Introduction

The story of *Interstellar* was written by Jonathan Nolan and co-written and directed by Christopher Nolan in 2014. *Interstellar* is a science-fiction epic film that details the journey that Cooper and his space crew embark on in order to find a solution to humanity's peril. On Earth, severe agricultural degradation by a mysterious plant virus known as blight, led to the extinction of multiple staple food crops, subsequently pushing the globe into world-wide starvation. The protagonist of the film, Cooper, is a NASA engineer and pilot who was pushed out of his field of occupation when global famine caused by blight began to arise. Cooper and his family, alongside many others, were forced to become farmers and undergo an agricultural lifestyle. The U.S government saw agriculture as the only appropriate path to pool their funds into in order to maintain the survival of the human species. As a scientist Cooper always envisions a scientific approach to solving a problem and this situation was no different. Thus, it comes to no surprise that he despises the idling nature of sitting by and farming his life away as starvation slowly eats humanity into obscurity. The story begins with Cooper's daughter, Murph, explaining her encounter with strange supernatural occurrences in her room which she deems the work of poltergeist. Cooper later discovers one of these supernatural occurrences in the form of neatly made dust piles from a severe dust storm. Cooper deduces that these dust piles display binary coordinates to a specific location. Cooper and Murph arrive at an unknown and unmarked facility. They are pulled in for questioning by the authorities of the facility where they are greeted by Prof. Brand, one of Cooper's former professors, who is also the head of NASA's research program for solving humanity's crisis. Brand details Cooper about the presence of a wormhole, which leads to an alternate galaxy, and a possible solution to preventing humanity's extinction. Prof. Brand explains that the crew of the Lazarus Mission set out over tens years ago

and ventured into the wormhole documenting three promising/habitable planets. Brand wants to recruit Cooper as the main pilot of the *Endurace* space station to collect data on these three planets to determine which is the most hospitable. The crew will consist of Brand's daughter, Amelia, Doyle, and Romilly. The method to saving humanity will consist of two plans. Plan A is to provide Professor Brand with enough time to complete his gravity equation, allowing the launch of a space station containing most of humanity's population through the wormhole into a new galactic home. Plan B is to find a habitable planet that the three Lazarus' crew members explored and start a colony with the 5,000 frozen fertilized eggs. Cooper makes the difficult discussion to take on the mission. Murph barricades her bedroom door, as she is visibly upset with her father's decision and him abandoning her. Murph and her father don't leave on good terms. Cooper and his crew safely lift off and dock on the *Endurance.* The crew collectively take a 2-year long hypersleep in order to sleep away the time required to reach Saturn and the wormhole. When they awake the crew enters the wormhole and decides to visit Miller's planet. One of the habitable planets found by the Lazarus crew, Miller, Mann, and Edmund. The crew realizes that Miller's planet resides extraordinarily close to a black hole, named Gargantua, which exerts a tremendous gravitational pull on the planet. The immense gravity distorts the passage of time relative to that on Earth. One hour on the surface of Miller's Planet equates to seven years on Earth. Cooper devises a plan to quickly retrieve Miller's data without the distortion of time being too severe. However, upon descending down, the crew is faced with a planet that is completely engulfed in water, with periodic tidal waves reaching 4,000 feet in height crashing down onto the surface. Amelia is able to make it back to the Ranger safely but Doyle is swept away. With the Ranger being water-logged from the tidal wave, Cooper and Amelia are forced to wait on Miller's planet. Upon arriving back on board the *Endurance*,

Romilly has visibly aged. He informs the both of them that they have been gone for over 23 years. In the present day, adult Murph is involved in Prof. Brand's research on the gravity equation. While on his deathbed Murph promises to Prof. Brand that she will complete his research and find a way to launch the space station. However, with his dying breath Brand apologizes for lying to Murph about Plan A's proposal. The equation was solved decades ago and the conclusion was that humanity was doomed from the start. Back on board the *Endurance* the crew take a vote to decide their two choices of action: either visit Dr. Mann's or Edmund's Planet. Cooper explains that visiting Dr. Mann's Planet is the better course of action because his signal is still pinging, indicating a very likely chance that he is still alive. Amelia is dissatisfied with being outvoted in favor of visiting Dr. Mann's Planet. Upon arriving at Mann's Planet the crew wake up Mann from his hypersleep. He details the environment and its habitable conditions to the crew's pleasant surprise. However, Mann confirms to the crew that Prof. Brand never intended for Plan A to work. Mann later betrays the crew by lying to them about the habitable conditions of the planet. He cowardly let his signal continuously ping so that he could be rescued. Romilly is killed in an explosion that Mann set up to cover his actions. Mann boards a Ranger but is unsuccessful at docking the spacecraft causing a massive explosion on the *Endurance*. After stabilizing the *Endurance*, Cooper and Amelia decide to utilize the Gargantua's gravitational pull to slingshot themselves on course to Edmund's Planet. Unbeknownst to Amelia, Cooper planned on venturing inside the Gargantua alongside TARS so that the adequate amount of weight could be shed, allowing Amelia to reach Edmund's Planet. Cooper and TARS enters the Gargantua and arrives at a fifth dimensional plane that is represented in the third dimension, known as the Tesseract. The Tesseract was constructed by the Bulk Beings, cosmic entities that exist outside the fourth-dimension. They created the Tesseract

