

The Influence of Science Fiction in Healthcare Technology

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Abstract

With technological advances, the human being becomes more and more reliant on technology. We use it to work, to enhance our social experience, to learn, and healthcare, is no exception to this. We are used to hearing concepts originated on Science Fiction coming to life in areas such as spatial exploration or even communication and see how it helps those teams know what consumers were expecting for the future. However, we rarely hear about it influencing the technologies that keep us alive. Has healthcare also benefited from Science Fiction worlds to create new or enhance their technological devices? This literary and cinematic genre pushes the boundaries of what is thought "possible" by idealizing artifacts that go beyond what is conceivable in their time. It is an outlet for those who want to imagine what the future might be like, without forgetting to distinguish possible or plausible from fantasy. In this article, I will go through why it is important to look to Science Fiction as a guide when it comes to conceptualizing new ways of incorporating technology in our healthcare, as well as how it has been done before.

Keywords: Science Fiction, Healthcare, Technology, Fiction.

Introduction

Art and entertainment always reflect the society they are created in. As humans, we have always had the need to tell stories to make records of our past and present experiences, and more recently, even wonder about what our future ones might be like. Science Fiction works as a tool for storytellers to bring their ideas of the future into an entertainment format, so that the general public can explore these ideas, as well as creating their own. But what is the practical aspect of Science Fiction? Can we use it in our favour, in order to prepare for what is to come? In this paper I discuss how Science Fiction has influenced one of the most crucial features today: healthcare, exploring the possibilities of taking decisions in this field.

Science Fiction as a Genre

The term Science Fiction first appeared in a work of William Wilson's entitled *A Little Earnest Book upon a Great Old Subject* (1851). However, according to Paul K. Alkon (2002) it was forgotten, until it reappeared in 1926, in an issue of *Amazing Magazine*, a literary magazine that published short stories of this genre (*Critical Theory and Science Fiction*, Carl Freedman, 2000). In spite of that, there are some works that have been released much before that and that we refer to as Science Fiction (as it is the case of Mary Shelley's

Frankenstein (1818), *The Time Machine* by H. G. Wells (1895) and Jules Verne's *Around the World in 80 Days* (1873). In fact, some argue that the 1890s were the times when the first Science Fiction books began to appear, as is the case in *Science Fiction by Gaslight: An Introduction to English-Language Science Fiction in the Nineteenth Century* (James, 1994). Fuelled by the excitement of the approaching new millennium, James discloses, this particular era of literature was referred to "Literature of Ideas", leading the path to grouping this type of fiction - and sometimes even non-fiction - into the same category. Nonetheless, it was in the 20th century that most of the great works of Science Fiction appeared: from books such as H. G. Wells's *The First Man in the Moon* (1901), Aldous Huxley's *Brave New World* (1931) and George Orwell's *1984* (1949); to films like Georges Méliès's *A Trip to the Moon* (1902) and Byron Haskin's *The War of the Worlds* (1953). Many argue that the reason for this was the impact of the changes that the Industrial Revolution implied in people's lives. Until then, as Asimov points out in the interview *On the Thrill of Lifelong Learning, Science vs. Religion, and the Role of Science Fiction in Advancing Society* (Maria Popova, 1988), life had been pretty much the same, however with the introduction of the steam engine, society was to be changed permanently. As technology started evolving, each day more rapidly, works of Science Fiction started to emerge as a way of coping with evolution and the "rapid urbanization that was a claustrophobic result of better transportation" (Alkon, 2002). As people started realizing that the future would look very differently than the present, and that they might not live to see some of the most outlandish inventions, they began imagining what they could be. Georges Méliès's *A Trip to the Moon* (1902) marked the beginning of the timeline of Science Fiction films, as claimed by Schmitz et. al in *A Survey of Human-Computer Interaction Design in Science Fiction Movies* (2008). In the same article, the authors affirm that there were two tendencies for Science Fiction films: the ones that presented future technology as neat "error free", and the ones who addressed their possible "flaws and drawbacks". They also explain that, on the first stages of this genre, films did not really portray visions about the future, but technologies that already existed, in a futuristic context. According to *Influence of science fiction films on the development of biomedical instrumentation* (Boutillette et al. 1999), there was a fascination with special effects and interest about the future, which together with their vision, ended up being a stimulation for filmmakers to produce more within this genre.

