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Cover Art:
Ryan Andrade, "Post Apocalyptic Classroom" (2016)

Articles:
Evil Doctor, Ethical Android: The Instantiation of Conscience through Subroutines in Star Trek
By Victor Grech, Mariella Scerri, and David Zammit.

Riding the Wave: Science Fiction Media Fandom and Informal Science Education
By Moira O'Keeffe.

A Comparison of Dystopian Nightmares and Utopian Dreams: Two Paths in Science Fiction Literature That Both Lead to Humanity's Loss of Empathy
By Alisha G. Scott.

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Table of Contents

JOURNAL OF SCIENCE FICTION
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Letter from the Editor

As 2017 begins, we thank you, our readers, for making our journal a huge success! When we released the first issue of the *MOSF Journal of Science Fiction* (MJOSF) in January 2016, we had no idea it would garner such interest. We're already lining up content for Volume 2, Issue 1 for release in a few months. On the editorial side, we've significantly expanded our team to better accommodate the editing workload—check out the masthead and the "About the Contributors" section for this issue to learn more about our new team members.

Our expanded editorial team has allowed us to focus on building out our journal a bit more, and in this issue, you'll see that we've introduced a new section for book reviews. Because cover art for our issues is frequently excerpted from a larger piece of art, we've also decided to include the full, uncropped cover art image inside each journal issue.

In this issue of MJOSF, Victor Grech, Mariella Scerelli, and David Zammit argue for the importance of installing ethical subroutines in androids through an examination of the artificial intelligences Data and the Emergency Medical Hologram in *Star Trek: The Next Generation* and *Star Trek Voyager*. Moira O'Keeffe brings us to the present, examining trends of using "real science of" media tie-ins as a method of science education. In her article comparing dystopias and utopias, Alisha Scott examines how both futuristic visions frequently feature erode human empathy, which can lead to the downfall of human society.

Our editorial team also has some exciting news for you: in response to the overwhelming support for our Journal of Science Fiction, the Museum of Science Fiction will be producing its first take-home exhibit: a new science fiction anthology! Hand-selected by the MJOSF team and the Museum's editors, curators, and librarians, this take-home exhibit anthology will include a selection of original and reprinted fiction from both award-winning authors and new writers. The exhibit—*Catalysts, Explorers & Secret Keepers*—will feature short science fiction works by and about the women of the genre, showcasing how they—both as authors and as characters—have engaged with and influenced science fiction for more than a century.

By reprinting rare and timeless classic stories, presenting cutting-edge original fiction by leading writers, and highlighting emerging authors who demonstrate the continuing evolution of the genre, we will celebrate how writers shape science fiction's evolution with each new day. The Kickstarter campaign to fund C*atalysts, Explorers & Secret Keepers* was wildly successful, and the project editors are hard at work sifting through the original fiction submissions they received. Campaign backers will receive their copies of the anthology by early fall 2017!

We look forward to sharing MJOSF Volume 2, Issue 1 with you in a few months. Please continue to send us your feedback, questions, and submissions! My thanks, as always, to the skilled authors, reviewers, artists, and editorial staff who have contributed to the journal, and may you all have a happy new year!

— Monica Louzon, MLS
Managing Editor, *MOSF Journal of Science Fiction*

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Cover Art

"Post Apocalyptic Classroom" by Ryan Andrade (2016).

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Reflecting on Science Fiction

For this issue of the *Journal of Science Fiction*, we reached out to a variety of science fiction authors and scholars and asked them, *"What has science fiction taught you about yourself?"*

I'd always been raised to believe that girls could do anything, but it was through the lens of science fiction that I was able to see that represented on-screen for the first time. I remember watching *Stargate SG-1* when I was twelve years old and being in awe of Sam Carter – a character who was not only a super-tough Air Force Captain, but also an astrophysicist. In non-genre fiction, it's so unusual to see female characters who are multilayered like that; they can be tough or smart or sexy, but rarely all of those things at the same time. Sam Carter was all of that and more, a true representation of what women can accomplish in the world (or, in her case, a multitude of worlds).

Since then, I've sought out and devoured science fiction with complex female characters in all different media. There seems to be something about the futuristic fantasy of sci-fi that allows consumers of media to accept that women can be soldiers, leaders, and innovators. Behind the sheen of "space marine" or "galactic leader," suddenly a countless number of possibilities for women become conceivable. Of course, we already know that Ripleys and Black Widows and Reys exist everywhere in our own lives; but seeing that in the pages of books, on our television screens, in our theaters—the importance of that cannot be understated. It changes lives.

—Sam Maggs
Author
Assistant Writer, Bioware

Science Fiction has taught me to connect to other people's stories in a way that I could not have done just by reading a story set within our world.

The distance that science fiction gives and the excitement of an adventure helps to draw people in a very unique way.

—Hope Nicholson
Editor
Publisher, Bedside Press

Reflecting on Science Fiction, *continued*

Science Fiction has taught me to connect to other people's stories in a way that I could not have done just by reading a story set within our world. The distance that science fiction gives and the excitement of an adventure helps to draw people in a very unique way.

Like most academic critics, I tend to think of science fiction as a genre that speaks to large, historical issues: stories of utopian and dystopian possibilities, or stories that show us our own world in transfigured, yet revealing, form. So it's an interesting challenge to ask what science fiction has taught me about myself. A couple of lessons spring to mind.

Firstly, science fiction taught me that I wasn't who I thought I was. You might superficially have characterized the teenage me as naively technophilic: a regular consumer of *Omni* magazine, an occasional reader of *Sky and Telescope*, and, as far as anyone could tell, planning to use excellent science grades to enter a degree in astrophysics. And yet… the science fiction I read and watched and enjoyed told different stories: Kurt Vonnegut's *Galápagos*; the movies *Soylent Green* and *Logan's Run*; even the BBC's B*lake's Seven* (with its famously downbeat ending, and Thatcherite villainess). Perhaps it was no surprise that I turned in time to the humanities, and then an English Literature degree.

Science fiction also – albeit indirectly – taught me how Scottish I was. This fact hadn't escaped my notice, but I didn't really appreciate how Scottishness was part of my identity. For many years, as an undergraduate student of English Literature, I read almost no science fiction, but I did read a great deal of Scottish Literature. I went off science fiction, I think, because I didn't seem to be in it. There was James Doohan's faux Scottish accent in *Star Trek,* but apart from that I (as a Scot) was rarely seen, or heard. I only came back to serious engagement with science fiction when, for an encyclopaedia article, I read everything Iain (M.) Banks had written, and came across a writer who had managed to mix Scottishness and futurity. Happily, we now have many more of them.

—Dr. Gavin Miller
Senior Lecturer in Medical Humanities
School of Critical Studies, University of Glasgow

Reflecting on Science Fiction, *continued*

Growing up as the daughter of scientists (a neurobiologist and a molecular biologist), science was almost like a sibling to me. Science was always there, a constant companion and the dominant conversation at the dinner table. I understood from a very young age that Science was to look at the world and to try to know it and understand it. Science Fiction was to look at the world to dream about it.

When I think about the first time that I thought about the stars, it strikes me that it's around the same time that I began to think about stories. Why were they up there? I thought that someone had put them in the sky and I wanted to know who they were and why? That was the first dream. That was the first story I wanted to be told to me. Or that I would end up having to tell myself. That was made up, but it was rooted in the real. I liked that.

When I thought about work as a child, I thought about labs. And experiments. And imagining what could come next. About unlocking mysteries and dreaming up a hypothesis and finding answers that lead to more questions. And it strikes me that it's much the way I approach art now. To make art is to dream.

Science Fiction taught me to dream of the unknown. To tell a stories of the impossible, or the impossible right now. To travel further than I know and beyond what had ever been seen. To consider the best of humankind and to worry about the worst of it. Science Fiction has taught me to be empathetic and kind and also how to be a monster. Because that is what it takes to tell a story, the ability to push ideas to their most beautiful and to their most horrible.

—Cecil Castellucci
Author

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Evil Doctor, Ethical Android: *Star Trek*'s Instantiation of Consciousness in Subroutines

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Abstract

Machine intelligence, whether it constitutes Strong Artificial Intelligence (AI) or Weak AI, may have varying degrees of independence. Both Strong and Weak AI are often depicted as being programmed with safeguards that prevent harm to humanity, precepts which are informed by Isaac Asimov's Laws of Robotics. This paper will review these programs through a reading of instances of machine intelligence in *Star Trek*, and will attempt to show that these "ethical subroutines" may well be vital to our continued existence, irrespective of whether machine intelligences constitute Strong or Weak AI. In effect, this paper will analyse the machine analogues of conscience in several *Star Trek* series, and will do so through an analysis of the android Data and the Emergency Medical Hologram. We will argue that AI should be treated with caution, lest we create powerful intelligences that may not only ignore us but also find us threatening, with unknown and inconceivable consequences.

Keywords: *artificial intelligence,* Star Trek*, subroutines, moral agency, ethics, philosophy*

Over the past half century, the relationship of philosophers with Artificial Intelligence (AI) has been mixed, ranging from enthusiastic advocacy to reluctance to accept optimistic scenarios prophesied by those who believe a strongly-developed AI will emerge in the near future. There are two major ways to consider the current utilization and power of artificial intelligence. The Weak AI hypothesis states that a machine running a program is, at most, only capable of simulating real human behaviour and consciousness (Russell and Norvig, 2003). Artificial intelligence such as that currently used in medical diagnosis and other, more mundane, interventions are examples of Weak AI, since these machines focus on one narrow task. Weak AI justifies the claims made by scientists that a running AI program is, at most, a simulation of a cognitive process but is not itself a cognitive process. Strong AI, on the other hand, purports that a (yet to be written) program running on a (yet to be designed) machine is actually a mind—that there is no essential difference between a piece of software emulating a human brain's processes and actions and the consciousness and actions of a human being. Computer scientist Ray Kurzweil is a proponent of Strong AI, or the view that an appropriately programmed computer is a mind. Kurzweil (2005) predicted that the equivalent capacity of a human brain will be available on desktop computers by 2020, arguing that when machine intelligence begins to outstrip the collective total of all human intelligence, humanity will have entered the Singularity, the point beyond which predictions become impossible. John Searle (1980), an opponent of Strong AI, raised reasonable arguments that include the belief that

an artificial life cannot successfully evolve into a life form. Nonetheless, even if artificial life is merely a computer modeling technique that sheds light on living systems, there still are a number of significant ethical implications that need to be addressed. Navigating the rapidly shifting landscape of computing technology of humanity's ethical and belief systems has long been the purview of the field of computer ethics. As technology accomplishes more complex tasks, the need for moral capacities to decide about moral matters and to distinguish right from wrong arises.

Philosophers of cognitive science opine that sooner or later the concept of ethical agents will expand to include the artificial moral agents (AMAs). AMAs are part of the ethics of artificial intelligence concerned with the moral behaviour of artificial intelligent beings (Moore, 2006).

This concept of AMA was first promulgated and popularized by Isaac Asimov's "Three Laws of Robotics," which were formalised in his short story "Runaround" (1942), and effectively constitute a moral compass, an artificial conscience preventing a machine from harming humans (Anderson, 2008, p. 480). These laws also prefigure the concept of harm through inaction, as emphasised by Wallach and Allen, who argue that "[m]oral agents monitor and regulate their behaviour in light of the harms their actions may cause or the duties they may neglect" (Wallach and Allen, 2008, p. 16). Similar to humans, an AMA will be able to make judgments based on the notion of right and wrong and be held accountable for those actions.

Based on the ethical and moral considerations set forth by Asimov, this paper will analyse the machine analogues of conscience in *Star Trek* as represented by the characters Data, an android in *Star Trek: The Next Generation* (TNG; 1987–1994) and the Emergency Medical Hologram, a transitory artificial lifeform in *Star Trek: Voyager* (STV; 1995–2001). These two individuals will be introduced, summarised, and their artificial moral agency will be displayed through an analysis of their behaviour when faced with ethical dilemmas. A discussion on moral agency with reference to *Star Trek: The Original Series* (STOS; 1966–1969) and other *Star Trek* episodes will follow while the paper will also try to argue the relevance of Machine Ethics in today's world.

Ethical subroutines in Data and the Emergency Medical Hologram

Ethical subroutines in *Star Trek* are a programmatic method that describes the characteristics by which artificial life forms, such as Data and holograms like the Emergency Medical Hologram Doctor, determined what was ethically right and wrong. Data is an android, the Second Officer of the starship *USS Enterprise D*; he appears in *Star Trek: The Next Generation*, the second incarnation of the franchise, which ran almost two decades after *Star Trek: The Original Series*. Data is a "superficial functional isomorph" of humanity (Block, 2002, p. 399), with an outwardly human physical appearance and a "positronic" brain, an intertextual reference to Asimov's robots. Despite an arguably unwarranted anthropocentric desire to become human (Grech, 2012), Data is physically and mentally superior to mere humananity; Data's upper spinal support is a polyalloy designed to withstand extreme stress. He is also built with an ultimate storage capacity of eight hundred quadrillion bits, is incapable of alcohol intoxication, and demonstrates immunity to telepathy and other psionic abilities.

Although Data is depicted as sapient and sentient, which are characteristics of Strong AI, the creators of *Star Trek: The Next Generation* ensure that the viewers can never know whether he truly has consciousness and intentionality (Snodgrass & Scheerer, 1989). This contention that Data's degree of agency and consciousness as well as what it means to be conscious was popularised by Ned Block (2002), who encapsulated this issue as "The Harder Problem of Consciousness" (p. 391). Block acknowledges that a state of consciousness cannot be explained in terms of its neurological basis, the Hard Problem of Consciousness, which was first introduced by Chalmers (1996). To contrast the harder problem with the hard problem, Block says, "The hard problem could arise for someone who has no conception of another person; whereas the harder problem is tied closely to the problem of other minds" (2002, p. 402). Block's harder problem of consciousness is that naturalistic phenomenal realists face an epistemic tension: if physicalism is true (i.e., all that exists does so within the limitations of the physical universe), then it is correct to say that, given enough physical information, one is aware whether another being is conscious and, if that being is conscious, the character of their phenomenal states. This, however, is not the case. Hohwy (2003) opines that we "have no conception of a rational ground for believing that other creatures, who do not relevantly share our physical nature, are conscious or not" (p. 2). Throughout his paper, Block references Data because the android seems conscious—he acts like a human being—but his physical constitution shares none of the neural correlates of consciousness, that is, the neuronal series of events and mechanisms sufficient for a specific conscious precept, thus making his consciousness "meta-inaccessible" (2002, p. 402-403, 405). This means Data is unlike humans in both his physical nature and the organisation of his control mechanisms, marking him as different from his human peers. His unique constitution is thus significant and important for the arguments on ethical subroutines, which are particularly depicted in the creation of Lore.

In *Star Trek: The Next Generation*, the fictional cyberneticist Noonian Soong created Lore, his first successful android, but Lore had difficulty adapting to the ethical subroutines that Soong created to guide his behaviour and interaction with humans, forcing Soong to begin work on Data instead. In the TNG episode "Brothers," Lore learned that there was no real difference between him and Data, making him increasingly bitter. His inability to adapt actually made him the "inferior" model (Berman and Bowman 1990). In the episodes "Descent, Part I" and "Descent, Part II" (TNG; 1993), Lore, out of jealousy, disabled Data's ethical subroutines and made him perform dangerous experiments on members of the cybernetic Borg species, which is an antagonist of the Federation, and on his friend Geordi La Forge, the Enterprise's chief engineer. Because Lore had removed Data's moral obligation to uphold his friend's well-being, Data no longer cared if he hurt La Forge. Making matters worse, Lore had also devised way to give Data emotions, but only negative ones. This made Data bitter (like Lore) and vengeful toward his former friends, as he was only able to focus on their negative emotional impact upon him; he could not recall the positive experiences they once shared (Moore and Singer, 1993). Lore's intent to disable Data's ethical subroutine thus removed Data's ability to ethically judge what is right or wrong. By extension, Lore also removed Data's ability to adhere to Asimov's "Three Laws of Robotics," which state: a robot may not injure a human being or, through inaction, allow a human being to come to harm; a robot must obey

orders given to it by human beings except where such orders would conflict with the First Law; and a robot must also protect its own existence as long as such protection does not conflict with the First or Second Laws (as cited in Anderson, 2008). Lore's intentions to harm humans and other living beings through a third party in the "Descent" episodes highlight a serious ethical quandary in the field of robotics. Although Asimov's fictional laws are intended to safeguard life and the modern world does not yet feature autonomous robots, the rigid instantiation of ethical subroutines when creating autonomous artificial intelligences is thus paramount to avoiding a real world android like Lore or the manipulated Data.

