BEYOND COSMOS: CARL SAGAN AND A NEW APPROACH TO MEDIA SCIENCE COMMUNICATION

by

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Daniel John Schmidt

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To the many scientists willing to partake in a better public understanding of science through documentary filmmaking.

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ABSTRACT

Much can be gleaned by reflecting on how Carl Sagan captured the hearts and minds of so many people through science. I will examine the tenets of science communication Carl Sagan successfully employed to overcome the many problems inherent to explaining complex topics. Though Sagan inspires in us a belief that the public can be intrigued by the wonders of science, the methods employed by *Cosmos* to connect with viewers are now outdated. Television has evolved beyond the heavy box in the corner of the living room and has become the iPad, the laptop computer, and the mobile phone. All are personal devices populated by Internet channels teeming with endless amounts of information. Not only have our modes of watching changed but also so have our programs. The format that worked for science television in the 1980s no longer seems to entertain or captivate audiences like it used to. This paper will examine the need to respond to those changes in consumption and production to create opportunities for the public to connect with science through the modes most common to our current culture. Reality-based, competition-driven, and audience- participation shows are the new standard in nonfiction television. With the willing participation of scientists and the creativity of filmmakers, we should work to mold those formats around new science programs. This effort would ensure a better public understanding of science and bring science more prominently into the realm of popular culture and discussion.

INTRODUCTION

Typically, the nonfiction television scientist is a smart, authoritative male delivering intellectually stirring one-liners in a lab lit like a noir crime drama. Clever dialogue editing gives the audience only the most compelling information, conveniently omitting the other ninety percent of the interview (*NOVA* & Morgan Freeman's *Through the Wormhole* are examples). Because of their presentation and the clever work of the filmmaker, audiences absorb the words even when they do not quite understand them. We hear the nuggets of truth and are certified of their veracity by the impressive lower-thirds informing us of the speaker's distinguished academic credentials or "expert" status. This automatic conferring of authority can be seen in nearly all episodes of NOVA, for example, a show that relies heavily on testimony from scientists to back up its exposition.

In my short career as a filmmaker, I have interviewed dozens of scientists - experts in their fields, renowned authorities on the way the world works - and in many cases I have encountered the same shortcomings. A fair number of scientists seem to struggle with explaining their work in a way that is not riddled with jargon and complicated acronyms. Even major science journals like *PhysicsToday* are writing critically about this issue:

> Scientists typically fail to craft simple, clear messages and repeat them often. They commonly overdo the level of detail, and people can have difficulty sorting out what is important. In short, the more you say, the less they hear. And scientists tend to speak in code.... Many words that seem perfectly normal to scientists are incomprehensible jargon to the wider world. And there are usually simpler substitutes. Rather than "anthropogenic," scientists can say "human-caused." Instead of "spatial" and "temporal," they could say "space" and "time." (Somerville and Hassol 48)

The problems presented by *PhysicsToday*, the flagship publication of the American Institute of Physics, seem to be omnipresent across most disciplines of science and symptomatic of its stagnation in the public eye. Very few people seem to care or pay much attention to recent developments in science and technology, even though this is a time when both will greatly affect individual lives. The biennial *2012 NSF Science and Engineering Indicators Report* notes that "In the 2008 Pew Research Center survey on media consumption, 13% of the respondents reported following Science & Technology news 'very closely'"(7-14). These numbers aren't surprising considering that over 80% of Americans polled in 2011 were unable to name a living scientist ("Your Congress – Your Health" 51).

If current media trends give us an accurate barometer of what people value, then it is a bit disquieting when the trivial subjects of reality TV are of greater relevance than how we will power our cars in the next decade or how climate change might affect the places we live. Science blogger Bora Kivkovik put it bluntly in a recent *New York Times* article when he said, "Lindsay Lohan is our competitor. We have to get her off the screen and get science in there instead" (Lin). This apathy and, at times, disdain for science is not just unfortunate. It is frightening. As author Chris Mooney points out in *Unscientific America*:

> This is a time when science is pivotal to our political lives, our prosperity, and even our lifestyles and habits. And yet again and again, we encounter disturbing disconnects between the state of scientific understanding and the way we live our lives, set our policies, define our identities, and inform and entertain ourselves. (4)

It is useful to look back to a time when science *was* in the public eye and was far more prominent on television. By looking back, perhaps it is possible to move forward, to once again engage television viewers with thoughtful, challenging, and inspiring science content. We do, of course, currently have personalities like Neil De Grasse Tyson, Michio Kaku, and Brian Cox who are faithfully carrying the torch as public scientists, but it is questionable how much they are doing for actually advancing the popularization of science. Additionally, there are many examples of other prominent figures who have changed the way we approach science like Isaac Asimov, David Attenborough, Stephen Hawking, and Stephen Gould. Of all of these popularizers of science, however, none seems to have had the affect of one young astrophysicist who, in the 1980s, changed the way the world interacted with scientific information. That scientist was Carl Sagan.