It is important to address that the point of Science Fiction is not to be scientifically accurate, but to wonder about where progress might take us. It does, as Dani Cavallero explains in *Cyberpunk and Cyberculture: Science Fiction and the Work of William Gibson* (2000), purposefully resemble a scientific discourse in order to

be more “realistic” (if we can call it that) and believable as a possible future, but never trying to make the reader or spectator believe that those are possible in the present of will be in the near future. Jules Verne even critiques H. G. Wells says that his work is further away from reality than his own. The French author comments “I go to the moon in a cannonball, discharged from a cannon. Here is no invention. He goes to Mars in an airship, which he constructs of a metal which does away the law of gravitation” (*Shooting for the Moon: Méliès, Verne, Weils, and the Imperial Satire*, Sandner, 1998), showing a preoccupation with keeping their works seemingly plausible.

The thrill of consuming Science Fiction is often not to paint a picture of our future *per se*, so much as it is envisioning our reactions towards the scenarios that are presented to the characters. As Sherryll Vint clarifies in *Bodies of Tomorrow* (2007), “Although set in the future or elsewhere, Science Fiction is commonly understood to be about the moment contemporary to its production and the anxieties and anticipations that form that moment”, meaning that it serves as a means to explore those “anxieties and anticipations” as well as either finding ways to prevent the root of those fears, or else delve into the consequences of them becoming true - even if only in the fictional realm.

Science Fiction as a Starting Point

For this reason, it is not that odd to expect that some of the objects that were imagined in Science Fiction works would emerge in real life. In fact, in *Writing the future: Computers in science fiction* (Vos Post and Kroeker, 2000) they claim that “many science fiction authors have envisioned the future as accurately as historians have chronicles the past.” After all, they are often exploring future scenarios through logical thinking, which make them, presumably, plausible. Vos Post and Kroeker even claim that these authors have counted “countless technologies in the virtual environments of their fiction” (2002). Alkon claims, imagination does not unfold on its own, it always has some starting point in day-to-day life and some of those are common between writers and artists as well as scientists and inventors, especially in a time where, for the first time in history, change and novelty were constant. The only difference between these two groups of people, is that the first was wondering about what the future would look like, while the others were actively working on projects now that would get us to those futures. That dreaming reflected on Science Fiction, without prejudices or judgement, ends up being exactly what makes it such an interesting thing to look upon when developing technology today: some of what we are building now was already been thought about by visionaries of the past, but tossed aside for it was not possible to build then.

In *A Survey of Human-Computer Interaction Design in Science Fiction Movies* (2008), Schmitz et al. talk about some technologies portrayed in films that resemble ones that appeared later in reality. In *Logan’s Run* (1976), there are implants inserted into children’s

hands in order to track their lives. These resemble RFIDs, that were already in use at the time of writing of this article for “storing or pointing out at your medical record”, besides resembling more recent technologies used today to track our heartbeat or the path we took on our run. In *Gattaca* (1997), they use a drop of blood to analyse DNA, that does the procedure in real-time, much like the devices we have today for blood analysis, that give us the results almost instantly. In the same film, we also have mentioning of genetic alteration of children, which we can perform today, at some level, as Fielder, John discusses in *Issues in Ethics: the ethics of creating designer children* (2003). Boutillette et al., in *Influence of science fiction films on the development of biomedical instrumentation* (1999), also comment on some medical technology that we use today that seem to have some resemblance to appearances in previous Science Fiction works. They begin by talking about how, in the Mary Shelley’s *Frankenstein* 1931 film adaptation, Victor used what the authors of the article call “a huge electrical device (powered by lightning from an electrical storm)” to perform a process very similar to defibrillation, which was first introduced in medicine in 1947. In *Alien 3* (1992) there is an ultrasound device that produces 3D images, which nowadays is pretty common to follow the development of a pregnancy, among other uses. Another technology the authors mention is the artificial skin represented in *Star Trek: First Contact* (1996), affirming that it is a “fairly recent product on our medical market, used to help burn victims” (Boutillette et al., 1999).

