Developing Design Methodology to Represent Paradoxes in Gameplay Systems

Abertay University

A thesis submitted for the degree of Masters by Research (MbR)

by

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Declaration

Candidate's declarations:

I, Vedant Sansare, hereby certify that this thesis submitted in partial fulfilment of the requirements for the award of Masters by Research (MbR), Abertay University, is wholly my own work unless otherwise referenced or acknowledged. This work has not been submitted for any other qualification at any other academic institution.

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Date……01/10/2019

Supervisor's declaration:

I, Robin Sloan, hereby certify that the candidate has fulfilled the conditions of the Resolution and Regulations appropriate for the degree of Masters by Research in Abertay University and that the candidate is qualified to submit this thesis in application for that degree.

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I certify that this is a true and accurate version of the thesis approved by the examiners, and that all relevant ordinance regulations have been fulfilled.

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Abstract

This thesis aims to provide a preliminary framework for developers aiming to utilize paradoxes as part of their game design. Research has shown that games do not follow the laws of paradoxes while integrating paradoxes as part of their design. As such, these games misinterpret paradoxes with two different concepts: *Contradiction* and *Subversion of Expectations*, which individually and combined form the definition of paradoxes. Consequently, a structured framework differentiating paradoxical and non-paradoxical design would alleviate this misinterpretation and simultaneously allow designers to develop truly paradoxical games. To achieve this, the primary attribute from the three concepts was extracted, based on their interaction with the game layer and through permutations of the presence and absence of these attributes, a framework composed of four paradoxical and four non-paradoxical principles was devised.

Correspondingly, to verify the feasibility of the framework, a comparative analysis of nineteen existing games was conducted to observe their paradoxicality. Consequently, the results indicated that a game cannot be paradoxical, as it would produce an inconclusive outcome and be non-progressable. Although, the results also suggested that a game can act as a container for paradoxical gameplay systems within it. To explore this phenomenon, the framework was applied to four existing gameplay systems through practice-based research in game design. This application resulted in the emergence of four non-paradoxical and four-paradoxical counterparts of each existing system. Among these, the modular systems which could perform independently were categorised as ‘event-based’ systems and the ones which could function as games themselves were term as ‘scenario-based’ systems.

The results indicated that games with a commercial focus, due to the risk of potential revenue loss, are more dependent on a hybrid approach of utilising both non-paradoxical and paradoxical gameplay system, with non-paradoxical systems composing the majority of the design. On the other hand, experimental games, which afford higher creative freedom, utilised a greater frequency of paradoxical system within their design. As such, further research in this area would allow paradoxes to reach a wider acceptance among the players as well as the developers.

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1. **Practitioner's Statement**

This thesis outlines research that was in part grounded in practice-based research, where the practice was game design. As such, it is vital that my own experience and aspirations as a game designer are discussed at the outset, to both provide creative context and make transparent my perspective on game design.

My games are based around the corruption of real-life concepts, exploring their bastardization in a virtual world. Furthermore, these are often inclined towards enigmatic and abstract ideas, to enticing the feelings of intrigue, uncertainty and self-doubt among the players.

Correspondingly, from a player's perspective, this allows them to experience these precarious emotions in a relatively safe (virtual) environment, introducing them to novel and perhaps unexplored territories of self. On the other hand, from a developer's perspective, I find that when players are confronted with this 'fear of the unknown', they often do something completely unexpected in an attempt to break the system. As such, this permits me to grow as a designer, allowing me to develop 'free form' game mechanics with potential for emergent gameplay, acting as tools rather than constraints for the player.

The philosophy of my games' design is based on Huizinga's concept of play as an activity which is disconnected from reality (Huizinga, 1938). This allows me to design systems that contradict the constraints of real life, through the freedom granted by the virtual world. The games I design are heavily influenced by obscure concepts such as 'déjà vu' and 'jamais vu'. These game worlds and gameplay systems affect the player's perception of reality, causing them to question their ability to make optimal decisions.

My games follow a design methodology, formed through my experience as a student studying game design as well as by my participation in game jams. As such rather, than full-fledged games, I prefer to develop several gameplay systems based around themes that seek to explore contradictions of reality. Upon finalizing the system, I develop several levels around these gameplay systems, exploring how they interact with one another.

2. **Introduction**

The term ‘paradox’ originated from the Greek words *para* (“contrary to”) and *doxa* (“opinion”), which originally meant contrary to common opinion. In current times, paradoxes are defined as ideas or statements which, despite sound (or apparently) reasoning from acceptable premises, lead to illogical or self-contradictory conclusions (Oxford Dictionary, 2019). These are often observed as ambiguous and inconclusive due to them featuring aspects of vicious circularity and self-contradiction. Furthermore, due to their etymological origin, paradoxes on occasions are used interchangeably with concepts which could be considered ‘almost paradoxical’ namely ‘contradiction’ or ‘subversion of expectations’. These concepts are considered ‘almost paradoxical’, as they only showcase partial aspects of what constitutes as a ‘paradox’.

Because paradoxes are enigmatic and inconclusive, paradoxes are often observed in various fields ranging from complex, theoretical subjects such as philosophy or mathematics to creative fields such as literature, films and games. Due to their vast flexibility and their infinite nature, paradoxes provide a potentially rich creative space for game designers to explore. Although, in these games, ‘almost paradoxical’ concepts are misinterpreted as paradoxes. This misinterpretation is observed in the case of games like *Monument Valley* (ustwo, 2014) which proposes “impossible architecture” in the form spatial paradoxes, although the player can progress through the game which contradicts the definition of paradoxes to be “inconclusive”.

Consequently, this suggests that game designers lack a proper rationale as to how the language of paradoxes is utilised to describe the elements of game design. Further implying that truly paradox-based game design may differ from ‘almost paradoxical’ design. For these reasons, the aim of this research was to identify how paradoxes are currently represented in games, observing whether the systems of gameplay are unambiguously paradoxical or are they based on the misinterpretation of paradoxes. Moreover, this research was designed to generate a specialised framework which identified the aspects of paradoxes and translate them into game design components. This would allow game designers to efficiently translate paradoxical principles into game design elements while avoiding the pitfalls of the misconception of ideas. Furthermore, to evaluate its

practicality and examine its behaviour in the various layers of a game, this framework was utilised to generate several paradoxical and non-paradoxical gameplay systems through practice-based research.

2.1 Research Questions

1. What approaches are utilised by developers to represent paradoxes in games?
2. How can a self-contradicting implicit idea, a paradox, be represented as an explicitly rigid structure - or rules - within a game?
3. What is the appropriate design methodology required to develop a paradox-based game?
4. What are the challenges and limitations in the development of a paradox-based game?

