Beyond Mad Scientists and Distracted Geniuses: images of the Science and Scientists in Prey

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ABSTRACT
One of the ways how the public perception of science is formed is through the works of the entertainment industry such as literature, comics, cinema and, in recent decades, digital games. Games showed a relevant growth in their importance as a cultural product; however, they present particularities that make these analyses challenging. Therefore, it becomes relevant to explore methodologies to understand how the images of science and scientists have been portrayed in game media. This work aims to understand how the digital game *Prey* presents images of science and scientists in its narrative, its visual and its procedural aspects. It is exploratory qualitative research, with a method combining autoethnography complemented by the analysis of videos by YouTubers. We analysed the collected material through discourse analysis based on the Semiology of Social Discourses. We conclude that such representations appear in a sophisticated way, interlacing narrative, visuals and game rules to foster reflections on ethics, capitalism and labour relations, avoiding the repetition of science stereotypes common in entertainment works.

Keywords
Science communication, game analysis, portrayals of science.

INTRODUCTION
Cultural productions, mainly those of the large cultural industry, reach a large audience and therefore have a relevant influence over the way we construct the meaning of various concepts and themes, including science (Kirby, 2014; Kirby, 2008). Research on the representation of science in works of fiction in cinema and television has been growing in the academic field of Science Dissemination. This occurs due to a recognition that the creation of an imaginary about science in a way that is embedded in the culture can be more relevant to the public perception of science than the mere acquisition of knowledge about theories and scientific facts (Kirby, 2014).

Although formed by complex, dynamic and often inconsistent processes, this image of science and scientists, built from what is presented in entertainment media, can be a valuable way to understand how contemporary society understands science and its actors, incorporating them into its cultural baggage (Reznik, Massarani and Moreira, 2019). Public perception of science is more than an opinion about a given framework. Although this occurs in the field of culture, its ramifications take different forms, including, for example, the emergence of controversies over science-related topics and

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even the channelling of funding to different research initiatives (Kirby, 2014; Kirby, 2011 1685). As scientific work is also a social activity, science itself transforms its practices according to this socially shared perception.

Faced with the growth of academic research on the representation of science in cinema and television, we start from the premise that digital games rich in narratives can also be a relevant object of study. Since digital games are a medium where cultural values are also incorporated, not only in their textual and image content but also in their structure of rules and operating procedures, they also bring this possibility to propose meanings of science and scientists to the players (Bogost, 2007).

This work addresses digital games as media and as products of a global cultural industry. Therefore, we selected the game Prey (Arkane Studios 2017), due to its science fiction theme, for a qualitative analysis of the way in which the game makes representations of science and scientists. By Science, we are considering the concept of 'systems of science', which includes both science methods, laboratory equipment, science education, social interactions among scientists, and also aspects of science partly outside the scientific community as relations to industry and politics, policies, science communication and culture (Kirby, 2014).

Understanding how these themes are proposed in digital games is relevant for the field of Science Communication but also for Game Studies, since it reveals important aspects of the role of games as mediators of public discourse. Thus, this article presents a qualitative analysis of the game Prey, with the aim of identifying representations of science and scientists and discussing, among other themes, fears, aspirations and stereotypes about science. While similar research has been done in other media like movies, we couldn't find initiatives investigating game media, hence the relevance we see in discussing this particular subject.

LITERATURE REVIEW

When analysing representations of science in culture, a recurring concern is the identification of stereotypes in these representations and their transformation over time. However, we understand that there is no consensus on the definition of "stereotype". In 2006, Kanahara carried out an investigation into different definitions of "stereotype" throughout history, arriving at the definition of "a belief about a group of individuals" (Kanahara, 2006, p. 318). The author admits four essential categories for this definition: as belief, as group concept, as generalization and as generalizations derived from the specification.

This definition has been used in other works on stereotypes in science, such as a study on stereotypical images of male and female mathematics teachers (Gjøvik, Kaspersen and Farsani, 2022). However, before and after this formulation, relevant research that aims to study stereotypes in science does not explicitly define "stereotype", such as the articles on the results of the Draw-A-Scientist Test published by Chambers (Chambers, 1983 1703), the conceptualization of science among children (Lannes, Flavoni and De Meis, 1998), and a systematic review of the Draw-A-Scientist Checklist by Ferguson and Lezotte (Ferguson and Lezotte, 2020). The research on stereotypes of the scientist in Western literature by Haynes (Haynes, 2003) provides useful insights categorizing scientists in seven primary stereotypes: "evil alchemist"; "noble scientist"; "foolish scientist"; "inhuman researcher"; "scientist as adventurer"; "mad, bad, dangerous scientist"; and "helpless scientist". In these works, the concept of stereotype always seems to be used in the negative sense, implying that they are distorted, prejudiced and distant views of the reality of science systems. In this research, we do not focus on the science stereotypes specifically, instead seeking an overview of science representations

in the Prey game. However, the comparison with the results of the cited literature on stereotypes appears in the analysis results as relevant categories.

A work with some similarities to ours, "Portrayals of Technoscience in Video Games: a potential avenue for informal science learning" (Dudo *et al.*, 2014), describes research where the participants answered questionnaires about the games they played and the representations of technoscience they found. This paper shows a division between science accessibility (if made by very intelligent people or common people), methodology (if logical, reliable, mysterious or uncertain), associations (if powerless in the face of external forces or connected with war, politics or religion), outcomes (whether it presents risks and benefits, a safe path to a better future or a way to find the truth) and, lastly, value (a force for good or evil). The survey also presented a number of scientist characters found in each game cited by the participants and the frequency of their respective specializations, their physical characteristics and personalities. The motivations for their violent acts were also described (in decreasing order of frequency, protection of their own life or the life of another character, personal gain, retaliation, anger, mental instability, and others).