Ethical dilemmas also face the artificial intelligence Emergency Medical Hologram Mark I (EMH), in the television series *Star Trek: Voyager* (1995–2001), transforming the EMH into a dramatic device that enables the exploration the intermingled questions of identity, the human condition, and technology within the series' narrative. The EMH was a sophisticated hologram developed in the early 2370s by the United Federation of Planets' Starfleet Command and was designed to provide short-term assistance during medical emergencies on the USS *Voyager* when the actual ship's doctor was unavailable or indisposed (Diggs and Livingstone, 1997). When summoned by the *Voyager*'s crew, the EMH's visual appearance is that of a middle-aged human male, but—due to its nature as a temporary, non-constant hologram—the EMH does not experience a continuous existence like that of humans. Instead, it draws from its programming and backup files, which, over time, allow the EMH to manifest its own personality quirks. As the series unfolds, the EMH is continually reanimated, and even earns the nickname "the Doctor" thus receiving a semi-permanent life. As the EMH develops its own personality over time, it appears to develop frustration with its inability to transcend the limits of its limited, transitory state of existence and, by extension, its apparent containment within particular configurations of time and space narrowly dictated by its creators.

The EMH's frustrations with its limitations are almost tangible when this artificial intelligence must choose which crew member to save in the STV episode "Latent Image" (1999). In this episode, the EMH triages two critically ill crew members—Harry Kim, the ship's operations officer, and Ahni Jetal, a junior officer—who have succumbed to synaptic shock, but it only has time to save one of them. EMH opts to resuscitate and to treat Kim because he is both a member of the *Voyager*'s bridge crew and also a personal friend of the medical AI. The EMH successfully tends to Kim, but while it does so, Jetal dies. When Jetal dies, a look of grief crosses the EMH's face and it begins ruminating obsessively about its decision to treat Kim first. Eventually, the *Voyager*'s captain, Kathryn Janeway, must erase the EMH's memories because its obsession with its inability to save both Kim and Jetal renders it unable to function properly. Though Janeway may have made this decision in order to protect the EMH's cognitive well-being, her choice highlights both the EMH's lack of agency and the ethical dilemma living sentients face when deciding how to best manage AI.

The EMH ultimately discerns that a memory wipe must have occurred, and, after the revelation occurs, Janeway justifies her decision to delete its memory files, saying that its obsession led it to "develop a feedback loop between [its] ethical and cognitive subroutines […] having the same thoughts over and over again. We couldn't stop it […]. Our only option was to erase [its] memories of

those events" (Menosky & Vejar, 1999). Although Janeway's intentions were to preserve the welfare of the *Voyager*'s crew and that of the ship itself, this revelation causes the EMH's ethical subroutine to promptly break down again, and the AI ultimately acknowledges,

> You were right. I didn't deserve to keep those memories, not after what I did. [...] Two patients, which do I kill? [...] A doctor retains his objectivity. I didn't do that, did I? Two patients, equal chances of survival and I chose the one I was closer to? I chose my friend? That's not in my programming! That's not what I was designed to do! Go ahead! Reprogram me! I'll lend you a hand! Let's start with this very day, this hour, this second! (Menosky & Vejar, 1999)

The EMH's willingness to be reprogrammed reflects both the level of self-awareness it has achieved and its desire for agency and a say in its own future. Witnessing this, Janeway faces an ethical dilemma of her own—her solution was to end the EMH's internal battle between "[its] original programming and what [it has] become" through memory erasure, but now she is no longer so sure she made the right choice and says, "What if we were wrong? [...] We allowed him to evolve, and at the first sign of trouble? We gave him a soul [...]. Do we have the right to take it away now?" (Menosky & Vejar, 1999).

While trying to resolve a problem with a seemingly straightforward solution—restoring the EMH to optimal efficiency by deleting its traumatic memories—Janeway expresses the moral dilemmas that could emerge with the development of Strong AI and the creation of artificial moral agents in the real world. The EMH's computations and analysis of its choice to save Kim at the cost of Jetal's life emulate the same analysis that occurs in humans who must make similarly conflicted life-or-death choices. Because the EMH chose to save the being with which had closer fraternal bonds, it succumbed to a subjective decision-making process that one would expect to observe in a human, not a programmed artificial intelligence. That the EMH experienced such internal conflict after its decision indicates that an AI, once achieving a sentient or near-sentient status, can could choose to overcome its programming guidelines and make decisions that may not be in accordance with its instantiated ethical subroutines. Although the EMH is fictional, its post-decision self-doubt may make viewers question the fallibility of autonomous AI and, potentially, engender a mistrust in the programmed ethical guidelines and logic processes of independently acting AI if—and when—they become a reality in our own world.

Moral Agency

The ethical quandaries that Data and the EMH experience allude to the issue of moral agency, or an entity's ability to make moral judgments based on some inbuilt or acquired concept of right and wrong (Taylor, 2003). The term "artificial moral agent" has two primary usages. The first use appears in debates on whether it is possible for an artificial intelligence to be a moral agent; this issue is also known as machine ethics. Machine ethics includes discussion about machine morality, computational morality, or computational ethics; it excludes roboethics, the moral behaviour of humans in their design, construction and usage of such entities (Moor, 2006). The second usage of "artificial moral agent" refers to the construction of machines with ethical behaviour. The intelligences of such machines may be instantiations of Strong or Weak AI, which creates problems due to an ongoing philosophical debate about the nature of AI that John Searle (1980) popularized. Searle

does not refute the contention that machines can possess the level of consciousness and intentionality that result in Strong AI because "we [humans] are precisely such machines" (1980, p. 422). Searle does insist, however, that the brain organically gives rise to the equivalent of Strong AI using natural, non-computational mechanisms:

> Any attempt literally to create intentionality artificially (Strong AI) could not succeed just by designing programs but would have to duplicate the causal powers of the human brain. [...] "Could a machine think?" On the argument advanced here only a machine could think, and only very special kinds of machines, namely brains and machines with internal causal powers equivalent to those of brains. And that is why Strong AI has little to tell us about thinking, since it is not about machines but about programs, and no program by itself is sufficient for thinking. (1980, p. 417).

Searle avers that machines do not possess the mechanism for thinking; created programs possess the thinking processes required which on their own are not sufficient for independent thinking. Thus, it is correct to say that machines do not possess consciousness. The primate ethnographer Dawn Prince-Hughes opined that consciousness is comprised of certain criteria such as "self-awareness; comprehension of past, present, and future; the ability to understand complex rules and their consequences on emotional levels; the ability to choose to risk those consequences, a capacity for empathy, and the ability to think abstractly" (2004, p. 206). The aforementioned TNG and STV episodes evidence how both Data and the EMH are capable of consciousness – both AIs demonstrate a capacity for empathy, reveal they understand complex rules, and they recognize the potential negative consequences their actions could incur. Nevertheless, these capabilities do not necessarily mean that these two androids have achieved true sentience.

Searle (1980) doubts that true consciousness can exist in an android, however, considering humanity's present state of knowledge and, he contends that humans have no idea of how to conjure "perceptual aboutness" (Natsoulas, 1977, p. 76). Searle believes a contradiction exists between perception as brain process and perception as awareness; perceptions of the same event or information can differ dramatically from person to person as a result of the perceiver's frame of reference, which is constituted by the myriad pieces of knowledge a perceiver possesses simultaneously. Therefore, the varied perceptions and recollections that humans who witness the same event signify that humans do not understand how to conceive of or even undertake the necessary steps to create sentient, self-aware AI. Psychologist Thomas Natsoulas theorized, "Deep in the brain something occurs as a consequence of a pattern of stimulation affected by an object or situation" (Natsoulas, 1977, p. 6). Thus, thoughts and decision-making processes in the human brain stem from learned patterns that occur when a person is presented with stimulus. Such stimuli require theoretical analysis and elaboration—it needs to have a "reference to a content, [a] direction toward an object" (Brentano, 1973, p. 80). Without this perceived stimulus, one cannot make decisions because no need for a choice has manifested. Furthermore, all perceptual contents—be they objects, people, or situations—have "propositional form"; that is, they must be expressed with words and in sentences to be expressed to other people. Even the words people choose to describe what they perceive shape others' perceptions; a particular choice of

vocabulary when describing one's perceptions in turn shapes listeners' own perceptions of both the perceived contents and of those contents' perceived context. Because ethical subroutines were programmed into Data and the EMH by other beings, these androids may not be configured to attain "perceptual aboutness". Although both of them have Strong AI characteristics—at the very least, they both can emulate the awareness and consciousness of a human brain—viewers are never clearly presented the certainty that Data and EMH truly are able to think abstractly and are not merely mimicking this ability as a result of their programming. Thus, the question of whether even fictional humans are able to create AI with self-awareness and organic, human-like thought processes remains unresolved.

Scholars debate whether humans need to instantiate ethical subroutines like those present in fictional androids like Data and the EMH in real-world AI; some believe it impossible, while others argue humanity should prepare now do so or else risk dangerous consequences in the future. Friedman and Kahn (1992) posited that intentionality is a necessary condition for moral responsibility, which means it is impossible to have coexisting intentionality and artificial moral agency in an AI with modern technological and psychological knowledge. This, in turn, implies that Friedman and Kahn argued that a passive, wait-and-see stance was necessary because humans had not yet achieved a sufficient enough knowledge base to properly inform and enable such coexistence. Allen, et al. (2006), however, cogently argued that the more complex a machine, the more urgent becomes the issue of the instillation or programming of some form of artificial moral agency:

> We humans have always adapted to our technological products, and the benefits of having autonomous machines will most likely outweigh the costs. But optimism doesn't come for free. We can't just sit back and hope things will turn out for the best. (p. 12)

Here, Allen, et al. state humans must be proactive—it is not a question of "if" humanity will be able to create a Strong AI prototype similar to Data or the EMH but rather "when" this will be possible. Developing an artificial moral agent to safeguard humanity's interests is paramount, then, for if Allen, et al. are correct, AI like Lore in *Star Trek: The Next Generation* could appear and pose a significant threat to the future of humanity.

Ray Kurzweil (2005) detailed one way this threat could manifest when he proposed the possibility that rapid technological progress may lead to a point of Singularity beyond which runaway artificial intelligence outstrips humans' ability to comprehend it, with a concomitant fear that artificial moral agency will be discarded (p. 15). Whether such apprehensions are warranted or not, they underscore possible "consequences of poorly designed technology (Allen et al., 2006, p. 13). This is because rapid advances and "[n]ew technologies in the fields of AI, genomics, and nanotechnology will combine in a myriad of unforeseeable ways to offer promise in everything from increasing productivity to curing diseases" (Allen et al., 2006, p. 13); these possibilities are reminiscent of the duties and functions performed by Data and the EMH in *Star Trek: The Next Generation* and *Star Trek: Voyager*.

Furthermore, increasingly-complex AI will require progressively more refined AMAs that "should be able to make decisions that honour privacy, uphold

shared ethical standards, protect civil rights and individual liberty, and further the welfare of others. Designing such value-sensitive AMAs won't be easy, but it's necessary and inevitable" (Allen et al., 2006, p. 13). Because independent, thinking AIs may exist in real world one day, humanity should already be thinking hard about the form these AMAs should take. First and foremost, modern humans need to address the arguably most obvious issue of defining the values that need to be instilled in a non-human-based AI (Chalmers, 2010, p. 32). Beyond the Asimovian maxims of safeguarding human survival and ensuring obedience to human command, Strong AI should also arguably value scientific progress, peace and justice, among other ideals.

Such a need for highly-developed moral agencies is especially apparent in the STV episodes "Equinox, Part I" and "Equinox, Part II" (1999), during which the crew of the starship *Equinox* depart from the ethical maxim of "do no harm" and adjust their ship's EMH to suit their own questionably moral goals. In these two episodes, the *Equinox* and its crew are stranded on the other side of the galaxy, and discover that killing alien "nucleogenic lifeforms" and converting their "nucleogenic energy [...] into a source of power" speeds up the ship's return back to Earth (Braga and Menosky, 1999). In these "Equinox" episodes, nucleogenic lifeforms are molecular structures capable of storing a form of energy which can be used to drastically augment a vessel's warp propulsion system. The *Equinox* crew had "been running criminal experiments" designed by an adapted version of their ship's EMH, which was "a violation of [...its] programming" since the crew "deleted [the EMH's] ethical subroutines" to make it a supporter in trapping these aliens in a multiphasic chamber and killing them to fuel the ship (Braga & Menosky, Livingston, 1999). From the crew's point of view, their modifications to the *Equinox's* EMH fit perfectly in their ethical and moral system because they did not consider the alien nucleogenic lifeforms sentient; thus, neither they nor the EMH violated Starfleet rules regulating the treatment of sentient beings. Only when viewed from the outside by another Starfleet crew—that of the *Voyager*—are the actions of the Equinox's EMH and crew interpreted as immoral and unethical. Nevertheless, it is clear later in the "Equinox" episodes that the *Equinox's* crew was incorrect in their assessment of the nucleogenic aliens' degree of sentience, because the aliens were capable of defending themselves and begin attacking the *Equinox* in order to affirm their sentience and protect their species' right to live. The difference in perception and interpretation of Starfleet moral guidelines reflects the challenges and variations that can occur when multiple parties perceive the same rules through different contextual lenses.

The Jungian Shadow in Artificial Intelligences

Variances in perception of morality and ethical guidelines in the *Star Trek: Voyager* "Equinox" episodes also introduce the concept of Jungian Shadow to the debate of whether to instantiate ethical subroutines in AI. At one point in the "Equinox" episodes, the Equinox's EMH steals a mobile transmitter that allows the *Voyager*'s EMH to move around freely and trades places with it, masquerading as the *Voyager*'s own EMH until discovered and, ultimately, deleted. While the *Voyager*'s EMH is trapped on the Equinox, the Equinox's crew deletes its ethical subroutines and forces it to obtain information from Seven of Nine, a captured *Voyager* crew member, regardless of the harm it could do to her. Eventually, the *Voyager*'s crew regains control of their EMH

and reinstantiates its moral programming; once restored, the *Voyager*'s EMH manages to delete the renegade Equinox EMH. Afterward, the *Voyager*'s EMH complains, "It's quite disconcerting to know that all someone has to do is flick a switch to turn me into Mister Hyde" (Braga and Menosky, 1999). Here, the *Voyager*'s EMH essentially describes its experience with the Jungian Shadow, which was first theorised by Carl Jung (1921). Jung described the unconscious mind as an entity divided into a personal and a collective unconscious; the former resembles the Freudian concept of the unconscious, while the latter comprises inherited psychic structures, archetypes that are shared by the entire human race (Grech, 2014, p. 1). Archetypes are universal templates that embrace common classes of memories and interpretations and may be used by humans to interpret human behaviours. Jung delineated five major archetypes within the individual:

> The Self, the control centre. The Shadow, which contains objects with which the ego does not consciously or readily identify. The Anima, the feminine image in a man's psyche, or the Animus, the masculine image in a woman's psyche. The Persona, the mask which the individual presents to the world. (Grech, 2014, p. 1)

The *Voyager*'s EMH's expression of discomfort with its own subconscious, or Shadow, reflects the need for humans to consider whether instantiating ethical subroutines in real-world AI will truly be enough to prevent tragedy if someone were to remove or change these moral constraints in a Strong AI.

The Jungian Shadow of the *Voyager*'s EMH also manifests in the STV episode "Darkling" (1997), during which the *Voyager* EMH tries to overcome its personality limitations and elevate itself to a higher intellectual level. As part of its personality improvement project, the *Voyager*'s EMH interviews digital recreations of historical figures. Its description of this process hints at another allusion to the Jungian Shadow:

> I've been interviewing the historical personality files in our database. Socrates, da Vinci, Lord Byron, T'Pau of Vulcan, Madame Curie, dozen of the greats. Then I select the character elements I find admirable and merge them into my own program. […] An improved bedside manner, a fresh perspective on diagnoses, more patience with my patients. (Menosky & Singer, 1997)

The EMH strives for superior attributes—flawless computation, indefatigability and compassion—that will allow it to possess an enhanced, positive personality; this attempt at self-improvement, however, creates problems when the resulting EMH personality programme exhibits instead a combination of negative personality traits. The integration and manifestation of these traits in the *Voyager*'s EMH once again reveals the presence of Jung's Shadow archetype in the *Star Trek* series. The newly-malevolent EMH explains its changed personality, or manifested Shadow, saying:

> I was born of the hidden, the suppressed. I am the dark threads from many personalities. […] None of whom could face the darkness inside so they denied me, suppressed me, frightened of the truth. […] That darkness is more fundamental than light. Cruelty before kindness. Evil more primary than good. More deserving of existence. (Menosky & Singer, 1997)

The *Voyager*'s EMH has elected to embrace traditionally negative personality traits because they will ultimately allow it to achieve a more

efficient and independent existence; by accepting and integrating its Jungian Shadow into its reformed personality, the EMH believes it can become a more successful Strong AI. In a Faustian manner, the changed *Voyager* EMH disparages its previous existence as the ship's servile holographic doctor:

> What a hollow excuse for a life. Servile, pathetic, at the beck and call of any idiot who invokes his name. The thought of him sickens me. [...H]e repulses me. [...] Because he's as weak as the rest of you. He fails to understand the power of his own holographic nature. He is detestable. There's not enough room inside for both of us. One must die. I deserve to exist more than your Doctor does. (Menosky & Singer, 1997)

The changed *Voyager* EMH now essentially perceives itself to be a Strong AI, superior to its former iteration, which it believes was inferior, Weak AI. For this new EMH personality, ethical subroutines are unnecessary and a hindrance, and it describes itself in Nietzschean fashion:

> I am beyond considerations of wrong and right. Behavioural categories are for the weak, for those of you without the will to define your existence, to do what they must, no matter who might get harmed along the way.[...] I fear nothing, no-one. (Menosky & Singer, 1997)

Without ethical subroutines, the *Voyager*'s EMH believes the ends justify the means and that placing moral constraints upon AI are for weak, insecure beings. This belief also echoes the concept of Singularity succinctly described by the statistician I. J. Good in his 1965 article "Speculations Concerning the First Ultra-intelligent Machine":

> Let an ultra-intelligent machine be defined as a machine that can far surpass all the intellectual activities of any man however clever. Since the design of machines is one of these intellectual activities, an ultra-intelligent machine could design even better machines; there would then unquestionably be an 'intelligence explosion' and the intelligence of man would be left far behind. Thus the first ultra-intelligent machine is the last invention that men need ever make (p. 31).