Carl Sagan's Legacy

Sagan's quest to engage the public in the shared amazement of the world and beyond has gone unmatched in the 15 years since his death. As Sagan's biographer Keay Davidson notes, "To a generation of young Americans, his eloquence on television and the printed page was an irresistible summons to scientific careers" (xii). Although Sagan had created a massive fan base and loyal following, these acolytes were not all that was left behind when he died. With Sagan's death, the world lost a true communicator of science, a person whose gifts for breaking boundaries and connecting us with our planet (and others) have been unrivaled. We lost a role model to which young and

impressionable Generation X'ers could look to be inspired to pursue science as a career. We lost a television personality with that rare combination of charm, passion, and credibility who could grace the late night talk shows with a dose of scientific knowledge as engaging as any Hollywood gossip. The fact that Sagan appeared on *Johnny Carson's Tonight Show* twenty-six times in thirteen years is testament to his mainstream popularity (Davidson 264). This fame is more than a case of celebrity showboating. It is emblematic of something amiss in today's society: the precarious lack of science in the mainstream public media. Sagan's passing created a massive void into which much of the average American's interest in science has vanished. Author and science filmmaker Randy Olson sums up this point admirably:

> No one told Carl Sagan to write science fiction novels, get involved with Hollywood filmmaking, or go on Johnny Carson's *Tonight Show*. He simply had an inner voice driving him to reach out and share his passion for science. He *was* the voice of science, by his own doing (172).

Now, more than ever, filmmakers need to create meaningful and memorable narratives that create a long-term re-engagement of the public with science. The following paper will examine the tenets of science communication that Carl Sagan successfully employed. I will briefly apply them in the context of current issues facing science outreach. It is worth examining how Sagan's stunning combination of language, personality, politics, and passion informed and engaged an impressionable American populace with the scientific method and the mysteries it could unlock in our universe. This paper will also investigate accomplishments in film and television in the last 10 years that uphold Sagan's vision. Many bright minds and shiny personalities have followed Sagan's footsteps since his death nearly twenty years ago. They often mimic

his mystical and inquisitive personality in on-camera presentations of astrology and physics, but it remains questionable whether they are truly acknowledging the shifting paradigms in nonfiction television.

I will also discuss how we might move forward as science filmmakers to better fulfill our role as communicators, translators, and facilitators of positive, fulfilling interactions between scientists and the public. The precarious position of science in the public eye requires new approaches to communicating its significance to a weary populace. I suggest that applying new genres of television, such as reality and contest-based formats to science might help to popularize science, democratize the often hierarchical scientific profession, and force science to acknowledge its existence in the realm of popular, political, and social cultures.

Because it is often difficult to assign motives to filmmakers who have not discussed their work openly, I will also use examples from my short career in the science communication field to discuss the production of my thesis film as a case study in applying new narrative modes to science communication. I hope the exercise of illuminating my own experiences within the context of Sagan's lessons and insights will encourage others on a similar path to explore alternate methods of presenting complex science to their audiences.

OVERCOMING THE LANGUAGE BARRIER

In 1959, British scientist CP Snow delivered his famous lecture, *The Two Cultures*, lamenting about the growing gap he saw developing between science and the humanities. This seminal work has since been dissected, rehashed, and referenced for its ideas of how rectifying this disconnect could enable a more complete education system and produce intellectuals with broader understanding of both art and science. Evidence of Snow's lasting impact is just a few clicks away. A Google News search reveals no less than 5 references to the original article in a recent month on major news blogs from newspapers like *The Guardian* and *The Seattle Post Intelligencer.* Nonetheless, quite a lot has changed in the more than fifty years since Snow's lecture. While Snow was largely concerned with the disconnect between intellectuals in science and the humanities, the current concern in both society and this paper is the perilous gap between scientists and everyone else.

