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Les vaisseaux générationnels sont un concept de science-fiction qui représente un vaisseau spatial conçu pour de longs voyages dans l'espace qui traversent plusieurs générations pour atteindre une destination finale. Tout au long du document, ce concept de science-fiction est une métaphore de la vie humaine sur terre. Il examine les effets transgénérationnels sur les définitions de la personne, de la vie privée et de la mort, et analyse la manière dont les grands principes bioéthiques s'appliquent.

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ART, CULTURE ET OEUVRE DE CRÉATION / ART, CULTURE & CREATIVE WORKS

Ethical Considerations of Generation Ships: A Bioethical Analysis

Israa Sinan[a], Gavin Park[a]

Résumé
Les vaisseaux générationnels sont un concept de science-fiction qui représente un vaisseau spatial conçu pour de longs voyages dans l'espace qui traversent plusieurs générations pour atteindre une destination finale. Tout au long du document, ce concept de science-fiction est une métaphore de la vie humaine sur terre. Il examine les effets transgénérationnels sur les définitions de la personne, de la vie privée et de la mort, et analyse la manière dont les grands principes bioéthiques s'appliquent.

Mots-clés
vaisseaux générationnel, espace, éthique de la santé, bioéthique, autonomie, non-malfaisance, bienfaisance, justice

Abstract
Generation ships are a concept in science fiction that represents a spaceship designed for long space journeys which travel over multiple generations to a final destination. Throughout the paper, this science fiction concept is a metaphor for human life on earth, to examine the transgenerational effects on definitions of person, privacy, and death, and analyzing how major bioethical principles apply.

Keywords
generation ships, space, health ethics, bioethics, autonomy, non-maleficence, beneficence, justice

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INTRODUCTION

Using metaphors in bioethics reflects on the knowledge of balancing values or weighing several perspectives (1). Metaphorical communication may open new perspectives and coping strategies in healthcare, improving medical communication and supporting the inclusion of marginalized perspectives in moral reasoning (1-3). This paper critically uses the science fiction concept of a generation ship as a metaphor to examine the transgenerational effects on definitions of person, privacy, and death, analyzing how major bioethical principles apply in comparison to human life on earth. Additionally, the paper explores the impact of paternalism, utilitarianism, deontology, consequentialism, capacity, and personhood.

DEFINING GENERATION SHIPS

A generation ship is a science fiction concept that represents a spaceship designed for long space journeys which travel over multiple generations to a final destination. These first appeared in the writing of Robert Goddard, famous for his work on rockets in the early 20th century. Goddard was the first to link the use of a spacecraft to biblical concepts of Noah's Ark, a chance to save humanity from the ultimate flood by taking to the stars (4). This concept has been used by multiple authors in multiple scenarios, covering planned situations like that of Goddard, but also situations forced on a society, as found in both the 1970s and the multiple award-winning early-2000s versions of Battlestar Galactica (5).

Generation ships create a contained environment that is composed of the community that runs the ship, otherwise known as the crew. Throughout fiction, the makeup of the crew can be wildly variable, from fully planned as featured in Isaac Asimov's *Foundation* (6), to accidental in the Battlestar Galactica series, to comical as featured in both Douglas Adams' *The Restaurant at the End of the Universe* (7) and The Simpsons episode *Treehouse of Horror X* (8). Because of the variability in fiction, we start by establishing some parameters. The crew in this case study will be assumed to be made up of engineers (including mechanical and electrical technicians), doctors, education professionals, police officers, lawyers, information technologists and programmers, as well as religious personnel from different religions.

An assumption is that generation ships limit breeding to only fulfill the replacement of the crew; because of this, some of the occupations first brought on the ship may not survive and will be replaced with more demanding occupations. Due to the limited number of families breeding, infertility may arise causing a threat to the survival of the mission. For this reason, it will be assumed that the ship will transport embryos and gametes that will be used in critical conditions for colonisation endeavours (9).

The ethical challenge is that there is a major difference between getting on a spaceship at high speed to take you to the moon and voluntarily getting on a ship that will be the final resting place for you and the future generations that will be produced. It also raises the question of how a closed environment for multiple generations will affect psychological and sociological living conditions.