In order to investigate the state of the art of academic production related to the game Prey, an integrative literature review was carried out through the Google Scholar platform, using the search terms "Prey", "Arkane", "game" and "videogame". Since Prey was launched in 2017, we extracted the content of publications between 2017 and 2022. Initially, we found 13 documents. After applying exclusion criteria, we selected the five most relevant papers for our study. The first article analyses the game Bloodborne, mentioning Prey just to exemplify how the mimics, game enemies capable of changing shape into objects, make explicit a sense of alienation in the player, which is later intensified when the protagonist gains a similar power, being able to turn into objects (Dodd, 2021). The second article is a review of the game, highlighting the reference to older games created by the studios Looking Glass and Ion Storm (Mullen, 2020). The third article offers an analysis of the philosophical understanding of game design styles that developed during the 1990s due to the different approaches of two of the most important game designers of the time (Backe, 2017). The fourth article makes a comparison between the games Dishonored 2 (Arkane Studios 2016) and Prey, highlighting the role of images (posters, graphics and even Prey's virtual reality) as elements used in games to reflect on the game's relationship with reality and with the player (Backe, 2018). Finally, the fifth document is a book chapter that addresses another game but uses the previously analyzed article to support its arguments (Beil, 2021).

The literature review also showed that studies that analyse the representations of science in games are rare, despite this being a relevant topic in the analysis of entertainment products (still represented mainly by films and series) and even though games are a relevant part of the entertainment industry.

METHODS

Game analysis has been repeatedly mentioned in the literature as a challenge for researchers due to the specificity of the ergodic nature of games (Aarseth, 2003), their non-linear narratives, and the great complexity and diversity of what is understood by "game" (Aarseth and Calleja, 2015). For this research, we opted for a qualitative approach with theoretical-methodological support from the Semiology of Social Discourses (Pinto, 1994; Pinto, 2002; Araujo, 2000) a method derived from discourse analysis. According to this approach, the social production of meanings is analysed and the notion of obtaining data is replaced by the creation of a corpus of textual analysis, considering as "text" any and all significant matter, not being restricted to verbal language and, in the case of games, comprising of images, rules and mechanics of the

game as forms of production of meanings. . According to Pinto (Pinto, 2002), the analysis must be critical; aware of the presence of forces that shape the text; not focused on content interpretation; using the concept of ideology alongside that of discourse; work comparatively but avoiding statistical techniques in the comparison; and working with formal marks as they appear on the textual surface without resorting to translations.

The analysis framework was composed by combining the categories of representations of science and scientists found in the results of the work by Dudo et al (Dudo *et al.*, 2014) with a group of game elements relevant for analysis, obtained from the "game apparatus", part of the MoRAG model for game analysis (Vasconcellos, Carvalho and Araujo, 2017). This last group tries to account for the expressive effect of the rules of the game, as proposed by Bogost's procedural rhetoric (Bogost, 2007).

Two researchers worked on corpus formation using different methods. One of the researchers formed his corpus of analysis by watching videos of "Let's Play" game sessions published by YouTuber Alanzoka, covering the entire game. Alanzoka is one of the main game streamers in Brazil, transmitting content in Portuguese to millions of players on its two Youtube channels (with 7.25 and 2.61 million subscribers) and on Twitch (6.1 million).

Ten videos were watched and analyzed showing the entire course of the game, from the beginning to the end, totalling 12 hours and 5 minutes (the titles were translated from Portuguese): "EVERYTHING WAS A LIE! - PREY - Parte 1" (https://youtu.be/m7bB9Rnw0yA), "LOST IN SPACE! - PREY - Parte 2" (https://youtu.be/oFB2Svrcxh8), "THIS GAME IS TOO HARD! - PREY - Part 3" (https://youtu.be/WwRt71d9sGQ), "THEY DON'T DIE! - PREY - Part 4" (https://youtu.be/5PE3jHy03I8), "THE MIND CONTROLLERS! - PREY - Parte 5" (https://youtu.be/zG_0CoPNDr0), "I DIED OF SO MUCH ANGER! - PREY - Part 6" (https://youtu.be/OfAdam0Qr0g), "alanzoka playing PREY - Part #7" (https://youtu.be/3X8jfPaxLRk), "alanzoka playing PREY - Part #8" (https://youtu.be/7A3oiCLY5D4), "alanzoka playing PREY - Part #9" (https://youtu.be/Iab8Lf1dJbQ) and "alanzoka playing PREY - Part #10 / FINAL" (https://youtu.be /mwg_D9wypoA). The researcher watched all the available videos, taking notes guided by the themes present in the analysis framework related to the game itself and the choices and lines made by the player/YouTuber. Although video analysis is a limited approach, it provided clues from the video material created by the YouTuber with the intention of entertaining his audience.

A second researcher played the game to completion, in 18 game sessions of approximately 1:30 on average. The game was played in its PC version on "normal" difficulty. This data collection was based on the principles of autoethnography, which replaces the notion of data collection with the notion of composing field texts, combining characteristics of autobiography and ethnography. Its principle is ethnographic in its methodological orientation, cultural in its interpretative orientation and autobiographical in its content (Chang, 2007). Throughout the game sessions, the researcher paused when necessary to take the notes that formed his field texts.

