Utolypse: Balancing Game Mechanics and Worldness

Thesis Presented

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ABSTRACT

Game mechanics are major interactive methods connecting players with the game world, and many games have an imaginary world to provide legitimacy for game mechanics. Game designers need to balance game mechanics and worldness (imaginary world features). In this paper, we analyzed the relationship between game mechanics and worldness from the perspective of game design, and propose “representation” as bridges to connect these two elements. Representations means objects and scenes displayed to players.

Based on this concept, we developed a method for evaluating representation in games to determine if worldness and game mechanics were cohesive and consistent, which we applied to the analysis of existing game worlds. This resulted in a design framework, with six design principles to assure the balance between worldness and game mechanics. To test the practical application of these design principles, we developed a game Utolypse set in a post-apocalyptic utopian world specifically designed to illustrate the relationship between game mechanics and worldness. Although the game itself had mixed results, the outcome suggests that this framework used as part of an iterative game design process has the potential to help ensure consistency between game mechanics and world design.

Keywords

Game mechanics; Worldness; Representation; Affordance; Game Design Framework; Utolypse
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1. INTRODUCTION

As game mechanics facilitate interactions between game worlds and players, player perceptions of game mechanics will shape their understanding of game worlds, and vice versa. Successful game design can better express the uniqueness of game worlds through sensory elements that motivate players to continue discovering. Also, game worlds can allow game designers to design unique game mechanics by aligning with world features. This is often used as a way to extend a fictional world through game adaptations.

While past researchers analyzed how game mechanics should be designed to make games fun to play, they focused less on the connection between game mechanics and game worlds. Virtual worlds, or imaginary worlds, are hard to describe because of the richness of their content and structures. Researchers use the concept of worldness as the main measurement of virtual worlds (Klastrup, 2003), summarizing the characteristics of imaginary worlds. Worldbuilders can depict a whole virtual world from clearly-defined worldness features and build more world details. Many video games introduce a virtual world to players and use it as the container to hold mechanics and gameplay. However, the potential conflicts of game mechanics and game worlds are understudied. Using a gun in a primal world is fun, but players will be confused if no explanations are given.

In this study, I analyzed the relationship between game mechanics and worldness, proposing evaluation traits, and a design framework for designers to balance game mechanics and
worldness as part of the game design process. To verify the validity of those concepts, I designed a game called Utolypse. This first-person perspective puzzle game is set in a post-apocalyptic world, based on the concept of “Universe 25” (a rat utopia named by John B. Calhoun, 1973) and the gameplay of player perspectives. Playtesting and further discussions around this game are also included.

2. BACKGROUND

In this section, I will discuss worldness because this concept requires more attention from a design perspective. Video games are not simply a bundle of game mechanics. Not all game mechanics are appropriate in a given game world. Designers need to filter them to create the desired effect.

2.1 Discussion of Worldness

The concept of worldness is first proposed by Lisbeth Klastrup (2003). Adapting the “literariness” to define literature, she used “worldness” to characterize game worlds, which is “the essential aspect which characterizes all virtual worlds” and well-defined features for a specific virtual world (Klastrup, 2003). J.R.R. Tolkien (1983) has a worldness-like concept called “secondariness,” which represents the most distinctive features that differentiate the real world (the “primary world”) from the imaginary one, or the “secondary world.” Since the imaginary world shows a strong similarity to the real world, worldness is used to separate the two worlds in terms of their essences: details, specific rules of existence, habitat, etc. Synthesizing the work of Klastrup and other scholars, Pearce (2011) proposed worldness as a
“sense of coherence, completeness, and consistency within the world’s environment, aesthetics, and rules.” This definition gives three clear aspects of worldness (coherence, completeness, and consistency), which will be discussed later as metrics of evaluating worldness in game mechanic design.

In the discussions above, worldness can be summarized to comprise three main driving forces that are worth a separate description (Pearce, 2011; Wolf, 2014). These aspects are completeness, coherence and consistency. Completeness sets up boundaries for the imaginary world, defining what can and cannot exist within it. Coherence requires world features to be coherent with each other and understandable to players. They should understand and expect what’s happening next based on world rules. As for consistency, the imaginary world should always keep its rules, and give a reasonable reason if modified.

Imaginary worlds function as interpretative frameworks (Klastrup, 2003) in which players use the game world as a reference point to assign values and meanings. In this process, worldness behaves as a decisive judgment in worldbuilding. It decides the form and meaning of props, actions, and expressions. For example, death is a common concept and game mechanic in almost all games. Different games have various interpretations and applications of in-game death. At any rate, death is recognized as an important stage in the game world. It declares the end of the game (game over) or forces players to engage in specific activities to continue gaming (waiting for re-spawning, or character resurrection) (Klastrup, 2006). No matter what form, death represents penalty because of the meaning of extinction, by default. Worldness supports this
unless all characters are immortals in the world, and thus they cannot die. In this case, death as the penalty would conflict the worldness, and designers have to use another meaningful action. Game designers need to make game mechanics understandable and meaningful; worldness and game mechanics have to be adjusted with each other. Once a new rule is added to the worldness, it also further restricts the game mechanics, making many forms become unavailable in the game.

For imaginary world adaptations, keeping the wordness is more important than designing new mechanics. Because the adaptation is not just a copy-and-paste, it is more like the recreation based on existing worldness, which is called “remediation” by Bolter and Grusin (1999). This is usually determined by its transmedial nature that can be observed in the expansion of the world beyond specific content or the primary storyline (Klastrup and Tosca, 2004). Klastrup and Tosca proposed three core elements of a transmedial world: Mythos (Main conflict, character, event features, backstory), Topos (Historical periods, space and civilization features) and Ethos (Explicit and implicit ethics features). The transmedial world can be defined as a collection that includes multiple characters and notions that can simply be transitioned from one media form to another. For example, the Mortal Kombat universe involves games, movies, comics, standalone projects, etc., and creates a big fan-base. In the same vein, the uniqueness of game mechanics can be achieved by means of specific gameplay features that reflect on the game world (Kücklich, 2009). Further adaptations can even reshape the original imaginary world, which Pearce and Schweizer describe as “Re-Remediation” (2016), with reference to Disney’s Pirates
of the Caribbean world, where rides were retroactively modified to match the later film adaptations.