2.2 Thesis Structure

The ‘Introduction’ chapter presents an introduction to the topic of paradoxes and a brief summary of their representation in games. The chapter also addresses the primary aim of this project and specifies the relevant research questions and hypotheses to support them.

The “Literature Review” begins with an overview of paradoxes and their breakdown into three governing laws, and then presents the application of paradoxes across several fields such as literature, films and music. The chapter further delves into the representation of paradoxes in games and concludes by describing the disparities observed in the literature and how this research has worked to address them.

The “Research Design” chapter highlights the design process of this research, divided into two main sections: Theoretical Framework, and Methods. Theoretical Framework works towards formulating a functional framework by analysing the composition of a game, and interpreting how paradoxes are represented in ‘layers’ of a game. This section analyses the laws of paradoxes and presents a new design methodology for representing paradoxes in game layers. Consequently, the Methods section presents a two-stage research design, where the first stage tested the application of the framework in existing games using comparative analysis, a mixed-methods approach. The second

stage explored how the framework could be utilised to develop new gameplay systems through practice-based research.

The “Results – Comparative analysis” chapter presents the outcome of the comparative analysis, observing the existence and frequency of paradoxical and non-paradoxical gameplay systems in games as well as each of their subsequent ‘game layers’. Likewise, the “Results – Prototype Analysis”, showcases the application of the ‘Paradoxical Games Framework’ in the development of new forms of paradoxical and non-paradoxical gameplay systems through practice-based research.

The “Discussion” chapter focusses on the interpretation of the findings, to understand the representation of paradoxes in current games. Furthermore, it also develops associations with existing literature to understand the new gameplay system developed as part of the research, discussing their roles in their games industry.

Finally, the “Conclusion” chapter summarises the thesis by reflecting upon the relevancy of paradoxes in game design. This chapter also observes the potential impact of ‘paradoxical game design’ on the games industry.

3. Literature Review

3.1 Definition of a Paradox

The literature about the definition of paradoxes could be considered convoluted in the sense that there have been many attempts to define them (Hughes, 1980). For example, philosopher Quine (1962) defines a paradox as “any conclusion that at first sounds absurd but that has an argument to sustain it” (Quine 1962). As such, Quine defines paradoxes as an idea which sounds absurd in the beginning but on further inspection, an argument could be devised to sustain. From Quine’s definition, it is suggested that a paradox is solvable, regardless of the logicality of the argument utilised to solve. This suggests that the solution of a paradox should not be restricted to the context set up by it, and rather different perspectives, whether logical or illogical, could be considered to generate a solution.

On the other hand, artist Hughes (1980) defines paradoxes as ‘vicious circles’. He further describes paradoxes as impossibly, painful tasks with a common beginning and an end. Additionally, scholar Bolander (2013), defines a paradox as “a seemingly sound piece of reasoning based on apparently true assumptions that leads to a contradiction.” As such, looking at both of these definitions it could be summarised that a paradox is “A statement or proposition which, despite sound (or apparently sound) reasoning from acceptable premises, leads to a conclusion that seems logically unacceptable or self-contradictory.” (Oxford Dictionary, 2019). This definition suggests that the premise set up by a paradox is based on reasonably true assumption, which on further inspection leads towards a self-contradiction (Bolander, 2013). Consequently, by this definition, it could be assumed that there exists no outcome to a paradox. As the process of generating the outcome is the same as setting up its premise, resulting in a vicious cycle (Hughes, 1980).

This definition of paradox being inconclusive, contradicts Quine’s interpretation of paradoxes being solvable. In Quine’s case, his method of solving a paradox is based on a premature assumption that “all paradoxes are solvable” (Quine 1962) and the solution needs to be moulded from ground-up to fit the premise of the paradox. Furthermore, in scenarios where the solution to

paradoxes did not exist, Quine categorised them as “falsidical”, which contradicted his definition of paradoxes as ‘solvable’.

As a result, for the purpose of this research, it is assumed that paradoxes contain logically inter-related yet contradictory elements that exist simultaneously, while the conclusion to this idea leads back to setting up the original premise the idea began from. Furthermore, all these paradoxes governed by a set of rules, these rules define the composition of a paradox as well as to classify paradoxes from other phenomena which might be mistaken as paradoxical due to one or multiple laws of paradoxes existing within them.

3.2 **Laws of Paradoxes**

Hughes (1980) defines the composition of a paradox using three laws: ‘self-reference’, ‘self-contradiction’ and ‘vicious circularity’.

3.2.1 **Self-Reference**

Self-reference occurs when an idea refers to itself. There are many examples of self-referential sentences which refer to themselves as sentences, as observed in Figure 1. This law is often observed in paradoxes which are innately semantic, set-theoretic or epistemic. Semantic paradoxes are related to theories of truth, set-theoretic paradoxes are concerned with mathematics while epistemic paradoxes are relevant to epistemology or the theory of knowledge (Bolander, 2013). An example of a self-referential, paradoxical statement is “This statement is false”, also known as the ‘Liar Paradox’ (Eubulides, 4th century BCE).

Statement 1: This is a sentence.
Statement 2: This sentence has five words.
Statement 3: This sentence is written in English.

Figure 1 Self-Referential Statements

Deconstructing the ‘Liar Paradox’, it is observed that the statement the paradox refers to is itself. If the above statement is considered to be true, then what its states must be false. On the other hand, if the statement is assumed false, then it must be true. The binary truth value of the above statement is a

product of its own self, causing a self-recurrent loop of true and false conclusion, existing simultaneously.

3.2.2 **Self-Contradiction**

Self-contradiction is a combination of the previous law of self-reference and the idea of contradiction, in which two or more ideas are dichotomous and incompatible in existence. In this law, an idea not only refers to itself, but it also contradicts itself. Examples of self-contradictory statements are observed in Figure 2.

Statement 1: This is not a sentence.
Statement 2: This sentence has ten words.
Statement 3: This sentence is written in Greek.

Figure 2 Self - Contradictory Statements

These statements not only indicate self-referentiality but also demonstrate 'Fallacies of Relevance' such as argumentum ad ignorantiam[1] or argumentum ad lapidem[2] (Walton, 1989) to demonstrate self-contradiction.