in the future for humans to find and use in order to solve the problem of humanity's extinction. TARS was able to encrypt the black hole's data into Morse Code, allowing Cooper to translate this information onto the watch he gave to Murph 23 years ago. With the black hole data transmitted, the Bulk Beings close the Tesseract and Cooper is transported back through the wormhole. Cooper awakes on Cooper Station, a space station orbiting Saturn named after Murph commemorating her accomplishments at completing the equation that saved humanity. Cooper visits Murph to see that her entire lifetime has passed since his departure for the space expedition. Murph explains that right now Cooper should be going out in search of Amelia and helping her establish a colony instead of staying with her. The last scene shows Cooper taking off on a NASA spacecraft in search of Amelia.

Methods

Near the middle of the film, when Cooper and his crew successfully take off into orbit in their Ranger and dock on the Endurance. The crew collectively decides to take a two-year long hypersleep so that they could pass the time required to reach Saturn and the wormhole, without needing to sustain natural bodily processes when they are otherwise awake. As portrayed in the film, astronauts departing on long space expeditions can utilize hypersleep pods to set a hibernation time which aligns with the arrival time of their desired destinations. The many beneficial factors of implementing hypersleep in a space expedition includes preserving limited resources such as food and fuel, slowing down the aging process, and the prevention of psychological stress from loneliness and isolation, which is an often overlooked factor in space exploration. The film does not explicitly detail the properties of the hypersleep pods and its functionalities. It is unclear whether the hypersleep pods cryogenically freezes their host or not, and these are the beginning moments of where science and science fiction in *Interstellar* blurs.

This is especially true in the film where the exact science behind hypersleep is not explicitly illustrated and the viewers are left to fill in the gaps. From the film's depiction of hypersleep pods viewers could infer that these pods act similar to cryogenic chambers in the real world. Similar to the ideas of hypersleep and its implications on health, cryogenic therapy or cryotherapy, also provide benefits to human health although to some extent. Whole body cryotherapy (WBC) has been utilized to treat patients with inflammatory responses from autoimmune diseases such as multiple sclerosis (MS), rheumatoid arthritis, and ankylosing spondylitis since the 1970s (Doets et al., 2021). WBC works by encompassing the entire body, including the head, to cooled air or water. Patiences performing WBC can experience cooled air temperature from -60 Celsius or even as low as -200 Celsius. As a result of these extraordinary low temperatures research on this particular treatment option for autoimmune diseases indicate that WBC can reduce inflammatory reactions from such diseases by suppressing the immune system's response. However, the anti-inflammatory effects of WBC extends to sports science and health, as well, where they see the most popularity. Many athletes implement WBC and cold water treatment into their recovery process after a strenuous game or workout session. Consequently, studies on athletes from varying sports using cold therapy post exercise demonstrated improved performance in sport outcome. Some of these outcomes include, "better exercise capacity, more regular circadian rhythm, improved quality of sleep, less tiredness, lower levels of pro-inflammatory cytokines", according to Doets et al., 2021. However, there are limited studies and scientific evidence to prove the effects that WBC and cold therapy has on preventing aging or prolonging lifespan prior to death. After a person is legally declared dead, the practice of preserving their bodies in extreme cold can be performed. This practice, known as cryonics, involves infusing the human body with cryoprotectants to prevent ice formation in the

cells. Keeping the body at a low enough temperature that metabolism slows enough to reduce the chances of body degradation (Best, 2008). In the film, the crew submerges themselves in a pod filled with an unknown liquid substance. This liquid could be the chemical substance that helps protect their bodies from bodily degradation. Together with the pod itself, the hypersleep chamber could help induce a coma-like sleep until the time set is reached and the pod wakes up the host.