Besides game content reflecting the worldness, game interfaces can display worldness as well. One of the most common trends in games is the presence of diegetic game interfaces, which are game interfaces that exist inside the game world (Iacovides et al., 2015). Diegetic interfaces are parts of the game world, and how they translate useful information to players reflects the worldness. Using diegetic interfaces instead of non-diegetic interfaces can improve player immersion and enjoyment (Iacovides et al., 2015). This tendency can be observed in a variety of games, as it satisfies a number of goals, such as making the game more challenging, realistic, and atmospheric (Salomoni et al., 2016).

### 2.2 Game mechanics, Gameplay and Narrative

Speaking about game mechanics as the primary variable that affects the worldness of a game, Björk and Holopainen describe two relevant concepts of great significance. The first one is the game patterns, the “framework for how to structure knowledge about gameplay that could be used both for design and analysis of games.” It focuses on a specific relation between players and the game and can be modified based on what design questions need to be answered. The second concept is the game components. Game components are considered as fundamental parts that form the game, used to define how a game is unique and different from others. There is a wide range of components based on different scales of the game, including four types: holistic, bounding, temporal, and structural (Björk and Holopainen, 2004).
In other perspectives, gameplay and narratives are often discussed together. Gameplay and narrative contribute much to the creation of the unique worldness of a game. It is imperative to differentiate game narrative and gameplay, as they are entirely opposite aspects (Lindley, 2002). The narrative presents a certain premise of the entire game—the sequence of events that generates the storyline, whereas gameplay is a factual representation of game mechanics (Lindley, 2002). In other words, the gameplay is a set of functions, actions, characteristics, and opportunities available to the player for progress throughout the storyline and the whole game world as such (Shirinian, 2010). Nonetheless, game narratives are often structured as recursive, and the players’ progress is associated with passing a certain stage (Lindley, 2002). Since this aspect limits the completeness of worldness, many game developers tend to segregate the advancement of gameplay opportunities from the primary narration of the game (Pearce, 2011).

Overall, the aforementioned concepts and notions introduce the related concepts, and suggests that the analysis of the relationship between worldness and game mechanics has requires a credible research methodology.

3. DESIGN PHILOSOPHY

As this study is for game designers, a deeper analysis of worldness in game mechanics and how the relation inspires game designers is necessary. Further analysis of the relation between game mechanics and worldness is discussed in this section. The analysis of games used the close reading method (Aarseth, 2003; Bizzocchi and Tanenbaum, 2011), which is a deconstruction process applied to multi-text media. While holding an argument, researchers are required to
analyze as many details as possible in limited contextual materials. It is useful to analyze video games, as there is so much information displayed on the screen every second.

3.1 Representations: How Mechanics and Worldness Work Together

Mechanics and worldness are not shown to players directly. What players see or hear in the game are interfaces that reflect mechanics and worldness. And because they are not conveyed to players directly, players need to learn game rules through visual or other sensory objects, like characters, weapons, enemies, UI, etc. If we pack these game objects together, we can call them "representations." In art, representation is defined as a tool for humans to express feelings, ideas, thoughts, and ideologies (Ryder, 2004). In games, representations are parts of mechanics that are used to convey information directly to players, including sensory appearances, characters, items, props, environment, etc. Representations can be categorized mainly into structural components (Bjork and Holopainen, 2004).

Narratives or stories can also be considered as representations. They are based on existing mechanics and worldness to provide a media-independent sequence of events. In games, other representations need to comply with narratives to adjust story pace and render the atmosphere. Different types of stories, like Aarne-Thompson folktale types (Thompson, 1961), need different additional designs to merge stories into the game.

Even though mechanics and worldness should comply with each other, they cannot influence each other directly, and they have to influence each other through a medium, which is the
representation. The relations, using representation as a bridge, work as flows from mechanics to worldness and vice versa.

Figure 1. Flows of Mechanics, Representations and Worldness

Conversely, it is often seen that worldness changes the mechanics by defining representations in the world. Especially for transmedial worlds (Klastrup and Tosca, 2004), the three transmedial elements (Mythos, Topos, and Ethos) of worldness often have specific representations like religions, characters, conflicts, props, etc. Mechanics have to adapt to existing representations. For example, in an imaginary world where humans have a supreme ruler (worldness), the representation of the ruler can be a dragon (Bostrom, 2005), or peaceful aliens (Clarke, 2012). By defining the representation, the potential mechanics should be specified. If the ruler is a dragon, it will have the ability to spit fire. If the ruler is aliens, they will have the ability to talk. Designers need to design mechanics accordingly.

Different representation choices based on the same mechanics and worldness can have different game effects. The main reason behind this is players could interpret the potential uses and restrictions in representations, which is also affordance. Affordance means what the environment offers, provides, or furnishes (Gibson, 1966), and further can be considered as perceived action possibilities (Norman, 1988). However, affordance is quite different between the real world in games, as the mechanics may not be realized. For example, pistols have potential use as a melee
weapon to knock out enemies, but few games allow that. It's not necessary to do so; especially since game designers use the game to convey messages (Swain, 2010). Incorrect choice of representations may deliver unwanted messages to players. Only the most appropriate representation with desired affordances should remain.