1. Every rule has Exceptions (Paradox)
2. Then "Every rule has Exceptions" has an exception. (As per 1)
3. Therefore, there exists a rule 'X' which has no exceptions (As per 2)
4. As a result, 3 has an exception (As per 1)
5. But 3 cannot have an exception (As per 3)

Figure 3 Exception Paradox

An example, as well as the deconstruction of a self-contradictory, paradoxical statement, is observed in Figure 3. The paradox and its subsequent proof observed in Figure 3 is a result of reductio ad absurdum, where the

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1 A fallacy in informal logic consisting of a hypothesis is which is assumed to be true on the basis that is not been proven false *(*Hansen, 2002*)*.

2 A fallacy in informal logic which dismisses a statement to be absurd without any proof of its absurdity. (Hansen, 2002)

conclusion (5) is an interpretation of a logical process which contradicts the proposed statement (1). As a result, the original statement only demonstrates self-reference and circular self-contradiction. Consequently, fulfilling only two of the three laws of paradoxes, the statement could be considered paradoxical, but not a true paradox (Hughes, 1980).

3.2.3 **Vicious Circularity and Infinite Regress**

Vicious Circularity occurs when an idea reinforces itself with no tendency to arrive at an equilibrium, creating a never-ending loop. An example of a vicious circle is the *Ouroboros* symbol (Figure 4) which depicts a serpent eating its own tail. The symbol indicates a viciously circular loop where there is no explicit beginning or an end as both of them are one and the same (Browne, 1656).

Figure 4 Ouroboros (Browne, 1656)

Furthermore, a practical application of ‘vicious circularity’ is observed in the Grelling–Nelson Paradox (Grelling & Nelson, 1908). In this paradox, two words are considered ‘autological’ and ‘heterological’. Table 1 presents an explanation of these words, followed by a practical example.

TERM	DESCRIPTION	EXAMPLE
Autological	An adjective which describes itself	English, polysyllabic
Heterological	An adjective which does not describe itself	Arabic, monosyllabic

Table 1 Autological and Heterological Terms

Consequently, a paradox occurs when it is argued whether the word “heterological” is heterological. In this case, if the answer to the question is assumed to be “no”, then “heterological” is an autological word. But this leads to a contradiction as the word “heterological” does not define itself, as such it must be heterological. On the other hand, if the answer is assumed to be “yes”, then “heterological” is a heterological word. Although, this again leads to a contradiction as the word “heterological” does define itself and as a result, it must be autological. This paradox showcases vicious circularity, where the process of achieving either outcome results in a self-contradiction.

While vicious circularity represents one end of the spectrum where infinity is a self-feedback loop, another end of the spectrum represents infinity as a never-ending sequence of events. This is defined as ‘infinite regress’, where an argument relies on a series of infinite propositions, with each proposition relying on the plausibility of the preceding ones. An example of infinite regress is “Turtles all the way down”, proposing the idea of Earth resting on the back of a turtle, which in turn rests on a larger turtle, which again rests on an even larger, and so on, ad infinitum. Accordingly, infinite regress could be observed in the paradoxes proposed by Zeno of Elea, where one of his paradoxes proposed a scenario about a race between Achilles and a tortoise. In this race, Zeno proposes, if the tortoise is allowed a one-hundred meters head start over Achilles and both participants are moving at constant speeds, then it is impossible for Achilles to overtake the tortoise (Aristotle, 4th-century BCE). To prove this, Zeno argues “In a race, the quickest runner [Achilles] can never overtake the slowest [tortoise], since the pursuer must first reach the point whence the pursued started, so that the slower must always hold a lead.” (Aristotle, 4th-century BCE) As per the paradox, if an individual is supposed to traverse a certain distance, they must first cover half of it, then they must traverse half of the remaining distance or a fourth

of the original, then they must traverse half of the remaining distance or an eighth of the original and so forth, ad infinitum. This results in an infinite series of finite distances which must be successively traversed to reach the end, which would result in the individual requiring an infinite amount of time to traverse a finite distance, concluding the absence of motion.

As previously mentioned, 'vicious circularity' and 'infinite regress' are two extremes of the same principle, infinity, where 'vicious circularity' presents infinity in the form of a never-ending cycle while 'Infinite Regress' portrays infinity in the form infinitely 'ascending' or 'descending' hierarchy. Although Hughes may consider these as two individual concepts, Hofstadter in his book *Gödel, Escher, Bach* (1999), combines these concepts by proposing the idea of "strange loop". He defines this term as a series of viciously cyclical stages which are arranged in an upward or downward hierarchy and yet these successive hierarchical shifts lead back to the origin (Hofstadter, 2008).

To summarize, paradoxes are defined as self-referencing, infinitely regressive statements with non-attainable solutions. To further explain the theoretical nature of paradoxes, practical examples will be outlined to analyse their functions and their applications in various fields.

3.3 Paradoxes – Application and Functionality

As paradoxes are theoretical scenarios with no definite conclusions, their functionality and applicability are, more often than not, subtle and indirect. As such, they are not limited to any one area of study and are observed in various fields where they function as 'logical deterrents', leading towards the revision of theories, as observed with set theory (Russel, 1902). This revision occurred when Russel proposed "Does the set of all those sets that do not contain themselves contain itself?" (Russel, 1902). To analyse this statement, a hypothetical scenario could be considered, where "There exists a barber who 'shaves all those, and those only, who do not shave themselves'. The question is, does the barber shave himself?" (Russel, 1918). In this scenario, if the barber shaves himself then he cannot be considered the barber. On the other hand, if the barber does not shave himself, then he would fall in the category of people 'who are shaved by the barber', thus he must shave himself.

On the other hand, paradoxes could also lead to the introduction of entirely new knowledge, as observed with ‘asymptotic freedom’ (Gross and Wilczek, 1973). This discovery came to be as a result of two paradoxes in particle physics; “Quarks are Born Free, but Everywhere They are in Chains” and “Special Relativity and Quantum Mechanics Both Work”. These two paradoxes ultimately resulted in the development of a new dynamic principle ‘asymptotic freedom’, that indicates that the force between quarks becomes vanishingly small as the quarks come close together, or, equivalently, that the quarks become free particles at very large energies. This is idea paradoxical due to the observation that quarks behave as free particles when close together while feeling much stronger forces when separated at large distances. (Gross and Wilczek, 1973).

As observed from the previous examples, paradoxes in positivist fields such as mathematics and the sciences function to promote the expansion of knowledge in these subjects. And subsequent occurrences of various paradoxes in these fields resulted in the introduction of new knowledge using existing schema[3], also known as ‘assimilation’. Additionally, these paradoxes also resulted in the revision of existing schema due to the introduction of new knowledge, also known as ‘accommodation’ (Piaget, 1936). As a result, it is vital to understand what role paradoxes play in more humanities fields such as literature and art. In this research, particular interest is given to humanities fields, as they potentially relate intimately to games rather than positivist fields.