What is important to take away from *The Two Cultures* is Snow's idea of the "mutual incomprehension" between science and non-science. The reasons for this deficit in reciprocal understanding are many, but one of the primary reasons we find science alienated from the rest of society is a problem inherent in the current practice of science itself. The extremely competitive nature of science today, both in terms of recognition and research, results in a forced specialization that further compartmentalizes its practitioners. Sagan was the rare breed of multidisciplinarian who specialized in both biology and astrophysics and seemed to be enchanted by nearly all realms of science. While Sagan seemed to exempt himself from the problems of compartmentalization,

many other scientists do fall victim to the insular quality of discourse that isolates their professions.

The difference in vocabulary between any two scientific disciplines has become so distinct that the terminology of the microbiologist is hardly recognizable to that of a geochemist - even if the respective subject matter is inextricably linked. This language barrier is more than just a detriment to the collaboration between scientists of different disciplines. Language remains one of the largest obstacles to communicating the work and importance of scientific exploration to the public. The complexity, and often incomprehensibility, of terminology has become a method of conveying seriousness and intellect rather than simplicity of communication. Sagan, in contrast, possessed an innate ability to rise above the jargon and acronyms of scientific papers and explain the world in terms non-specialists could understand. Sagan's gift for communication and language is likely the envy of most public figures and scientists. Although the grace he possessed cannot be taught, his ability to speak of complex matters in a simple fashion can be. As Carl Sagan proved, it is possible to be both a great scientist and great communicator. No one sums it up better than the Nobel laureate chemist Ernest Rutherford who said "if you can't explain your physics to a barmaid, it is probably not very good physics" (Science Kids).

Given the time spent obtaining undergraduate and doctorate degrees as well as post-doctorate and tenured positions, most scientists will have spent no fewer than twelve years heavily engaged in academia by the time they have officially reached the security of a tenured position. The competition and cycle of academic credibility require a

substantial degree of focus and specialization that does not lend much time to developing public communication and language skills. Dwindling federal funding reinforces the "publish or perish" attitude that relegates more scientists to their labs and fewer to the public square. Yet, there are many young scientists who not only have an interest in explaining their work to the public but also have inventive and creative ideas about how to do it.

The issue here is that it seems most of our research institutions do not reward science communication in the same way they do for publications and discovery. If successful outreach played more of a factor in a scientist's ability to remain in the cycle of credibility, many more scientists would augment their research with a public component. This outreach could come in many modes using traditional tools like television and film and newer digital forms using the ever-stronger tools of social media and networking. The bar is moving forward on this issue with most National Science Foundation grants now requiring some outreach component, but, unfortunately, it seems these requirements are often met at only a minimum level with a poster, public lecture, or brief video appearance. While requiring "outreach," the National Science Foundation fails to properly define the term, lacks clear protocols, and leaves the requirement open to speculation and interpretation. Corie Lok wrote critically in *Nature* about the vagueness of the "broader-impacts" requirement of every new NSF grant proposal:

> Because it lacks conceptual clarity, the broader-impacts requirement often leaves researchers unsure about what to include in their proposals, and leads to inconsistencies in how reviewers evaluate applications...To make matters worse, the NSF has made little attempt to systematically track how its broader-impacts requirements are being met, or how much grant money

> is being spent in the process. Nor does it have a system in place to evaluate the effectiveness of the various projects (416).

While the NSF may realize its funding depends on proving to Congress the fruitfulness of the research, scientists at the NSF appear hesitant to open the door to public scrutiny or apprehension.

As a result of our institutional structures failing to reward them for public communication, scientists rarely have an opportunity to leave the vacuum of their labs and take their work to a public forum where they can break down the barriers of language. On a very basic level scientists deliver public lectures, provide quotes for newspapers and magazines, and even consent to the occasional interview for film or television documentaries. Additionally, we should not overlook that some institutions like NASA have done an admirable job at creating a loyal and attentive following for their missions. Yet, if these often fleeting events are the only opportunities to practice translating scientific work for the public, then nothing will change in the public perception of scientists.

We have yet to encounter a scientist as eager as Sagan to disregard the language barrier between scientists and non-scientists. Not only did he serve as his own spokesperson - he actively sought the opportunity to do so. Sagan, nonetheless, underestimated his colleagues' fear of or prejudice against public communication. His popularization of science came at the cost of severe damage to his reputation and credibility among his colleagues.

THE NEED TO POPULARIZE

Carl Sagan did not seem to view the popularizing of science as a particular career move, much less a risky one. As evidenced in his final book, *The Demon Haunted World*, published in the same year as his death, Sagan makes clear that his efforts to explain his work came as naturally as the work itself:

> Popularizing science - trying to make its methods and findings accessible to non-scientists - then follows naturally and immediately. *Not* explaining science seems to me perverse. When you're in love, you want to tell the world (25).