In summary, representations are the medium of mechanics and worldness and will affect game effects on both sides. Designers need to balance the requirements on both sides, because representations will add “hidden assumptions” to the world. A representation of “pistol” only exists in a world where it’s possible to have weapon industries or workshops, and the game realizes the mechanic to shoot. It is possible to see mechanics and worldness that do not match, making the representation quite confusing. In the next section, I will discuss the analysis method I developed in order to evaluate this potential disconnect between mechanics and worldness.

3.2 Evaluation of Worldness in Game Mechanics

For an existing design, designers need to check if the design follows the worldness of the imaginary world. However, evaluating worldness in game mechanics is a tough job as there are currently no clear standards. To describe the worldness features, we can evaluate the representations in the game, as they are the bridge between mechanics and worldness. The worldness from these representations should be consistent during the game, which can be summarized into four metrics: coherence, completeness, consistency (Pearce, 2011) and acceptable affordance (Norman, 1988).
• **Coherence**: The game component itself can exist in the imaginary world without conflicts. It may be contextually reasonable or philosophically reasonable. Contextually reasonable means the content is possible to exist in the contextual background, or important enough to be considered, as the wand in wizard worlds.

• **Completeness**: Different game components should generate no loopholes when they integrate together and all functions should exist and respond as expected. For example, if a button is added to the menu view but designers forgot to assign functionalities to it, the completeness is violated.

• **Consistency**: During the game, games rules should be constant in the applicable scenario. They should be kept within a certain range so that players cannot abuse them. If it will change, the limitations should be presented to players as early as possible, or extending the existing rules instead of replacing them.

• **Acceptable affordance**: A fourth factor affecting the worldness is acceptable affordance, meaning the affordance of representations should be a good match for mechanics and worldness. For example, using a gun to knock out enemies is accepted in most worlds, but this is not a good representation for mechanics - instead, players may use hammers or maces instead. This factor is an addition to the Coherence, which only requires the representation to be available in the game world and reflect the functionalities of mechanics. Acceptable affordance further requires the representation to be appropriate and easy to learn; thus the representation will make the mechanics more legible to the players.
The four metrics can be used to analyze any representations in the game. Designers can list all of them and evaluate them one-by-one. A good order here is to use the four kinds of components (holistic, bounding, temporal, and structural) by Bjork and Holopainen (2004). These four components talk about different scales of the game, and this work can give us an integrated perspective of game design. Designers can make a form that analyzes all notable components by four criteria through "close reading" of a specific game. The following analysis of Final Fantasy XV illustrates how this method is applied (First five rows).

<table>
<thead>
<tr>
<th>Representations</th>
<th>Component Type</th>
<th>Coherence</th>
<th>Completeness</th>
<th>Consistency</th>
<th>Acceptable affordance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four main characters: Noctis as the prince, while Prompto, Gladiolus, Ignis as Blades.</td>
<td>Structural</td>
<td>The kingdom of Lucis has the setting of kings and Blades as royal guards that can use &quot;blade-wrap&quot; skill. It's natural for the prince to have three bodyguards (Blades), and as they accompany together from childhood, it's okay for them to see each other as close friends.</td>
<td>As a prince, Noctis deserves the privilege and it reflects in the game: people’s loyalty and assistance.</td>
<td>The identity and relationship keep the same during the game. Noctis finally becomes the king, but the three friends are still loyal to him. During the game, they may have some distrusts, but it will be proved as misunderstandings.</td>
<td>The prince-guard bond highlights the player’s special identity, and relations with other NPCs are strengthened.</td>
</tr>
<tr>
<td>Enemies: the evil Empire</td>
<td>Structural</td>
<td>The biggest enemy. Set to push the story forward. Empire soldiers are mindless puppets, indicating its injustice.</td>
<td>The existence of the Empire makes the story complete, pushing players to hate them and feel natural to attack them, even though they have human figures. Also, the interaction with imperial chancellor Ardyn is one of the major conflicts.</td>
<td>The Empire keeps the high-tech style with powerful control of all identities, and it keeps the same during the game.</td>
<td>The empire and the dictatorship render the evil atmosphere to the enemies. Especially the soldiers are mindless robots shows its inhuman aspect.</td>
</tr>
<tr>
<td>Loading screen shows introductions to different maps.</td>
<td>Temporal</td>
<td>Loading screens with some introductions to the game world to help players revise it if needed.</td>
<td>This mechanic is to load assets to the new location. The loading time is always too long and make players bored.</td>
<td>There are different introductions, and this is based on the location.</td>
<td>Players have some responses to get them attracted. However, the same image and text shown to players make them bored.</td>
</tr>
<tr>
<td>For each combat, players will get a score and rank for the combat.</td>
<td>Temporal</td>
<td>This is to potentially indicate player/character can do better and better with skills, and performing well will lead to a natural good result.</td>
<td>The rewards would change little for different ranks, so it would not influence too much.</td>
<td>It is constant during the game.</td>
<td>The numbers of scores are large and uncommon compared to real life (millions, or hundreds of thousands), to show players’ moves are great and exceptional. The rank uses the common ranking system (S5, S3, A, B, C) to let players get a response after each combat.</td>
</tr>
<tr>
<td>Players have different modes, moving on ground, in car, in combat, etc.</td>
<td>Bounding</td>
<td>This is a clear hint to players, to show something they cannot do in certain states.</td>
<td>Different states are clearly defined, e.g. combat states would show a red navigation bar to show enemies nearby.</td>
<td>The states keep the same</td>
<td>This helps players to process different actions separately, but players may get bored as there is no clarification in real life.</td>
</tr>
</tbody>
</table>

Figure 2. Evaluation of Worldness in Game Mechanics, Analysis of Final Fantasy XV (part)
In the table, we explain the four criteria for each game representation in Final Fantasy XV, and we marked red for representations failed at certain points. This table can help designers evaluate design change accordingly. We can find that a certain game component may satisfy one criterion but fail in another. In the table, we can find that the loading screen cost players too much time and ruins the consistent game experience, so it violates the completeness. Another example is from Xenoblade Chronicles 2. For the combat companion "Blades," there are two types—robots and living creatures. Because of this setting, there are two different ability systems and the gears are not interchangeable. It satisfies the coherence because robots and creatures are different identities. But for the game, it's not necessary to introduce another ability system, making the game so complex and trivial, which fails in completeness and acceptable affordance.