3.3.1 **Literature**

Paradoxes in literature are rhetorical devices functioning as methods of composition and analysis involving the anomalous juxtaposition of contradictory ideas to present unexpected insight (Rescher, 2001). They function as a literature’s diction, helping it convey its thoughts and ideas in an entertaining manner while simultaneously prompting the reader to devise the message concealed behind it.

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3 A cohesive, repeatable action sequence possessing component actions that are tightly interconnected and governed by a core meaning. (Piaget, 1936)

In George Orwell's *Animal Farm* (1945), pigs controlling the government proclaim, "All animals are equal, but some are more equal than others." In this instance, the paradoxical statement comments on the contradictory behaviour of the government's claim of equality among citizens but the concentration of power limited to a small group of individuals. Furthermore, it could be hypothesised that the author's intention to utilise a paradoxical statement is to highlight the government's self-contradictory notion of 'equality'. Additionally, in the statement all three laws of paradoxes are observed; 'Self-Reference' in the pigs referring to themselves as the "animals", while 'Self-Contradiction' and 'Infinite Regress' is observed when the second part of the statement contradicts and reinforces the first by stating the inequality or selective equality among animals.

Similarly, Wordsworth's *My Heart Leaps Up When I Behold* (1802) lyrics state *"The Child is father of the Man"*. In this case, the paradox is not related to the physical upbringing of a person, but it concerns how childhood experiences shape the personality and views of an individual as they mature. Similar to Orwell's case, it could be hypothesised that Wordsworth utilised a paradoxical stanza to act as an allegory, but in addition, it also functions as part of the poetic diction. In this statement 'Self-Reference' occurs where the child in question is being fathered by the Man himself, 'Self-Contradiction' arises when the possibility of a child raising their own parent from birth is considered while 'Infinite Regress' follows when the concept of a child raising their father and a father raising the same child both appear simultaneously.

As a result, from the previous examples, it is observed that paradoxes function as a literature's diction, helping it convey its thoughts and ideas in an entertaining manner while simultaneously prompting the reader to devise the message concealed behind it. In the examples presented previously, it is observed that authors utilise paradoxes to present the absurdity of ideas in a self-contradictory manner. Additionally, it also reinforces the idea within the reader as they are compelled to devise the 'hidden' meaning of the paradox and not accept the statement at face value.

As such, from these examples, it is observed that authors utilise paradoxes to present the absurdity of ideas in a self-contradictory manner. Additionally, it also reinforces the idea within the reader as they are compelled to devise the 'hidden' meaning of the paradox and not accept the statement at face value.

3.3.2 **Art**

In art, particularly in case of paintings, paradoxes are visual rhetoric used by the creators to convey their thoughts by prompting the audience to question their conception and perception of reality, where their conception works as intended but their perception is deceived (Penrose & Penrose, 1958). An early depiction of visual paradoxes is observed in William Hogarth's *Satire on False Perspective* (1754), where the scene showcases several events progressing with contradictory perspectives (Figure 5). Although each action in the image appears to be individually self-consistent, when observed collectively they appear to be contradicting each. The primary intent of this image is stated in its subtitle, "Whoever makes a Design without the Knowledge of Perspective will be liable to such Absurdities as are shown in this Frontiſpiece" (Hogarth, 1754). The subtitle indicates that Hogarth developed this work to highlight the pitfalls of lack of knowledge of perspective could lead to.

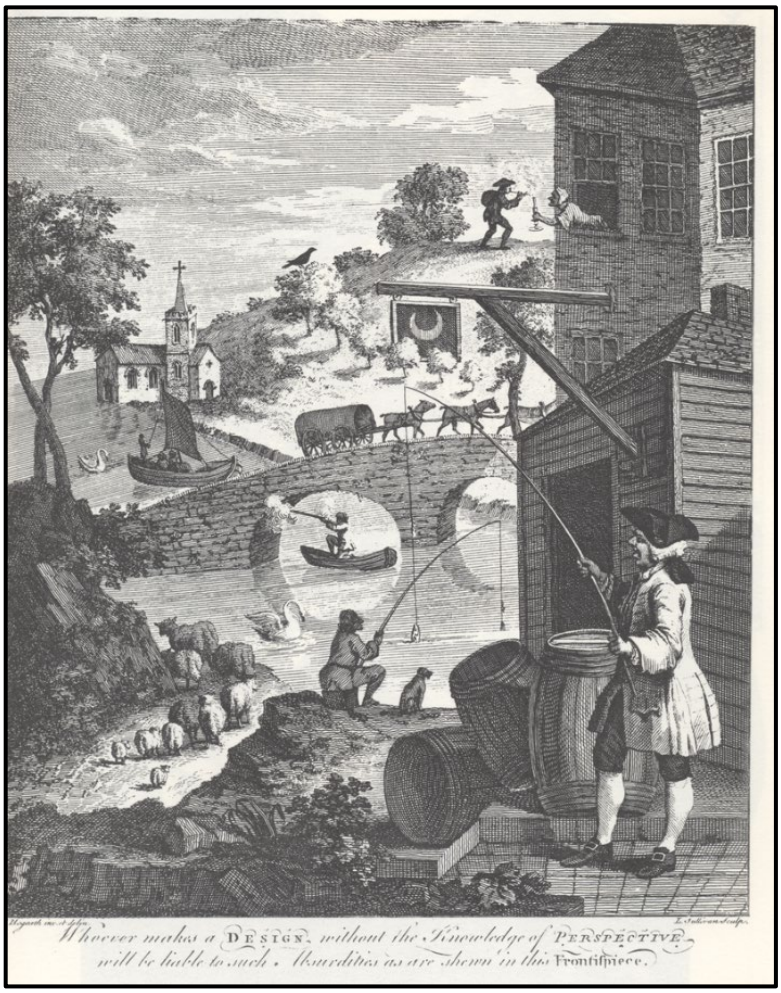

Figure 5 Satire on False Perspective (Hogarth, 1754)

Subsequently, in modern times, paradoxical paintings were revived by M.C. Escher, who eventually pioneered the field by designing several lithographs depicting unlikely scenarios. A prime example of this being Escher's work on *Drawing Hands* (1948) (Figure 6). Here, Escher designs a scenario where two hands are rising from a sheet of paper engages in the paradoxical act of drawing