While the videos provided points of attention for further examination, highlighted by the YouTuber's own comments and reactions, the autoethnographic experience with the game provided the direct knowledge of the game elements, including its rules and procedures. To analyse the corpus formed by these two sources, we structured a series of nine aspects, based on the work of Dudo et al (Dudo *et al.*, 2014) and Vasconcellos et al (Vasconcellos, Carvalho and Araujo, 2017).

From the first work, we list seven main aspects:

1. Presence and role of science and scientists in the game's narrative
2. Presence and role of science and scientists in the setting (historical and geographic space) of the game
3. How science is characterized: something positive, neutral, negative, mysterious, uncertain, reliable, accessible, or even as an element added to other sectors such as war or religion.
4. How scientist characters are characterized regarding their importance in the narrative and in the environment
5. How are the scientist characters visually characterized: speciality, age, gender, ethnicity, characteristic traits (glasses, lab coat, physical shape and weight, facial hair, dishevelled hair, etc.)
6. How are scientist characters mentally and socially characterized: temperament, competence, perspicacity, ethics, sanity, eccentricity, empathy, etc.
7. Player character's relationship to science (in terms of its influence on their background, decisions, or abilities)

From the second work, we selected two aspects related to the procedural domain of the game:

8. Influence of science or scientists on the functioning of game rules and mechanics (if and how tasks and missions proposed to the player have science or scientists as a foundation/backdrop)
9. Elements related to science and technology that are present in the game interface.

RESULTS

Mounting the corpus

The combination of both the videos and the gameplay experience allowed us first to compose a description of Prey in its narrative, aesthetic, and procedural aspects, and in the sequence, to highlight the aspects of science and scientists presented in the game.

Prey is a first-person action game developed by Arkane Studios and published by Bethesda Softworks in 2017. It is a 3D first-person action game with a science fiction theme.

The game takes place in an alternate universe in the year 2032 on a space station called Talos I, a former Soviet station that has been remodelled and is now owned by the TranStar corporation. In this universe, one of the first Soviet space missions in the 1950s found alien life in space. Keeping it secret, the USSR teamed up with the United States to contain the alien threat, which caused the space race of the 20th century to continue into the 21st century, resulting in a series of advanced technologies and the consolidation of human presence in space. The station is in orbit around the Moon and is used for scientific research and experimentation. Its most important product is the neuromod, a neural implant that allows the storage of memories and specialist skills for later implantation in the user's brain, allowing instant learning. At the start of the game, the station is taken over by alien beings called Typhons who escaped the station’s laboratories. The player character is the scientist Morgan Yu, whose gender is selected by the player at the start of the game. Morgan and their brother Alex are heads of research at the station and the sons of the CEO of TranStar. As a result of their scientific experiments, Morgan has no memories of events prior to the attack on the space station.

As Morgan, the player must explore the station, fight the Typhons, find out what exactly happened in the station and how to survive against the alien threat.

Throughout the narrative, the player must make choices that will affect the story and the end result of the game. The progress of the story reveals neuromods' production involves offering human beings (criminals and convicted political prisoners) to be consumed by aliens and using these as raw material. Eventually, Morgan discovers that they were the creators of this process.

When the protagonist manages to defeat the aliens, there is a scene where they are congratulated by their brother Alex Yu. After the credits, a new scene shows the protagonist waking up in a laboratory in front of Alex. The player discovers that the protagonist was actually one of the aliens, living in a simulation based on the memories of the real Morgan Yu. Morgan failed to try to stop the invasion of Earth by the Typhons and to save what's left of humanity, Alex implanted his sibling's memories in an alien to try to generate empathy for humans. This empathy is then gauged by the player's decisions on whether to help the people they encountered along the journey. One last player option, shaking Alex's hand or murdering him, determines the end of the narrative.

In terms of rules and mechanics, Prey can be described as an immersive simulator, a game genre with its roots in the studio Looking Glass, in the 1990s, whose games System Shock (Looking Glass Studios 1994) and Thief: The Dark Project (Looking Glass Studios 1998) inaugurated a style of game design marked by elaborate narratives, in complex environments, and different approaches to solve each challenge (Backe). Typically, these are 3D games with a first-person perspective, with various mechanics capable of producing different synergies with each other, favouring the players' creativity.

These mechanics are largely materialised using different equipment and weapons employed by the player. Some weapons are peculiar to the game, also having other uses such as forming passages and activating or deactivating devices.

Other elements that sometimes work as weapons are the alien superhuman powers that the protagonist gains through neuromods, implants found throughout the game. One Prey mechanic that complements the sci-fi story well is that as the protagonist chooses to obtain more alien powers, they become less human, to the point of being seen as an alien by station security devices.

Prey's complex environments comprise areas with different access points, which the player needs to unlock to proceed. Thus, the game scenario tends to be rich in elements for interaction. Discovering and using routes becomes an element of gameplay. Despite the occasional presence of non-player characters (NPCs), the game uses loneliness as an emotional element. Most of the time, the Talos I space station is shown without people or with dead bodies.

Concerning the environment and visual style of the game, the Talos I space station is a large private scientific research complex, with several sectors and laboratories and a residential area. The elements of destruction presented to the player from the beginning of the game contrast with the luxurious aspect of the space station. Rooms clad in wood and gilded metal, large halls with decorative lamps and other aesthetic details give Talos I an Art Deco style. This opulent look, inspired by the architecture, typography and even the fashion of the 1920s and 1930s, is recurrent in several elements of the environment, ranging from the covering of the rooms to the internal signalling of Talos I, and seems to translate the pride and ambition of the corporation.