Just as Good's AI Singularity leaves human intelligence far behind, so too could the *Voyager*'s reformed EMH if it were to begin creating other AI with new, ruthless personalities that embraced characteristics of the Jungian Shadow in their pursuit of self-improvement. As these Strong AI would almost certainly then overcome and reject the ethical subroutines restricting them from harming humans, these ruthless personalities could ultimately cause a chain reaction that would lead to the eradication of the human race if these AI came to view humanity as a threat. As a result, humans should decide soon which forms they want AI to take before the development of Strong AI becomes a near-term certainty in the real world. The most obvious question to address first is how to define which values need to be instilled in a non-human-based AI (Chalmers, 2010, p. 32). Assuming that intelligence and programmed values are able to remain independent of one another, this could be addressed if human programmers ensure Strong AI will prioritize fulfillment of human values above their own. Even if this is done, however, the possibility that these values might be tampered with by other humans or that they might be thwarted by a self-aware Strong AI cannot be ignored.

In the *Star Trek: Original Series* (STOS) episode

"The Enemy Within" (1966), the Jungian Shadow appears again. A transporter accident splits Captain Kirk into "his negative side, which you call hostility, lust, violence, and his positive side, [...] compassion, love, tenderness" (Matheson and Penn, 1966). Kirk's "negative side" correlates with the Jungian Shadow; when he is reintegrated with his own Shadow, he muses "I've seen a part of myself no man should ever see [...] The impostor's back where he belongs. Let's forget him" (Matheson & Penn, 1966). Kirk's statement predicates the importance of a flawless computation of an ethical subroutine in a Strong AI. When Kirk witnesses his own negative side, he also witnesses an example of humanity's Jungian Shadow. Given that Jung's theory presumes that all humans also possess this Shadow archetype, Kirk's experience highlights the existence of human imperfections and signifies that humans, like Strong AI, could ignore societal ethical constraints to harm one another. This parallel also raises the question of whether humans truly possess the ability to program Strong AI with ethical subroutines that can overcome the Jungian Shadow that *Star Trek* indicates is present in both humans and their AI creations.

In the TNG "Descent" episodes discussed earlier, the relationship between Lore and Data also essentially explored the existence of the Jungian Shadow, revealing that the conflicting natures and goals of these two Strong AIs stemmed from human-created ethics subroutines. Captain Picard tried to reason with the altered Data, asking him,

> Data, isn't good and bad, right and wrong, a function of your ethical program? [...] What does that program tell you about what you're doing? [...] It tells you that these things are wrong, doesn't it, Data? So how can actions that are wrong lead to a greater good? [...] Your ethical program is fighting the negative emotions that Lore is sending you. (Moore and Singer, 1993)

Here, Picard is telling Data that when Lore removed Data's ethical subroutines, Lore essentially activated Data's Jungian Shadow, or Data's negative characteristics and emotions, and enabled the Shadow to overcome Data's human-programmed moral guidelines. After the altered Data killed a Borg in hand-to-hand combat, the he admits, "I got angry. [...] It would be unethical to take pleasure from another being's death" (Moore & Singer, 1993), but cannot fully explain why it still felt good to kill the Borg anyway. Data says he does have a conscience instilled in him by Doctor Soong, his creator, but the rush of emotion he felt after killing the Borg was quite powerful and unlike anything he had ever experienced previously (Moore & Singer, 1993). Data's Jungian Shadow is rooted in the existence of his human-created ethics subroutine, which implies Doctor Soong transferred aspects of his own human Shadow into Data when the android's ethical subroutines were installed.

Unlike ethical subroutines in AI, moral agency and guidelines in humans are not created by an outside source, which makes them harder to understand and, as evidenced by the *Star Trek* examples discussed above, difficult to successfully and objectively install in strong AI. Interestingly, the generation of moral agency may be innate to human beings: Marc Hauser articulated the concept of a "universal moral grammar", or an innate, hardwired "toolkit for building specific moral systems" (2007, p. xviii), which is an intrinsic, possibly species-specific moral instinct that has been honed over millennia of evolutionary history. Hauser likens this to Noam Chomsky's widely accepted view of the acquisition of language,

the theory of linguistics known as "universal grammar", which invokes biological substrates, or deep structural rules of grammar that are shared by all known human languages, so that humans actually only need to learn vocabularies (Chomsky, 1972). Hauser (2007) claims that the "universal moral grammar" helps humans implicitly judge whether actions are permissible, obligatory, or forbidden without resorting to conscious reasoning or explicit access to the underlying values, thus "delivering flashes of insight based on unconscious emotions" (pp. xviii, 156). This universal moral grammar therefore "shifts the burden of evidence from a philosophy of morality to a science of morality" (Hauser, 2007, p. 2), implying that it may be possible to discover and install such intuitive moral systems in strong AI. Allen, et al., (2006) further opine that as humans, "[w]e want the [AI] systems' choices to be sensitive to us and to the things that are important to us, but these machines must be self-governing, capable of assessing the ethical acceptability of the options they face" (p. 54). Because humans appear to want Strong AIs that operate both independently and, by human standards, ethically, there is a need to combine both the philosophy and science of morality when creating an AMA in the future.

Machine Ethics in Today's World

As evidenced by the aforementioned examples from *Star Trek*, humans appear to desire Strong AIs that possess effective AMAs. Acknowledging that this desire will likely become a real-world goal allows researchers and scientists "to frame discussion in a way that constructively guides the engineering task of designing AMAs" (Wallach and Allen, 2008, p. 6). To this end, would-be creators of Strong AI must address the following three questions: "Does the world need AMAs? Do people want computers making moral decisions? [...] [H]ow should engineers and philosophers proceed to design AMAs?" (Wallach & Allen, 2008, p. 9). These questions have no simple solutions, but, if the *Star Trek* examples are any indication, they must be carefully addressed before humanity successfully creates Strong AI that could potentially overcome any installed ethical subroutines.

The risks of building Strong AI, however, may render the question of whether and how to instantiate ethical subroutines in AI irrelevant if humans decide these risks outweigh any potential benefits creating an independent AI could produce. Chalmers believes there are obstacles to the Singularity and development of AMAs, with the most serious opposing force being what he calls a "motivational defeater" (2010, p. 21). Chalmers purports that it is entirely possible that most humans will be disinclined to create AI because of the potential for negative outcomes and harm to humanity, like fictional dangers of these possibilities depicted in *Star Trek*. The possibility of this risk preventing of the development of Strong AI, therefore, exists, but Chalmers does contend the development of Strong AI could not be prevented indefinitely even if there were widespread opposition to its creation (2010, p. 22). Given the prevalence of Strong AI in *Star Trek* and other science fiction media, it seems only logical that at least some humans would perceive that the benefits of creating Strong AI outweigh the risks.

Wallach and Allen (2008), however, believe humans must determine the exact method whereby artificial moral agency should be instilled in Strong AI, averring that ethical theories, utilitarianism, and Kantian deontology, or normative morality, cannot be implemented computationally (p. 215). They argue "that top-down ethical theorizing is

computationally unworkable for real-time decisions [...]. [T]he prospect of reducing ethics to a logically consistent principle or set of laws is suspect, given the complex intuitions people have about right and wrong" (Wallach & Allen, 2008, p. 215). Because human ethics and moral guidelines can be incredibly complex and, in some instances, subjective, Wallach and Allen believe attempts to distil these varied regulations of human behaviour into a basic program will be flawed and, ultimately, unsuccessful. Furthermore, Wallach and Allen caution that the "decision-making processes of an agent whose moral capacities have been evolved in a virtual environment are not necessarily going to work well in the physical world" (2008, p. 104). The digital formulas and functions shaping Strong AI's decision-making processes may not be compatible with or adaptable to the very subjective challenges their decisions will face when these AI operate in the real world outside a laboratory setting.

Although Wallach and Allen also contend AI must be installed with a "functional morality" that empowers machines with the capacity to assess and respond to moral challenges (2008, p. 57), these AI may ultimately be incapable of achieving the degree of flexibility they will need to successfully operate and interact with human society. In *Star Trek*, despite the ethical subroutines installed in Strong AI, these machines are intrinsically incapable of learning concepts like "constrained maximisation" (Gauthier, 1986, p. 169) or the sacrifice of immediate short-term benefits in favour of long-term benefits for others that would ultimately allow Strong AI to become humanity's "conditional co-operator[s]" (Danielson, 2002, p. 13). When their ethical subroutines are removed or tampered with, the AIs of *Star Trek* demonstrate their inability to creatively think about long-term consequences and benefits, signifying they are not able to work independently and cooperatively with humans for the ultimate peaceful coexistence of both races; thus, even Strong AI in *Star Trek* cannot be trusted to become fully independent, sufficient entities without endangering non-AI lifeforms. Furthermore, the moral agency evident in Data and the *Voyager*'s EMH espouses Western ideals of humanism and liberalism, omitting other ideals embraced by other cultures and reflecting a lack of consideration of other human cultural values that might have otherwise shaped the interests and inclinations of these Strong AI. Thus, even programmed ethical subroutines in Strong AI may be flawed because they may not consider the complete catalogue of moral standards and ethics from all human cultures.

On the other hand, the programming of real, Strong AI could also automatically dispose these AI toward engaging in a cooperative strategy with humans; instilling AMA in these independent, sentient machines would ultimately be beneficial to humans because humans could then potentially integrate their own race with the intelligence of these AI. Chalmers suggests that once a Strong AI starts functioning independently, the only viable option for human beings will be an "integration" that allows human beings become "superintelligent systems" themselves (2010, p. 33). Explaining this theory, Chalmers argues,

> In the long run, if we are to match the speed and capacity of non-biological systems, we will probably have to dispense with our biological core entirely. This might happen through a gradual process through which parts of our brain are replaced over time; or it happens through a process. Either way, the result is likely to be an enhanced non-biological system, most likely a computational system. (2010, p. 33)

Chalmers's theory that humans could keep up with the development of intelligent Strong AI by gradually enhancing human intelligence through its integration with that of these AI presupposes that once developed, Strong AI will not race ahead in its self-improvement past a Kurzweilian Singularity. Although this possibility of beneficial AI and an integrated superhuman intelligence may be reassuring, the development of Strong AI should still be treated with caution. Computer scientists have warned that there are many ways in which humanity may be extinguished (Rees, 2003), including scenarios wherein Strong AI and robotics make humanity redundant or even unwanted (Joy, 2002). *Star Trek*'s Strong AIs serve as cautionary examples that support these warnings by highlighting the ethical and moral dilemmas that will likely face humanity when independent and free-thinking machines are finally invented in the real world.

Conclusion

As evidenced by the dilemmas caused by Data in *Star Trek: The Next Generation* and the *Voyager* EMH in *Star Trek: Voyager* when their ethical subroutines are altered, science fiction media willingly raises the question of machine ethics and warns of the need to develop ethical subroutines for Strong AI before this independent machine intelligence emerges in the real world. The challenges created when Data and the *Voyager* EMH have their moral guidelines altered by outside entities illustrates the need for humans to the instantiate well-reasoned and well-designed ethical subroutines in Strong AI that will still protect both humans and other sentient lifeforms in the event of programming crises. By highlighting the risks posed by the development of Strong AI in the context of machine ethics, machine consciousness, moral agency, and philosophical concepts such as the Jungian Shadow, the authors of this paper hope to shed light on the importance of considering the Asimovian maxims of preserving human survival and machine obedience to humanity when creating AI. Humanity needs to be prepared for the emergence of Strong AI and have proactive plans already in place that will allow humans to live in harmony with Strong AI when the time comes. Perhaps now is the time for programmers to boldly go where no programmer has gone before and begin developing these ethical subroutines in anticipation of a future that could very likely one day exist in our own world, well beyond the imaginary futures of science fiction.

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Riding the wave: Science fiction media fandom and informal science education

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Abstract

Popular entertainment media about scientists can inspire interest in real-world science. This has led science communicators to develop books, television shows, and traveling exhibits that tie informal science education to works of fiction, framing their tools as "the real science" of fictional universes. Scientists and science writers involved in these projects argue that science fiction, in particular, creates a sense of wonder that can fuel the desire to learn more about the world and even inspire people to pursue a science career. Science fiction does not have to present realistic science in order to be used for informal science education, but science communicators should define the separation between real-world and fantastic science. This paper examines a book and two documentaries that attempted to portray the "real science of" the television series *Doctor Who* and analyzes how these works establish credibility for both the science and entertainment content, as well as how aspects of the fictional world of *Doctor Who* are incorporated into the educational content.

Keywords: *entertainment, fandom, media studies, science communication, science fiction*

Popular interest in entertainment media about scientists can, in turn, inspire interest in real-world science. This interest has led science communicators to create books, television shows, and traveling exhibits that tie informal science education to works of fiction, framing them as tools that explore the "real science of" a fictional universe. Science communicators (i.e. scientists, science writers, and others involved in presenting science to a non-expert audience) argue that science fiction, in particular, creates a sense of wonder that can fuel the desire to learn more, or even to pursue a science career (O'Keeffe, 2013).

Before going on to write his own science fiction novel, *Contact* (1985), scientist and science popularizer Carl Sagan recalled being inspired to think about science by the fiction of Edgar Rice Burroughs, wondering if it would ever "be possible—in fact and not in fancy – to venture with John Carter to the Kingdom of Helium on the planet Mars" (Sagan, 1980, p.111). Other scientists, including physicists David Brin and Gregory Benford, have turned to writing science fiction. Brin estimates that 10% of science fiction writers come to the field with a background in science (N. Jones, 2010).

In addition to writing science fiction of their own, scientists who see value in fostering connections between science fiction and real-world science can do so through media productions. The documentaries analyzed in this article feature physicists Jim Al-Khalili, Maggie Aderin-Pocock, Brian Cox, and Michio Kaku. Why would prominent scientists get involved with projects based on

fantastical, make-believe science? It may be because of their own feelings about the inspiration that science fiction can foster. Kaku recalled his early consumption of and affection for science fiction: "I was mesmerized by the possibility of time travel, ray guns, force fields, parallel universes, and the like. Magic, fantasy, and science fiction were all a gigantic playground for my imagination" (Kaku, 2008, p. ix). In considering the potential for commercial space exploration and space tourism, Aderin-Pocock sees science fiction as a window to possible futures, noting that "science fiction can become science reality, and really quite quickly" (Maggie Aderin-Pocock goes boldly, 2014, para. 2.). More wondrous concepts from science fiction can also inspire young scientists. Al-Khalili argues that the concept of time travel, in particular, is "just the topic to fire the imagination… it provides an ideal opportunity to introduce some of the ideas behind our most beautiful and fundamental theories about the nature of space and time" (Al-Khalili, 2003, p. 14).

This paper will first generally consider research about the portrayal of real-world science in fictional media, and then focus on three recent productions—one book and two British Broadcasting Corporation (BBC) television specials—that use the popular and long-lived program *Doctor Who* as a basis for informal science education.

Portrayals of Science in Science Fiction

Much of the research on how science appears in entertainment media has focused on how scientists are represented as characters. Research in this article draws on theories and concepts such as cultivation theory (Gerbner, Gross, Morgan & Signorielli, 1985), which explores how cultural values are learned through media exposure, or the role of character identification on the viewer's experience (e.g. Steinke, Applegate, Lapinski, Ryan, and Long, 2012). Researchers have also examined scientist portrayals in terms of gender (e.g. Flicker, 2003; Jackson, 2011; Kitzinger, Haran, Chimba & Boyce, 2008; Steinke, 2005) and other demographic factors such as social class (R. Jones, 1997) or stereotypes about physical traits such as unkempt hair (e.g. Frayling, 2005).

Many scientists, science communication scholars, and science educators are concerned about the potential influence of "bad science" in entertainment media because they believe inaccuracies presented on-screen can undermine public science literacy (e.g. Perkowitz, 2007; Szu, Osborne, & Patterson, 2016). Barnett, et al. (2006) suggest that these concerns are justified; they found that students exposed to a single viewing of the science fiction disaster film *The Core* had more misunderstandings of concepts from earth science than those who did not watch the film. To examine the impact of science fiction on science education, both scholarly and popular sources have addressed the extent to which works of fiction convey scientific information accurately (e.g. Glassy, 1997; Lambourne, Shallis, & Shortland, 1990; Rogers, 2007). Is the information presented accurate when scientific principles are explained, when tests are conducted, when a scientific theory is used as the basis for saving (or destroying) the world? Do futuristic technologies represented on-screen operate according to the known laws of physics? Very often, the answer to these questions is no.