So, could healthcare also benefit from Science Fiction worlds to create new or enhance their technological devices? In *Towards and Agenda for Sci-Fi Inspired HCI Research* (2016), where Mubin describes a study where scientists were watching Science Fiction films and analysing them through their scientific knowledge, the author discloses that they were also, subconsciously, wondering about their viability in outside of the screen. By freeing oneself from the concept of what is possible at the time, some remarkable ideas can arise that would not have otherwise. Ultimately, through scientific means such as research and experimentation, these ideas might become objects of the real world. It might be useful to bring together the ideas of writers and visionaries that have elaborate ideas of what is to come with the practical minds of scientists and engineers to design our future.

However, as said before, the idealization of a future world through Science Fiction does not only concern physical objects, but also the implications that it has on a social, economic, environmental and even legal level, among others. Storytelling has always been an important part of the human experience. Most of what we know from the generations that came before us come from storytelling: from the rupestrian paintings of the caveman, to the grandiose works of Homer. We have told stories about who we are, about what happened to us and even about things that we can only imagine happening. In order to use Science Fiction as a tool to help developers, the stories must be about the future.

By using methodologies such as Design Fiction, it is possible to play through a hypothetical situation in which a developing object is the centre element and foresee things such as problems with user experience, design details, the impact of that object being introduced in society, among others. Such exercise can be a helpful tool not only to make the developing process, but also to save resources and reduce costs, as it is supposed to be performed before the first physical prototype is built. Kirby illustrates this in *The future is now: Diegetic prototypes and the role of popular films in generating real-world technological development* (2010), giving the example of *Threshold* (1981), which narrates the story of the first artificial heart implant, exploring the question surrounding the differences between man and machine. By portraying the character who gets the artificial heart in a truly humanizing way, the film helps introduce the idea that person does not give up their human nature when replacing a part of their body for a metal counterpart. It was also crucial, at the time, that there ceased to have an aversion to the merging of flesh and metal, as we were at the edge of this exact science breakthrough, for the first artificial heart actually appeared in the following year of the release of this film, in 1982.

As I have said before, there are multiple methodologies that aim to use Science Fiction as a tool to help developers and their teams. Design Fiction, a term coined by Bruce Sterling (Eva Knutz, 2014), is one of these methodologies and consists of the creation of “what if” scenarios in the future in which the diegetic prototype (the name given to the objects conceptualized in Design Fiction) is placed. These scenarios, that might be drawn directly from Science Fiction or totally original, have the objective of helping understand what kind of challenges (technical, social, ethical) might be presented during an interaction of the object we are creating. Design Fiction is a research method, as Joseph Lindley claims in *A Pragmatics Framework for Design Fiction* (2016), which means that this process is supposed to be carried out before the actual building of the physical prototype.

We also have another methodology that has an even more direct relationship to the genre, which is Science Fiction Prototyping. In *The Role of Context in Science Fiction Prototyping* (2014), Potstada and Zyburá explain that this methodology aims to help designing for the future. By creating a short narrative within the realm of Science Fiction, where their depiction of what the future will look like is a key-element, the developers will be able to foresee some of the “benefits and pitfalls before they actually occur” (Potstada and Zyburá, 2014). The main goal of these types of methodology is not only to speed up the process, but also to make the process less expensive, time-consuming and high on resources. It is also possible, by understanding the context there will be in the future, to draw out new business models and other techniques as a response to issues that were not yet presented to us.