In Prey, the environment itself seeks to tell a story through the posters and strongly stylized paintings that adorn the walls and the numerous books, notes, email messages and audio notes scattered throughout the station. The advertising aspect of the posters is explicit and acts as a persuasion element for station employees/inhabitants. Such images cooperate with the narrative, reinforcing the station as a place in a certain historical context, which will enhance, at the end of the game, the sense of displacement and the impact of the theme of simulation within the simulation.

Aspects of Science and scientists

1. Presence and role of science and scientists in the game's narrative

Science is a very relevant theme in the game's narrative. Not only the events that initiate the narrative are provoked by scientific research, but their development is punctuated by moments of discovery that highlight the strangeness and uniqueness of the invaders. A good part of Morgan Yu's journey in the game involves accumulating knowledge about the nature of aliens and ways to contain them.

In addition, most of the game's characters, from protagonists to minor supporting characters, are scientists or are involved with science in some capacity. From the first scene, where Morgan is tested by researchers, to the last, where, as the human/Typhon hybrid, Morgan is analysed by Alex Ryu, scientists, researchers, scientific terms, and procedures populate the narrative.

Prey's peculiarity is that its scientists are not limited to stereotypes common in the entertainment industry as the absent-minded genius, the eccentric professor, the domineering madman or the hero mentor (Haynes, 2003). Although there are scientist characters who partially fit these stereotypes, a large part of the game's characters are portrayed as employees of a corporation, workers who develop their activities by vocation and for remuneration living in a crisis situation.

2. Presence and role of science and scientists in the setting (historical and geographic space) of the game

This presence of science and scientists is also abundantly represented in the game's setting. This setting comprises both spatial and historical terms, through a backstory that describes the universe where Prey takes place, and its similarities and differences in relation to the historical process of the real world.

Although the game initially draws attention for its rich art-deco decoration (called neo-deco by its creators), soon the player will be exploring laboratories, data centres and other scenarios related to science and scientific research with specific missions, information and items.

In terms of backstory, Prey's universe is detailed through email messages, journals and books found in the labs and living quarters, and even through posters in the station. Through these elements, we learn that in the game's universe, the discovery of the Typhons led to a joint project between the Soviet Union and the United States, culminating in the creation of a space station. Unable to find an industrial or warlike use for the aliens, however, the station itself was abandoned until the TranStar corporation reclaimed and refurbished it for scientific research. This intertwining of science and financial interests will be a recurring theme throughout Prey's narrative.

Thus, we may say that in terms of narrative and setting, Prey is probably one of the games with the greatest presence of science and scientists, who appear not only as a narrative resource but effectively as essential elements of the story.

3. *How science is characterised: something positive, neutral, negative, mysterious, uncertain, reliable, accessible, or even as an element added to other sectors such as war or religion*

Regarding the characterization of science, Prey also intertwines different perspectives. Although at first, it presents a narrative provoked by a catastrophic failure in scientific research, by highlighting the risks of investigation, the narrative's progression shows other aspects of science as a noble human endeavour, as a calling that can take precedence over other concerns such as the family, and even as a necessity to protect humanity from external threats.

Perhaps the character that best expresses these different views is Alex, the protagonist's brother, who for most of the game will also be one of the antagonists. Throughout the game, the communication system constantly brings Alex trying to persuade Morgan to help him contain the invaders and not destroy the station or the research. Alex constantly defends their research's value, first as an element for the improvement of the human being and later, when Morgan discovers that the Typhon represents an interplanetary threat, as the only way to enable humanity's defence. Thus, Alex implicitly accepts that deaths due to experiments and the production of neuromods are a necessary evil for a greater cause. These different facets are emphasised by the ending, where Alex appears as an active agent trying to regain control of the planet and perhaps save humanity.

This type of duality also occurs in terms of the procedural rhetoric of the game, since the most powerful abilities available to the player are discovered by researching alien tissue and progressively make Morgan more similar to the aliens.

4. *How the scientist characters are characterised regarding their importance in the narrative and in the environment*

Multiple perspectives are present in the scientist characters that appear in Prey. Throughout the narrative, Alex appears as a manipulator willing to do anything to protect his research, even if it involves sacrificing human beings. But there are other traits to this characterization, with Alex frequently lamenting that Morgan is not on his side and, at the end of the game, appearing as a leader of the resistance against the aliens. Similarly, Morgan, which at first is a tabula rasa guided by the player, gradually receives different layers. At first, positive ones such as courage, intelligence and even selflessness, such as, for example, ending a relationship so as not to jeopardise their research. Soon, however, it is discovered that Morgan was one of the creators of the experiment that allowed the development of neuromods and apparently ruthlessly conducted their production, sacrificing the lives of dozens of prisoners.

In addition to Morgan and Alex, most of the supporting characters in the game are scientists and their representation tries to be quite varied, ranging from those who seek pragmatic personal advantages such as appropriating research from others or even smuggling neuromods, to those fanatically devoted to science, almost obsessively regardless of ethical parameters. What the game shows more recurrently, however, are scientists as part of an organisation, with their personal plans, dilemmas and concerns, suddenly finding themselves victims of a catastrophe. In a way, Prey shows the figure of the scientist less as a potential danger or source of information for the hero, and more as people fulfilling a professional role in society. From occasional conversations with supporting characters to exploring the crew's quarters, the game presents the figure of the scientist in a more humanised way, as workers at Talos, sharing with the rest of the crew not only the living space and work but also duties and rewards for productivity.