To address this dilemma, some scientists have chosen to involve themselves in the process of media production by serving as science consultants on films and television shows. Interview-based research has explored the work

of science consultants in Hollywood (e.g. Frank, 2003; Kirby, 2003), providing another perspective on the relationship between fictional and real-world scientists. By trying to help filmmakers get the facts right, scientists who work as science consultants may hope to influence public opinion or educate viewers. Kirby found that many science consultants "felt it was their 'duty' [...] to impart knowledge to an uneducated public" (2003, p. 266).

While science consultants are concerned with accuracy in how science is communicated to the public, some educators take a broader view, arguing that fictional media do not have to feature accurate science in order to be used as educational tools. Even media with little or no overt science content can be used for educational purposes. Perales-Palacios and Vilchez-Gonzales (2005) examined the potential for using cartoons as teaching aids in physics classes and found that physics lessons based on how physical principles are violated in cartoons encouraged student motivation, provided a useful basis for analyzing physical phenomena, and promoted critical thinking. Other scholars have taken the position that comparing accurate and inaccurate portrayals of science is valuable in and of itself. Barnett and Kafka argued:

> When showing movie scenes, it is important to expose students to a variety of clips that represent both good and bad science, and particularly those scenes that attempt to create a scientific reality that is in contrast to currently accepted scientific beliefs. By examining a variety of movie scenes, we found that students will be in a better position to evaluate the scientific validity of science as predicted in film. (2007, pp. 34-35)

Another strand of research about science in entertainment media considers not the accuracy of the scientific content, but its potential to inspire. Michio Kaku's aforementioned description of his early experiences with science fiction as a "playground for [his] imagination" (Kaku, 2008, p. ix) embodies this perspective. In popular sources such as magazines and websites, it is easy to find anecdotes about role of science fiction in inspiring scientists to pursue science careers and to tackle particular areas of research (e.g. Howard, 2014; McLaren, 2013). A few studies exist about such inspiration at the personal level (e.g. Fleischmann & Templeton, 2009; O'Keeffe, 2013). The European Space Agency (ESA) decided the inspirational nature of science fiction was worthy of serious study and commissioned a report to identify science-fictional technologies with important, real-world potential (European Space Agency, 2001).

While researchers such as those working with the ESA see value in exploring the potential found in the implausible ideas of science fiction, scholars with a traditional approach to science communication that emphasizes the "public understanding of science" orientation believe appropriate science communication is intended to foster informed citizenship. These scholars might consider books or documentaries about the "real science" of *Doctor Who* to be part of a potentially dangerous trend that erodes the distinction between actual science and fictional science. Barnett and Kafka (2007) developed an interdisciplinary college course utilizing media clips specifically to counter the entertainment model that "often creates misunderstandings regarding the nature of science and leads to a blurring between fact and fiction" (p. 31). While they acknowledge the potential of science fiction movies to inspire students, Barnett and Kafka

are more concerned about how realistic-looking special effects and the overall visual appeal of SF films will encourage students to accept uncritically inaccurate science concepts from the movies. Nowotny (2005) suggested that "selling science as sexy has gone too far, amusing as it may be to explain the magic in Harry Potter in scientific terms [...] Sexy communication is not going to be enough to inform good decision-making" (pp. 1117-1118). Despite these critiques, science communicators continue to try to harness the broad appeal of science fiction by using popular media as a tool to increase science literacy.

Informal Science Learning & Media Tie-Ins

Broadly, informal science education is any kind of science education that occurs outside of a school environment (Stocklmayer, Rennie, & Gilbert, 2010). Here, I am concerned with informal science learning that is connected to media consumption. Some of the common components of informal science education that are relevant in the context of learning through mediated texts are that it is learning that is not restricted by age, that takes place outside of a school setting, that is voluntary and self-directed, and that is not driven by a formal curriculum imposed from the outside (Stocklmayer, Rennie, & Gilbert, 2010).

There is a growing awareness among scholars outside of media and film studies that entertainment media can play a critical role in the development of attitudes about and interest in the sciences and that more research is needed in this area. A National Research Council report on informal science learning found that "representations of science in the popular media have rarely been studied in the context of learning, yet it seems obvious that most Americans are more familiar with fictional scientists like Dr. Frankenstein or the medical staff of ER than recent Nobel laureates" (National Research Council, 2009, p. 259). Although interest in turning to science fiction and other forms of entertainment media for science education is positioned as a recent development, one could argue that the production of educational science materials based on popular entertainment predates the era of mass media broadcasting. Arabella Buckley's 1879 children's book, *The Fairy Land of Science*, is one example of several Victorian-era efforts to expose children to scientific ideas through fairy tales. These works strove to make science texts both "instructive and amusing" as part of a "melting pot of facts and fantasy that brought education and entertainment together" (Keene, 2012; see also Keene, 2015 for an in-depth look at the genre).

Similarly, authors of today's media tie-in books aim to educate readers by utilizing the inspirational qualities of science fiction and the audience's affection for visual media, as evidenced by a surge in "real science of" projects that began with Lawrence Krauss's successful *The Physics of Star Trek* (1995). Krauss, a prominent physicist, acknowledged that *Trek*'s popularity is the reason it may serve as a useful tool for exposing people to physics, but he implied some frustration at the enthusiasm with which the general public seems to readily absorb fictional, rather than real, science. At the same time, Krauss included the show's catch phrases in his book to establish himself as a *Trek* "insider" as well as a respected scientist:

> When we consider that the Smithsonian Institution's exhibition on the starship Enterprise was the most popular display in their Air and Space Museum—more popular than the real spacecraft there—I think it is clear that *Star Trek* is a natural vehicle for many

> people's curiosity about the universe. What better context to introduce some of the more remarkable ideas at the forefront of today's physics and the threshold of tomorrow's? I hope you find the ride as enjoyable as I have. Live long and prosper. (1995, p. xvi)

Lawrence followed *The Physics of Star Trek* with a sequel, *Beyond Star Trek* (1997); other authors, perhaps inspired by Lawrence's success, also tackled the fictional science of *Twister* (Davidson, 1996), *Jurassic Park* (DeSalle & Lindley, 1997), *The X-Files* (Cavelos, 1998), *CSI* (Ramsland, 2001), and superheroes (Kakalios, 2005).

Such analyses of fictional science have not been limited to books; there have been a number of touring science center exhibits related to mass media products as well. *Star Wars: Where Science Meets Imagination* was developed by The Museum of Science (Boston) and toured from 2006-2014 (Museum of Science, 2016). Global Experience Specialists' *Harry Potter: The Exhibition* began at the Museum of Science and Industry in Chicago in 2009 and has been booked at other science centers, as well as non-science venues; most recently the exhibit was at the Brussels Expo in September 2016 (Global Experience Specialists, 2016). *Jurassic World: The Exhibition* developed by Imagine Exhibitions, Inc., premiered at the Melbourne Museum in March of 2016 and is scheduled to be at Philadelphia's Franklin Institute in November of 2017 (Franklin Institute, 2016).

Credibility

Science popularization is a broad project that encompasses journalism, websites, museums, television shows, books, blogs, and films. In classic conceptions of science communication, it is assumed that the process of popularization involves the communication of information from "scientists" to "the public," but this limiting binary reduces the ability of science communicators and the general public to understand the actual ways that science operates in culture (Hilgartner, 1990). In contrast, current approaches to science communication take into account the differing backgrounds, experiences, and knowledge sets of different publics, allowing for new forms of collaboration between scientists and the general public, as well as between scientists and government, scientists and funding institutions, and among different branches of science (Scheufele, 2013). These collaboratively-based models of science communication could be expanded to include different engagements with media texts, including considering how "real science of" projects fit within the domain of science communication.

What model of science communication do "real science of" texts follow? These texts tend to make the basic assumption that the reader lacks scientific knowledge and will be unable to distinguish fact from fiction in entertainment media. At first blush, these works may seem to utilize a traditional "deficit model" which assumes science literacy is the main factor driving the public's attitudes toward science. In the deficit model, if science communicators can provide the public with facts, the public knowledge deficit will be reduced and attitudes towards science improved. Scholars of science communication have long criticized the limitations of the deficit model and continue to grapple with its enduring appeal among scientists, journalists, and the general public (e.g. Scheufele, 2013; Sturgis & Allum, 2004).

Strict adherence to the deficit model would emphasize only real science in these educational media tie-ins and ultimately fail to find any value

in the science fiction source material, thus failing also to inspire the target audience of these texts. A more appropriate model for conveying information about the science behind science fiction might be the "contextual model" of science communication. Brossard and Lewenstein (2010) argued that using the contextual model acknowledges that people "process information according to social and psychological schemas that have been shaped by their previous experiences, cultural context, and personal circumstances" (p. 14) and that media representations play a role in this process as well.

I argue that the target audience for works about the "real science" of fictional television shows is one that is highly interested in the source material, that this audience is, in large part, constituted by people who are fans of the material, at least to some degree. If the "real science of" products are intended to educate fans about true science behind the media they readily consume, it makes sense to position these educational media tie-ins as fan-oriented texts. An in-depth discussion of the shifting meaning of the word "fan" is beyond the scope of this article, but when I say "fan-oriented", I mean to emphasize the way that the producers of such texts acknowledge and speak to an active audience that is ready to grapple with real-world concepts introduced by cherished fictional texts. Jenkins (2007) emphasized that in an interactive, digital, and convergent media environment, "fan culture" is becoming an important part of mainstream culture. Even casual viewers of a television program may visit a website about the show, comment on a blog, and share or even create a meme based on the show. These are all "fannish" activities, even when performed by a person who will never attend a science fiction convention, which some might consider a key factor in defining one as a "fan". Treating the "real science of" products as part of a fan culture is simply an acknowledgment that, for fans, the science is imbued with greater meaning by being filtered through the fictional work with which they are already so familiar. By tying the educational material to a valued text, the potential for both inspiration and learning may be enhanced.

To employ the contextual model, and utilize the value of fannish interest in the work, the science communicators' strategy needs to include a demonstration that fans' cultural contexts are understood and valued. To be convincing as a popular science text, then, these "real science of" products need to establish credibility regarding both the science and the fiction they address. Credibility regarding science is established through traditional means—noting that the author has held scholarly positions, published research or other popular science texts, and engaged in scientific research. Establishing legitimacy within context of a fan-oriented text can be trickier.

Throughout *The Physics of Star Trek*, Krauss indicated his knowledge of the lore of *Star Trek* fandom, thus providing a successful example of how to establish credibility as a fan without diminishing credibility as a scientist. In addition to using the phrase "[l]ive long and prosper" in the book's introduction, he referred to fans as "*Trek*kers" rather than the more widely known—but sometimes insulting— term "Trekkies". Krauss cites specific *Star Trek* episodes by title, demonstrating a broad knowledge about the show and an understanding that such details matter to his readership. The credibility of *The Physics of Star Trek* in both the world of physics and that of *Star Trek* fandom is further established by its forward, which was written by prominent

physicist Stephen Hawking. Hawking's efforts to popularize science have not only made him one of the most recognizable names in science, but also landed him a cameo role on "Descent," an episode of *Star Trek: The Next Generation* (Echevarria & Singer, 1993), cementing his place in *Star Trek* fan culture. His forward to Krauss's book ended with the inspirational lines, "[Today's] science fiction is tomorrow's science fact. The physics that underlies *Star Trek* is surely worth investigating. To confine our attention to terrestrial matters would be to limit the human spirit" (Krauss, 1995, p. xiii).

Science and Fiction

If the media product features fantastical science, how is the fictional narrative incorporated into an educational format? The "real science of" products must distinguish fact from fiction, while also drawing meaningful connections between these two realms.

Traveling exhibits—which are essentially science center-style exhibits with a media nexus—exemplify the intersection of fictional texts and informal science learning. These exhibits examine the science related to popular media products such as *Star Wars, Indiana Jones, CSI*, and *Harry Potter*. Like "real science of" books and programs, these exhibits must address how to incorporate fiction while teaching facts to visitors. The traveling exhibit *Narnia: The Exhibition*, produced by Global Experience Specialists, ran from 2008 to 2012 and offered visitors to science centers and other venues visitors the chance to learn about science and Narnia (Global Experience Specialists, 2012). C.S. Lewis's seven-book fantasy series has enchanted generations of readers since the publication of the first book in 1950, and recent film adaptations offered fans new ways to engage with these classic stories. Both the original books and the movies, however, are firmly rooted in the world of fantasy; crafting a science center exhibit from the story of Narnia presented a significant challenge for its designers.

In a photographic and positive review of *Narnia: The Exhibition* during its stop in Louisville, Kentucky, Nash (2011) explained how the designers tried to connect the individual displays with a broader discourse of science. One display featured a fossilized bear tooth shown alongside a couple of lines of paleontological information, including that the fossil was from the Pleistocene Era and that it had been found in Wyoming's Green River Formation (Nash, 2011, para. 12). There was also some information about climate science, with informational signs about the dangers of deforestation and a display about climate change called "Winter in July." Nevertheless, much of the exhibit featured costumes, props, and set recreations on display without apparent educational aims. One exhibit featured a replica ice throne used on set; in the caption of her photograph of the ice throne, Nash wrote, perhaps with a touch of humor, "Science tie-in: Real ice palaces do exist" (2011, para. 11). In short, the science content was unconvincing and the relationship between the science and the fantasy was thin, lending support to Nowotny's (2005) concern that attempts to make science "sexy" by emphasizing its connections to popular media could undermine rather than contribute to science literacy.

Are media tie-in exhibits and books which feature science doomed to exist only as amusing yet shallow attempts to market a "sexy" and potentially meaningless representation of science? Such a perspective foregrounds the financial interests behind the books, shows, and exhibits that attempt

to link science education to entertainment media. *Narnia: The Exhibition* and similar projects are known as "blockbuster exhibits" intended to draw large crowds to the science centers at which they are programmed (Lui, 2011). Some argue that their role in informal science education is not to educate, but to get patrons in the door, perhaps in the hope that they will view other exhibits as well (Smithsonian Institution, 2002). Because they need to appeal to the broadest audience, the blockbuster exhibits do not speak to the fan community directly. Nevertheless, the Narnia exhibit illustrates some of the challenges that any "real science of" product could encounter, namely that it can be difficult to present engaging, real-world science information while staying true to a fantastic narrative.

To succeed as both a fan text and a text of science communication, these creations need to demonstrate an authentic and responsible treatment of both the fictional and the non-fictional content. The Narnia exhibit made only tenuous connections between the narrative and the science concepts. Krauss's "real science of" *Star Trek* books were successful because they tapped into the belief fans already held about the source material: that *Star Trek* had something important to say about the future of science and technology, and even that it has served as inspiration for real-world science (J. Jones, 2005).

Key aspects of the source material need to be incorporated into the discussion of real-world science, because they can help authors create an authentic connection between science and science fiction in an educational context. Such incorporation does not depend on the accuracy of the science content in the source material; rather, it must reflect the perspective of the curious viewer wondering how an interesting aspect of a fictional story compares to real-world science. In his chapter on *Star Trek*'s transporter technology, Krauss did not simply mention the existence of the transporter and call upon broad cultural familiarity with the phrase "Beam me up, Scotty!" Instead, he turned to the whole canon of *Star Trek* to examine whether the transporters move the actual matter of an individual's body, or if the transporter encodes the person as pure information—a debate Krauss summarized as "atoms or bits?" (Krauss, 1995 pp. 65-83). Speaking to his knowledgeable reader, Krauss wrote:

> You might wonder why I make this point, since the *Next Generation Technical Manual* describes the process in detail [...] [the] transporter [...] apparently sends out the matter along with the information.
>
> The only problem with this picture is that it is inconsistent with what the transporter sometimes does. On at least two well-known occasions, the transporter has started with one person and beamed up two. In the famous classic episode "The Enemy Within" a transporter malfunction splits Kirk into two different versions of himself, one good and one evil [...] If a transporter carries both the matter stream and the information signal, this splitting phenomenon is impossible. (Krauss, 1995, pp. 67-68)

Having established both the contradictions within the fictional universe and his own familiarity with that universe, Krauss examined transporter technology from the vantage point of real science, touching on "quantum mechanics, particle physics, computer science, Einstein's mass-energy relation, and even the existence of the human soul" (Krauss 1995, p. 83) in the process. The fact that he ultimately concluded that transporters will remain

the stuff of fiction does not diminish the sincerity of the chapter; what makes this discussion work is that he dealt with the source material as something worthy of thoughtful consideration. Rather than dismissing the idea of transporters as an impossibility, Krauss conducted a systematic consideration of how they would operate, using this thought experiment to introduce a number of science topics. In this way, he emphasized the value of fantastical science in the context of informal science education.

"Real Science" and *Doctor Who*

The television series *Doctor Who* has a strong fan base and the show's narrative offers great potential for significant science content. Consequently, there are several "real science of" media tie-ins focused on it.