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TRANSGENERATIONAL EFFECTS ON TERMINOLOGY

In the generation ship, the term *person* will, over generations, change to mean an individual with responsibilities to protect, under any occupation, the people of the ship and to uphold the mission on which the ship is embarking. As such, the term *privacy* will also undergo a gigantic conversion to mean restricting the information based on your occupation on the ship; any reports of harm must be reported as the person's responsibility is to uphold the goal of the mission. Although similar in perspective, privacy on Earth will indicate the sharing of information as a person, whereas on the generation ship, it will mean sharing information based on occupation. This may cause a problem due to the fact that effective communication is required between members of the generation ship to maintain harmony. At times, it will be relevant to disclose highly confidential information during the time of death. Death on Earth means the cessation of all vital functions of the body, including heartbeat, brain activity, and breathing. On the other hand, death on the generation ship will add to that definition to include the passing of responsibilities between generations that will take over that occupation. In parallel, the passing of responsibilities may be considered as end-of-life care. Within the discussion of transgenerational effects on the definitions of person, privacy, and death comes the ethical question of how the principles of bioethics will be implemented.

AUTONOMY: SHIFTING DYNAMICS

Autonomy, the principle of individual choice faces challenges as definitions evolve. As the definition of person includes the responsibility to obey the mission of the ship, the crew members would most likely be obeying the decision made by the initial crew members that began this journey. The informed consent that was made by the initial crew was based on definitions we know to be linked to individual and family perspectives. However, over many years, autonomy in the generation ship would be linked to the occupation and mission goal. This may mean that the autonomous decision made initially by the first generation becomes translated so that each family in the community only follows the head of the family in the generation ship. Family structures mimic a patriarchal model, with decision-making reliant on the head of the family. While this simplifies adherence to initial decisions, it limits the autonomy of future generations, restricting their capacity to make individual life choices. Moreover, if the ship faces problems, the head of the family would be responsible to enforce civil disorder. Eventually, this would help eliminate mission drift that may cause the development of conflict between the crew and difficulty in reaching compromises.

NON-MALEFICENCE: MISSION-CENTRIC SAFETY

Non-maleficence is the action of not intentionally hurting participants. The intention of the generation ship is to explore and potentially colonize new worlds to benefit humanity. In return, this would open a new habitable environment for humanity, thus benefiting future generations. However, instead of having the drive to explore, the crew members shift their drive to pioneer and to reach the finish line of the mission. Safety shifts from conventional protection against external threats to safeguarding teamwork, autonomy, social cohesion, and habitability. The ethical focus lies on protecting the mission, thereby reducing concerns about intentional harm to crew members in future generations. Instead of making choices to promote the greatest happiness for the greatest amount of people, choices are made to protect the mission.

BENEFICENCE: REPRODUCTIVE CHALLENGES

Beneficence, prioritizing individual benefits, faces significant challenges in the context of generation ships. Although the end goal is the creation of a new habitat, there is considerable risk and uncertainty with long space journeys, including psychological and reproduction issues. The first ethical concern is the ability to reproduce future generations, where capacity is disregarded on the ship because reproduction is needed to maintain active crew members. Paternalism would play a major role in this issue where the participant's care and outcomes are disregarded for the need to maintain life on the ship. Specifically, it is a direct versus indirect paternalism, where direct effects indicate benefits to the future generations that do not have restrictions, and indirect effects indicate benefits to the initial crew members who voluntarily began this journey. In the case where fertility may become an issue, reproduction may occur through ectogenesis through artificial wombs using the embryos and gametes initially brought onto the ship. The second ethical concern is the ability to maintain well-being in the case of unexpected circumstances. The biggest example of unexpected circumstances is the case of COVID-19, where contaminated air can easily infect persons and even cause mortality. In a way, unexpected circumstances can relate back to the concept of consequentialism, where actions are morally assessed by the consequences of the act.

JUSTICE: RESOURCE ALLOCATION DILEMMA

Justice, which addresses a fair and equitable approach to the treatment of a person, encounters a dilemma of resource distribution on the generation ship. Uneven allocation impacts the survival and experiences of future generations, questioning the fairness of their human experience. From another perspective, it can be seen as a way to ensure the survival of specific occupations that keep the mission going. Moreover, deontology, which means the rightness or wrongness of an action is judged by a defined set of rules and not by an outcome, can be incorporated into responses to justice dilemmas. This can be thought of as the fight to ensure humanity's survival on the ship by using extreme measures to reproduce and compromise on resources, power, and opportunities. As such, the uneven distribution of resources, power, and opportunities will cause a massive shift in the appropriate treatment for all persons.

CONCLUSION

In conclusion, the four bioethics principles all undergo a disturbance throughout the long journey taken by the generation ship. Autonomy becomes family-centred, non-maleficence prioritizes the mission, beneficence is compromised for mission success, and justice can even be extinguished due to resource disparities. Eventually, these results all harm the concept of personhood, the moral obligation to defend and promote the life and health of all human beings in proportion to their needs.

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