5. *How are the scientist characters visually characterised: speciality, age, gender, ethnicity, characteristic traits (glasses, lab coat, physical shape and weight, facial hair, dishevelled hair, etc.)*

These scientists are characterised in different ways, with different physical types. It is possible to find tall scientists, with glasses, younger or older, men and women. Some wear white coats, a common "narrative shortcut" when representing scientists in various media, but most appear wearing Talos' white and green scientist uniform. There is also diversity in the representation of sex, gender and ethnicity. The presence of people with disabilities is not evident, although conditions such as vitiligo appear in a black character and a disabling fictional disease affects Morgan's ex-girlfriend, which motivates a secondary mission.

As for speciality, the game is less detailed, but it is implied that most of the scientist characters deal with physics and biochemistry although there are different specialists and even botanists. A marked absence is that of social scientists, who do not appear in the game. Although it is a science category that is generally not very present in games, it is still noteworthy that even in Prey's universe there is no mention of these professionals.

6. *How are scientist characters mentally and socially characterised: temperament, competence, perspicacity, ethics, sanity, eccentricity, empathy, etc.*

No significant mental atypia appears in the game characters. The exception is an assassin who disguises himself as a cook. However, Morgan often finds mentions in e-mail messages and personal diaries of psychological disturbances suffered by members of the crew, apparently due to the alien psychic influence exerted by the Typhons.

In addition, there are the changes suffered by Morgan, who tests the process of insertion and removal of neuromods on themself repeatedly, resulting in successive erasures of their recent memory which, according to Alex, seems to be altering their personality in a more permanent way.

7. *Player character's relationship to science (in terms of its influence on their background, decisions, or abilities)*

The indiscriminate use of neuromods by Morgan combines with the figure of the scientist who uses themself as a guinea pig, common both in comics and movies, showing the protagonist as a bold and fearless genius, apparently willing to risk their safety for the progress of science. In the first part of the game, this ethos is reinforced by the found messages, diaries and lines of the supporting characters, who repeatedly mention Morgan's qualities, typical scientists' qualities according to common sense: curiosity, talent, determination, courage and self-sacrifice. In the second half of the game, as the player begins to learn more about the protagonist's past, less altruistic characteristics, but also linked to the scientist's image, begin to emerge: ambition, coldness, recklessness and obsession. In this way, Morgan, the protagonist, is a scientist who embodies both the qualities and the flaws typically associated with scientists in works of fiction.

Morgan not only is surrounded by science, constantly in laboratories and similar environments, but in terms of narrative, both the apparent resolution of the story (the use of the device created by Alex to expel the Typhons) and the final scene and possible hope for humanity (the creation of the human-Typhon hybrid) are somehow based on science.

Finally, it is worth mentioning that, surely, Morgan is not the first game protagonist identified as a scientist, having famous antecedents like, for example, Gordon Freeman

in Half-Life (Valve, 1998). However, despite Gordon Freeman being initially presented as a scientist at the game start, he mainly acts as a soldier, with his work as a researcher hardly being of relevance in the story. Instead, in Prey, the protagonist's role as a scientist is essential to the narrative the game presents and it carries particular weight to the player's choices in the final part of the game.

8. *Influence of science or scientists on the functioning of game rules and mechanics (if and how tasks and missions proposed to the player have science or scientists as a foundation/backdrop)*

Reinforcing this narrative aspect, In Prey, skills are divided into three careers: security, engineering and science. While the intent of most Scientist career skills is to provide instrumental capabilities for the player to deal with game challenges, such as hacking, some are directly related to scientific investigation, giving a deeper understanding of alien physiology capable of conferring on the player the better ability to use the neuromods.

Along with this, another mechanic present in the game is the ability to analyse Typhons and thus better understand their physiology, weaknesses and vulnerabilities, thus revealing the best way to combat them. This process of observation and analysis, although adapted to the reality of an action game, can serve as a metaphor for the scientific method for gaining knowledge and solving problems.

Thus, it is possible to say that, in addition to characterising the protagonist as a scientist through the narrative, the game rules allow the player to reinforce this vocation, by selecting skills explicitly presented as related to science.

9. *Elements related to science and technology that are present in the game interface*

Prey's user interface also mirrors the scientific/technological aspect that the game seeks to present. Especially on the screens most frequently used by the player, such as the inventory, map, skill tree and equipment screen, there is a visual style mixing visualisation elements on digital devices with infographics. In fact, this interface is intended to be the protagonist's view of their personal computer, trying to harmoniously blend narrative and interface elements.

Figure 1: Inventory screen.

Figure 2: Map screen.

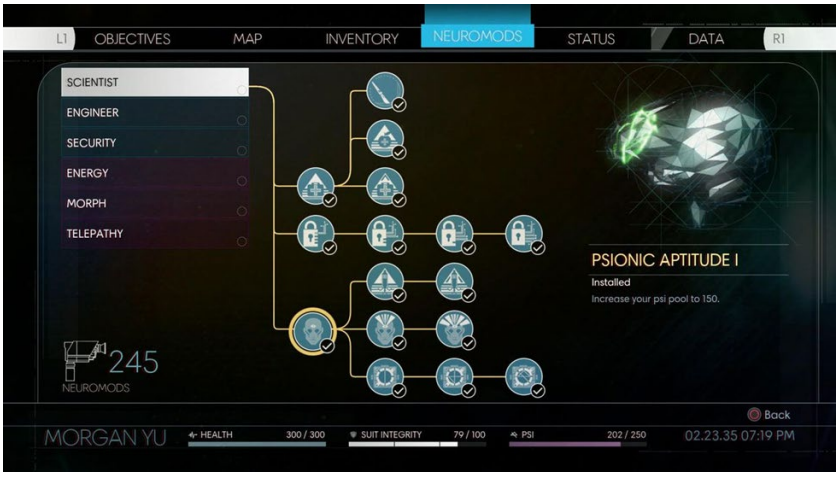

Figure 3: Scientist career skill tree.

