doubles. Not as an accident, not as something it's trying to avoid, but in fact in the very nature of its representation. It takes away the world that we see and gives us another world which may look very much like the one that it replaces, in terms of its physics, and in terms of its graphic appearance, or it may be a totally imaginary world. The concept of the metaverse from science fiction is something that virtual reality is now pursuing, at least, again, in principle, if not able yet to realize it.

So, this ties to a larger theme that I was talking about at the conference, the theme of reality medium, where I have argued with my colleagues Maria Engberg and Blair MacIntyre[4] that not only virtual reality and augmented reality, which have the word reality in the title, should be thought of as reality media, but, in fact, film and television, and several other media in history of representation deserve that title as well. And in every case, one of the characteristics of reality media is this concept of doubling; they take whatever their representational practice is and use it to double the world in some sense for us.

*Talking about photorealism, the tendency to refrain to this safe solution in confrontation with uncanniness produced by contemporary digital media strikes me as an example of cheap ethics of image-making. I wonder to what extent the uncanny can be treated also in more productive terms. Such a productive stance might be also related to some subjective transformations, alluding to Tom Gunning talking about* 'La Ciotat' effect *in terms of the transformation of the subject produced by the moving image. In his explanation of the effect, he does not interpret the moving image as an illusion of reality, but instead he focuses on what is happening to an audience when they see a moving image of a train for the first time.*[5]

Yes, let me elaborate on what Gunning was talking about first. There's a very famous film at the very birth of cinema called *The Arrival of a Train at La Ciotat Station,* which is one of the earliest films of the Lumière brothers. And a legend grew up about the reception of that film. The idea was that the audience was terrified that the engine of the train looked so real that it was going to burst through the screen into the theatre and crush them. And so they ran for the door; they got up and left their seats in a panic. And this myth is an early version of what virtual reality is still trying to propagate — the notion that a medium could be so real that it could replace reality for us, that it could lose any sense of mediation, become immediate to our experience.

The film historian and media archaeologist Tom Gunning in the 1980s already argued that this myth was, in fact, not very likely to have occurred. It was hard for him to imagine, as he put it, that an audience of sophisticated Parisians of the end of the 19th century

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4)    Jay David Bolter – Maria Engberg – Blair MacIntyre, *Reality Media. Augmented and Virtual Reality* (Cambridge, MA: The MIT Press, forthcoming).

5)    Tom Gunning, 'An Aesthetic of Astonishment', *Art and Text*, vol. 34 (1989), pp. 31–32.

would be so naive as to think that what they saw on the screen was actually going to jump out of the screen and crush them. Instead, what he thought happened was a sense of astonishment, or wonder, that a medium **could** seem so real. So that the audience was able to entertain at the same time a kind of frisson, a kind of shiver that the train was actually there, while maintaining a sophisticated response of understanding that it was a medium they were watching, and their wonder was that medium could do that, that medium could get that response from them.

I'm not sure that Gunning actually called this the *La Ciotat* effect, but we've called it that, my colleagues and I, to think about how certain reality media can function, both causing us a kind of suspension of disbelief, leading us to a kind of suspension of disbelief, while at the same time keeping us, allowing us to maintain our understanding that it is a medium. So that to me is a very important aspect of the way reality media in general function, and it relates to the concept of doubling in a sense that we are conscious of this double, the double layer, this double logic of representation, as we experience the medium. For example, if we think, again, about virtual reality: you may put on the headset today, we'll never get to the point when we actually forget that we are wearing a headset and imagine that we're in another world. Despite the rhetoric that often surrounds these VR experiences, it's simply the case that the representation is not good enough, nor is the technology transparent enough that we totally forget it. But, in fact, we get close. And that closeness combined with an understanding of mediation is what seems to me to connect our reaction to VR to that sense of astonishment that Gunning was describing in *La Ciotat*.

*When we talk about doubling, it seems to me as one of the many instances of a general proliferation of culture in media technologies, and that brings me to your last book that you've recently published, which is* The Digital Plenitude.[6] *What does the plenitude mean for you? And why did you bring this term into the scholarly debate?*

The plenitude is the proliferation of media forms and media artefacts in which we live today. And it's something that is so much a part of our everyday lives that we tend to forget how remarkable it is, or at least how new and unusual this condition is in relation to the way we have lived as a culture for hundreds and even thousands of years. So, today we live in a sea of media and media artefacts, everywhere we turn there are media that we use or that bombard us. And we all know this, we all understand that this is the condition. So, in a certain sense, I'm not saying anything that we don't already know. But in the book I'm trying to account for the historical dimension of this condition.