By the time Sagan wrote those words he seemed to have already joined the ranks of Aristotle and Einstein in the popular imagination as household names in science. He was not necessarily at risk of jeopardizing his career. Nonetheless, as Sagan began to enter the limelight with talk show interviews, book tours, and magazine articles, many of his colleagues grew critical of his efforts at popularizing his work. As a result, the most severe blow to Sagan's career was the denial of tenure at Harvard University for reasons of "self-aggrandizement and pandering to the public." A second and perhaps more lasting blow to Sagan's career was denial of election to the National Academy of Sciences. Sagan's biographer Keay Davidson notes, "the life of an American scientist, admission to the National Academy of Sciences is generally regarded as the peak of a career, the scientific equivalent of election, in politics to the U.S. Senate" (389). Although Sagan rebounded from this blow with lucrative television and book deals, the Academy rejection says much about the precarious position of scientists willing to step forward as the face of their fields. It was not, however, as though Sagan was solely

focused on popularizing science. An online search of the NASA Astrophysics Data System reveals literally hundreds of scientific articles published by Sagan (SAO/NASA ADS). This should serve as evidence that scientific discovery and popularization are not mutually exclusive endeavors.

Not every scientist possesses the innate abilities of Sagan to communicate his or her work, but surely scientists should not operate with the fear that doing so could compromise their careers. We are now in a time when popularization is essential both to the scientists and the public. Few put it better than Sagan's wife and collaborator Anne Druyan who mused philosophically about why science should be popularized:

> We can have science without democracy. But I wonder if we can hope to have democracy without science. How can a citizen with little or no understanding of the methods, laws, and language of science hope to be an informed decision maker in a society utterly dependent on science and high technology? If science belongs only to the few, how can the many hold them accountable. . .Should science be popularized? You might as well ask: Should we have a democracy (164)?

Without a clear understanding of the importance of basic and applied research, the public's interest in directing tax dollars to this work will likely dry up. In the age of YouTube and social media, bringing science into the sphere of popular discussion has become the responsibility of selected filmmakers and media producers. With the information on the web becoming overwhelmingly visual, our collective memories seem to now be formed and molded by photography and video. Whether by accident or by design, media producers have become the keepers of much public knowledge. The critical element here, and indeed the most uncertain, is the willingness of scientists to participate and collaborate in the process.

As I mentioned earlier, many young scientists possess the creativity and desire to take their results further than their lab bench. This drive seems to be characteristic of younger scientists and I think it has to do with technology and media being such an integral part of their lives from an early age. As the democratization of technology enables people to create and disseminate information faster and easier, young scientists, often digital natives in their own right, have taken advantage of this development and used it to broaden the outreach of their own work.

This new willingness to communicate can be seen in the hundreds of independently maintained science blogs, the ongoing *ScienceOnline* conferences and, of course, the relatively young demographic that makes up our own Science and Natural History Filmmaking Program at Montana State University. Many scientists have also embraced social networking. The most prominent example is the website *ResearchGate* (www.researchgate.net) that connects over a million researchers from around the globe in a collaborative online environment similar to Facebook. This website helps to address the problems I noted earlier of compartmentalization and lack of communication among scientists of different disciplines by enabling them to "join" research groups in different subject areas.

INSPIRE, DON'T INSTRUCT

One of the fundamental differences between *Cosmos* and the science programming that predated it was its lack of didacticism. *Cosmos* did not concern itself with teaching the details of astronomy or astrophysics or how a certain result is measured. That is perhaps why it was so attractive to a general audience. Each episode of *Cosmos,* instead took the audience on a surreal journey of enlightenment with Sagan in the driver's seat. A layperson could take joy in watching *Cosmos* purely based on the stunning special effects, score, and captivating on-camera presentation by Sagan. While sailing on a schooner or weaving through European villages on a moped, Sagan would provide elegant metaphors and simple examples of how captivating our universe is. Sagan's *Cosmos* was indeed his own "personal journey," and the audience was invited simply to amble through his world, slowly digesting the nuggets of inspiration he would toss out along the way. The concept of inspiring rather than instructing is one of the most fundamental to creating useful media for and about science and it is also one of the most difficult to employ.