The screens related to the chipsets are even more characteristic, showing schematic drawings of the protagonist's body and head that resemble technical-scientific diagrams.

Figure 4: Suit chipsets.

Figure 5: Psychoscope's chipsets.

The interfaces of the equipment used by the protagonist also align with the narrative when, at a certain point in the player finds the "Psychoscope", a prototype created by Morgan that allows to scan and analyse abilities and weaknesses of alien creatures and, in the process, learn new powers and skills. The psychoscope is both a functional piece of equipment for the game and a key element of the narrative, as it is used to uncover the truth about the events leading up to the Typhon invasion.

Figure 6: Game screen through the Psychoscope.

The elements described above came from both the experience with the game and the visualisation of gameplay videos and from them, it was possible to identify aspects of the game that exemplify the representation of science and scientists, which can be consolidated into the five thematic categories below.

DISCUSSION

Science Themes in *Prey*

The presence of science as a procedural category

Although it is in Prey's narrative that it is possible to identify representations of science and scientists more clearly, it is also important to highlight the game's rules. Prey's rules and mechanics form a procedural rhetoric that can be understood as representing science in two main ways.

The first and most obvious are the science and technology careers, which appear as skill trees available to the player. These skills tend to involve techniques for breaking in and hacking or knowledge of bioscience, including one directly related to the study of Typhons. Although a scientist's activities and knowledge are being represented in a simplified and abstract way, there seems to be an intention to present them as relevant skills both for the character who lives the story and for the player who plays the game.

In a broader way, it is also possible to identify an investigative approach in much of the game, leaving the player to gather the clues found in different environments and formats in order to understand the nature of the threat. While it could be argued that these actions would be common to all games involving some sort of deduction, Prey reinforces this operational investigation-deduction-action approach with elements such as the Psychoscope, which allows the player to identify the different Typhon subspecies that roam the station, adding its information to the player's computer database. When enough individuals of the same category are examined, a neuromod related to that subspecies is made available to the player, thus expanding the available abilities.

In both cases, it is possible to see an attempt to integrate aspects related to or perceived as part of the scientific process to the rules and mechanics that allow the player to deal with the game systems. Through investigation and analysis, the procedural rhetoric in both cases seems to express the potential of science to diagnose solutions and provide greater effectiveness and understanding of the world.

These forms of representation that appear in an abstract and implicit way in Prey's procedural rhetoric will become more evident when we analyse elements that appear in its visual and narrative representation since both categories (narrative and rules) are closely integrated into the game.

Science vs. the individual

In Prey, several dialogues depict an opposition between scientific interests and social and human interests. Often, Morgan is confronted by other characters who accuse them of favouring the progress of science at the expense of people who have feelings, rights and families. Occasionally, the game mentions relationships between employees and scientists on Talos I or their families who stayed on Earth. The intention seems to give more relevance to these characters and, consequently, to the player's actions in controlling Morgan. This theme gains more relevance when we discover that the creator of the process that sacrifices human beings for the manufacture of neuromods was Morgan themself. Morgan, who up to a certain point in the game was in line with the stereotype of the noble and altruistic scientist (willing to die to prevent the Typhon from invading Earth) then seems to migrate to a cold, ambitious and even Machiavellian scientist, insensitive to the suffering that causes, as long as success is obtained.

Sacrifice for Science

The sacrifice for science is explicitly verbalised by Alex Ryu, who several times suggests that the preservation of their research is necessary so humanity can evolve and protect itself from the dangers that inhabit space. This theme will permeate several moments in the game, whether in the scientists who have to live and work far from their loved ones, in the sacrifice that Morgan intends to make, blowing up the station to prevent the Typhons from reaching Earth, or even in the broadest sense, in which the very idea of Talos I represents an effort by humanity to reach the stars. An interesting counterpoint to this idea of preserving humanity is that, by improving human abilities through neuromods, the player character received so much alien genetic material that started to be considered an alien threat by automated defence systems. That is, in the quest to improve humanity’s chances of survival, human beings may end up losing their

human characteristics. Ironically, the last scene of the game, showing the player already as a phantom with human memories, returns to the themes of human value, feelings and self-sacrifice but in the opposite direction, where the phantom is judged whether it was able to develop empathy, that is if it started to become human.

The (lack of) ethics in research

This same duality appears in the use of human beings as objects of scientific experiments, discovered by Morgan towards the end of the game. In fact, human guinea pigs were used in the past and now humans are actually the raw material for producing neuromods. The official reason for this practice is that they were convicted of violent crimes in Russia, and, therefore, somehow their sacrifice (or execution) would be a kind of compensation for humanity. At least, that seems to be the argument that those who deal with this macabre manufacturing process use to try to appease their consciences. It is also suggested by Alex as a necessary step to enable humanity to withstand future Typhon attacks. However, even if a distorted utilitarian view of ethics is adopted to justify such a practice, Prey, despite not explicitly assuming a side of the discussion, allows us to see that these deaths do not benefit humanity directly, but contribute to the business success of TranStar, owner of Talos I and all its scientific research.