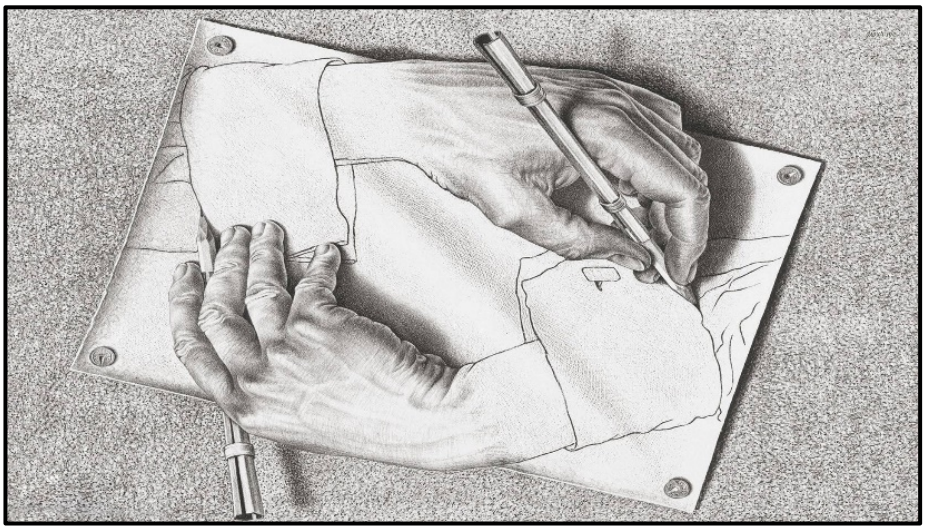

Figure 6 Drawing Hands (Escher, 1948)

each other, leaving the interpretation of the image to the audience as to how the hands came into existence and which hand was the primary instigator in the scenario. In Figure 6, all three laws of paradoxes could be observed. Each hand drawing the other into existence while it is being drawn itself is an indication of 'Self-Reference'. The impossibility of two hands drawing each other into existence from nothingness presents 'Self-Contradiction'. While 'Vicious Circularity' occurs when two hands create a reinforced loop of drawing each other into existence while the fact that there is no clear indication as to the primary instigator of the loop suggests that both came simultaneously into existence, drawing each other. This work by Escher is a visual representation of linguistic paradoxes such as the *Liar Paradox*, where it provides a kinship between the language of art and language of words (Hughes, 1980). Furthermore, Hofstadter describes *Drawing Hands* as an example of a "strange loop", warping the concept of reality by utilising the concepts from reality (Hofstadter, 1979) (Hughes, 1980).

While the previous examples could be considered metaphorical (non-geometric) in nature, Escher inspired mathematicians who proposed geometrically-sound paradoxical figures, which were termed as impossible objects (Rogers-Ramachandran & Ramachandran, 2008).

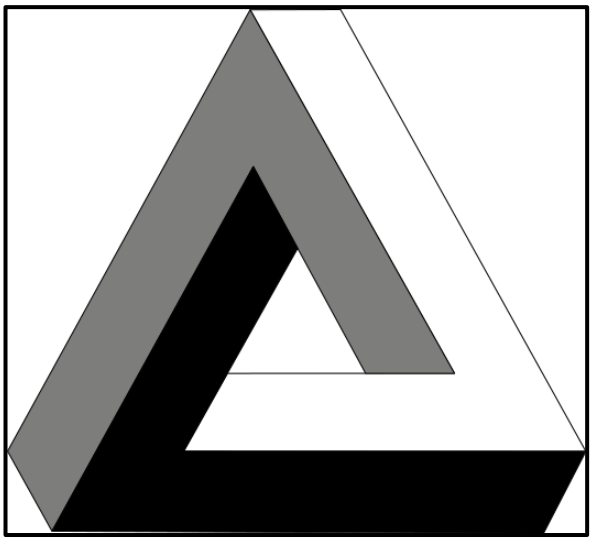

Figure 7 The Penrose Triangle (Penrose, 1958)

One such impossible object is *The Penrose Triangle* (Figure 7), a two-dimensional depiction of a three-dimensional triangle comprised of three straight, square beams meeting at right angles at the vertices of the triangle. Further building upon the concept of the *Penrose Triangle*, Roger Penrose and Lionel Penrose created the *Penrose Stairs* (1959), observed in Figure 8. A variation of the *Penrose Triangle*, it is a combination of four individual staircases which when placed at right angles form a never-ending closed loop. Later on, this staircase became a centrepiece to Escher's lithographs, namely *Klimmen en dalen* (1960) and *Waterval* (1961).

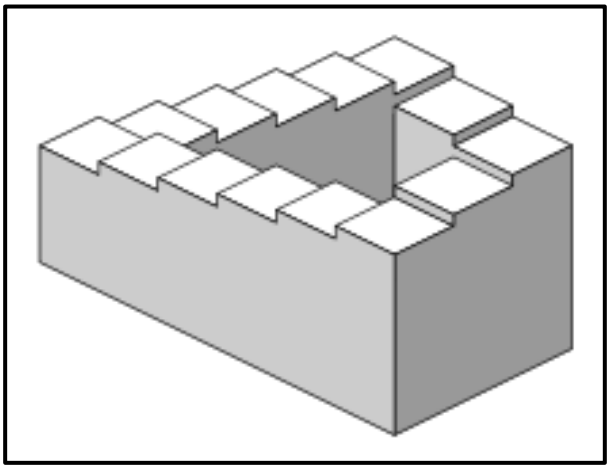

Figure 6 The Penrose Stairs (Penrose, 1959)

Observing both the Penrose Triangle and the Penrose Stairs, it is seen that the laws of paradoxes are more subtle than they were found to be in previous examples. In these figures, 'Self-Reference' and 'Self-Contradiction' are

symbiotic in the sense that, the figures refer to themselves as to how a two-dimensional projection of a ‘typical’ three-dimensional would like. But it contradicts itself by presenting subtle impossibilities in how these projections are composed. On the other hand, ‘Vicious Circularity’ is observed if a line is traced through these, where the line would have to pass through impossible, yet feasible angles to return back to the start.

3.3.3 **Film**

In films, similar to art, paradoxes are utilised as a form of visual rhetoric to communicate the message of the creator (Penrose & Penrose, 1958). These applications are observed in two different manners, with the first case making explicitly clear to the audience how the paradox was framed. This is experienced in movies such as *Inception* (2010) which utilises previously mentioned paradoxes in the art such as the *Penrose Stairs* and *Waterval* to convey the message of the world being a malleable dream, only limited by imagination. On the other hand, certain films present paradoxes in an overly subtle manner where it is discreetly integrated into the film’s narrative, prompting the audience to discern its meaning. This approach is observed in *Paradox Bullets* (Sachs, 2018) (Figure 9) where the main character wishes to drive an impounded car but is unable to do so as the process requires him to be in possession of an already running car.