One of the greatest challenges in working with scientists to illuminate their research is asking them to talk about *why* it is important and *why* we should care. Scientists tend to focus far too much on information, nearly always trying to fill in the minute details they think are necessary for the audience to grasp their explanations. They also tend to think that the importance of their research is self-evident; that is, if a scientist performing research wishes to explore an idea or concept then it is by default important. Many television producers are likely bogged down by this problem when

attempting to work with scientists. Randy Olson, the noted scientist-turned-filmmaker, illuminates this idea with his own experience of working with scientists in his new profession:

> Sometimes, particularly with a mass audience, people don't want their information told to them directly...they're just going to clamp their hands over their ears until finally you figure out a more indirect pathway into their brains (67).

This reluctance to hear science "facts" could be a product of the varying modes of learning that dictate the way that different people connect with and absorb information. Sagan, it seems, found that indirect pathway into the brains of the audience by appealing to our inherent sense of wonder about our place in the Universe.

The issue is whether science filmmakers can create a sense of wonder or appreciation for a complicated problem while retaining the appropriate amount of information to keep the audience engaged. This dilemma is, of course, easier to solve when working in applied, rather than basic, sciences. Applied research, like finding a cure for cancer or developing an algal biofuel, is easier to communicate and will inspire confidence in the audience if it can be shown that the lives of citizens will be made easier, safer, healthier, or cheaper if their tax dollars are used in this way. Basic research however, that which simply advances our fundamental knowledge of the world, is more difficult to explain and defend to a skeptical public and leery legislators.

THE FACE OF TELEVISION SCIENCE AFTER CARL SAGAN

In his book, *The Demon Haunted World*, Sagan devotes a chapter to his misgivings about the fate of science on television and makes clear his worry over the potential for pseudoscience to trump factual, informative programming. His optimism for change, however, concludes the chapter as he offers potential show ideas that might help counter the nonsensical shows disguised as science programming. Among the ideas are shows that highlight "fundamental misunderstandings made by famous scientists, national leaders, and religious figures." Another show presents "regular exposes of pernicious pseudoscience" and how they "bamboozle" the public. Of all the TV show ideas presented by Sagan, only one has since come to light. He called it "Solved Mysteries," a program in which "tremulous speculations have rational resolutions" (354). We know the show as *Mythbusters*.

Mythbusters debuted on the Discovery Channel in 2003. The description on the program website (http://school.discoveryeducation.com/teachers/myth-busters/) says that

> Mythbusters uses the scientific method to prove or disprove common beliefs about physical science. Each episode explains a specific concept about the interactions between physical matter and the forces of nature that shape our world. (Discovery Education)

Though the through-line may sound dry, the show is a far cry from the *Mr. Wizard*-style of instructional science programming for kids that plagued the airwaves in the 1950s. The character/hosts of *Mythbusters*, Jamie Hyneman and Adam Savage are, indeed, not even scientists but rather special effects experts. Hyneman and Savage do not play to the stereotype of nerdy, Bill Nye-esque science geeks. Their demeanor is cool,

measured, and logical with clever and entertaining one-liners that keep the show engaging and funny.

On each show Hyneman and Savage examine a myth or commonly held popular belief. Experiments are then conducted to test the veracity of the myth by creating similar circumstances that the myth or belief claims to be true. Though they are not and do not claim to be scientists, Hyneman and Savage measure their results in a manner scientifically applicable to the experiment. One of the most effective elements of the show is the focus on *how* to design the experiments. Generally in communicating science to the public, laypeople are only privy to the facts that result from hundreds or thousands of iterations of the same tests. We know little about the actual *process* of science and scientific method used to produce "results." By illuminating the scientific method and by centering the narrative arc on the creation and execution of the experiment, the *Mythbusters* give the audience an unrivaled "scientific" experience on television.

During a panel discussion at ComicCon 2009, Adam Savage commented on how the scientific method forms the basis of their show:

> So when we say it is not science, we mean that the results are never, ever publishable...It just so happens for us that we take the scientific method seriously because that process of discovery turns out to grid beautifully on the narrative arc which I think is what every episode is about. (*Mythbusters: Science vs. Scientific Method*, Discovery Video)

Savage's sentiments echo those of Carl Sagan, who advocated for the presentation of the "wonders and methods of science" on television because of the "real human drama in the process of discovery" (354). It is clear by watching the show that, like most scientists, both Savage and Hyneman thoroughly enjoy the process of discovery.