There are two key aspects to bear in mind when considering Science Fiction as a method of exploring plausible futures. On one hand, that what is portrayed

in Science Fiction works is not totally applicable to reality, which means that one has to have an understanding of the evolution that technology will have from the point of creating the narrative to the time when it takes place. On the other hand, according to *Lab Coats in Hollywood: Science, Scientists, and Cinema* (Kirby, 2011), the point of these narratives, especially when it comes to cinema, is not really their plausibility per se, but the impact that that possibility will have on how the public perceives the represented technologies. Among all the narrative techniques that are used to create these future scenarios, we must include cinema. Besides being a more visual means of portraying a scenario, it can also be used as a tool to understand, and perhaps even mould, public opinion in regards to what is being discussed in a certain film, as well as one that allows “science consultants to represent systems and phenomena with a very sophisticated visualizing technology” (*Lab Coats in Hollywood: Science, Scientists, and Cinema*, Kirby, 2011). As Kirby affirms in *The Future Is Now: Diegetic prototypes and the role of popular films in generating real-world technological development* (2010) “Movies can show audiences how a new technology works, why it is safe and why they needed it.” Science Fiction films with this intent often have certain objects in the centre of the scene, or else the discussion of said object or of the problems that surround it (whether because it causes them or because it solves them). Kirby also states that there is an “avoidance of scenes that would undermine the technology or cast it aside as risky”, although, as we have seen before, this is not true when it comes to storylines exploring the flaws of future technology. By creating a fictional account of events, especially one that is to be seen by the mainstream consumer, one has to face questions that it might not have otherwise, especially when it comes to the external aspect of the objects and the aesthetics of the future world depicted.

Science Fiction and Healthcare Technology

In *The Future Is Now: Diegetic prototypes and the role of popular films in generating real-world technological development* (2010), Kirby explains that there three main aspects that the film *Threshold* (1981) was trying to establish: “(1) the necessity of this technology; (2) the normalcy of a person who receives the artificial heart and (3) the heart’s viability. (...) *Threshold* that overtly addresses these three concerns.” These issues were related to the fears that the public had at the time regarding these kinds of technology and Kirby tells us that one of the goals of the film was to reduce those anxieties and instead incite the desire for these technologies to become a reality. To help make these three goals as scientifically plausible as possible, *Threshold* (1981), according to *The Future Is Now: Diegetic prototypes and the role of popular films in generating real-world technological development* (2010), had 11 doctor in the team, including one of the main researchers on artificial hearts.

It is quite common now for films to have experts in their teams to help make the narrative more believable as a scientific possibility, and according to Kirby in *Lab Coats in Hollywood: Science, Scientists, and Cinema*, (2011), scientists think that some of the issues that are being portrayed are so important that “it justifies calling attention to these issues by any means necessary.” This is especially true when it comes to what Kirby calls “disaster movies”, that is, productions depicting a, many times plausible, dystopian future. This is the case of films like *Outbreak* (1995), where a new virus appears to take the world by surprise. Kirby discloses that “Historically, public health and environmental issues are the two primary science-based social concerns for which cinematic cautionary tales were made with scientists’ help” in the first half of the twentieth century. This is because these are two main global concerns in our day and age, and the experts, as stated by Kirby, believe that by exposing the audiences to possible future disaster scenarios, they will create more awareness and impel action in the public. These films are sometimes so realistic, in fact, that in *Lab Coats in Hollywood: Science, Scientists, and Cinema* (Kirby, 2011) is affirmed that when the Ebola outbreak happened in Zaire in 1995, news media actually used footage from *Outbreak* (1995) in their coverage of the event.