Figure 7 Paradox Bullets (Sach, 2019)

Analysing the film through the lens of ‘Laws of Paradoxes’, the film as a whole is not a paradox, as then it would be never-ending. The film acts as a container to present instances of paradoxical phenomena embedded in it. An instance of this when the protagonist experiences a paradoxical event while trying to start his car, but the course of events requires the car to be already running, to begin with. Further observing this example through ‘Laws of paradoxes’, ‘Self-Reference’ here occurs when the events surrounding the car refer to themselves while ‘Self-Contradiction’ transpires when a car is required to be running and immobile at the same moment. This directly links to ‘Viciously Cruciality’ due to the destructive loop of the interdependency of an immobile car and a running car, in which case starting a car requires it to be already being started.

Additionally, the difference between the application of paradoxes being explicit and implicit boils down to the production of the film. While *Inception* was a film aimed to be published commercially as observed by its trailers and advertisement as well as its worldwide success (Boxofficemojo, 2019), on the other hand, *Paradox Bullets* is a relatively low-budget film premiered as part of a non-profit film programme, whose aim was to convey the ideas of the creator to an audience (Sach, 2019). Consequently, it is observed that the paradoxes showcased in *Inception* are a product of intricate visual effects made remarkably noticeable to the audience. On the other, the paradoxes in *Paradox Bullets* originate from the film’s narrative, as such the audience are compelled to analyse the sequence of events to devise the message concealed beneath it.

3.3.4 **Architecture**

Until now, paradoxes observed in fields such as literature, drawing and lithographs were constrained to the two-dimensional space, but the paradoxes in architecture allow the audience to visually and physically experience these impossible spaces and objects in a three-dimensional space. Although deemed ‘impossible’, it is possible to construct these objects so that individually they appear self-consistent while collectively when viewed from certain angles they appear to be paradoxical.

Figure 8 Penrose Triangle (Abas A. & McKay, 2008)

This phenomenon is observed in the sculpture of the Penrose Triangle (Abas A. & McKay, 2008) situated in Perth, Australia (Figure 10). This sculpture utilises depth in such a way that one end of the square beam is placed behind another, which when viewed from a certain angle provides the illusion of an impossible object. Another instance of a three-dimensional realisation of an impossible object is the Undecidable Monument (Hayward, 1967). This figure was recreated in three-dimensional space through the usage of two permeable mirrors which allows the viewer to observe the impossible pillars when viewed from a specific angle (Lingelbachs Scheune, 2007). Consequently, it could be suggested that paradoxes in architecture are visual rhetoric conveying the message of how the same object can be perceived as paradoxical or non-paradoxical when observed from different perspectives.

3.3.5 **Music**

Paradoxes in music, are effectively auditory illusions caused by the looping and contradictory application of pitch and tones. An example of an aural paradox is the *Shepard's Tone* (Shepard, 1964) otherwise known as "sonic barber's pole", which proposes a tone comprised of multiple sine-waves (separated by an octave) layered on top of each other creating an illusion of infinitely ascending or descending notes but goes neither higher nor lower.

In 1986, psychologist Diana Deutsch utilised a pair of sequentially played *Shepard's Tones* related by a tritone (half-octave), to synthesise a phenomenon

where the same notes could be heard as ascending to one group of listeners while descending to another group, presenting contradictions in how sound is perceived by humans. Applications of *Shepard Tone* are found in various forms of media such as the track *Endlessly Downwards* (Beatsystem, 1995) uses a descending *Shepard's Tone* to complement the beats of the song. Another example is in the film *A Pair of Paradoxes* (Shepard R. & Zajac E., 1967), where the tone was used to complement the computer-animated Penrose Stairs.

If these paradoxes are observed through the lens of 'laws of paradox', 'self-reference' and 'infinite regression' are simultaneously observed when these tones build upon themselves to provide a 'self-contradictory' note which infinitely ascends and descend. From these examples, it is observed that musical or aural paradoxes are always used in conjunction with another participant to augment the effect of the second entity.

While the previous examples present the application of paradoxes in a more static manner, where the creator presents a paradoxical idea and the audience consume it, they do not demonstrate the interactive capabilities of paradoxes, for instance, interactive media, where the audience is capable of manipulating the variables of an artefact, an applicable example being games. Furthermore, the next chapter observes the application and functionality of paradoxes in different areas of games, simultaneously discovering the discrepancies experienced when integrating them as part of a game.

3.4 **Paradoxes in Games**

A game is a form of interactive media, which is defined as a system determined by rules where players engage in an artificial conflict, that results in a quantifiable outcome (Zimmerman & Salen, 2003). Additionally, this can be divided into three different areas, namely 'Gamespace', 'Gameplay' and 'Game Narrative'.

3.4.1 **Gamespace**

Gamespace represents a game's visual and aural presentation of space, which the player can navigate to engage in conflict with other game-objects (Zimmerman & Salen, 2003; Stockburger, 2006). These spaces encompass the game environments with emphasis upon aesthetics and architecture as well as

game levels which are built upon gameplay, existing solely for the player's progression. (Bycer, 2018).

Consequently, paradoxes in gamespace also exist in a two-part form: aesthetic and mechanic. Richard Coyne (2016), in his paper 'The magic circle', emphasizes the two-part existence of paradoxes through the usage of non-Euclidean Spaces. These spaces themselves, as well as the geometry within them, violate the postulates of a regular Euclidean Space (Klein, 1871). Building upon the work of Johan Huizinga (1955) and Jesper Juul (2008), Coyne discusses the existence of the magic circle or a virtual space, which subverts the laws of physics found in real-life. Identifying them as 'spatial paradoxes' or space-based paradoxes, he alludes to anamorphism, suggesting their role as visual rhetoric to help communicate the uncanniness of a game world. It is the apparent impossibility of the existence of an artefact or space, which allows the player to explore the limits of an "alternative magic circle" other than the one they are accustomed to.