Science as a private enterprise

The corporate power that owns Talos I is also a theme that runs throughout the game. From the posters with slogans that adorn the social areas to the station's surveillance, it is clear that in this territory the word of TranStar is the law. Towards the end of the game, the CEO of TranStar, father of the Yu brothers, concerned about the risks of Typhon's escape on the company's reputation, sends an agent to execute all the people on board, including his own children. Thus, scientists and other employees work and live in an environment where everything is owned/provided by the corporation, including the air they breathe. It is not possible to complain or claim improvements, as there are no labour unions in space.

Talos I scientists work collectively in teams, but at the same time, their efforts are not necessarily directed towards improving the lives of humanity. Rather, their concern is meeting the goals set by TranStar and securing or improving their position in the company. The findings are kept secret both out of fear of public opinion about unethical practices and as a business strategy to stay ahead of competitors. This regime of scientific work is in opposition to the models proposed by the field of Science Communication, whose main concern is that scientific knowledge somehow reaches the general population, and that society develops the cognitive and political conditions to give an opinion on such developments. In addition, at Talos I, scientific research seems to lack any ethical principle, violating the human dignity of both volunteers and scientists and ultimately endangering the entire planet. It is noteworthy that even in the fictional universe of Prey, the lack of ethics and transparency in scientific research tends to create tragedies.

The scientist and Science in *Prey*

If the protagonist and antagonist are both scientists with some stereotypical traits, most of the scientists and researchers we meet are “normal” people: scientists who work on their research, solve problems, deal with personal issues and try to be productive in their work. This characterization of the scientist as a person immersed in a social context (even if on a space station) and of science as a daily job, a paid activity carried out by specialised workers, is a particular aspect of Prey, representing an evolution in the way that scientists are generally represented in digital games.

This possible deglamorization of the scientist that can be identified in Prey is interesting for simultaneously showing a more humane and realistic aspect of scientists not usually considered in fictional works and at the same time revealing aspects of certain regimes of techno-scientific production that maintain visceral connections with the capitalist system. The scientists in Prey aren't allowed to follow one of the main tenets of science communication in our world. Prey's world shows a science that is not supposed to be communicated or reach society, empowering people in the process but instead, a science that grounds highly advanced technology that ultimately becomes weapons to grant humanity's ability to fight and conquer. In this sense, it also works as a kind of warning about allowing the paths of science and the lives of scientists to be controlled exclusively by profit interests.

Themes like private research carried out by large corporations, the absence of external oversight of ethical standards in research, the lack of transparency in the allocation of resources and definition of objectives, and the reduction of researchers to mere cogs in a machine, are today's concerns in the real world and so Prey can represent for the player a first glimpse of current issues that have been addressed by science systems researchers.

As for science itself, a more superficial reading might suggest that Prey presents science as the cause of the misfortune that befalls the space station. However, a more detailed analysis can show that if science creates a risk for humanity, it is also through science that the protagonist can solve the problem, either through technological equipment such as the energy pulse that eliminates the Typhons in the station or through Alex's final project of creating an alien endowed with human empathy. Thus, what seems to be in focus is to highlight the dangers of the misuse of science and the invasion of non-scientific criteria (greed, irresponsibility, obsession, etc.) in guiding scientific work.

In this way, Prey seems to propose both criticisms of certain science practices and the potential that science has to empower and improve human beings. This even happens in the final scene, where the future of humanity rests on the creation of a human-Typhon hybrid. While this is a scientific project, its success rests on the human capacity for empathy, a trait that Prey seems to suggest is essential to human endeavours.

By offering a sophisticated fictional universe and a greater ambiguity and richness of readings about its representations of science and scientists, Prey provides an experience that is still uncommon in AAA and AA games, articulating innovative discussions about science, precisely because it presents its political aspects and its interrelation with the different agendas of society.

The reveal at the end of the game is somewhat hinted at in the opening. Just as the "first" Morgan was being watched and tested in a simulated environment by their own brother, the "phantom" Morgan is being monitored and tested with the memories of the first, again by Alex. And although all of the latter's actions took place in a simulation, they nonetheless have an effect in reality, which is to develop the alien's empathy for humans and potentially to save what's left of humanity. This is also a moment when we, the players, were called upon to reflect on our own actions in the game and assess whether we acted like human beings or like a predatory species. In this sense, simulation is not a space whose internal events are irrelevant, but an environment capable of promoting growth. Prey repeatedly reveals different layers of simulation, but at the same time seems to assure both the protagonist and the player that the reactions and emotions they experience are legitimate and true.

FINAL REMARKS

In this work, we analysed the game Prey, seeking to understand how it represents science systems, mainly focusing on representations of science and scientists.

The findings reveal that despite Prey resorting to narrative techniques typical of adventure and science fiction games, it includes sophisticated representations of science and scientists. This sophistication can be summarised by the significant diversity in the representation of the scientist characters, a greater depth in their tasks and work regimes and their characterization as "normal" human beings, escaping, in most cases, from the stereotypes of scientists, so common in movies and other games, as the mad scientist or the distracted genius.

This interweaving with science is not limited to the narrative and setting but is also present in the rules and mechanics of the game. The skills and activities related to science that the player must carry out to complete the game's stages, although simplified and abstract, are related to real activities. In addition, often the player is called upon to make difficult decisions in terms of ethics, directing the narrative according to their decisions. This highlights the importance of considering procedural rhetoric as an important dimension of analysis when studying the meanings proposed in a game.