Worldness is sometimes sacrificed for player convenience. An example is the save/load system. This mechanic is not a context-related game component and can be used directly in almost all games. Players need this flexibility and normally players would not treat this as a part of the worldbuilding. For most imaginary worlds, saving or loading is not part of the worldness. Game designers can use diegetic interfaces to solve the potential conflict. For instance, in Nier: Automata, players have to save their game on certain data machines. These machines are distributed on the map, and function as the medium for players to access some game system features like messaging, saving, purchasing, fast travel, etc. As the whole world is set in a robot world, all actions are interpreted as data transmission. Some games use these mechanics as a part of worldness. For example, in Doki Doki Literature Club, the character Monika seems to understand its existence is built upon program codes, and players have to delete actual game files.
(including save files) to modify the game world. If players do not delete the file to destroy the character "physically," no matter how many times they restart the game, they will see the same screen indicating that they need to delete the file. Computer file storage is a part of the game worldness, and also makes the game unique and special.

There is another case when designers purposely violate the "acceptable affordance" metric to create a hilarious effect. Those representations are plausible to exist in the world, but it should not be abused. If these representations are violations to existing worldness, the introduction of them will disrupt players' world perception and game experience.

3.3 The Design Principles: Inspiring New Design

Game designers often face the situation to add a new game mechanic without violating the existing world design or design a new one from initial ideas or world features. To assist in new game designs or even inspire designers, we can use the evaluation method from the start of the game design process. Beginning from an empty table, we add a new design representation to the table based on priority and analyze the four criteria to see if it's suitable in the game and fix it accordingly. However, the main problem with this method is that it requires an existing uncompromised initial design (core mechanics and worldness) as the standard to evaluate new designs. For game designs requiring worldbuilding, the solution is required more urgently.

Designers need to clarify the "standards" of core mechanics and worldness as the context background, which are different for different game ideas. To clarify the beginning of the initial
design, we can find three archetypes of initial game design based on former research:

Mechanic-based, World-based, or mixed.

- **Mechanic-based**: The first one is to start from basic game mechanics, and then build a world upon. *Super Mario Bros* is an example. The core mechanic is jump, and all other game mechanics are built around it, like jump to kill a Goomba. As the game design is completed, we can gradually see the overall picture of Mario world (Mushroom Kingdom).

- **World-based**: The second one is often an adaptation from other media, like the Harry Potter video game series. The unique world features like the wand, spells, and characters are kept in the game to keep the canonicity of the original story.

- **Mixed**: The third one is a mixed one, which game mechanics and some world features are both important to start. The feature of the third type is designers have to balance the world features (worldness) and game mechanics. The *Portal* series is a good example. Portal is set in a cyberpunk world controlled by a powerful artificial intelligence, and it has a core mechanic of creating portals. We can see the game combined the two together closely, and each element promotes another perfectly.

For the test case of this project, we chose to take the Mixed approach, developing the game mechanics and the game world concurrently. But for other types, designers need to think of a basic mechanic/worldness. This can be simple, like "cyberpunk world" for Portal or the alternative history of "Westward Movement" in Red Dead Redemptions.
Now we can start thinking about what might be a good representation based on our basic ideas. At this time, I think there are two tools that can help organize ideas. The first one is the evaluation table (Figure 2). Once we have a new representation, we add it to the table based on priority and analyze the four criteria to see if it's suitable in the game and fix it accordingly. This step-by-step process can ensure that representations are suitable in games at all times. The second tool is to use a diagram. Designers first write down their basic ideas (mechanics and worldness) on a paper, then write down possible related ideas. These ideas may be worldness features, existing representations, new mechanics, etc. Designers need to then draw lines to connect related ideas together. Through this process, we'll produce a diagram showing a possible game design, which is like the diagram I made for the game Utolypse:

![Image](image.png)

Figure 3. Representation Idea Diagram of Utolypse Design.
This diagram shows how game ideas developed through time. The arrows in the diagram mean that we can think of new ideas from existing ones. For example, from the basic mechanic and world design, I set the core player ability is “scanning.” For mechanics, we need to create a scenario for players to let them lining up pieces in space. This action should have some meanings to them. For worldness, making it “scanning” is a good way to show the sci-fi world feel. Thus, this extension is a good balance of the two.

It's a good idea for the iteration process above to use two tools at the same time. The design diagram and evaluation table can be modified or updated freely, but designers need to consider the scenarios before and after the change. Also, there are some design principles for reference, which can be used all the time:

- **Stick to core ideas.** Ideally, the design should start from initial fundamental ideas, and be extended and adjusted into a complete game. These core ideas are also the standards that all representations should follow.

- **World features as mechanics:** Some world features can be translated into world mechanics directly. For example, in Assassin's Creed, assassins stand in the freedom and justice side. So certain actions like stabbing citizens are unacceptable and players will be warned.

- **Choose representations wisely:** Representations will affect how players understanding the game and its available actions (affordances), so choosing appropriate representations is important. Representations can also introduce potential worldness or mechanics to
enrich the gameplay. The triple jump in Super Mario is an example. The action requires players to click jump button three times at the same pace to jump much further. This action is based on the representation of jumping - if it's jetpack thrusting, perhaps it would be represented differently.

- **Focus on proportions of game activity**: Different game mechanics take players a different length of time to play. The proportion of different game activities should be controlled following world features. If a minor game activity takes too much time from players, designers should consider removing or modifying it.