Although their discoveries may come at the cost of mayhem, explosions, and wrecked cars, these antics inspire a true sense of wonder and interest in how the world works. Just as *Cosmos* likely spawned the careers of many scientists in the 1980s, *Mythbusters* has surely encouraged an interest in physics and engineering for many of its young viewers and stands as a solid example of a television program that has gone beyond what audiences expect in a science show.

Sagan's Heirs

While *Mythbusters* seemed to have created its own genre of science program, there are many scientists, young and old, who have picked up where Sagan left off. They emulate his mystical and curious on-camera presence and use clever analogies to wow audiences about the complexities and interrelatedness of life on earth and beyond. Of these scientists/TV personalities, Brian Cox and Michio Kaku are especially significant as both of their programs (*Sci Fi Science* and *Wonders of the Universe*) and have received acclaim, giving the hosts celebrity status. The host-driven, direct address to camera approach, albeit dated, reigns as the most common convention for serious science programming on television. The question remains as to whether this type of program truly accomplishes a better public understanding of science. This section will explore these programs that "toe the line" set by Sagan in the 1980s and offer insight into how they might be more effective in reaching a larger audience in the way that *Mythbusters* successfully accomplishes. As evidenced by the popularity of reality TV, audiences are hungry for television that is less scripted, more real, and more personal. What worked for

Sagan in the 1980s does not necessarily still work today. Our attention spans have shortened, our interest in hard science has seemingly diminished, and our TV experience is based around sharing in purported "authentic" moments with characters on the screen. Indeed, it may be argued that the fundamental reason for the popularity of programs like *American Idol* is that they allow viewers to join in the creative action and become part of a national project. Those shows still emulating *Cosmos* seem to be stuck in a model that was once successful, but may now be less effective for captivating audiences.

Wonders of the Universe

Dr. Brian Cox has all of the makings of the perfect on-screen scientist. Besides being brilliant, he is young, good looking, and was literally a rock star keyboardist with the group D:Ream before getting his Ph.D. At age 43, he still looks the part of a young hip musician dressing in hooded sweatshirts and skinny jeans and wearing a typical Euro mop-style haircut reminiscent of John Lennon. To top it off, in 2009 *People* magazine voted him one of the "Worlds Sexiest Men Alive."

So how do all of these elements combine for his television show, *Wonders of the Universe*? In a manner similar to Sagan's *Cosmos*, Cox spends each hour investigating a broad scientific question: What was the big bang? How does entropy work? What are the chemicals that make up the universe? His journey to answer these questions takes him all over the world, from Victoria Falls to the deserts of Ethiopia. Sagan used a very similar approach, most memorably when he toured the library of Alexandria in Egypt. Cox speaks softly to camera in his distinguished British accent, describing in layman's terms the intricacies of various scientific theories. Like Sagan, Cox's presentation is

almost hypnotic, demanding the viewer only sit back in wonder about how this relatively young man knows so much about the universe.

While the show provides ample opportunities to be wowed by the nature of our universe, it fails to capitalize on its young talent to connect with an audience on an emotional level. Why not talk about how Brian Cox changed from rock music to science? We need to find out *why* he cares so deeply about exploring the universe, so we can connect and empathize with his passion. Rarely do we have a science personality like Cox that could potentially appear on the pages of *Vanity Fair* and *Nature* in the same month. Cox should take his place as a science rock star, showing young people that it is possible to be cool, smart, and good looking all at once.

Sci Fi Science: Physics of the Impossible

Another example of a TV scientist who is strikingly similar to Carl Sagan is Dr. Michio Kaku. Although Kaku is trained as a theoretical physicist, he is widely known for his television work including his most recent program, *Sci Fi Science: Physics of the Impossible.* In the show Kaku explores themes from popular science fiction - light sabers, time travel, force fields - and dissects the possible or impossible physics required by these imaginary technologies. There are obvious connections here to the way the popular Discovery Channel program, *Mythbusters,* operates but more importantly, it is worth pointing out that Kaku's show carries the torch of Sagan in establishing clear boundaries between science and science fiction. In his book *Physics of the Future*, Kaku rings Sagan-esque in his musings about the importance of science for humanity:

> Science is a double-edged sword; it creates as many problems as it solves. . .There are two competing trends in the world today: one is to create a planetary civilization that is tolerant, scientific, and prosperous, but the other glorifies anarchy and ignorance that could rip the fabric of our society. We still have the same sectarian, fundamentalist, irrational passions of our ancestors, but the difference is that we now have nuclear, chemical, and biological weapons (16).