However, despite medical experts having been involved with the production of Science Fiction for some time now, it still is rather difficult to find articles that speak about the influence of the genre in science and technology when it comes to healthcare. By looking at *A Meta-Study and Content Analysis of Science Fiction in Computer Research* (2019), where Philip Jordan analyses thousands of scientific articles with the intent of identifying which of them refer to Science Fiction, one can understand how very few are related to healthcare in comparison to other areas, such as space exploration. However, there already are some methodologies out there being created in order to use Science Fiction as a tool in order to make more informed decisions during technological development, as is the case of Design Fiction and Science Fiction Prototyping. These methodologies use the creation of a plausible future scenario to explore the interaction of future objects - creating what is called a Diegetic Prototype - and identify possible flaws it might have. The appearance of this kind of methodologies ends up being quite important to the influence of this genre in science and technology, as it helps distinguish between objects inspired by Science Fiction and ones that simply coincide to what has been described in the genre. One of the areas of healthcare that has supposedly gained the most from the application from Science Fiction works to reality has been surgery. Hockstein et al. comment in *A History of Robots: from science fiction to surgical robotics* (2007) “While robots are commonly employed in the healthcare laboratory setting, they have been more slowly integrated into clinical medicine.” The authors also give the examples of two of those robots, used by surgeons to execute their functions with more precision or reach places that would be very difficult to access with traditional

techniques. One example of one of these robots, that Hockstein et al. also mention is DaVinci, which we can see in figure 1. When we go to the realms of micro robotics, discussed by Rachel Courtland in *Microbots on a Fantastic Voyage* (2015), we can operate with even greater accuracy and in smaller scales, enabling earlier diagnosis and more precise targeting therapies, as Courtland claims. In this article, we can also read a comment from a worker of the Physical Intelligence Department of the Max Planck Institute for intelligent Systems, in Germany, saying that their “biggest impact will be in healthcare.”



Figure 1 – Retrieved from *A History of Robots: from science fiction to surgical robotics* (Hockstein et al., 2007)

When the Plot Becomes Real

As we have seen before, one of the goals of writers of Science Fiction is to understand the threats that the future holds and imagine how we would react to certain situations if they were to happen. Moreover, the purpose of using methodologies such as Design Fiction is to think ahead of our present situation, devising ways to deal with possible future threats. The situation that we are presently (April 2020) going through is one that was not unexpected at all, one might say. The COVID-19 outbreak that started in China in December of 2019 and had spread all around the world by March of 2020 is not that different from those we have heard in works like *La Peste* by Albert Camus (1947) or the already mentioned film *Outbreak* (1996), but was also mentioned in the Netflix documentary *Explain: the next pandemic*, released as close as November of 2019. So let us look into the similarities between these Science Fiction works and the COVID-19 crisis.

Hanna Mamzer actually comments on the similarities between *La Peste* and the crisis we are currently living in her article *Postmodern Society and COVID-19 Pandemic: Old, New and Scary* (2020), commenting that by looking at works as these one, we can seek guidance of how to act in such a situation. She starts by stating that, in *La Peste*, as in reality, there was a lack of preparation for an event like this one, and the issues regarding the denial of the adequate sense of urgency. The same can be witnessed in *Outbreak*, where we see figures of power refusing to go into a state of emergency, and, of course, as it happened in various countries in the beginning of the COVID-19 crisis. Mamzer continues, referring to the lack of a vaccine and the requirement of people to stay inside

their homes, central issues in *Outbreak*, as well as in real-life. And as in *Outbreak* some people insisted on trying to avoid the rules, the same happened in countries Italy and Portugal, at least in the beginning of the crisis. The author of *Postmodern Society and COVID-19 Pandemic* even observes that, as people stop being able to speak in person in *La Peste*, they overflowed telephone lines - in our case, mostly video call platforms - while remarking how “astonishingly different” the empty streets looked. Other aspects of *Outbreak* that we can also link to the COVID-19 pandemic is the fact that the virus evolved from a wild animal, and that it has mutated since it was first recognised. Besides, like in the film, this new disease has flu-like symptoms and caused the hospitals to be more crowded than they should be, as well as the unusual images of the military in the streets.

In *Lab coats in Hollywood: science, scientists, and cinema* (2011), Kirby comments regarding *Outbreak* that “Jahrling, Francis, and Morens, medical consultants, clearly felt that their advice kept *Outbreak* enough within the ring of truth for the film to be used as an effective public relations device.” The COVID-19 crisis that we are presently going through might be a prime example of how Science Fiction, together with experts, can help us prepare for possible future scenarios in the most informed way possible, and most importantly, ahead of time.