- **Balance diegetic and non-diegetic interfaces**. A well-designed set of game interfaces can reduce work explaining what players can do and create a better immersion experience. As observed in the playtest, players tend not to read text in the game. Using diegetic interfaces can help players quickly master game controls as they take on game controllers.

- **Adapt conventions**. Using conventions can reduce players' efforts to learn the game. We should use them if possible. But designers need to check them carefully as some conventions do not fit in the game or game world.

These design principles can help designers create better and more consistent game designs, resulting in greater integration between worldness and mechanics. However, other aspects of game designs like the playability, player development, difficulty levels and game fun are not discussed here, which are also important and can influence player game experience.
4. UTOLYPSE: GAME DESIGN

4.1 Design Overview

Using the design framework in the last section, we can apply it to the design of a new game. To apply these principles, I co-designed a game with a classmate, Yu “Lynn” Xiao Utolypse is a 3D puzzle game, and it starts from two game ideas: The first one is the mechanic that players need to find a perspective around pieces in 3D space. In the desired perspective, the pieces look complete as a whole. The second about worldbuilding; the game takes place in a post-apocalyptic world after the failure of a utopian experiment.

For the basic rule of game mechanics, players are wanderers in the 3D space. There are different floating pieces in the space which cannot be controlled by players directly. Players solve puzzles by lining up these pieces in the specific location and perspective to make them look complete. Some games explore the mechanic of changing perspective as a puzzle-solving method, but by rotating pieces instead of changing player location. In Shadowmatic, Players “rotate abstract objects in a spotlight to find recognizable silhouettes in projected shadows, relevant to the surrounding environment.” (Shadowmatic official website) Vignettes lets players rotate a chest box, and while rotating, it gradually reveals the changes to the backside and makes players discover the spatial relations of the box. Neither of these games takes place in a complete world; they are simply free-floating objects with their own distinct characteristics.
For the basic rule of worldbuilding, the Utopalypse world is set in an imaginary post-apocalyptic world after a failed utopian experiment. In this world, humans built a Utopia in the 22nd century. At first, people felt satisfied because they were free from material worries. But as time went on, the lack of goals and responsibilities lead to the collapse of society. Many people became violent and ruthless, and others only cared about themselves. When the population dropped vastly, humans became almost extinct. This is where the game story of the game starts.

This setting is based on a series of famous experiments conducted in the 1960s and 1970s by John B. Calhoun (1973). In these experiments, researchers created a utopian living environment for rats called "Universe 25." Researchers expected the rat community would prosper until the number of rats exceeded the capacity of Universe 25. In fact, the rat population grew at first; however, it dropped quickly until all rats lost fertility because of the new violent, indifferent social structure caused by the lack of responsibilities. This experiment reveals the cruel fact that if humans made a utopia, it would only become a disaster. As designers, we wanted to discuss what features should be in this "post-apocalyptic utopian world."

The protagonist is a volunteer of the Seed Project, a project that selected a small number of people before the Utopian age went into hibernation. Because a Senator was firmly against the Utopia plan, he secretly built a lab beneath an abandoned prison to work on this project. At the start of the game, the protagonist is woken up and an AI explains what happened in this world. To further explore what happened in the Utopian world, the protagonist should first escape the prison building.
The game demos have two iterations designed and developed. The game is built on Unreal Engine 4.19 (iteration one) and 4.22 (iteration two). In the development team, Lynn worked as the artist in the iteration one and did game design jobs. I as the programmer developed on project. We designed the game together.

4.2 Major Game Elements

The fundamental worldness is the game world is in a post-apocalyptic world where even though humans have advanced technology, the society still faces survival crisis. We can design other game representations based on this setting. For more details, please refer to Appendix A.

**Scanning, the main ability:** We have the major mechanic of using location and perspective to solve puzzles. To translate it as a valid representation, we design this action as "scanning," that using a camera-like device to scan hidden pieces in space. In the triggered "Scanning Mode," players can find highlighted holographic projected patterns unseen by eyes while other objects are desaturated. By making the patterns complete, players gain access to different areas and progress through the game. In the game world, this security type is a standard procedure by different companies, and the pieces are shown in different colors. The security level refers to the difficulty level of players. If the player's ability level is lower than the puzzle security level, the pieces cannot be shown correctly. Players can upgrade their skills via progressing the story.
**Protagonist and the AI:** The protagonist is a volunteer that joined the experiment. He is a male soldier. The AI who woke him up is called Barton, and it has no entity. In the game, it talks to the protagonist directly into his mind. The AI behaves as the narrator to explain what happened in the game.
**Entropy**: In computer science, this term indicates a measure of order. In the game, this is the unified energy value used to power the scanning tool and can be restored slowly. This is the energy used in this game to prevent players from keeping in the scanning mode and solve the puzzle easily. Considering it is the energy form in future worlds, I assume they are advanced enough to have unlimited energy. So I used "entropy" as the energy name. This concept is more advanced in physics to show how future humans' resources.

### 4.3 Puzzle Design

Puzzles are designed to progress the story and let players practice abilities learned from the game. To ensure players can solve them, the difficulty will increase based on story progress. Because the mechanics require players to line up pieces, using simple and easy-to-recognize models are important.

#### 4.3.1 Iteration One Puzzle Design

In iteration one, there were three puzzles in the whole game. These three puzzles were non-skippable and required players to use the skill they learned from the environment and subtitles. These puzzles were:

1. **Key Puzzle** - Players woke up in the prison cell. They were told to make two pieces look complete in the view to open the door.
2. **Computer Keypad Puzzle** - To open the door going upstairs, players need to input the passcode they found on the wall.
3. **Number Pieces Puzzle** - In the prison building, the passcode number requires players to find the perspective to make them look complete.