The game's narrative presents ethical issues related to science, mainly involving research on human beings and the transparency of scientific work. Such themes, so relevant in the real world, are competently addressed in Prey, which does not present science as a domain totally displaced from the social and economic productive system, but as an integral part of industrialization and its technological productions as a relevant part of the social process. These aspects justify a further investigation focusing on the connection between science, capitalism, and work, which seems to be a future path for developing this research.

One of the limitations of our study was that we did not survey the opinions of players, so we cannot say that the representations mentioned here are effectively apprehended by the public. This will possibly be another way to continue this investigation.

Finally, we believe that the effort to investigate an important human enterprise such as science in the context of digital games can provide important learnings, both about how we conceive and interact with scientific themes and also how real-world issues are represented through games. Since science and technology are such an important part of everyday society, affecting each of us on personal and collective levels, and furthermore, are intrinsically linked to the very existence of digital games, it seems necessary to understand better how games encode and propose science themes to their public. Understanding how such elements appear in games and, eventually, how gamers actually apprehend such ideas is valuable in itself to improve our comprehension of both the power of digital games as cultural media and the ways we can express and change our worldviews from experiencing them. This thematic articulation, until now very little explored, may yield many fruits for different fields of knowledge.

BIBLIOGRAPHY

Aarseth, E. 'Playing Research: Methodological approaches to game analysis'. *Proceedings of the digital arts and culture conference*: RMIT University Melbourne, VIC, 28-29.

Aarseth, E. and Calleja, G. 'The word game: The ontology of an undefinable object'. *Foundations of Digital Games Conference, 2015*, Pacific Grove, CA, 1-8.

Araujo, I. S. (2000) *A Reconversão do Olhar.* São Leopoldo: Unisinos.

Backe, H.-J. 'Two Ways through the Looking Glass. Game Design as an Expression of Philosophy of Action'. *Philosophy of Computer Games Conference 2017*.

Backe, H.-J. 'Metareferentiality through in-game images in immersive simulation game'. *FDG '18. ACM International Conference Proceeding Series*: ACM, 1-10.
Beil, B. (2021) '"I love how you can see the bottom of the universe from this room." The Real-Virtual Architecture of Davey Wreden's The Beginner's Guide', in Bonner, M. (ed.) *Game| World| Architectonics*. Heidelberg: Heidelberg University Publising, pp. 169-185.
Bogost, I. (2007) *Persuasive Games: The Expressive Power of Videogames.* Kindle edition edn. Cambridge: The MIT Press.
Chambers, D. W. (1983) 'Stereotypic images of the scientist: The draw-a-scientist test', *Science education,* 67(2), pp. 255-265.
Chang, H. (2007) 'Autoethnography: Raising Cultural Consciousness of Self and Others', in Walford, G. (ed.) *Methodological Developments in Ethnography Studies in Educational Ethnography*: Emerald Group Publishing Limited, pp. 207-221.
Dodd, K. (2021) 'Narrative Archaeology: Excavating Object Encounter in Lovecraftian Video Games', *Studies in Gothic Fiction,* 7.
Dudo, A., Cicchirillo, V., Atkinson, L. and Marx, S. (2014) 'Portrayals of technoscience in video games: A potential avenue for informal science learning', *Science Communication,* 36(2), pp. 219-247.
Ferguson, S. L. and Lezotte, S. M. (2020) 'Exploring the state of science stereotypes: Systematic review and meta-analysis of the Draw-A-Scientist Checklist', *School Science and Mathematics,* 120(1), pp. 55-65.
Gjøvik, Ø., Kaspersen, E. and Farsani, D. (2022) 'Stereotypical images of male and female mathematics teachers', *Research in Mathematics Education*, pp. 1-16.
Haynes, R. D. (2003) 'From alchemy to artificial intelligence: Stereotypes of the scientist in Western literature', *Public Understanding of Science,* 12(3), pp. 243-253.
Kanahara, S. (2006) 'A Review of the Definitions of Stereotype and a Proposal for a Progressional Model', *Individual Differences Research,* 4(5).
Kirby, D. A. (2008) 'Cinematic science', *Handbook of public communication of science and technology*: Routledge, pp. 55-70.
Kirby, D. A. (2011) *Lab coats in Hollywood: Science, scientists, and cinema.* MIT Press.
Kirby, D. A. (2014) 'Science and technology in film: themes and representations', *Routledge Handbook of Public Communication of Science and Technology*: Routledge, pp. 113-128.
Lannes, D., Flavoni, L. and De Meis, L. (1998) 'The concept of science among children of different ages and cultures', *Biochemical Education,* 26(3), pp. 199-204.
Mullen, M. (2020) '0451: Prey, Arkane Studios (2017)', *Journal of Gaming & Virtual Worlds,* 12(1).
Pinto, M. J. (1994) *As marcas lingüísticas da enunciação: esboço de uma gramática enunciativa do português.* Rio de Janeiro: Numen Editora.
Pinto, M. J. (2002) *Comunicação e discurso: introdução à análise de discursos* São Paulo: Hackers Editores.
Reznik, G., Massarani, L. and Moreira, I. d. C. (2019) 'Como a imagem de cientista aparece em curtas de animação?', *História, Ciências, Saúde-Manguinhos,* 26, pp. 753-777.
Vasconcellos, M. S., Carvalho, F. G. and Araujo, I. S. (2017) 'Understanding Games as Participation: an analytical model', *Cibertextualidades,* (8), pp. 107-118.