Conclusion

Throughout history we have seen the imaginable and the unimaginable become true. We have watched the man fly, set foot on the moon, reach some of the deepest parts of the sea. But above all, we have seen Man evolve, thanks to modern medicine, to live twice the time He used to some centuries ago. There still are a lot of stigmas and prejudices surrounding Science Fiction as a genre. However, it is crucial to understand that the works are not meant as an act of divination, but as an exercise to think ahead of our time and be more prepared for what might come. One must be aware that they do not depict a reality, but a plausible version of it, and the key to take advantage of this genre lies in the capability to adapt objects and actions portrayed in these films (or that would have solved the issue presented on them) to real problems. Science Fiction may help us surpass exceptional new frontiers in healthcare if we only give it a chance to.

Bibliography

- Alkon, Paul K. 2002. *Science Fiction Before 1900*. New York: Routledge.
- Anderson, Michael. 1976. *Logan's Run*. USA. <https://www.imdb.com/title/tt0074812/>.
- Boutillette, Michael, Christopher Coveney, Stevan Kun, and Laura J. Menides. 1999. “Influence of Science Fiction Films on the Development of Biomedical Instrumentation.” *Bioengineering, Proceedings of the Northeast Conference*, no. July: 143–44. <https://doi.org/10.1109/nbec.1999.755802>.
- Camus, Albert. 1947. *La Peste*. Gallimard.

Cavallero, Dani. 2000. *Cyberpunk and Cyberculture: Science Fiction and the Work of William Gibson*. London: The Athlone Press.

Courtland, Rachel. 2015. “Microbots on a Fantastic Voyage.” *IEEE Spectrum* 52 (6): 70–74. <https://doi.org/10.1109/MSPEC.2015.7115573>.

Explain: The Next Pandemic. 2019. Netflix.

Fincher, David. 1992. *Alien 3*. 20th Century Fox.

Frakes, Jonathan. 1996. *Star Trek: First Contact*. Paramount Pictures.

Freedman, Carl. 2000. *Critical Theory and Science Fiction*.

MiddleTown: Wesleyan University Press. https://books.google.pt/books?id=2YJyxDzv5EoC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false.

Gernsback, Hugo. 1926. “Amazing Stories,” 1926. <https://archive.org/details/AmazingStoriesVolume01Number07>.

Grand, Simon, and Martin Wiedmer. 2010. “Design Fiction: A Method Toolbox for Design Research in a Complex World.” *Applied Sciences*. <http://www.designresearchsociety.org/docsprocs/DRS2010/PDF/047.pdf>.

Hockstein, N. G., C. G. Gourin, R. A. Faust, and D. J. Terris. 2007. “A History of Robots: From Science Fiction to Surgical Robotics.” *Journal of Robotic Surgery* 1 (2): 113–18. <https://doi.org/10.1007/s11701-007-0021-2>.

Huxley, Aldous. 1932. *Brave New World*. Chatto & Windus

James, Edward. 1994. “Science Fiction by Gaslight: An Introduction to English-Language Science Fiction in the Nineteenth Century.” In *Science Fiction in the Twentieth Century*. Oxford University Press.

Jordan, Phillip. 2019. “A Meta-Study and Content Analysis of Science Fiction in Computer Science Research.” *Journal of Chemical Information and Modeling*. University of Hawaii.

Kirby, David. 2010. “The Future Is Now: Diegetic Prototypes and the Role of Popular Films in Generating Real-World Technological Development.” *Social Studies of Science* 40 (1): 41–70. <https://doi.org/10.1177/0306312709338325>.

Kirby, David A. 2011. *Lab Coats in Hollywood: Science, Scientists, and Cinema*. MIT Press.

Kirby, David A. (David Allen). 2011. *Lab Coats in Hollywood: Science, Scientists, and Cinema*. Cambridge, Massachusetts: MIT Press.