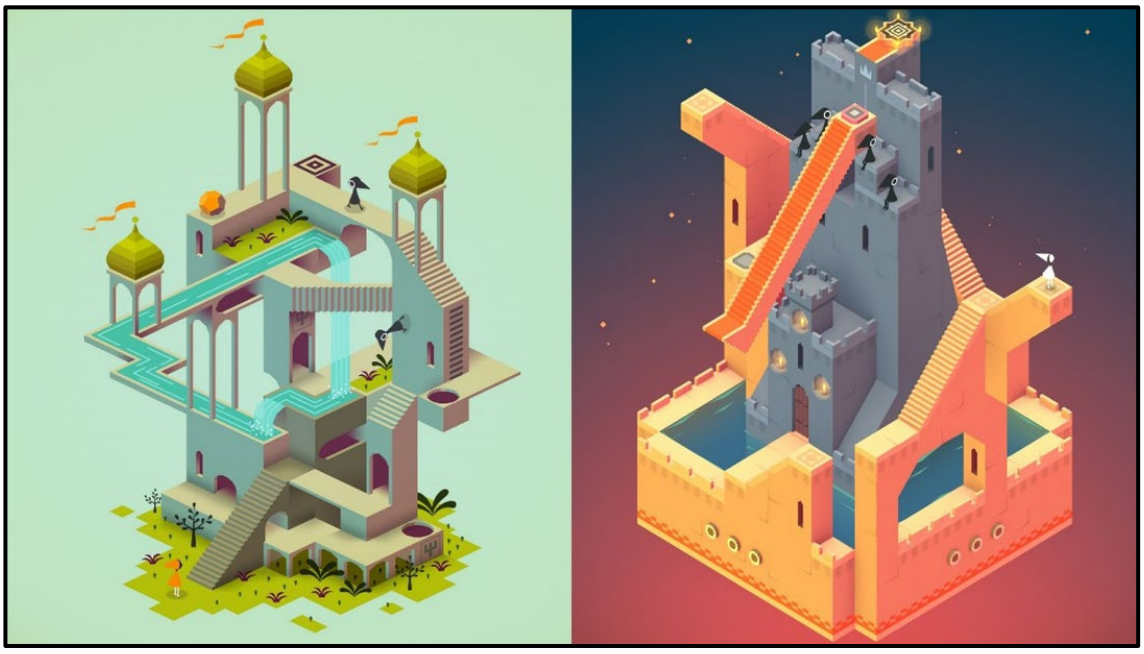

Figure 9 Monument Valley (ustwo studio Ltd., 2014)

Coyne proposes that these paradoxes are in fact optical illusions which seem paradoxical when viewed from a certain perspective such as from a distinct angle or through the reflection curved surfaces like cones and cylinders. He uses the examples of games such as *Monument Valley* (ustwo studio Ltd., 2014) (Figure 11), whose aesthetics and gameplay are based on enigmatic lithographs

from M.C. Escher namely *Klimmen en dalen* (1960) and *Waterval* (1961). The uncanniness which Coyne is referring to is what Jentsch (1906) attributes to an 'intellectual uncertainty', further describing it is as a "fundamental feeling of insecurity brought about by a 'lack of orientation', caused by a sense of new, unfamiliar and hostile invading an old, familiar, customary world."

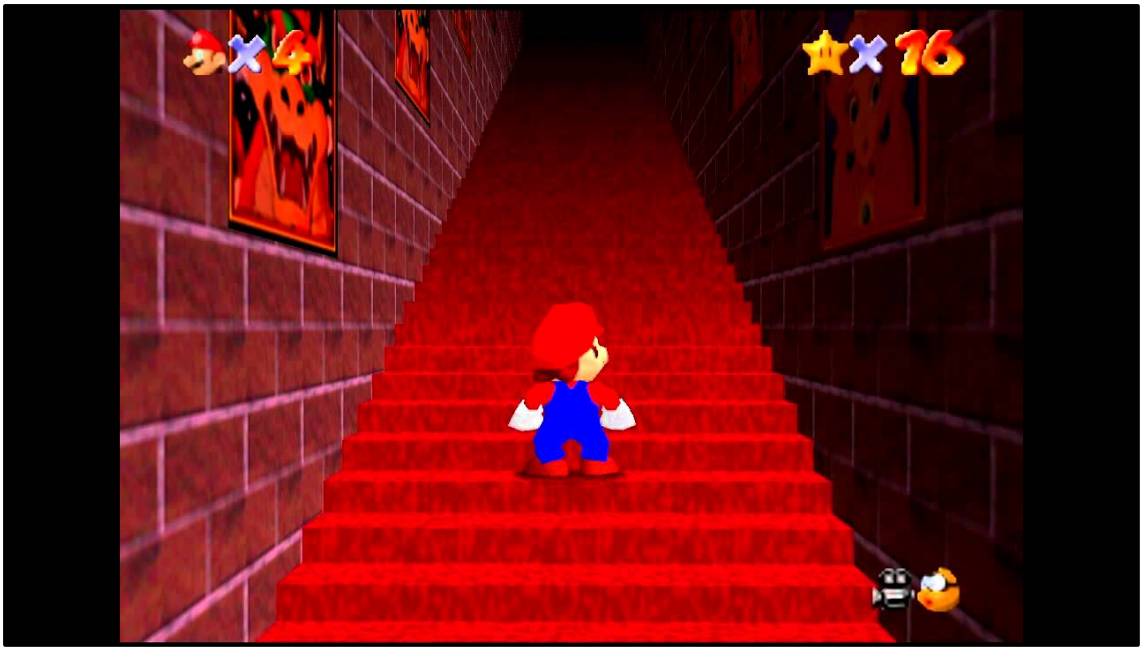

Figure 10 Endless Stairs - Super Mario 64 (Nintendo, 1996)

The uncanniness in gamespaces which Coyne alludes is observed in games such as *Mario 64* (Nintendo, 1996), in the form of 'Endless Staircase' as observed in Figure 12. In this case, it is the product of overlapping architecture, where the player loops back to the same place from where they started. This staircase is an obstacle in the Mushroom Castle, which only occurs if the player possesses less than seventy 'Power Stars', although, the player can exit this 'loop' if they decide to walk downwards towards the entrance. In the event that the player collects seventy stars, the stairs come to an end and the player is able to progress to the next level. In this scenario, the 'paradoxical' gamespace exists to deter the player from reaching the final level, enforcing an implied condition to complete a certain goal, to progress further.

Similar to how paradoxes are utilised in literature, where the reader is required to devise the hidden meaning of a statement or poem, in this scenario, paradoxes require the player to discover the hidden goal, which is necessary to

progress further. Likewise, if this gamespace is observed through the ‘lens of paradoxes’, ‘self-reference’ and ‘self-contradiction’ are observed when the player tries to move but remains in the same place, while ‘vicious circularity’ is observed when the player moves at the top of the staircase only for them to back to their original location.