Artificial intelligence in the form of robots like TARS and CASE is also a contentious science topic in relation to *Interstellar* and the real world. In *Interstellar* robots like TARS have extremely human-like personalities. Doyle, the AI technologist in Cooper's crew, could code different levels of human emotions such as humor and honesty into TARS. Not only that, TARS and CASE have the capabilities and technological advancement to record data, perform calculations on command, and even take manual control of the Ranger spacecraft and the Endurance. According to (Chuanh & Yu, 2021), many businesses and companies employ service robots to greet and communicate with customers. A Hong-Kong based company employed a humanoid robot named Sopia, which possesses a range of over 60 different emotions. The journal also details human/AI emotional interconnectedness. If AI robots were to convey positive, human-like emotions, humans would likely reciprocate those emotions and portray positive emotions in response (Chuah & Yu, 2021). This is evident in the film where Doyle coded TARS to possess a specific humor percentage so that their space expedition would be less dry and monotonous. Subsequently, when TARS responded to Cooper with a sarcastic joke, Cooper rebutted with a sarcastic joke of his own.

In the pursuit of trying to find another home for humanity, the crew faced a major obstacle. On the planet to which they are traveling, Miller's Planet, time is observed at a much

slower pace than that on earth. The difference in time is monumental, for every hour the crew spends on Miller's Planet, around 7 years have passed on earth. This phenomenon is known as Time Dilation. In efforts in understanding time dilation, one must accept and understand that time is relative and changes based on the observer and individual. Time is experienced and observed differently throughout different areas of the universe. The basic premise of time dilation is the gravitational force, the greater the gravitational pull the slower one will experience time. This is true in our present life, the further you get from the earth's surface the faster time moves. However, this change is so little that our human senses aren't able to pick up on it. This is also in part because the gravitational force present on Earth is moderate, which means we experience time dilation just at very very little rates. In a more visible example, you would have to look at a planet that has a very strong gravitational force, such as one that is near a black hole, just like Miller's Planet. Due to this greater gravitational force time is observed much slower than on a planet that has moderate gravitational force such as Earth. This is a part of the movie that is most expressed and focused on, and is also very different from "our" world.

Results

The scientific accuracy presented in this film is reasonably high. All concepts such as time dilation and wormholes are supported by theoretical physics, however, have just not been observed in practice and are 100 percent proven. The part in which the film strays from the truth or factual science is how much slower time moves on Miller's planet. As previously stated, time on this planet moves at a pace that 1 hour is equal to 7 years passed on earth. The movie presents the fact that Miller's planet's gravitational force is around 130% of Earth's, this simply isn't even close to what is needed to create this extreme time dilation. In order for such a time dilation to occur, a gravitational force of a black hole would be needed, and there is just no planet that is

capable of harnessing that much force. If there would be a planet that did have such a strong gravitational pull, the force would be way too powerful and lead to being crushed, as the weight of the crew would be around 7 million tons, according to the gravity needed. This movie leaves little space for huge false scientific claims. The film was created hand in hand with an actual renowned physicist to create different theoretical equations based on science to help develop an accurate and scientific depiction of space. This film was created during a time of constant technological advancements and an increased worry about the future of this planet.

Discussion

Interstellar was created to symbolize the connection between our human connection coupled with the ever growing technological advancements we see around us. The way humanity bands together in efforts to survive. The use of science fiction adds an element of seriousness to the overall tone of the film. It creates a world that is very similar to ours and showcases concepts that are foreign to us but are theoretically possible. This bridges a gap between something that is completely fictional and makes it into something that feels very real, which allows the viewer to empathize with it more. This is especially significant as it applies to our current situation now. As this planet nears its capacity and as humanity learns to destroy it in new ways more rapidly, one possible solution is to look for alternative planets that can sustain human life. The movie describes and illustrates this situation in a more dramatic and intense way but it really brings attention to the seriousness of the condition of planet Earth. Nolan also plays around with the concept of time and the relations between the planets they are visiting, earth, and the spaceship traveling. This results in a dramatic end to the movie where the main character is portrayed as younger than his daughter. Furthermore, this introduces the theory of time and its relativity along with the concept of thinking of time as a resource similar to food and water. The intense scenes

dramatize a lack of time with close calls but this can be applied on a larger scale to the time we have to save our planet. The movie also draws attention to nature and the essential resources of life like food and water. Although all of the futuristic ships and technology help them transport through space, it certainly isn't enough. The movie as a whole proves the worth of our planet and the possible outcomes of the current climate crisis on Earth.

Conclusion

The film *Interstellar* showcased a plethora of unique science fiction concepts that do have grounds in the real world. From the introduction of hypersleep pods which bars resemblance to the cryonic chambers in our reality, to gravitational time dilation resulting from a black hole, and even the gravity equations used in the film, *Interstellar* goes above and beyond in portraying the middle ground between science fiction and scientific fact.

References

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