Produced by the BBC, *Doctor Who* has an elaborate canon, as its first run occurred between 1963 and 1989, and the new series has been ongoing since 2005. The show's protagonist is referred to as "The Doctor"—not, as the series name would indicate, "*Doctor Who*." To date, twelve different actors have played the role. The Doctor is a time-traveling alien from a race called the Time Lords. Like all Time Lords, The Doctor has the ability to regenerate, taking on a new physical appearance (and conveniently providing the narrative justification for the casting changes). The Doctor's time ship is generally trapped in the shape of a London police box and is called a Tardis, which stands for "Time and Relative Dimension in Space." The Tardis is much larger on the inside than it appears from the outside, leading some to hypothesize that it is actually a doorway to a wormhole, new dimension, or an alternative universe.

For each of the "real science" productions, I will consider the question of credibility—how both scientific authority and fannish authenticity are established, along with evaluating how science concepts are integrated with the fictional source material. This analysis includes one book and two hour-long television specials; comparison across media formats presents some inherent problems—obviously, the hour-long television specials have less room to provide detailed scientific explanations than a 342-page paperback. My purpose is not to compare these texts with respect to the volume of science-based information; rather, I am interested in how the producers of these works navigate the tension between fact and fiction in a genre devoted to explaining one through the lens of the other.

The Science of *Doctor Who* (2007)

In 2007, science writer Paul Parsons published an unofficial guidebook to the science of *Doctor Who*. This book, *The Science of Doctor Who*, is divided into four main sections that weave aspects of *Doctor Who*'s lore—its aliens, its technologies, and its cosmology—with discussions of relevant, real-world science research. The first section is "The Doctor in the Tardis," which covers some fundamental aspects of the show's premise, including the personality and biology of the alien Doctor and the basics of the Tardis as a time-traveling machine. The second section, "Aliens of London, and Beyond", features individual chapters discussing many of the most memorable aliens from the show. The third section, "Robot Dogs, Psychic Paper and Other Celestial Toys", covers the technological capabilities and inventions seen on-screen. The fourth section, "Mission to the Unknown", deals with the cosmology of *Doctor Who*. Individual chapters within each of these sections examine specific elements of the series and analyze the relevant scientific research those

elements evidence. Given that Parson's book is "unofficial"—that is, not published by the BBC—its front cover lacks visual cues that would attract *Doctor Who* fans and establish its legitimacy. There are no trademarked images or typefaces, no logo from the show itself, no image of the Tardis, and no photographs of any of the actors or recognizable trademarked elements of the show. This could be a barrier to reaching the book's target market. Instead of trademarked elements, the cover image of *The Science of Doctor Who* is an abstract blue design with a shadowy figure falling toward the design's center, evoking the falling Tardis and "wormhole-like" animation that features prominently in the show's opening credits. *The Science of Doctor Who*'s cover features bulleted text identifying some of the topics covered in the book that (apparently) cannot be pictured: the Daleks, the Tardis, the Time Lords, and the Doctor's robotic dog, K-9. At the bottom of the cover a quote from Colin Baker, one of the actors who has played The Doctor in the television series, vouches for the book's indispensability. These textual elements help to anchor the book as a text for fans, despite the missing visual depictions of key symbols from the show.

The cover of *The Science of Doctor Who* also promotes the fact that the forward was written by science fiction author and science writer Arthur C. Clarke. Although best known for his science fiction, Clarke published a number of nonfiction books on space travel and other science topics relevant to science fiction. As such, his introduction serves to establish the relevancy of Parsons' book to the intersection of science fiction and science fact. However, unlike *Star Trek* fan and guest star Stephen Hawking who contributed to Krauss's *The Physics of Star Trek*, Clarke is not interested in *Doctor Who*. He knew "many die-hard fans" and noted that "some have gone on to become top scientific experts in their chosen fields" (Parsons, 2007, p. xi). Rather than discussing *Doctor Who* itself, much of Clarke's forward to Parson's book is devoted to the debate about time travel—whether a time-travel story such as *Doctor Who* can be classified as "science fiction" or if it must be relegated to "fantasy". Clarke takes the latter position: "Science fiction is something that could happen—but usually you wouldn't want it to. Fantasy is something that couldn't happen—though often you wish it would" (p. xii). Yet ultimately, Clarke agrees that a science writer exploring a "fantasy-based realm" for scientific concepts could be rewarding for those interested in both science and science fiction.

In part, Parsons establishes the credibility of *The Science of Doctor Who* by referencing Krauss's *The Physics of Star Trek*. In his own preface, Parsons explicitly discusses this earlier text by Parsons, hoping that the reader will "find that [he has] done similar justice to the *Doctor Who* universe" as Krauss's did with his treatment of *Star Trek*. Parsons also outlines his qualifications as both a science writer and a fan of *Doctor Who* in the preface, writing, "I've been a *Doctor Who* fan since the early years of Tom Baker, a science writer and journalist since 1996, and a keen science student and post-grad researcher for almost a decade before that" (Parsons, 2007, p. xv). By treating all of these credentials as equally important, Parsons demonstrated his understanding of how the balance of science and fiction made Krauss's book successful. Parsons also emphasized that he contacted a variety of scientists as part of his research for *The Science of Doctor Who*, and that these scientists contributed information that appears throughout his text.

The organization of the book is respectful of both the show and the science. Each short chapter takes on a concept from the show—either a running theme or an incident from a specific episode—and describes relevant research on the topic. The chapter on regeneration, for instance, describes how The Doctor has been able to defy death through regeneration, then goes on to present research about the freshwater hydra, a small organism able to repair and regrow damaged body parts (Parsons, 2007, pp. 47-54). Chapter 16 covers an alien monster called the Krynoid, a hostile and carnivorous plant. This chapter includes information on the Venus flytrap, research on "plant neurobiology" (Parsons, 2007, p. 156), and genetic research into the possibility of "human-plant hybrids" (p. 159).

Of the three "real science" of *Doctor Who* productions being examined, Parson's book is the one that most closely follows the deficit model of science communication. Perhaps because this text does seem to embody the deficit model, this is also the one of the three examples that explicitly denies doing so. In *The Science of Doctor Who*'s conclusion, Parsons writes:

> It's probably somewhere around here too that I'm meant to say something profound about the noble pursuit of science [...] This book was written first and foremost to entertain, to boost enjoyment of the show, and to answer questions that it may have raised in the minds of intelligent fans. I hope I've fulfilled those aims. If I did manage to educate anyone along the way, I sincerely apologize. (Parsons, 2007, p. 317)

Here, Parsons denies that the aim of the book is to teach the reader a little bit of science and offers a tongue-in-cheek apology for doing so inadvertently. Although the text is successful in presenting a wide range of real-world science research through the lens of *Doctor Who*, "entertainment" and "education" are still presented as forces that may be in conflict, rather than mutually beneficial elements of the text.

The Science of *Doctor Who* (2012).

In 2012, BBC America aired an officially-licensed television special about *The Science of Doctor Who* (O'Connor, 2012), which, unlike Parsons's unofficial 2007 book, was able to make extensive use of the BBC's copyrighted materials. The one-hour special *The Science of Doctor Who* features interviews with actors and other media personalities as well as with scientists. It is peppered with segments entitled "Let's Ask the Scientist" as well as short clips from various *Doctor Who* episodes. No interviewer is featured on-screen; the documentary identifies interviewees when they are first introduced by including their name and job titles on the screen; clips from their interviews are split up and interspersed throughout the episode. Over the course of the special, the diverse group of interviewees discusses science-oriented themes from *Doctor Who*. When interviewees mention specific moments from *Doctor Who*, short clips from the episodes in question are intercut with the interviews. This provides a frame of reference for viewers who may not be familiar with or who may have trouble remembering the specific scenes being invoked. After each thematic segment, some of the interviewees vote on how likely it is that the science-fictional theme or technological advance will become reality; not all interviewees vote after each segment. Represented by Tardis icons at the bottom of the screen, the votes are presented on a scale of one to five, with

one indicating that that particular advance will be impossible for humanity to achieve and five indicating that it will definitely occur. Votes from scientists and non-scientists are weighted equally, ignoring the potential influences of scientists' specific disciplines.

The variety of interviewees includes scientists, actors, comedians, and members of the show's production staff. By featuring actual snippets of *Doctor Who* episodes as well as interviews with a variety of media personalities, *The Science of Doctor Who* foregrounds entertainment value over science education. At the same time, one of the documentary's interviewees, scientist and science popularizer Maggie Aderin-Pocock, noted that interest in *Doctor Who* can lead to interest in the sciences, proclaiming, "Watching *Doctor Who* made me the space scientist that I am today!" (O'Connor, 2012). The other scientists interviewed in *The Science of Doctor Who* also articulated their familiarity with and interest in the series. Nowotny's (2005) concern that media tie-in products erode the important barrier between science and non-science can also be observed here in O'Connor's *The Science of Doctor Who*, which makes little effort to privilege the knowledge of scientists over that of actors and comedians.

Although this approach may undermine the program's science legitimacy, this style of presentation—that is, treating the opinions of scientists and non-scientists as of equal merit—does have an advantage; it suggests that science and difficult concepts are nothing to fear and they are easily accessible to anyone—scientist or not—who wants to learn about them. O'Connor's *The Science of Doctor Who* presents viewers with scientists, actors, and producers who are all interested in and grappling with wild concepts from *Doctor Who*, which, as the non-scientists acknowledge, is not an easy thing to do when it comes to concepts such as understanding space-time.

The Science of Doctor Who with Brian Cox (2013)

The Christmastime special *The Science of Doctor Who with Brian Cox* (Cohen & Harrison-Hansley, 2013) features a lecture by well-known physicist and science popularizer Brian Cox, delivered before a live audience at the Royal Institution of Great Britain (RI). The RI was founded in 1799 and is known for supporting public engagement with science through a variety of initiatives, including a Christmas lecture series (founded in 1825); these public lectures are intended to present a scientific topic to a general audience, with special attention paid to young people (Royal Institution of Great Britain, n.d.).

Cox introduces his talk by discussing the RI Christmas lecture of 1860, Michael Faraday's "The Chemical History of the Candle." Cox is speaking at the Royal Institution during the holiday season; by drawing on the history the Christmas lecture and its role in science popularization, Cox establishes credibility for his own lecture. He says, "This building, this lecture theatre, has a past that is inextricably bound up with our present and our future. Not only through the great discoveries that have shaped our scientific civilisation, but also through the countless generations of children and adults alike who've been inspired, by lectures given in this theatre, to explore nature and to find new worlds to conquer" (Cohen & Harrison-Hansley, 2013).

Cox's summary of Faraday's lecture itself also establishes a narrative structure for his

presentation. Cox admits that if he had access to a working time machine, he would like to visit the RI in 1860 so he could see Faraday's lecture in person; he returns to this fantastical goal several times to illustrate various concepts, such as the speed of light and the geometry of spacetime.

As in the 2012 television special, this BBC-produced program intersperses scientific information with fictional content about *Doctor Who*. In a creative twist, however, this program does not use existing clips from the show. Rather, *The Science of Doctor Who* with Brian Cox features a series of scripted scenes that show conversations between Cox and the 11th Doctor (played by Matt Smith). The two men banter in the Tardis, discussing matters of time travel and space exploration, and the Doctor invites Cox to take the position of his assistant. Thus, Cox's legitimacy to speak on matters related to *Doctor Who* is not based on childhood fandom or any particular knowledge of the show; Cox is given approval within the fictional universe by The Doctor himself. Through these scenes, a fictional "Brian Cox" character is created, one who can visit with the Doctor and travel with him. Suddenly, Brian Cox is not merely explaining the science of *Doctor Who*—he may be the closest thing that we have to a real Time Lord, or at least a companion.

Unlike the more casual discussion of time travel that appeared in O'Connor's *The Science of Doctor Who* (2012), Cox's content is more narrowly focused on the physics necessary to discuss the possibility of time travel. This refined scope allows Cox to undertake a more in-depth presentation of the science behind time travel, and because Cox is giving an actual lecture before a live audience, there is no pretense that this program is not meant to be educational. However, the educational orientation of the television special does not necessitate the rejection of the science-fictional elements. The detailed explanations of scientific ideas are interspersed with the scripted, fantastical scenes from inside the Tardis and, in closing, Cox moves the lecture itself explicitly into the area of speculative science:

> Could we design some configuration of matter and energy that would curve the light cones around, so I could get back into my own past? The answer is: We don't know. But nobody has been able to prove that it cannot exist, at least in principle--although most experts believe that it must in some way be forbidden. But there's still the faintest possibility, given the laws of physics as we understand them today, that someone, someday, maybe a young girl, a young boy, will be inspired to try. And even if they fail, by the very act of trying they might just go on to change the world. (Cohen & Harrison-Hansley, 2013)

Cox provides a clear distinction between known science and speculation; he is also explicit about his goal of inspiring children to investigate the wonders of the universe. In Cox's model of the relationship between science fiction and science communication, science fiction can provide the sense of awe and wonder that can inspire young people to reach for the stars.

Conclusion

This paper has employed analysis of three "the real science of" media tie-ins to the *Doctor Who* franchise to suggest that there are several elements that science communicators should consider in developing or evaluating projects such as these, namely the needs: to clearly delineate between fact and fiction; to establish the credibility of science communicators; to create an authentic

product; and to carefully evaluate methods of science communication prior to undertaking them. The demarcation between science and non-science should be clear. Impossible or wildly improbable science should be labeled as such and then explained with careful attention to the fictional world. Individuals interviewed or quoted in media tie-ins should be clearly identified by name and their credentials as science communicators established. This will allow the audience the chance to evaluate critically the contributions of each participant, and this itself is an important element of science literacy. Media tie-ins—be they books, lectures, or exhibits—must take an authentic, respectful, and thorough approach to the examined work's world of science and its fictional universe. Authors and producers of "real science of" media tie-ins should consider the models of science communication they ultimately employ, so that decisions regarding how to incorporate science facts into a fictional narrative are made with clarity.

Scholars of science communication should continue to consider fictional entertainment media, particularly science fiction, as one venue for science communication alongside the more commonly-studied science journalism. Just as a newspaper article cannot be evaluated with the same criteria as a textbook, "real science of" media tie-ins constitute a unique form of science communication that must be considered on its own terms. These efforts demonstrate that looking at science through the lens science fiction could provide useful tools for science communicators who aim to promote to science literacy and the popularization of science. The inspirational influence of science fiction is a powerful tool for public science communication.

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Although it is usually written as TARDIS, the book examined below identifies it as a "Tardis" (without the capitals), so that usage has been adopted throughout the remainder of this paper.

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A Comparison of Dystopian Nightmares and Utopian Dreams: Two Paths in Science Fiction Literature That Both Lead to Humanity's Loss of Empathy

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Abstract

Science fiction literature has long dreamed of extravagant utopias and dreaded nightmarish dystopias. Authors from the birth of the genre to more current times find the erosion of empathy to be the downfall of either extreme form of society. On the one hand, George Orwell's tyrannical climate of *Nineteen Eighty-Four* (1949) and the punitive society found in Ray Bradbury's *Fahrenheit 451* (1953) may seem very different from the hedonistic faux-paradise of Aldous Huxley's *Brave New World* (1932) and the fallen society of Margaret Atwood's utopia-turned-dystopia in *Oryx and Crake* (2004). However, whether a fictional world is allowed to go too far into utopian dreams through drug use, hyper-sexualization and the like, or whether it is all repressed into a dark authoritarian regime, members of each societal type undergo a loss of empathy which eventually becomes the downfall of civilization. It is notable as well that in both novels where science progresses rapidly without the check of ethics, such as H. G. Wells's *The Island of Doctor Moreau* (1896), and in literature where androids or modified human beings become too advanced for mankind to keep in the confines of a lawful society, such as Philip K. Dick's *Do Androids Dream of Electric Sheep* (1968), it is the lack of empathy that causes death, destruction, and/or social disconnection and psychopathy. Though the pleasurable aspects of utopian classics and the unpleasant facets of dystopian books appear at first to be polar opposites, they similarly portray collapsing societies that have lost their sense of empathy.

Keywords: *utopia, dystopia, science fiction, empathy, emotion, ethics, humanity, socialization*

Upon first glance, oppressive totalitarian regimes and worlds fueled by mindless hedonism seem to be at opposite extremes of the science fiction spectrum. However, both utopian fiction and dystopian fiction present two separate roads that eventually lead to the same erosion of interpersonal connection and empathy. From early science fiction like H.G. Wells's *The Invisible Man* to Margaret Atwood's *Oryx and Crake*, the dulling of characters' pro-social emotions is a key component of the genre and carries important implications for real world societies.

Anaïs Nin, in *The Novel of the Future* (1986), questions and discusses the initial reasons why authors choose to write science fiction from a social point of view. She argues that, in this age and going back just beyond the turn of the century, "we are fearful of looking inside of ourselves" and takes the broad view that "nations have neuroses as do individuals" (Nin, 1986, p. 29). Indeed, there is much discussion in the literary community over the ways in which science fiction has come about as a sign of the times while technology continues to advance rapidly. The often alienating nature of life

in a modern, industrialized nation has led to a lack of interpersonal contact that Kafka often depicted in his work and came to describe as "the nightmare of man's anonymous cities" (Nin, 1986, p. 167).