Kaku's passion and concern for the future of humanity is evident in many of his books and articles. Kaku is overtly socially and politically active, speaking out about the dangers of global warming, the lack of science education in America, and, like Sagan, against nuclear proliferation. This advocacy however, is all but absent from his TV show. It would be of much greater benefit for the audience to experience shows based on Kaku's activism rather than another exposition on how likely a meteor strike of the earth would be. Kaku and Cox have an amazing opportunity to stand on Sagan's shoulders and pick up where he left off, but the world has moved ahead in terms of what it wants in its television science. It seems that new approaches to programming are required by scientists like Kaku and Cox if we hope to move the bar forward in popularizing science.

With the remake of *Cosmos* slated to air in 2013, Neil DeGrasse Tyson, host and likely heir to the Sagan throne, will hopefully acknowledge the shifting paradigms in nonfiction television and come up with a novel approach to engage audiences with the wonders of the universe.

ALTERNATE MODES OF PROGRAMMING FOR SCIENCE COMMUNICATION

Although what Carl Sagan accomplished with *Cosmos* was extraordinary, filmmakers can no longer simply dazzle their audiences with animations and epic orchestral scores to encourage them to digest a bit of science. *Cosmos* must be appreciated in the context of its time. We now have an audience with shorter attention spans who can select from literally hundreds of channels. This audience no longer relegates the intake of media to their homes or movie theaters; they devour content, information, and entertainment on computer screens and mobile devices wherever and whenever they wish. Because of this overload of programming and information in time and space, the cream that rises to the top of the programming charts is nearly always the visceral, emotional, dramatic exposés we know as reality television. For many science programs still following the lead of *Cosmos*, the bar is simply too high to compete with the compelling fictional series and seemingly addictive reality shows that populate the airwaves.

The Nielsen Basic Cable Top 15 and Network Top 20 ratings for the week of March 12, 2012, do not include a single science program (*USA Today* – Neilsen). During this week, the most popular nonfiction programs were *American Idol*, *The Voice*, *Swamp People*, *Survivor*, and *The Amazing Race*. It seems that the fundamental problem between science and film is that science operates under a veil of objectivity, and film works best to create an emotional, subjective connection with the audience. This idea has been echoed by many science filmmakers, like Randy Olson, who would likely

agree that working past this dichotomy is paramount (182). Perhaps there is some inspiration to be gained from reality-based shows when trying to create a sense of empathy for scientists and their pursuits. Finding a character-driven narrative arc for science programming might be the fundamental step in getting audiences to care about the work of scientists.

Susan Sontag put it plainly when she wrote that in film "the notion of science as a social activity, interlocking with social and political interests, is unacknowledged" (113). A television show that recognizes that, just like everyone else, scientists work within a certain cultural framework and are subject to internal and external (societal, familial, political) pressures, would be an extremely important step in bridging the gap between scientists and the public.

Reality TV shows expand our understanding of people and aspects of society that we may not otherwise relate with on other levels. Of course, many shows like *Jersey Shore*, *The Bachelor*, and *Beverly Hills Housewives* are little more than guilty pleasures, but programs like *Muslim in America*, *The Biggest Loser, Cake Boss*, or *Swamp People* do provide an interesting cross section of America. More importantly, however, they show characters in their most intimate and vulnerable states and create a connection with the audience based on a mutual understanding of humility and self-worth. Yet, as of now, scientists are absent from this type of programming and seem to avoid it.

There is more than one way to illuminate the workings of science using the formats commonly employed by reality television. The contest-format subgenre of reality television is well established and comprises a natural arc well suited for storytelling.

Examples of such shows include *The Biggest Loser*, *Survivor*, *The Apprentice*, *The Bachelor*, and *American Idol* - all of which have developed cult-like followings and have created celebrity status (for better or worse) for otherwise unknown participants. It is possible to apply this format to create a television show that has scientists competing for funding by presenting their proposals in a public forum in which the audience votes for what they feel is the most compelling research and the most critical for the sustainability of our world. In the context of science, clearly the scientists who are the most adept at communicating the importance of their research to laypeople would rise to the top, highlighting the importance of connecting with an audience on a personal level.