Knutz, Eva, Thomas Markussen, and Poul Rind Christensen. 2014. “The Role of Fiction in Experiments within Design, Art & Architecture.” *Artifact* 3 (2): 8. <https://doi.org/10.14434/artifact.v3i2.4045>.

Lindley, Joseph. 2016. “A Pragmatics Framework for Design Fiction,” no. 2013. <https://doi.org/10.7190/ead/2015/69>.

Mamzer, Hanna. 2020. “Postmodern Society and COVID-19 Pandemic: Old, New and Scary.” *Society Register* 4 (2): 7–18. <https://doi.org/10.14746/sr.2020.4.2.01>.

Méliès, Georges. 1902. *Le Voyage Dans La Lune*. Star Film Company. <https://www.imdb.com/title/tt0000417/>.

Mubin, Omar, Mohammad Obaid, Philipp Jordan, Patricia Alves-Oliveria, Thommy Eriksson, Wolmet Barendregt, Daniel Sjolte, Morten Fjeld, Simeon Simoff, and Mark Billingham. 2016. “Towards an Agenda for Sci-Fi Inspired HCI Research.” *ACM International Conference Proceeding Series*, no. October 2017. <https://doi.org/10.1145/3001773.3001786>.

- Niccol, Andrew. 1997. *Gattaca*. Columbia Pictures. <https://www.imdb.com/title/tt0119177/>.
- Orwell, George. 1949. *1984*. London: Secker & Warburg.
- Owens-Liston, Peta. 2012. "The First Artificial Heart, 30 Years Later | University of Utah Health." December 2, 2012. <https://healthcare.utah.edu/healthfeed/postings/2012/12/120212ArtificialHeart30YearsLater.php>.
- Pearce, Richard. 1981. *Threshold*. Canada.
- Petersen, Wolfgang. 1995. *Outbreak*. Warner Bros.
- Popova, Maria. 1988. "On the Thrill of Lifelong Learning, Science vs. Religion, and the Role of Science Fiction in Advancing Society." *Brainpickings.Com*, 1988. <https://app.getpocket.com/read/711816000>.
- Potstada, Michael, and Jan Zyburka. 2014. "The Role of Context in Science Fiction Prototyping: The Digital Industrial Revolution." *Technological Forecasting and Social Change* 84: 101–14. <https://doi.org/10.1016/j.techfore.2013.08.026>.
- Sandeer, David. 1998. "Shooting for the Moon: Méliès, Verne, Weils, and the Imperial Satire." *Extrapolation* 39 (1): 5–25. <https://doi.org/10.3828/extr.1998.39.1.5>.
- Schmitz, Michael, Christoph Endres, and Andreas Butz. 2008. "A Survey of Human-Computer Interaction Design in Science Fiction Movies." *INTETAIN 2008 - 2nd International Conference on INtelligent TEchnologies for Interactive EnterTAINment*.
- Shelley, Mary. 1818. *Frankenstein*. Lackington, Hughes, Harding, Mavor & Jones.
- Stead, Michael, Paul Coulton, and Joseph Lindley. 2018. "Dolt-Yourself Medical Devices: Exploring Their Potential Futures through Design Fiction." *DRS2018: Catalyst* 6. <https://doi.org/10.21606/drs.2018.475>.
- Verne, Jules. 1873. *Le Tour Du Monde En Quatre-Vingts Jours*. Pierre-Jules Hetzel.
- Vint, Sherryl. 2016. *Bodies of Tomorrow. Bodies of Tomorrow*. University of Toronto Press. <https://doi.org/10.3138/9781442684072>.
- Vos Post, Jonathan, and Kirk L. Kroeker. 2000. "Writing the Future: Computers in Science Fiction." *Computer* 33 (1): 29–37. <https://doi.org/10.1109/2.816266>.
- Wells, H. G. 1901. *The First Man in the Moon*. George Newnes.
- Wells, H.G. 1895. "The Time Machine H.G. Wells." William Heinemann. 1895. https://www.goodreads.com/book/show/2493.The_Time_Machine.
- Whale, James. 1931. *Frankenstein*. Universal Pictures.