#### 4.3.2 Iteration Two Puzzle Design

Based on iteration one and playtest results, I updated the game and rearranged puzzles. As the Scanning ability was introduced, the hidden pieces were not visible by default. Puzzles were modified to make the detection more accurate. The new puzzles were:

1. **Computer Keypad Puzzle** - puzzle two in iteration one. The only difference is the color for all numbers was red in the Scanning mode.
2. Earth Globe Puzzle - Players need to find the perspective to make an Earth Globe and its base look together.
3. Key Puzzle - Puzzle one in iteration one.
4. Number Pieces Puzzle - Now after each scan, if there's a number in view, players will be confirmed by the addition of a number piece on the screen as a progress tracker. Players should know what numbers have already been discovered.

Another main update in iteration two was game interfaces. Making the former subtitle interface a diegetic interface, a message app-like widget was chosen, so players have a better feeling when reading these messages given by the AI. It will store the lastest four messages, and players can press the Space button to toggle the visibility of this widget. (Fig 5). The game pause menu was also added as an optional guide to players. It added control keys and background introduction.

![Figure 6. One of Several Terminal Mails.](image)

5. PLAYTEST METHODOLOGY
Playtests were required to evaluate if our design philosophy worked for players. The playtesting protocol includes participant recruitment, data collection, and analysis.
5.1 Participants and Structure

Players were invited to play a game demo voluntarily and answer some questions in the form of surveys and interviews. Participants were recruited through multiple ways, including posters, social media posts, and local game club events. Players were required to be older than 18 years old and able to play PC games using a keyboard and mouse. There were two game iterations for playtests. Game puzzles, levels and content are different in two demos.

5.2 Data Collection & Analysis

Different data collection methods were used in two iterations, which can be found in Appendix B and C. In iteration one, a post-play questionnaire was used to evaluate players' perception of the game’s world and mechanics. The questionnaire collected players' opinions on the game design and measured on an ordinal scale of 0-10, while 10 means strongly agree and 0 means strongly disagree. In iteration two, I used semi-structured interviews with coding. From game world descriptions in interviews, these codes can generate a keyword checklist to know the picture of players' world perception. The reason I changed the evaluation method in iteration two is based on player responses in iteration one for a better evaluative purpose. As worldness is qualitative metrics that cannot be evaluated through easily accessible data, using interviews was a better choice to understand players' perception of worldness.

The computer screen was recorded as videos in both testing iterations. Videos can be analyzed via close reading methods to compare player decisions and actions. Because the game demo is linear in both iterations, this can be separated into different sections. During the playtest,
personal player data but gender is not collected, and their identities are kept anonymous and not traceable based on existing data.

6. RESULTS

6.1 Iteration One Results

Eight participants playtested the iteration one game and finished the questionnaire. Most players finished the game within 5 minutes, and one player failed to finish the game. The questionnaire data for Question 1-4 are summarized in the table below. We can find the general score is quite low.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>How well do you think you understand the gameplay mechanics?</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>3</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>How well do you think you understand the world settings of the game?</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>How necessary do you think the world design helps you understand the game mechanics?</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>How well do you think the game mechanics suited for the game world?</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

From videos, players spent a lot of time on the puzzles. The reason is that they could not understand what the puzzle was and find out a way to solve it. For the first key puzzle, players seemed not to recognize that the puzzle is to make two key pieces look together in the view. They were confused about the model mesh and finally realized that the model is the pieces of a key. Also, when they understood the puzzle, sometimes the game detection did not work well
and let players solve the puzzle, though pieces were not complete in the view. This glitch caused confusion. The second puzzle was the easiest for players to find. When they met the computer keypad interface, all players would go around to find the numbers hidden in the scene, and they would find them at last. The final number puzzle requires players to stand at different locations to find the numbers hidden in the view. Most players could find the three of them, and guess the final one to find the correct passcode. They complained that the last number was hard to find.

The main narrative method in the demo is subtitle texts. However, only half of all players would read subtitles. The remaining players tried to skip them or ignore them. A lot of worldness description and story introduction are put in subtitles, and there's no other place players can seek help about how to play. As a result, the score in the questionnaire of understanding the worldness (Question 2) is low.

6.2 Iteration Two Results

Nine participants played the iteration two demo and accepted the interview. Compared to the iteration one, the time player playing the game was longer. The main reason was that more game content had been added to the game.

Table 2. Keyword Checklist for All Participants

<table>
<thead>
<tr>
<th>Keywords</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utopia/Utopian</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>The Seed Project</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>prisoner</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>AI/Barton</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

30
Ideally, players should know all the keywords and mentioned them in the post-play interviews. However, I found that the story players remembered was not completely the same. For example, in one participant's description of the world, the protagonist is “a prisoner, and he needs to escape the building. There's something bad happening outside the world, and people became violent.” This summary is only partially correct because it lacks the most important keyword in the game - "utopia." Without realizing the utopia is the world type, players cannot understand the fact of what disasters utopia can bring. After I explained the design ideas to these players, they thought it was acceptable to design this way. They suggested adding more puzzles and modifying the environment to make the story easier to learn.

Players still might have found that the puzzle detection mechanism was a little confusing, even though I calibrated the puzzles, making the detection more accurate. But I noticed players spent less time figuring out what to do in the game, probably because of the help of new game interfaces. There was a progress tracker, message app widget, and quest notifications to tell players what to do next. In iteration two, players began to view the subtitles given by the AI. Compared to iteration one, this is a notable improvement, meaning players following the story progress. Because players could press the Space button to check subtitles quickly, they used it to
reread them as a source to understand the current quest. Also, almost all players would read the terminal mails, though this is optional.

7. DISCUSSION

Generally, the playtest results show that the idea of using representations can benefit game design in combining game mechanics and worldness. In iteration one, players did not understand the game world correctly, and they thought the puzzles were tricky to solve. The results got better in iteration two, mainly because newly added widgets explained the story better to players. The comparison of iteration one and two results can give us several reflections on game design.