Imagine a contest program in which four leading energy researchers compete for a research grant to fund a novel new approach to alternative energy. They would be judged by audience viewers based on their skills in communicating the inner workings of the technology, the importance of the research to the public, and, more broadly, on their presentation skills. Scientists and communication experts would also evaluate both the performances and the plausibility of the proposal, offering insights into the broader value of the project and how to better communicate the elements of the research. This combination of public vote and peer review would reveal that even the most promising scientific ideas might lose to those whose advocates did a better job conveying information. Those scientists with the tact, humor, personality, and passion that Sagan possessed would likely succeed. Some scientists may react to such a show idea with the retort we would expect: entertainment, emotion, drama, and laughter at the expense of

science is counterproductive and would undermine the objectivity on which it thrives. Randy Olson bucks this assumption in saying the following:

> The bottom line is that it is indeed possible - and at times even advisable - to wrap a serious message in a silly package as a means of reaching a broader audience. Just because you opt to lighten the heaviness of science communication with a little humor, it does not mean you have anything less than the utmost respect and concern for the fundamental tenet of science, which is accuracy ("Don't Bend the Facts" 30).

Applying popular modes of reality programming to science on television would not be to its detriment if done in a tasteful way that upholds the integrity of the participants. Science filmmakers have always been charged with translating science to a weary public. As in every form of documentary however, they have the ability to represent, for better or worse, their subjects in whatever manner they deem ethically appropriate. Maintaining the stereotypes of "mad" or "nerdy" scientists does little more than filming them pipetting: it simply reinforces a view that has led many people to disassociate with science. The task is to market science and scientists as something cool that will, ideally, result in young scientists that reach celebrity status beyond the Ivory Tower. It should not be impossible to have a young, attractive, well-spoken scientist reach the stardom of a professional athlete, musician, or politician

CASE STUDY: THE VENICE BEACH EXPERIMENT

As we explore new methods of communicating science on the screen, I think we need to employ themes common to much of our favorite programming: simple narratives, well-timed humor, characters overcoming personal challenges, and a broad exploration of social conflict and universal emotion. In a recent film I directed I had the opportunity to put some of these ideas in motion. I wanted to know how two NASA scientists would fare if I placed them in a public place and forced them to answer questions about their work to passersby. I constructed a booth for them on the famous Venice Beach boardwalk in Los Angeles and stenciled on the front of it "HOW DID LIFE BEGIN? ANSWERS FROM REAL SCIENTISTS." Microphones were hidden in the booth and two cameramen were positioned out of sight with zoom lenses to film both the scientist and the people who came up to them with questions.

This was very much an exercise in language. We had conducted interviews with both of the scientists in their labs prior to our experiment in Venice, but I was never quite satisfied with the material. Their answers were measured and complex, and it was clear they had plenty of time to craft their responses in anticipation of our questions. The candid situation, however, on the boardwalk was entirely different, and it revealed as much about the public as it did about the scientists. As people's initial skepticism wore off and the credentials of the scientists became clear, the barrage of questions began. What would life on other planets look like? How much do we know about the early earth? What were the conditions when life began? It was apparent from the questions that people knew more about this obscure field of study then we had expected. The

NASA scientists, however, still had to leave behind the jargon and acronyms that filled their research papers and lab conversations and translate, in real time, the importance and significance of their work. The results were entertaining and informative and I look forward to putting this particular approach to work in future science programming. I think this model could be applied to illuminate many misunderstood questions of science like global warming, ecology, or animal testing.

We cannot be sure in this experiment that the explanations given to passersby necessarily transmitted more knowledge than a formal interview, but that was never the point of the exercise. As I mentioned earlier, a scientist's goal in public communication should be to inspire his audience rather than instruct them. In the case of the Venice Beach exercise, I was more interested in staging an experiment in science communication that I had not seen before. My only goal was to create a positive interaction between the scientists and the public and I can say with confidence that we succeeded. If experiments such as the boardwalk booth could solicit as much funding and recognition as publishing a successful journal article, we might see examples of this technique in more public places, involving the public in a scientific exchange that demonstrates their tax dollars at work.

CONCLUSION

The work of the science communicator requires new strategies. Just as the public consumption of media is no longer relegated to television sets and news magazines, the production of media is not monopolized anymore by studios and networks. The democratization of media production, consumption, and dissemination is of great benefit to those concerned with increasing public appreciation of science. We now have the ability to reach far beyond the walls of the Ivory Tower to connect people with the science and technology that will undoubtedly affect their lives. We are only limited by the imaginations of media creators and the willing participation of scientists to explore new ways of bringing science back into the sphere of popular conversation. By employing the new modes of television programming, the interactivity of mobile devices, and the endless possibilities of personal media creation, we can hopefully channel Carl Sagan's vision for a society where the power of science is in the hands of the people.

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