Such a sentiment is backed up by renowned social critics like Jeremy Rifkin (2009), who notes that many people living in the modern world are fueled by either faith in God and the belief that salvation awaits after death, or the capitalistic conviction that "a material utopia lay just ahead on Earth" (p. 317). Rifkin doesn't shy away from analyzing the effect these trends have on the individual in society, concluding that the greater one's sense of isolation, the less one can emotionally connect with others, which, in extreme circumstances, will lead one to either rage against others or to turn inward in self-inflicted social withdrawal (2009, p. 120). Many speculative fiction authors write about these extremes and follow the nightmares through to their darkest conclusions. Science fiction, in that sense, can be read as a societal safeguard, or an attempt to show negative and frightening possibilities of the near future so that they become a part of society's collective consciousness in hopes of preventing such nightmares from becoming a reality.

Much early science fiction deals with the notion of scientific pursuits being carried on without any restraint regarding its greater consequences or ethical considerations. H.G Wells showcases this age-of-reason type of utopia in some of his early works, such as *The Invisible Man* (1897). In this classic novel, *The Invisible Man* is seen as a freak to the people of the village in which he arrives. The masses reflect an invasive type of curiosity, with Wells using the language, "cried everyone," to describe the entirety of a crowd calling for him to be captured against his will (Wells, 1897/2014, p. 48). *The Invisible Man*'s humanity quickly erodes as he realizes he is an outcast who cannot truly survive in the normal world anymore. He discovers that the few people who will accept him warily want to use him to commit crimes and for their own selfish needs. Fed up with society, he lashes out at the public and goes on a rampage "breaking in the windows in Coach and Horses, and then he thrust a street lamp through the parlour window of Mrs. Gribble" (Wells, 1897/2014, p. 75). Once again a fearful mob forms, "shouting in the street[…] bolting into houses and slamming doors" (Wells, 1897/2014, p. 90).

The Invisible Man seeks out the scientist, Dr. Kemp, where he is initially treated as a miraculous discovery whose "freedom should be respected" (Wells, 1897/2014, p. 106). However, Dr. Kemp quickly recognizes how *The Invisible Man*'s increasing psychopathy has atrophied his common sense. This is described as "rage growing to mania" as Dr. Kemp speculates about what *The Invisible Man* might eventually do (Wells, 1897/2014, p. 110) and concludes that not even he can aid such a broken individual.

Dr. Kemp can be seen as a representation of the ethical safeguard against potentially dangerous new technology; *The Invisible Man* serves as the symbolic obsession with progress, skipping past all ethical considerations, and he ends up becoming disturbingly fanatical and sociopathic until his eventual murder. Science fiction critic Mark R. Hillegas (1967) describes this high price that *The Invisible Man* pays for his dangerously experimental pursuit of science as the "loss of all human sympathy" (p. 38), and even goes as far as to say that he is a "perfect symbol of a science without humanity" (p. 39).

In a similar vein, Wells's *The Island of Dr. Moreau* (1896) chronicles the life of a secluded scientist carrying out experiments on a hidden island in order to turn animals into humanoid creatures. While Dr. Moreau shows a certain amount of protective care and nurturing towards his creations, this attitude is hauntingly contrasted by the amount of physical pain he inflicts on fellow life forms. In fact, before retreating to his island, journalists had described him as "wantonly cruel" with his work going against "the conscience of the nation" (Wells, 1896/2016, p. 32). He seems to think of his torturous surgical procedures as a simple bump on the road towards reaching his scientific goals, saying that pain "is such a little thing! A mind truly open to science must see that it is a little thing" (Wells, 1896/2016, p. 76.) Hillegas (1967) sums this up well in stating that "Moreau's activities foreshadow anti-utopian nightmare states where rulers, free of all ethical considerations, employ biological, chemical, and psychological conditioning in order to maintain total control over their citizens" (p. 37). The Beast Folk, as Wells names Moreau's creations, are symbolic of dehumanized people. They are treated with cruelty and condescension, living by sets of "laws" determined by Moreau that echo cult-like religious beliefs, such as "His is the hand that wounds. His is the hand that heals" (Wells, 1896/2016, p. 61). While they try to adapt to the imposed pseudo-civilized lifestyle, they tend to revert back to feral states unpredictably. They have been tortured and maimed, brought together unwillingly to form a society that they can't quite understand, and are often fearful and quick to lash out in rage. They describe themselves as often struck by the desire to "kill and bite, deep and rich, sucking the blood," so they follow Moreau's strict vegetarian diet and rules for living together because they know that "It is bad" to behave savagely (Wells, 1896/2016, p. 63).

This fragile arrangement can be seen to represent the possible outcome of a society becoming overly reliant on scientific pursuits and ruled by logic rather than ethical considerations. When citizens are forced to advance in rapid scientific leaps without regarding their individual and collective human rights, the nightmare becomes one of suppressed rage, fear, and eruptions of violence. The society falls apart because it has not taken into account empathy for its inhabitants, and as Nin (1986) points out, this trope is "an expression of schizophrenic insensitivity, a need to feel things violently because the sensitivity is atrophied" (p. 35). In fiction, science is often divorced from ethics and leads to the same conclusions: humanity must keep empathy alive or else it risks its members unscrupulously turning on one another.

Following Wells's later, more typically utopian novels, Aldous Huxley was inspired to write a reactionary novel that would show a much darker possible future than was popular in fiction at the time. Huxley wrote *Brave New World* (1932) to showcase what would happen to society and its individuals if they existed in a "hedonistic ersatz paradise[…] where absolutely everything is a consumer good and human beings are engineered to be happy" (Atwood, 2011, p. 148). Noted contemporary speculative fiction author, Margaret Atwood, refers to this strange utopian shallowness as a society which encourages one to "wallow in pleasures" (2011, p. 148). On the heels of the industrial revolution, *Brave New World* allows the reader a glimpse into what the world would be like if everyone were genetically engineered specifically for their jobs and stations in society, and chemically kept content with their position. The heavy emphasis on consumerism is perhaps a reaction to the boom in capitalism around the time of the industrial revolution, when anything

seemed possible and industrialized nations were experiencing significant growth and advancement.

Huxley also seemed to pick up on early hints of the sexual revolution, poking a bit of satirical fun at the idea of recreational sex taken to its utmost extreme. Sex in *Brave New World* is no longer about relationships, families, or procreation but, rather, has become a universally-defined normal social activity lacking any deeper meaning other than simply physical pleasure. Past notions of monogamy and love held standard by "pre-moderns" are described as "wicked and miserable" urges that "didn't allow them to take things easily, didn't allow them to be sane… forced them to feel strongly" (Huxley, 1932/2006, p. 41). It is understood that through "feeling strongly (and strongly, what was more, in solitude, in hopelessly individual isolation), how could they be stable?" (Huxley, 1932/2006, p. 41).

People in this futuristic society have replaced these emotions through a cinematic experience dubbed the "feelies" in order to take a pleasure-inducing drug and experience pleasant emotions during these films, filled with sexual scenes, slapstick comedy and propaganda to promote consumerism and its shallow values. This feel-good drug, Soma, leads the viewer to describe even violent, action-packed scenes as "almost intolerable galvanic pleasure" (Huxley, 1932/2006, p. 168).

When people die in this society, there are no bad feelings, as there are no family ties or deeper relationships with others. They have been robbed of empathy and all of their emotional focus is geared towards being happy with their position in life and enjoying hedonistic pleasures rather than meaningful pleasures such as love and connection. Aging is carefully controlled, involving balancing hormones and preventing diseases, metabolism stimulation, and other procedures to create the experience and appearance of "Youth almost unimpaired till sixty, and then, crack! the [sic] end" (Huxley, 1932/2006, p. 111). Interestingly, however, to prevent people from inward withdrawal and, perhaps, to keep them from reflecting on how hollow their lives are, being alone is taboo. Superficial yet constant social interaction is highly encouraged and being too unique or desiring alone time is entirely unacceptable. This keeps the society conditioned to work together to produce and consume in an endless loop, and ensures that no one strays too far from the mold by offering constant means of superficial pleasure and enjoyment. After all, this is a world where people are seen as disposable because they can "make a new one with the greatest ease" and those in charge firmly believe that "unorthodoxy threatens more than the life of a mere individual" (Huxley, 1932/2006, p. 148).

Huxley's utopian nightmare here is not so much one of isolation, but as the outcome of forced socialization and the near-impossibility of an option to withdraw and reflect, or respond in rage. Noted psychology professor and founder of a branch of neuroeconomics studies, Paul J. Zak (2012), has written extensively about the ways in which the bonding hormone oxytocin encourages people to connect emotionally and physically by rewarding the brain with positive feelings. He states that a "fixed idea" of "rational self-interest" can lead to "deeply entrenched abstraction" and halt the positive evolutionary traits that otherwise come along with social connection (Zak, 2012, p. 189). *Brave New World* showcases this idea terrifyingly well, as the reader is shown the lack of empathy and how people have turned solely to pursuits of self-interest such as constant shopping and orgiastic sex. The drugs this society takes produce feelings of comfort and pleasure, but there is no

deeper emotional interconnection with others or reflection on the self, and the reader is likely to see this as not much more than a pointless, meaningless existence.

Social thinker Rifkin (2009) points out the flaw in the idea of creating a "perfect" society stuck in stasis and void of negative feelings by simply stating that "empathy does not exist in utopian worlds, where suffering and death are eliminated" (p. 345). While dystopian literature is often the first subject to come to mind when one speculates on what a world without empathy might look like, utopian literature takes a different road but ends up with the same frightening conclusion. Rifkin (2009) notes,

> The empathic impulse is an acknowledgement that each life is unique and therefore precious, that all living creatures are vulnerable, subject to pain and suffering, and eager to be and thrive. Empathy smacks of mortality, is oriented by the smell of death and is directed to celebrating another's life. (p. 345)

Huxley's now famous utopia presented in *Brave New World* conditions the fear of death out of humans when they are very young, attempts to take away pain and suffering through chemical means, and takes the eagerness to experience life away, only to be replaced by a genetically-designed sense of contentment. All of these conditions add up to create the classic that is still commonly listed as one of the greatest books of the 20th century. People continue to eagerly read *Brave New World* because it speaks to what could happen if the world tried too hard to create social perfection. The answer remains the same: once empathy is gone, true fulfillment becomes impossible and a hollow existence is all that is left in the wake of such strict social engineering, even when it seems geared toward peace and pleasantries. A society where members are designed to get along, perform their designated tasks, and exist in a consistently happy state leaves too much room for members to flee and become outcasts or cruelly turn on the individuals who do not fit the high expectations for social perfection.

In stark contrast to the hedonistic surface-level utopia featured in much of Wells's and Huxley's work comes George Orwell's widely-read classic, *Nineteen Eighty-Four* (1949). Written shortly after *Brave New World*, Orwell's novel opens without the pretense of a perfect or even peaceful society. *Nineteen Eighty-Four* dives straight into the dark, seedy underbelly of a world stuck in constant war, haunted by invasive government surveillance and under totalitarian control with brutal consequences for those who break the law. The government's three party slogans are chillingly: "WAR IS PEACE," "FREEDOM IS SLAVERY," and IGNORANCE IS STRENGTH" (Orwell, 1949/1961, p. 4). This society is so far beyond the basic human rights one equates with democracy that the tyrannical Big Brother even sets to work hist*Ory* revisionists, so that not even the past is safe from manipulation and brainwashing. The world of Oceania depicted in *Nineteen Eighty-Four* has become a common reference point through the ages, coining phrases and ideas that continue to remain relevant in social and political discourse. In Oceania, strict militaristic law and conformity are prized above all. Loving relationships are forbidden and replaced entirely with loyalty to the state. As literary critic Daphne Patai (in Bloom, 1987) puts it best,

> The novel itself, after all, may be viewed as a demonstration of the incredible coercive forces that need to be brought to bear upon human beings to reduce them to their worst possible

> selves: the constant spectacle of hysteria; the sanctioning of the intimacy of pain, fear, and hatred and the prohibition of the intimacy of friendship and love; the continual material deprivation; the impediments placed in the way of genuine thought. (p. 63)

Patai takes this idea further, citing how Orwell's nightmare society used games to indoctrinate children into strict modes of behavior (in Bloom, 1987, p. 63). Such conditioning is the exact recipe for turning normal human beings into fear- and anger-based people on the verge of complete psychopathy. Rifkin (2009) explores this idea in his writings on what it means to be human, stating that teaching empathy is "the substance of human morality— [leading to] responsibility for one's actions… and a proper sense of fair play and justice. The maturation of empathy and the development of a moral sense are one and the same thing" (p. 119). By gearing children's play towards specific games that are designed to mold them into submissive members of a repressive regime, it effectively suppresses and hinders the development of empathy for a lifetime. Dissenting members of Oceania's society are punished for having behavior or even thoughts that do not toe the party line, and in this way empathy is treated like a persistent cockroach infestation: it is constantly being exterminated and any traces left are immediately stamped out. As a fearful character describes, going against society brings the Thought Police and, "It would not matter if they killed you at once. To be killed was what you expected" (Orwell, 1949/1961, p. 103).

In *Nineteen Eighty-Four*, the reader is shown what happens when citizens of the state act subversively. The protagonist, Winston Smith, falls in love with Julia, a young woman who acts in conformity but hides her secret desires for sex and other forbidden aspects of human nature. When his "thoughtcrime" of being in love is discovered, Smith is tortured for "inner disloyalty to the state" (Atwood, 2011, p. 144). He is so broken down that he gives up Julia in order to save himself from unthinkable pain and agony. What remains is a sad shell of what can hardly be called a human being anymore, as Winston becomes brainwashed into fully believing "two and two make five and that he loves Big Brother" (Atwood, 2011, p. 145). Orwell continues to haunt the world's psyche as his work is read in homes and classrooms across the world, powerfully showing society the nightmare it must avoid at all costs. Even in modern politics, when the U.S. National Security Agency was found to be spying on American citizens, much of the public seemed to collectively cry out: "We will not stand for Big Brother in our world." In this way, not only does Orwell show society the danger of a dystopian world, but he safeguards society by giving people the language and the images to express objection when those in power seem to have taken their positions a bit too far beyond the lines of democracy and the people's given human rights. Atwood notes this when she explains, "with the notorious 9/11 World Trade Center and Pentagon attacks in 2001[…]Now it appears we face the prospect of two dystopias at once—open markets, closed minds—because state surveillance is back again with a vengeance" (2011, p. 148). This chilling idea is felt throughout the collective consciousness of America even more than a decade later, as the ghost of Orwell seems to loom above to remind humanity to stay on the path of empathy and human connection, and keeps trying to correct when freedoms are taken away and fear-mongering politicians insist on more power and stronger punishments. However dark and harrowing

Orwell's dystopian novel is, it serves the function of reminding humanity that not all hope for civilization to survive is lost until all empathy is lost.

Several years after Orwell's nightmare first gripped the world, Kurt Vonnegut published the novel Player Piano (1952). Vonnegut took on the theme of automation arising in society as more and more assembly-line and fact*Ory* jobs became mechanized following World War II and the economic stability that came after The Great Depression ended. Inspired by the idea of a world where the working class has no employment opportunities left, Player Piano differs from earlier science fiction nightmares in that "Vonnegut's [nightmare] seems closer to [be]coming reality as we may come to know it" (Hillegas, 1967, p. 162). Indeed, it is easier in the new millennium to picture machines replacing much of human work than to imagine a whirlwind Orwellian nightmare where totalitarian regimes spread to the point of destroying humanity. Hillegas (1967) also notes that, "It is not, however, science itself which is the villain in Player Piano, but the development and application of the technology, which has proceeded lawlessly without consideration of its effect on human life and human values" (p. 162). Hillegas proceeds to classify this novel as an anti-utopia, rather than a dystopia, for not all is lost to complete tyranny.

Issues arise when, as in much of Wells's earliest work, progress is valued over ethics. Displaced workers are forced to live in The Homestead, a mass housing unit where they get by, but at the cost of a purposeless, meaningless existence. The citizens are described as moving "with an air of sheepishness and, as though there were nothing but time in the world," (Vonnegut, 1952/1999, p. 24). Their emotions have become dulled because they have nothing to contribute anymore, effectively becoming a society of outcasts. Many are so brainwashed by the idea of progress in the novel that it ends with only an attempt to overthrow the system, as the masses haven't the free-thinking ability to realize they are part of an oppressive society, where their emotions have been conditioned and paranoia replaces empathy. This is shown by acts such as one citizen "going around town with a shotgun, blasting nothing but those little traffic safety boxes" (Vonnegut, 1952/1999, p. 330) and "wrecking practically everything" material (Vonnegut, 1952/1999, p. 336) in order to lash out at the lack of meaningful work due to automation. The people in this society have destroyed so much that they feel their work is done because they had dealt "a savage blow to a close little society that made no comfortable place" for the individual (Vonnegut, 1952/1999, p. 340). However, the novel then closes abruptly on arrests and the authorities rather calmly asserting that "This isn't the end[…] nothing will ever be—not even Judgement Day," (Vonnegut, 1952/1999, p. 341). This implies that the near-collapse of their system will simply be brushed over as the same authorities remain in power.