As I've described in the book, it's an attempt to chart a relationship, or understand the relationship between two important historical forces of the last 50 years or so. One of those is the declining elite culture, or to put it more positively, the rise of what used to be called popular culture, and a breakdown of a sense of hierarchy in culture that existed in Western culture certainly before the Second World War, or perhaps even a little earlier. If we think back to the period prior to the Second World War, we see a world in which cer-

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6)   Jay David Bolter, *The Digital Plenitude. The Decline of Elite Culture and the Rise of New Media* (Cambridge, MA: The MIT Press, 2019).

tain cultural practices, such as "serious literature", classical music and the visual arts, were simply understood as more culturally important than various popular expressions such as film, popular music, various forms of romance or other kinds of popular literature, comic books, and so on. What happened after the Second World War was a gradual flattening of culture in a sense that none of those earlier forms disappeared — in fact, they all continued to flourish — but what we saw was a rising status of precisely those popular forms that were considered relatively unimportant prior to that time. I think we can chart the rise, first of all, to the rise of popular music in the 1950s and 1960s. And this, in turn, has both cultural and economic dimensions. We have the rise after the Second World War of a middle class that had more disposable income, and particularly young people had the opportunity to buy music, listen to music, follow or create their own musical trends. And as they pursued these, the musicians, the artists of rock'n'roll, began to just be regarded as more culturally important that they had prior to this. So, by the 1960s the rock figures were regarded as artists in their own right, they were regarded as cultural icons. At the same time, however, film began to be regarded as a serious art form, and to some extent, more slowly, television, and even in comics and other popular forms of expression. So, one way to think about this rise is as a kind of levelling in which the culture that had been hierarchical had become horizontal, had developed what we could later call networks of affiliation, rather than simple hierarchies. Now, critics like Fredric Jameson and others who've talked about postmodernism have acknowledged this for a long time. Although, I don't think we've really taken it entirely as seriously as we should, it's a major watershed in the way our culture operates. And, in particular, I think this development of cultural communities, in place of cultural hierarchies, is something that has had a tremendous impact on how we understand the production of culture.

Now, this process happened independently of the other historical strand that I talked about in the book, which is, of course, the rise of digital media. And the computer itself dates from the Second World War — depending on how you want to define what a computer is, we have ENIAC, we have the first stored program computers, fully electronic computers, after the Second World War. Nevertheless, the computer wasn't understood as a medium until much later. Pioneers like J. C. R. Licklider and others who developed the ARPANET, which later became the Internet, pioneers such as Ivan Sutherland, Douglas Engelbart, and Alan Kay who developed computer graphics and the graphical user interface. And then, in the 1980s, we had the first really popular personal computers, we had Steve Jobs and the Apple Macintosh in 1984. And these pioneers eventually succeeded in giving us the computer technology and the software that made it possible for the computer to become a medium for millions of users. Or, as a computer technology, to create a series of media forms that became more and more influential at this time. That is actually happening a little bit later than the decline of hierarchies that I have just mentioned, but they're proceeding in parallel.

My argument is not that computer technology itself was the cause of the breakdown of this hierarchical culture. Nor do I think that the breakdown of these hierarchies necessarily had anything to do with the rise of the computer as a medium. But the two developed together, and it turned out, especially in the 1990s and the 2000s, that the computer technology has become the perfect matrix for the cultural condition that we have today. For

two reasons: one, because we can represent and store so many of media forms in digital formats, everything from music to video and games now. And other so-called new digital media forms are all available online or in digital formats. And through the Internet they can be delivered or transferred across wide distances, essentially without cost. And the other important factor was that the computer, especially with the rise of social media after about 2000, is able to support online communities. And these online communities can be social and political, but they can also be culturable. So that all sorts of different cultural forms have their own large and small communities that exist in this complicated network of overlapping identities. If you are interested in classical music, there are dozens or thousands of communities that you can take part in; if you're interested in hip-hop, there are thousands or hundreds of thousands of such communities. And, so, we now have the ideal technological affordances for the networking, the flattening out of our culture, at the same time that the culture wants to become flat. And that's what I mean by the digital plenitude; that's what I've been trying to describe in this book.

*Once I gave a question to my student — how to compare remediation with Manovich's concept of transcoding. My intuition was that certain concepts — such as transcoding or remediation — are tethered to certain periods of the development of digital media, in order to grasp some important historical dynamics happening at the beginning of the 2000s or at the end of the 1990s. In a similar vein, do you consider the term "digital plenitude" significant for our historical period, twenty years later?*

Yes, the 1990s was a period in which we were particularly occupied with these moments of transition. The rise of digital media was at that point already inevitable, but it certainly wasn't complete. Richard Grusin and myself, when we talked about remediation, we were struck by all the rhetoric of the 1990s that I referred to earlier, that the computer was a completely new media experience for which there was no parallel and no precedent. And that was kind of the driving force for making us argue the opposite. Now, in the case of Lev Manovich's work, his ground-breaking work *The Language of New Media*,[7] you would need to ask him. But it does seem to me he's very much trying to understand this moment of transcoding, as he puts it, in terms of both its historical antecedents and what makes it new. His argument is, essentially, that we are in a new moment, but it's not a moment without precedents — in particular, he finds them in the Soviet avant-garde cinema of the 1920s, in the works of Dziga Vertov. He argues that what the avant-garde filmmakers of that period were doing was a kind of what he called "database" cinema, that he saw as the operatable aesthetic of the new digital media. So, yes, in fact that was the moment for that. I think today what a number of film or digital media theorists are impressed by is what I'm calling a plenitude, this overwhelming impact of the wealth of media that are available to us in the absence of an organizing principle or hierarchy. We don't have settled categories anymore to describe the ways in which culture is both producing and absorbing these new media forms, and this lack of settled categories makes us, impels us to try to understand this phenomenon in terms of ecologies or communities.