The first thing is the narrative methods delivered to players. Players need to understand game worldness, and then they can judge if it's acceptable. Designers need to consider how to deliver the worldness. In the Utolypse game, I focused on the widgets to deliver information to players. Subtitle texts are the main method to introduce the game world. However, as tested in iteration one, many players did not read subtitles at all, and they could not understand the game because of the lack of information. In iteration two, players had multiple narrative methods to acquire information about game instructions and stories: the progress tracker, dialog message widgets, terminal mails, and the pause menu. Even subtitles are still the main method to progress the story, using a diegetic interface of messaging widget makes it more intuitive to communicate with players.
The second method to express the worldness to players may focus more on the representations, which I failed in the game development. For a utopia world, representations should be of high-tech and advanced, which can be shown via environment looks, objects and interactions, voiceovers, etc. In the Portal series, the whole environment is formed by artificial wall tiles in empty, large robot factories. Object art styles express a lonely feel of a sci-fi world where only artificial intelligence exists. Because of limited resources, the Utolypse game looks more like the earlier centuries. Even it’s embedded in the prison building, I did not settle the utopian lab environment clear enough, to make them look futuristic and magical. From this point, the representations violated the acceptable affordance as there’s a better choice in representations.

Finally, the gameplay should be calibrated carefully. In Utolypse, the gameplay is about lining up pieces from a certain perspective, and the puzzle should be solved only if patterns look complete in the view. Because I used a volume to detect if players are in the right location and camera orientation, there may be some edge cases that responded incorrectly. In the playtest, players were confused with the result. Though the main purpose is not making the game fun to play, confusion concerning this gameplay inconsistency made the explanations meaningless. The premise of “scanning” helped explain mechanics to players. A better realization will make it more reasonable.

8. CONCLUSION

This study proposed the idea of representations as the bridge of game mechanics and worldness shown to players. The evaluation metrics and design frameworks were developed to be be
applied to actual game design. The Utolypse game is designed and evaluated based on these metrics and frameworks.

Playtest results show that representations can help deliver the worldness to players and make the story complete. As the game design still does not completely comply with the evaluation metrics, players' experience was improved. To evaluate players' thoughts on the world perception and game design, I used interviews as the main data collection method. Using keywords from their world descriptions, I was able to analyze the effect of different representations.

Further analysis can focus on how to evaluate player responses to different representations. There should be better methods than the interview and keywords used in this study. The design framework can be used and developed further to make it more easy to use. Documenting process may need more clarification. Also, the gameplay is not focused in the framework. Making games fun to play is not discussed in this paper. Designers can further analyze what representations can make games more fun to play. More testing and design iterations will definitely improve game experience.
REFERENCES

Papers


Gibson, J. J. (1966). The senses considered as perceptual systems.


Swain, C. (2010). The mechanic is the message: How to communicate values in games through the mechanics of user action and system response. In Ethics and game design: Teaching values through play (pp. 217-235). IGI Global.


Games Discussed

The Witness: https://store.steampowered.com/app/210970/The_Witness/
Shadowmatic: https://www.shadowmatic.com

Vignettes: http://vignettesga.me

Gone Home

Firewatch

The Vanishing of Ethan Carter

Final Fantasy XV

Nier: Automata

Doki Doki Literature Club
APPENDIX A: UTOLYPSE GAME DESIGN

In Appendix A, I added the representation idea diagram and the evaluation table of the game Utolypse. As discussed in the paper, these two are corresponding in design. The initial game ideas are the worldness of the utopia world and the mechanic of finding the perspective to line pieces up. The diagram is used to inspire designers and find the relations from existing design:

![Representation Idea Diagram of Utolypse Design (Complete)](image)

The evaluation table is used to analyze the representations one-by-one, making sure they are appropriate to be added:

<table>
<thead>
<tr>
<th>Representations</th>
<th>Coherence</th>
<th>Completeness</th>
<th>Consistency</th>
<th>Acceptable affordance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many buildings and infrastructures are kept unused but functional and undamaged.</td>
<td>Technology in utopian worlds should be advanced enough. As there are only a few people remaining in the world, many facilities are not used for a long time.</td>
<td>Some facilities can be damaged due to violence or lack of maintenance, depending on the area.</td>
<td>The materials of buildings and equipment show a sign of lacking maintenance with dust, which is the main representation to show this.</td>
<td></td>
</tr>
<tr>
<td>The mechanic of using a certain perspective to solve puzzles is represented as &quot;scanning&quot; action, using a high-tech camera tool to scan the view to acquire information.</td>
<td>The mechanic requires representation for its action and we use the &quot;scan&quot; action to make it meaningful.</td>
<td>The reason to &quot;scan&quot; the view should be explained later.</td>
<td>This will be the main player ability in this game and kept all the time.</td>
<td>Scanning is the best representation set in a high-tech background.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>After each trigger, the game will fall into a “Scanning mode” that highlights all cue items and desaturate other objects.</td>
<td>This is realized by high-tech in the world and do not need to be explained thoroughly.</td>
<td>-</td>
<td>-</td>
<td>Highlighted objects will appear and have emissive colors compared to other grey scenes.</td>
</tr>
<tr>
<td>Scanning action has a time limit and cool down for each trigger.</td>
<td>Players can understand as power-driven so it has usage time limit and power recharge as cool down.</td>
<td>The power control, source and usage should be explained later.</td>
<td>The duration time and cool down time can be extended as a part of ability progress.</td>
<td>-</td>
</tr>
<tr>
<td>Power is the energy source for scanning.</td>
<td>The power is considered as entropy. Entropy means order, and it’s used as another form of the more advanced energy</td>
<td>There should be some HUD that shows the amount of power remaining.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Scanning ability can show the hidden pieces in space as a secretive and secure method for city management.</td>
<td>Without the tool to scan hidden pieces, normal people do not have access to management;</td>
<td>Scanning should be able to shift a new mode that shows hidden pieces.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hidden pieces can have different shapes and colors.</td>
<td>As for security and man-made items, it’s okay to have different shapes.</td>
<td>-</td>
<td>-</td>
<td>Different shapes of pieces are allowed to appear in the game to enrich the contents.</td>
</tr>
<tr>
<td>Different puzzles have security levels and security types (from different companies) that players may not be able to see pieces and gain access successfully.</td>
<td>-</td>
<td>The player development during the game includes the security type and security level hacks.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>While in the Scanning mode, other items are desaturated and blurred.</td>
<td>This is to make the pieces more visible.</td>
<td>-</td>
<td>-</td>
<td>A cloudy effect was added as well.</td>
</tr>
<tr>
<td>While falling into the Scanning Mode, a radial scan wave is created and spread to surroundings.</td>
<td>This is to strengthen the feeling of “Scanning”</td>
<td>Hidden pieces should be visible only when the waves each them</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hidden piece puzzles</td>
<td>This tries to explain</td>
<td>-</td>
<td>-</td>
<td>The relation of puzzle</td>
</tr>
<tr>
<td>are a security method in the future.</td>
<td>why there are puzzles like this in the world.</td>
<td>and result should be more explained or focused.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The puzzle has different security levels.</td>
<td>So level system should be added.</td>
<td>Players should be able to solve more hard puzzles by leveling up.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The game uses the first-person perspective.</td>
<td>As we want to use location and perspective together to solve the problems, this is the best game mode compared with others.</td>
<td>First-person perspective shows the best affordance to the mechanic. Similarly, third-person perspective can also do this job, but it will render the chatterer, which will increase the work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Players should be able to move freely to change its location.</td>
<td>As part of the core mechanics.</td>
<td>It can be a robot moving around;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Players should be able to rotate the camera freely.</td>
<td>As part of the core mechanics.</td>
<td>It can be a robot moving around;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The protagonist is a prisoner that was woken up from hibernation.</td>
<td>The technology is supported.</td>
<td>The conflict of his minds and the new utopian world thoughts is a key feature.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Th protagonist was woken up by an AI, which is also players’ guide and companion to the world.</td>
<td>How artificial intelligence is developed, and ability scale of robots should be defined.</td>
<td>The AI should be more like an assistant.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The dialog UI is placed in forms of a message menu.</td>
<td>It’s like the AI chatting with players in a phone.</td>
<td>As a diegetic interface, this is a better solution to pure subtitle texts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The hibernation is about an experiment called “the Seed Project” that is agreed by the protagonist himself. The team used an abandoned prison to do the experiment.</td>
<td>This explains why the protagonist is different from other humans.</td>
<td>As a diegetic interface, this is a better solution to pure subtitle texts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The terminal in the office room shows conversations among different people.</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woken up from the office, the first goal should be escaping the</td>
<td>Players are instructed to leave the place he woke up.</td>
<td>The change of different rooms should be natural.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>It should contain several stages.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B: POST-PLAY QUESTIONNAIRE, IN ITERATION ONE

As our game has two iterations, the playtest used different testing methods, targeting different goals. In the first iteration, the goal is trying to understand if players understand the game world from the playtest, which is described mainly in subtitle texts. The survey questions are listed below:

After playing the game, please help answer the following questions. The purpose here is to understand how you perceive the game, the world design, and game mechanics.

1. How well do you think you understand the gameplay mechanics?
   (0-10, while 0 means you do not understand what to do in the game and how it would be, and 10 means you clearly know what to do in the game and the reactions)

2. How well do you think you understand the world settings of the game?
   (0-10, while 0 means you do not understand the world design, and 10 means you clearly know the world design)

3. How necessary do you think the world design helps you understand the game mechanics?
   (0-10, while 0 means you think it's not necessary to have such a world design, and 10 means you think it's an important part to have a world design like this)
4. How well do you think the game mechanics suited for the game world?

(0-10, while 0 means you think it’s totally not suited together, and 10 means you think it’s integrated together well)

5. Do you have some suggestions for the next-step world design?

APPENDIX C: INTERVIEW AND KEYWORD CHECKLIST, IN ITERATION TWO

I used interviews and keyword checklists to measure if players understood the game world and mechanics. The interview is the source to get player responses and feelings and is semi-structured. The basic questions include:

1. Please describe this game world./How do you feel about the game world?

2. What did you know about the protagonist? How about the Ai talking to you?

3. Do you think the game mechanics (Scanning) fits in this game world?

4. What's your opinion about the puzzle?

5. How do you think you acquire the information about this world (like widgets, environment, ability, etc.)?

6. Do you have any suggestions to combine game mechanics and game world better?
The keyword checklist is to record if players remembered certain keywords in the game, which represents different worldness. Players should understand many of them to get a whole picture of the game world. These keywords include:

Table. Keywords and Meanings

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utopia/Utopian</td>
<td>The world type; the background of the game world</td>
</tr>
<tr>
<td>The Seed Project</td>
<td>The project that recruited volunteers into hibernation</td>
</tr>
<tr>
<td>prisoner</td>
<td>The protagonist’s identity</td>
</tr>
<tr>
<td>AI/Barton</td>
<td>The AI talking to players.</td>
</tr>
<tr>
<td>hibernation</td>
<td>The protagonist’s state before woken up</td>
</tr>
<tr>
<td>Scanner/Scanning</td>
<td>The tool and action to find the hidden pieces</td>
</tr>
<tr>
<td>globe/key/numbers</td>
<td>The puzzle of hidden pieces</td>
</tr>
<tr>
<td>violent/violence</td>
<td>What happened actually in the utopian world.</td>
</tr>
</tbody>
</table>