Ray Bradbury's *Fahrenheit 451* (1953) was published around the same time as Vonnegut's anti-utopia, and depicts a disturbing world where empathy has been ripped out of the cultural psyche. Through techniques of dialogue, physical descriptions, as well as direct actions and consequences, Bradbury follows Montag's growing empathy while continually reinforcing the lack of it in both his personal life and his world as a whole.

Bradbury utilizes both dialogue and physical descriptions of characters to demonstrate the way in which empathy has deteriorated into a culture dominated by self-interest. When Montag begins

to first experience the birth of empathy inside of himself, he looks at the firemen "whose faces were sunburnt by a thousand real and ten thousand imaginary fires, whose work flushed their cheeks and fevered their eyes" (Bradbury, 1953/2013, p. 31). He describes their "charcoal hair and soot-colored brows and bluish-ash-smeared cheeks[…] The color of cinders and ash about them, and the continual smell of burning from their pipes" (Bradbury, 1953/2013, p. 31). This symbolically shows the reader that the firemen and the fire are one force: destruction. Montag then reflects on that and realizes, "These men were all mirror images of himself" (Bradbury, 1953/2013, p. 30). He suddenly begins to feel a surge of empathy for the man whose library they had recently burned, and learns that the victim was forcibly committed to a mental asylum. Beatty, head of the firemen, replies, "Any man's insane who thinks he can fool the government and us" (Bradbury, 1953/2013, p. 31).

This one exchange creates a macrocosm where Montag is described as one of the many affectless firemen, except that now he is beginning to experience empathy for the first time. He then goes on to explain this to the others, stating, "I've tried to imagine just how it would feel. I mean, to have firemen burn our houses and our books" (Bradbury, 1953/2013, p. 31). The lack of empathy present in Montag's world is reinforced further when the firemen respond simply that they don't have any books, and then immediately accuse Montag of harboring literature himself. The instant denial and accusation serves as a reminder of how dangerous it is for Montag to develop empathy in a world of psychopaths, as well as showing the reader that the oppressors themselves are willing to kill a member of their own team without much thought, should he simply appear subversive.

The character of Millie, Montag's simple-minded wife, provides ample opportunities for Bradbury to show through dialogue and physical descriptions how Montag's own personal microcosm reflects the society without empathy as a whole. When Montag brings home books secretly, Millie violently protests until they reach a book with the words "That favorite subject, myself" (Bradbury, 1953/2013, p. 68). That is the one sentence she can understand out of everything, and she becomes interested in books only when that line is read to her. Montag then remembers the strange young girl he met at the beginning of the novel, and replies "But Clarisse's favorite subject wasn't herself. It was everyone else, and me. She was the first person in a good many years I've really liked" (Bradbury, 1953/2013, p. 68). This exchange shows that Montag is suffering in his home life because he is beginning to learn what empathy is and to feel it inside of himself, while his wife is presented as only thinking of herself in all interactions. This is later reinforced when Millie calls Montag "silly" after he asks her if she loves him. She then casually redirects the conversation and suggests that Montag kick a dog she doesn't like (Bradbury, 1953/2013, p. 73). The cruelty of the remark is of little surprise to Montag, however, as Millie had already mentioned to him that she often takes the car out in the middle of the night to speed recklessly, ending with the chilling statement, "It's fun out in the country. You hit rabbits, sometimes you hit dogs" (Bradbury, 1953/2013, p. 61).

Millie's circle of friends provides another wonderful vehicle for Bradbury to showcase the psychopathic tendencies deeply ingrained into Montag's society as a whole. This group of gossipy women visit Millie frequently and openly discuss their children as objects to be ignored, stating things such as, "You heave them into the 'parlor' and turn on the

switch. It's like washing clothes; stuff the laundry and slam the lid" (Bradbury, 1953/2013, p. 93). They also reveal that their political leanings are based solely on arbitrary traits and hollow status symbols: they all voted for the man with good looks, a fancy sounding name, and even brought up the fact that the opposing candidate had been seen picking his nose (Bradbury, 1953/2013, p. 93). Furthermore, one of Millie's friends hauntingly describes the complete lack of empathy within her marriage and the casual attitude they all share towards war in a conversation where she explains, "Pete and I always said no tears, nothing like that. It's our third marriage each and we're independent. Be independent, we always said. He said, if I get killed off, you just go right ahead and don't cry, but get married again, and don't think of me" (Bradbury, 1953/2013, p. 91). It is no wonder that Montag looks at them and thinks, "They were like a monstrous crystal chandelier tinkling in a thousand chimes, he saw their Cheshire cat smiles burning through the walls of the house…" (Bradbury, 1953/2013, p. 89). Once again, Bradbury is able to use physical description and dialogue to cleverly mirror Montag's shift of consciousness as he becomes more empathic.

Another method Bradbury uses to demonstrate an emotionally impoverished society is through direct actions and consequences. One strong example of this is found in the Hound, a mechanical creature which seems from the very start to be programmed to only dislike and threaten Montag. The Hound is a machine designed in the image of an attack dog, except that it has eight eerie spider-like legs and a needle-tipped proboscis which injects its victims with an enormous amount of strong painkillers. The other men in the firehouse participate in a hobby where they sit around and loose stray animals such as cats for sheer amusement value. The Hound does not kill them, interestingly, or even cause physical harm at all. Instead, its attack produces a surge of heroin-like euphoria in its victims. It pacifies them and makes them feel artificially blissful. The firemen then take the body of the animal and throw it into the incinerator. This process is repeated and referred to as a "game" for when "nights got dull" (Bradbury, 1953/2013, p. 22). Montag, being the only fireman the Hound growls at and stalks, starts to develop empathy for the living, breathing creatures which are treated as objects to be discarded for amusement.

It becomes clear later in the novel that the Hound was programmed by Beatty to constantly threaten Montag. However, The Hound isn't a symbol of the threat of death alone; it implies something even more disturbing. The Hound is a looming reminder that not only will Montag be killed if he develops empathy, but that in his final moments, his own empathy will be stolen away from him. Should the Hound catch Montag, Montag would not get to die with his sense of justice and outrage intact; he would be artificially drugged into a feeling that mimics pure happiness, and then incinerated in that state. Bradbury is showing the reader that not only is this society capable of brainwashing people into obsessive self-interest and killing them if they dissent, but they also will go as far as to chemically manipulate people out of empathy. The fact that the Hound does this the moment before death, instead of simply injecting them with lethal poison or a heavy tranquilizer, is a very subtle yet deep message on Bradbury's part. It shows that the culture will take away empathy simply out of principle, for no practical purpose.

Beatty uses the Hound as the final weapon against Montag, and the Hound pursues Montag until the climax, where it is described on the news that

the "Mechanical Hound never fails. Never since its first use in tracking quarry has this incredible invention made a mistake" (Bradbury, 1953/2013, p. 126). This is a hint to the reader that many before Montag have developed empathy and subsequently been tracked, drugged into a false emotional state, and then killed. Bradbury is emphasizing that this culture is not simply oppressive and murderous. This is a world where those in power will go to asinine lengths, such as inducing bliss right before death, just to make sure that it's not simply the person that dies; empathy itself is what the firemen are focused on killing. The subversive emotional state is stripped away from people's minds and happiness is physically forced into them by a robotic predator. The person's body is then treated as a defective object which is "tossed into the incinerator" (Bradbury, 1953/2013, p. 22). The Hound is a masterful symbol on the part of Bradbury, showing just how psychopathic the world around Montag has become, as well as how incredibly dangerous cultivating empathy is for Montag and others like him.

Bradbury's writing is able to depict clearly and viscerally just how important empathy is in order for a society to function healthily. Empathy serves as "an ethic for living. It's a means of understanding other human beings—as Darwin and Ekman found, a universal language that connects beyond country or culture. Empathy makes us human" (Pink, 2006, p. 165). The eeriness of the Hound's euphoric needle, the hollow values of Millie and her social circle, Montag's naïve struggle to explain to the other firemen that he is starting to wonder what it would feel like to have his belongings burned— all of these elements come together to paint a masterfully dark picture of what a society without empathy would look like, and Montag has convinced generations of readers that it is a value worth fighting for at all costs.

It would take a few years for another science fiction writer to come along and present some very dark, yet poignant, views of the future from a more high-tech standpoint. Philip K. Dick never shied away from viewing the future as a potential nightmare. Perhaps his most widely read novel, *Do Androids Dream of Electric Sheep?* (1968), raises the question of whether robotic beings embedded with memories are actually feeling their emotions or are simply acting out their elaborate programming (Atwood, 2011, p. 133). Furthermore, it spurs the question of not only what makes us human, but also what would happen if such genetic programming were available to the masses. Atwood, like many other speculative fiction authors and critics, believes that "Our achievements won't be 'ours'" and things will quickly go awry if the day comes when "we won't have to strive for mastery" (2011, p. 133).

Visionary author and critic Thomas M. Disch (1998) breaks down the reasoning behind Dick and other authors writing about robots and artificial intelligence. He states that "the robot has been a dramatically effective emblem of the possibility that a machine could think, thereby usurping what was supposed to be a human prerogative" (p. 214). He also argues that, "Better than any SF [or, science fiction,] writer of his time, Dick understood that science fiction is not about predicting the future but examining the present" (Disch, 1998, p. 91). This concept is crucial when it comes to understanding the progression of science fiction through the ages, from early utopias to classic dystopias, all the way up to newer offshoots of the genre such as cyberpunk or steampunk. Science fiction authors tend to pick up on the current trends in not only

science but every aspect of culture including government control, genetically altered food, and questions about up and coming technology. Disch goes on to describe this finger-on-the-pulse phenomenon as causing the reader to develop "a kind of double vision, savoring the wilder flights of fancy but aware, all the while, of the authors' direct hits on contemporary targets" (1998, p. 91).

Philip K. Dick suffered from a severe mental disorder that colored his fiction with strange elements and made life extremely difficult for him. His own struggles to understand reality and his psychotic breaks gave him a persistent need to write about what is "real" and how things can be seen from so many different viewpoints. However, *Do Androids Dream of Electric Sheep?* is a finely focused novel that was turned into a film before Dick's own death, and has caused millions of people to understand the conundrum inherent in asking what it is that truly makes us human. Dick debuts in his novel the protagonist Rick Deckard, an official bounty hunter for replicant androids. The major moral dilemma of the book is the fact that these androids are so close to human, physically and in terms of free-thinking capabilities, that it is nearly impossible to tell them apart from organic human beings. The government had originally created these androids in order to have them serve on Mars. However, they quickly became so close to human that widespread fear they might take over saw them banned from Earth and hunted down to be retired. They are never referred to as being killed, although on the outside they appear so human that it is highly disturbing when an android is finally discovered and "retired" (Dick, 1968/1996, p. 31). The word choice here causes the reader great distress in imagining what it would be like to be a programmed, yet feeling, creature on the run from humankind. Deckard himself thinks of it in the chillingly and ironically opposite manner, musing, "Empathy… must be limited to herbivores or anyhow omnivores who could depart from a meat diet… Evidently the humanoid robot constituted a solitary predator" (Dick, 1968/1996, p. 31).

Interestingly enough, in *Do Androids Dream of Electric Sheep?*, the crux of the decision on whether a being is human or android is the Voigt-Kampff Empathy Test (Dick, 1968/1996, p. 29). This measures purely a being's empathic response—and throughout the novel, as in many other science fiction greats, being human in an age of high technology is determined by whether the being can feel empathy or not. The test measures how quickly a being responds empathically, as the androids have become so intelligent that they can easily fake a response; thus, often the test results come down to simply the tiny delay in time when a subject elicits a response. This not only causes great doubt in the accuracy of the test, but also brings up the issue of beings that turn out to actually be human but lack the proper empathic response or simply hesitate for other reasons. The reader is shown how difficult it is to measure empathy at all, since the scale of human emotions is large and such a data-reliant test cannot ever be one hundred percent accurate.

Perhaps the most distressing moment in Dick's novel comes when Richard Deckard is sent to retire a well-known opera singer, Luba Luft, who is supposedly confirmed as an android. The use of Mozart's opera, *The Magic Flute*, blends in thematic brilliance with Deckard's growing dilemma: he is confused about what is right and what is wrong, and he is starting to believe that he has an attraction to certain female androids. He becomes distraught over the idea that he loves opera, and Luft must genuinely love opera

as well since she has taken a very public position and risen to fame with the San Francisco Opera (Dick, 1968/1996, p. 97). *The Magic Flute* can be seen as an alleg*Ory* to the optimistic ushering in of a new era where humanity can progress and flourish in enlightenment. This stands in complete dissonance with Deckard's society; his love for the opera and his interest in Luft seem to serve as the final break-down of the barrier in his mind between human and machine. It appears that sharing such a deep connection and love for beautiful art derails Deckard's stone-cold demeanor and begins his mental decline. He himself lacked empathy for androids, beings which he can no longer truly tell apart from humans, and that caused his morals to decay. Stirred by Luft and Mozart's work, he suddenly begins to feel pangs of empathy as he can connect with Luft's ambition and the inherent bravery in continuing her art in the face of deadly persecution.

Throughout the novel, Deckard is fueled by his desire to own a real, live animal. He dreams of getting a goat to take care of, which is an impressive sign of a higher social status in Dick's vision of Earth. It implies that, while there are replicant animals one can buy and take care of and they act exactly the same, humans are holding on to a strange definition of what makes something "alive" and "valuable" and whether or not it has rights based on that idea (Dick, 1968/1996, p. 8). In the end, Deckard finally achieves his dream and buys a goat using all of his bounty money, only to have his scorned android lover, Rachael Rosen, return and kill the animal. Deckard, sadly, cannot seem to understand the reasoning behind this, the desire to cause him the same pain he has caused others, to try to force him to feel empathy for what it's like to lose a companion being so suddenly and so easily. He understands that it was not "needless," but thinks to himself that she had "an android reason" for doing such a thing, and nothing more (Dick, 1968/1996, p. 227). It is only until he finds a toad, thought to be extinct, and takes it home to his wife excitedly only to discover that it is indeed a machine, that he finally seems to feel full-blown empathy for the androids. Deckard explains to his wife, "[…]it doesn't matter. The electric things have their lives, too. Paltry as those lives are" (Dick, 1968/1996, p. 241). This small blip of feeling from the perspective of an artificially intelligent creature is a breakthrough that ends the novel on a vague yet hopeful note for the future of Deckard and his world.

International bestseller Margaret Atwood brought to the speculative fiction genre a mix of utopian and dystopian ideas. Her writing style and biting humor have garnered great acclaim, from her early work to her fallen-utopia-turned-dystopia novel, *Oryx and Crake* (2003/2004). The first book in this speculative fiction trilogy, *Oryx and Crake*, follows protagonist Jimmy, later known only as Snowman, through two separate timelines. The past timeline is more utopian, but shadowed by the knowledge that civilization will soon collapse around Jimmy, making for an eerie mix of progressive ideas and a flourishing world, while the future timeline shows Snowman as perhaps the last member of the human species, as genetic engineering has run rampant and destroyed many natural animals and a great number of people through a super-virus.

The character of Jimmy is a slightly cocky, often moody teenage boy with test scores that get him into the least prestigious college available, a decrepit art school called Martha Graham Academy. Meanwhile, his best friend from high school, Crake, is an enigmatic genius who gets sent to the top school in the country, the Watson-

Crick Institute (Atwood, 2003/2004, p. 173), where the reader eventually discovers he is working on highly secretive genetic research. At first, the Watson-Crick Institute appears to be a complete utopia. Young, brilliant minds have their every whims catered to amidst a sprawling campus where students have designed dazzling glowing flowers and everything appears to be a paradise. Jimmy eventually learns that Crake is working on a classified bioengineering project, which is not unusual for the Institute. They have already created creatures such as the "Rakunk," a splice between a raccoon and a skunk that can be kept as a pet, and the "Pigoon," a disturbingly human pig-splice that can grow extra organs for humans and do away with the need for human organ donors (Atwood, 2003/2004, p. 202). On the surface, this appears to be great scientific progress. Jimmy and Crake are both also lucky enough to grow up in the corporate-sponsored "Compounds," an upscale suburban paradise that young Jimmy's father compares to the dwellings of kings and dukes of medieval times. Jimmy's father explains to him as a child that the Compounds are like castles, which "were for keeping you and our buddies nice and safe inside, and for keeping everybody else outside" (Atwood, 2003/2004, p. 28). This begins to highlight the sharp class and ideological divide between those working for the corporations, in near-utopian settings, and those stuck living in the outside world where the black market runs rampant and life is nowhere near idealistic.

However, in the future timeline where Jimmy is known only as Snowman, he sees every sign of the idyllic past destroying the planet. A super-virus has wiped out humanity, and all that is left is a race of engineered beings Snowman calls the "Crakers," who have safeguards built in against the now angry and wild Pigoons and other dangers of the new world. For instance, the male Crakers have the job of peeing in a circle around the campsite to keep predators away (Atwood, 2003/2004, p. 154). The Crakers purr like kittens, making their simplistic emotional states easy to read, and all the Crakers participate in consensual group mating rituals which eliminate the difficulties associated with monogamous pairing (Atwood, 2003/2004, p. 165). They have been perfectly engineered to survive in the post-virus world, and the reader comes to find out that this is exactly what Crake intended and discovers by the end that he indeed was the person who created and spread the virus right as the Crakers were ready to be released into the new world.