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7)   Lev Manovich, *The Language of New Media* (Cambridge, MA: The MIT Press, 2002).

*And does plenitude bring some new cultural forms? Would the database, for example, be a cultural form which is endemic or native to the digital plenitude?*

That's a good question. Just as I've said that the computer technology provides the matrix for this new kind of flattened cultural condition, the database is part of that same technological matrix. When you have an enormous number of different cultural units that can be reconfigured in a variety of ways, when you don't have a hierarchical framework that controls the way our culture is configured, you get a database rather than something that's more top-down, more hierarchical.

*At the end of your lecture, you asked a question to the audience: To what extent is science becoming increasingly cinematic today? It is true that climate models are presented to the broad audience in a cinematic manner, and in space exploration, for example, immersive media are used to navigate rovers in Martian terrain (I've recently seen this concept being developed — Jet Propulsion Laboratory (JPL)). It seems that we are in midst of a period when more and more cultural practices become visual to the extent that science itself takes over the visual as the tool of conceptual elaboration of the presentation of its outputs, of communicating new information, and even of producing new knowledge. How did it happen that the cinematic visuality became the dominant aesthetics of knowledge?*

This was a topic that came up at the end of the conference, and it was Daniel Strutt who raised this very interesting question. And he pursues that in detail in his new book called *The Digital Image and Reality*,[8] which is definitely worth looking into. I'm wondering if, in fact, what we're talking about is a change in science or a change, rather, in media technologies that have offered science a new venue for communication. In other words, it would be presumptuous of me as a non-scientist to argue that the way scientists work itself is changing as a result of these new visualization forms. And let's elaborate for a moment: what Daniel was talking about was the fact that we now have these especially graphic technologies that make it possible to visualize more effectively than ever the abstract concepts that scientists, particularly let's say cosmologists, have been talking about for decades. So that in a film like *Interstellar* we can have a visualization of a black hole that is as scientifically accurate as we can imagine at this point. What I'm saying is, I don't know whether scientists are finding these visualization techniques to be a new way of doing their work, doing the actual hard science. It may be that they are; we would have to ask them. They've been doing these things abstractly, this kind of reasoning abstractly, in mathematics, for decades, and made enormous progress. It may be that these new visualizations are, in fact, helping them make further progress. But what seems clear is that it's helping, and I think that this was Daniel's point — it's helping scientists to communicate to a larger audience more effectively than ever before.

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8)  Daniel Strutt, *The Digital Image and Reality. Affect, Metaphysics and Post-Cinema* (Amsterdam: Amsterdam University Press, 2019).

*In your practice you also work with the practitioners in the field of VR or cinema. Could you share a bit of your experience in this field?*

Yes, but I haven't been doing anything in the area of scientific visualization. The work that I've been doing with my colleagues at Georgia Tech and at Malmö University has more to do with cultural heritage, informal education, and, to some extent, experience, design, and expression. We've been using not only virtual reality but also augmented reality. For example, we've been creating an elaborate model of the Acropolis in Athens in a form in which it could appear as a virtual reality environment, or it could actually serve as an augmented reality manifestation. The idea of the virtual reality environment would be that you could have a virtual tour of the Acropolis led by a guide in VR space prior to an actual visit. And the VR model allows you to reconstruct a crude sense of what the Acropolis looked like in 400 BC, which you can then compare to what the Acropolis looks like today, to the situation, you know, after most of the temples have fallen. We characterize that kind of experience as cultural heritage or informal education — not an attempt to replace the experience, embody the experience of being there, but to supplement it. And one of the interesting things I noticed is that what's happening today in virtual reality, in augmented reality, is that the two are coming together, the technologies are converging. Although originally, in the 1990s and even in the 2000s, there was a fairly strong divide in the expert communities, now, because of the advent of a whole set of both headsets and devices for displaying AR and VR, we're in a situation where you can choose whether you want something to be an augmented or virtual experience, and very easily move from one to the other. That's going to be one of the interesting features of the way these technologies have deployed as media forms. And it's something that we've been experimenting with — my colleague Blair MacIntyre is working with Mozilla on creating a web-based protocol called WebXR for staging experiences that can be hybrids of webpages, virtual reality experiences and augmented reality experiences in the future. So, I think this convergence of media forms leads to a very interesting place, both in terms of the technology, but also in terms of expressive possibilities of these reality media.