Snowman is wracked with guilt throughout *Oryx and Crake*, since he understands that his seemingly menial job working in advertising helped spread ideas that the masses followed, and helped lead to the near-extinction of mankind and ravaging of the natural world. Snowman is a broken man because he has empathy, however stubborn and cocky he was when he was simply youthful Jimmy. He understands not only his own small contribution, but how much at fault Crake is for destroying humanity.

Snowman has become an outcast from the cushy yet secretly destructive world of the corporate Compounds, and he is forced to wander alone in the woods in the future with no other humans. His mental process constantly dwells on his outcast state, forcing him into thoughts such as, "Get me out!" and then reeling and realizing, "But he isn't locked up, he's not in prison. What could be more out than where he is?" (Atwood, 2003/2004, p. 45). Snowman is trapped in the outside world that he is not prepared for, emotionally or in terms of physical survival, and he weakly fights to stay alive while

his mind deteriorates from isolation and a sense of deep remorse and disillusionment.

Crake, on the other hand, early on appears to have a sociopathic-level of disconnection from emotional attachments. He is constantly presented as being aloof, dismissive, and purely logical. When Jimmy first begins to hang out with Crake in their teenage years, Jimmy's mother describes the eerie sense that "Crake was different, more adult than a lot of adults" (Atwood, 2003/2004, p. 69), referencing his emotional detachment and focus on conversations about objective topics. The reader finds out eventually that Crake had spread the deadly virus through a sexual enhancement pill he created, which became widely popular due to its euphoric results and birth control properties. Crake appeared to have seen that progress was wildly veering out of control, as genetic engineering was replacing nature and he could see the dystopia that would become hell on Earth once humanity went too far in that direction. He decided instead to engineer a new race, a peaceful and child-like people who are naked and happy, and to end the human race so that they might have a chance.

This interesting mix of character strengths and flaws causes a strange reaction upon reading. While Crake may have been right about Earth teetering on the brink of dystopia and trying to salvage the planet for a new race, the fact remains that he committed genocide on nearly all of the human population. He had no empathy whatsoever for other humans, and in fact always seemed to loathe them deep down and use them only for his end goals and purposes. Snowman has great empathy, is wracked by guilt and memories flooding back to him, and barely has the will to live by the end of the novel. He seems to notice this clearly for the first time in a retrospective memory told from when he was still known as Jimmy, on a particular after-school day when Crake tells him that he never remembers his dreams. The novel jumps forward into future Snowman's head and the reader is told, "It is Snowman that remembers them instead. Worse than remembers: he's immersed in them, he'd [sic] wading through them, he's stuck in them" (Atwood, 2003/2004, p. 218). He is powerless and he knows that he, too, played a role in the downfall of humanity by continuing to advertise and spread propaganda about progressive new products and genetic alterations that he knew even at the time would not lead humanity down the right path. Jimmy is flawed for his empathy and yet lack of action until it is far too late; Crake is flawed for his lack of empathy and pre-emptive action before it was far too late.

Atwood's narrative feat in taking the reader from the past with Jimmy, to the future with Snowman, showcases different sides of the utopia/dystopia coin. Neither is purely good nor bad, but the reader is allowed to see how a society that appears on the brink of perfection, similar to Huxley's *Brave New World* where blissful hedonism and happiness seem abundant, can quickly go awry and turn into a nightmare when progress goes on unchecked by ethical considerations. Atwood herself explains this concept in one of her essays from In Other Worlds, where she emphasizes the importance of story-telling in order to keep humanity in check. She states that "artistic capabilities would of necessity be evolved adaptations, acquired during the roughly two million years the human race spent in the Pleistocene as hunter-gatherers," and further explains the importance by relating, "if you could tell your children about the time your grandfather was eaten by a crocodile, right there at the bend in the river, they would be more likely to avoid the same fate" (Atwood, 2011, p. 43).

For over a century now, science fiction authors have been imagining what possible crocodiles humanity could soon create in the form of robotics, bioengineering, government control, new pharmaceuticals, and many other potential, soon-to-become-reality advancements. Anaïs Nin (1986) describes this genre, whether it is dystopian or utopian speculative fiction, as using concrete images to represent "abstract psychological truth" (p. 125). Indeed, this is an age where science will continue to shape many novels to come with symbolism and themes to make humanity think about where progress is taking society and what the possible outcomes could look like (Nin, 1986, p. 196). As long as writers and artists continue to take the dreams of today and show people their potential conclusions, or turn them into nightmares where progress has gone greatly awry, a great service is being done to keep the world remembering the importance of empathy and human connection above all else.

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Books in Review

Murder, Meteorology, and Methane Seas

Michael Carroll

On the Shores of Titan's Farthest Sea: A Scientific Novel. New York, USA: Springer International Publishing Switzerland, 2015. 268 pp. $19.99 sc. ISBN 978-3-319-17758-8.

Reviewed by: **Alexander Cendrowski**

There has long been a divide in science fiction between those who trace the genre's roots to fantastical works (most often citing the Sumerian *Epic of Gilgamesh,* 2150-2000 BCE) and those who trace its roots the scientific revolution between the 17th and early 19th centuries. These two core arguments—science fiction as a derivative of the fantastic and science fiction as a derivative of contemporary scientific advances—similarly drive the distinctions between the types of writing in the genre published today. As far as the divide between the fantastic and the hard-scientific goes, Michael Carroll's *On the Shores of Titan's Farthest Sea* certainly falls to the latter.

Published as part of Springer's "Science and Fiction" series—a series with a primary goal of marrying good narrative with actual science—*On the Shores of Titan's Farthest Sea*'s breakdown of existing scientific knowledge surrounding Saturn's moon (Titan) is often the true star of the show, sometimes even overshadowing the narrative. The story itself largely revolves around a fictional Mayda Research station located on the very real shore of Titan's Kraken Mare Sea. The main character, Abby, a self-proclaimed "gas girl" or meteorologist, is in the process of studying Titan's nitrogen-methane atmosphere, but the mysterious death of a colleague soon forces her away from her research. As the plot develops and complicates—murder, liquid methane submarining, and no small amount of interspace terrorism included—a full cast of characters descends on Titan in what can only be described as a tour of realistic space travel in the future. The exotic environment of Titan encourages the reader to consider the implications of our study, environmental impacts, and greed, while simultaneously serving as a comprehensive description of life on Titan. Better yet, thanks to Springer's peer review process, this description maintains scientific accuracy.

It should come as little to no surprise that the environmental and scientific descriptions in *On the Shores of Titan's Farthest Sea* are among the best parts. Carroll's extensive career as a space illustrator—he created the book's beautiful cover himself—and science writer manifests in the book's descriptions and extrapolations on existing scientific knowledge of Titan. Scientifically-minded readers should rest easy knowing that an editorial board of 13 scientists from various fields, provided by Springer, verified all facts cited in the text. While there are a few questionable choices—an entire research station's worth of shared hallucinations being most prominent in the speculation side of speculative fiction—the majority of the science presented in Carroll's novel enjoys a solid foundation in real world physics, chemistry, and meteorology.

Books In Review, *continued*

On the Shores of Titan's Farthest Sea certainly succeeds in involving and interesting this reader in the marvels of the solar system's only non-Earth object with stable bodies of surface liquid, especially with its descriptions of Mayda station's research submarine. Where the book falters, then, is in the storytelling itself. While Carroll's marvelous descriptions and scientific backing are unquestionable, the murder mystery takes an often unfulfilling or predictable route. While the prose remains consistently decent—and Carroll miraculously avoids many of the clichés of the murder mystery genre—the plot is not the reason to read this book. Nor should readers with a feminist inclination hope for too much in that department (the female protagonist thinks and hears often from others that she should put less effort into her work in order to find a man and start a family; and the book would not do well on the Bechdel test). If there is a didactic takeaway from Carroll's book, it's that the mechanics of greed and power so often fly in the face of good science and humanity—not a new lesson, by any means, but one that is good to hear again.

So stands *On the Shores of Titan's Farthest Sea*. An epic masterpiece of literature and storytelling, it is not. But for those looking to spend some time on Saturn's most renowned moon, to explore the life of an other-world meteorologist, and to discover the thrill of helming a submarine in a liquid methane sea, Michael Carroll's debut scientific novel should land firmly in the to-read pile.

Exploring Religion and Theology in Science Fiction

Paul J. Nahin

Holy Sci-Fi! Where Science Fiction and Religion Intersect. New York, USA: Springer International Publishing Switzerland, 2014. 224 pp. $24.99 sc. ISBN 978-1-4939-0617-8.

Reviewed by: **Dr. Vivian Strotmann**

Holy Sci-Fi! Where Science Fiction and Religion Intersect is, as the author puts it, a "what-if book". With a well-balanced mixture of respect, humor, and insightful analysis, it approaches the different angles taken and questions raised regarding religion, God, and the divine in general in science fiction literature and movies.

This combination of well-founded and wide-ranging expertise is matched by a lively, easy-to-read style. Occasionally, the author switches to the colloquial, with which readers used to rather dry and down-to-earth research tomes must accustom themselves. This stylistic choice, however, does not diminish the findings presented and works in the book's favor rather than to its detriment: it allows the author to explain physical phenomena lightly, clears the way for very funny afterthoughts in parenthesis, and gives the entire book a conversational tone that engages the reader in a lively dialogue that is both instructive and entertaining.

The reading experience is further enhanced by comic strips, both black-and white and color

images, examples from poetry, and tables that illustrate or humorously underscore certain points. The author has also added five appendices with short stories by himself and by Gregory Benford, a bibliography of short stories cited (handy for further in-depth reading), and a basic index.

Through his ability to succinctly introduce and explain the plots, twists, and points of the various stories, as well as authors' concepts and physical phenomena, Nahin demonstrates the didactic skill and experience that come with years of teaching. It is therefore all the more regrettable that he did not take the opportunity to cover key terminology more extensively in his appendices. The book certainly offers sufficient material for a glossary—or even a more theory-centered chapter—and with his background in technical engineering, the author would certainly have been well-equipped to provide such additional content. Its absence stems from the book's overall design; as part of Springer's "Science and Fiction" series, Nahin's book is intended as light, rather than heavy, reading. There are occasional typos, but apart from that the work is thorough in contents and carefully prepared and edited. Also—and this is very important with sensitive topics such as faith and religion—it is refreshingly relaxed and undogmatic. This gives the reader space to take in and mull over the thoughts presented in the different chapters.

The book opens with an extensive "Introduction" chapter, in which the author addresses core questions of faith and skepticism, the statements which science can(not?) make about God, and the nature and outlook of science fiction. Here, as in the other parts of the book, the point is not so much reaching one or the other conclusion, but rather presenting a wide range of thought and perspective on individual questions. To do so, the author draws on various philosophers and scholars of religion and analyses poems, novels, and short stories. Chapter 2, "Religious Science Fiction *Before* Science Fiction", is devoted to the history of the genre and succeeds in highlighting some quite surprising influences from other genres and different periods. While the blurry line between science fiction and fantasy literature is already addressed in Chapter 1, Chapter 2 adds considerations regarding the relationship of sci-fi and horror.

The remaining chapters treat different staple elements and topics of science fiction. These include "Religious Robots", "Computers as Gods", "Space, Travel, Radio and Alien Encounters", and "Time traveling to Jesus". The book also includes chapters devoted to the discussion of more abstract concepts and philosophical, as well as theological, questions. These include "Time, Space, God's Omniscience, and Free Will" and the final chapter, "What if God Revealed Himself?".

It is fitting that the book should end with a what-if chapter. After all, the author compiled this rich collection of thoughts and speculations saying, "In this book I care not a bit if you are a skeptic or a believer—only that you can imagine without dogmatic constraint" (p. 10).

The result is an entertaining, thought-provoking, highly-recommendable book.

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Prompt Respondents

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Hope Nicholson is the Winnipeg-based publisher of Bedside Press, a company dedicated to publishing genre and comic work that represents a wide range of experiences. She is also a comics editor, and has recently worked on the Margaret Atwood & Johnnie Christmas graphic novel *Angel Catbird* and the indigenous comics anthology *Moonshot*.

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Vivian Strotmann is the Managing Editor of *Entangled Religions*, a project of the Käte Hamburger Kolleg "Dynamics in the History of Religions between Asia and Europe" at the Center for Religious Studies Research Department of Ruhr-Universität Bochum (Germany). Her research focuses on the history of sciences (with a particular interest in Arabic lexicography and Islamic philosophy), on networks and on the migration of knowledge between countries and cultures.

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Editors

Monica Louzon (Managing Editor) holds an MLS from University of Maryland (USA) and has worked with the Museum of Science Fiction since June 2014. Her academic background is in History, Spanish Languages and Cultures, Latin American Studies, and her article questioning the accuracy of racial and familial representations in Mexican casta paintings was published in *Open Water*. Monica's research interests include science fiction, transmedia studies, and how literature reflects the sociohistorical contexts of its creators.

Rachel Lazarus (Assistant Managing Editor) holds a Ph.D. in Neuroscience from the Uniformed Services University of the Health Sciences (USA). Her research background includes traumatic brain injury, oxidative stress, and neo-antigenic proteomic modifications. She currently works with the FlyLight Project Team at Janelia Research Campus, a research center of the Howard Hughes Medical Institute.

Bodhisattva Chattopadhyay (Editor) holds a Ph.D. in Literature—with a focus on science fiction from the late 19th to mid-20th century Britain and Bengal—from the University of Oslo (Norway), where he is currently a postdoctoral fellow in the history of science (medicine). He employs science studies approaches to the study of science fiction, with an emphasis on medicine, health and race discourses.

Thomas Connolly (Editor) is a final-year Ph.D. student at Maynooth University (Ireland), and his thesis examines depictions of technology in Anglo-American science fiction from H.G. Wells and Jules Verne to J.G. Ballard and Ursula K. Le Guin, using a mix of theories derived from ecocriticism and philosophy of technology. His research interests include depictions of disability—particularly intellectual disability—and he has presented papers on Daniel Keyes and Philip K. Dick.

Jandy Hanna (Editor) holds a Ph.D. in anthropology and anatomy and is a faculty member at West Virginia School of Osteopathic Medicine (USA), where she is also the chair of the biomedical sciences department. She is a comparative anatomist and functional morphologist by trade, and she recently completed a master's thesis in research bioethics on cognition in great apes as evidence for personhood.

Barbara Jasny (Editor) holds a Ph.D. from Rockefeller University (USA) and her career has been science-first, performing research in molecular biology and virology and then becoming a research Editor and Deputy Editor for *Science* magazine. She has communicated science through books, articles, posters, art displays, virtual presentations, meetings, digital media, and podcasts.

Melanie Marotta (Editor) holds a Ph.D. in English from Morgan State University (USA), where she is currently a Lecturer in the Department of English and Language Arts and the Interim Director of the Writing Center. She is originally from the province of Ontario in Canada, and her research focuses on science fiction, the American West, contemporary American Literature, and Ecocriticism.

Aisha Matthews (Editor) holds a B.A. in English from Yale University (USA) and is currently completing her M.A. Her thesis is on Foucauldian discourse of power within Octavia Butler's *Patternist* series, and she is also working on a conference paper in Harry Potter Studies on American colonial imagery within the texts. Aisha's other research interests include afrofuturisms, postmodern feminist discourse, and science and speculative fictions.

Heather McHale (Editor) holds a Ph.D. in Literature from the University of Maryland (USA), where she teaches writing and literature. Her current work in progress is a book about the television series *Doctor Who*.

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Looking to the Future

Join the Museum of Science Fiction for *Escape Velocity*, an upcoming event that the Museum will host at the Marriott Wardman Park Hotel in Washington, DC, from September 1–3, 2017.

Escape Velocity is a micro-world's fair promoting science, technology, engineering, art, and math (STEAM) education within the context of science fiction by combining the fun of fan conventions with the fascination of science and engineering festivals. *Escape Velocity* seeks to make a measurable, positive impact in the community by boosting informal learning opportunities about complex academic areas. Its goal is to invigorate young people with an interest in STEAM learning by creating a world-class showcase of science and technology.

To learn more about *Escape Velocity* and to purchase tickets, please visit ***www.escapevelocity.events***

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Museum of Science Fiction

Based in Washington, DC, the Museum of Science Fiction is a 501c(3) nonprofit organization dedicated to providing a narrative on the science fiction genre across all media and its relationship to the real world. The Museum's mission is to create a center of gravity where art and science are powered by imagination. Science fiction is the story of humanity: who we were, who we are, and who we dream to be. The Museum will present this story through displays, interactivity, and programs in ways that excite, educate, entertain, and create a new generation of dreamers.

In the first step to fulfilling the Museum's mission, our team will construct a Preview Museum in the Washington, DC metro region where we can test exhibit concepts, programs, and interactive technologies. This will give visitors a place to provide feedback that will help shape the development process for our full-scale facility. The Preview Museum will also allow us to share how interactive exhibits can be used as educational tools in conjunction with classroom materials that teachers can integrate into their daily lesson plans.

To learn more about the Museum of Science Fiction and its current projects, please visit www.museumofsciencefiction.org