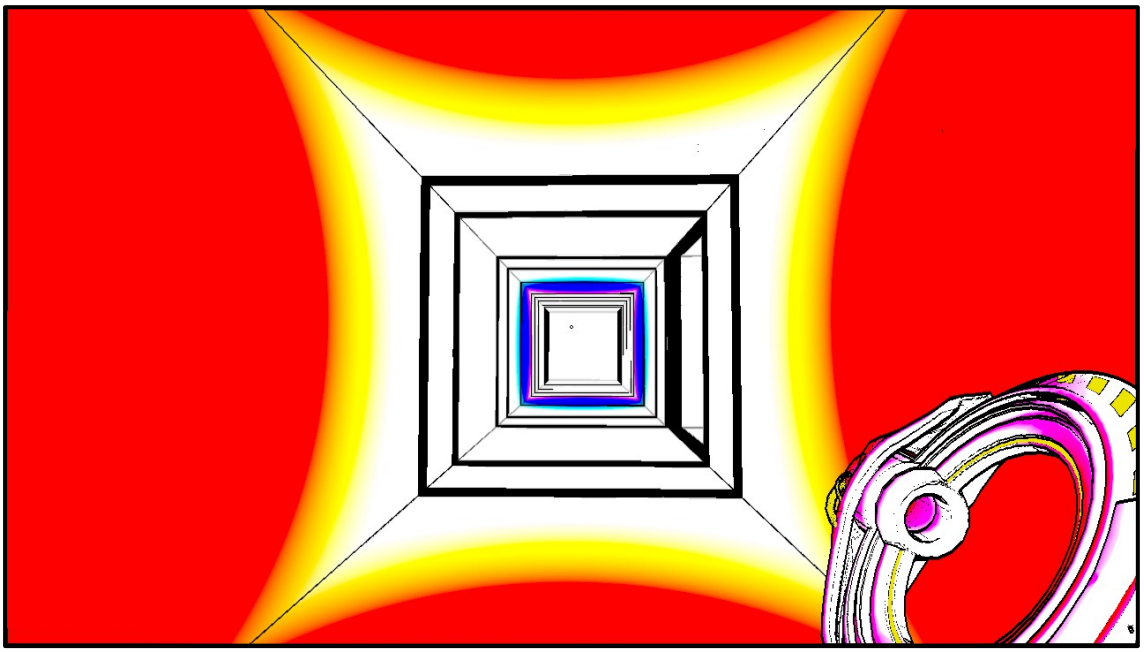

Figure 11 Infinite Maze - Antichamber (Demruth, 2013)

In a similar fashion, this ‘uncanniness’ in gamespace is also observed in the “Finding The Seams” stage in *Antichamber* (Demruth, 2013) (Figure 13). This stage consists of a non-linear, looping maze, where choosing the wrong direction leads the player back to the same location they started from. Furthermore, taking the ‘correct’ path leads the player to the beginning of the previous level. As a result, regardless of the player choices ‘right’ or ‘wrong’, the player is stuck in an infinite loop, although going back to the previous level and choosing a different route allows the player to progress further in the game. Consequently, it could be considered that the game utilises this paradoxical space to suggest that there exists an alternate option of solving this loop, which is to ‘give up’ and backtrack to the previous level and choose a different path.

Identical similarities are observed between the application of paradoxes in games as well as other forms of media. Which is to say, that in this scenario paradoxes perform the function of requiring the player to discover the hidden message, to progress further. Consequently, when this gamespace is observed through the ‘lens of paradoxes’, ‘self-reference’ and ‘self-contradiction’ are

observed when the player tries to move towards a specified direction but instead arrive at a different unintended location, although within the same maze. While ‘vicious circularity’ is observed when the player’s choice of direction leads them back to the original location they started from.

While the previous two examples presented the utilisation of paradoxical gamespaces within the constraints of game design they also observe practical applications. For example, in virtual reality (VR) these spaces allow the players to perceive the environment beyond the limits of the actual physical space available to them (Suma et al, 2012). To achieve this, Suma and his team developed virtual portals at the junction of two spaces which would seamlessly transition the user from the one area to the next without requiring them to traverse longer distances. Moreover, to maintain this illusion they used redirection techniques in conjunction with overlapping architecture to connect a series of impossible spaces, designing a seamless experience.

3.4.2 **Gameplay**

The gameplay is defined as the pattern that emerges when players interact with the game rules and the system to engage in artificial conflicts with other game elements, progressing towards a quantifiable outcome (Zimmerman & Salen, 2003). Gameplay generates interactivity, to be more specific ‘Explicit Interactivity’, where the player participates within the game system through voluntary choices. A seemingly contradictory notion, gameplay grants the freedom of movement to the player to freely move about in the gamespace while interacting with varying game elements within the game system’s rigid structure (Zimmerman, 2004).

The system’s structure is composed of rules which define the limit of freedom the player is able to achieve. Frasca (2013) categories these rules into three categories, ‘Manipulation Rules’, ‘Goal Rules’ and ‘Meta Rules’

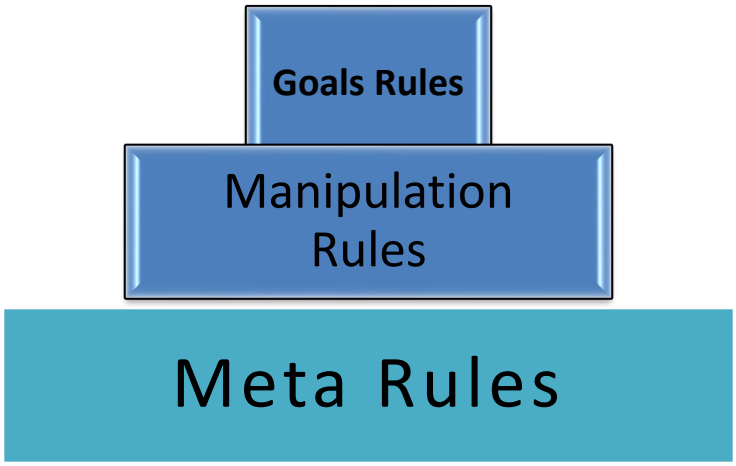

Figure 12 Game Rules Dependency

The rules, as observed in Figure 14, show pyramidical dependency where Goals Rules are dependent on the Manipulation Rules as the rules of interactions define how the goal is eventually achieved. Furthermore, the Meta Rules exist externally from the previous two categories as they can modify both the manipulation and goals rules to achieve results different from the one defined by the designer (Frasca, 2013). Furthermore, accessibility to these rules would result in a varying amount of personalised systems within the game each with own set of rules and goals, which results in them being unreliable and subject to fluctuation. Correspondingly, Meta-Rules are excluded in this research for the purpose of this research.

Paradoxes in gameplay are based around the infinite regression appearing in the manipulation rules and the extent to which these rules allow the player to interact with the game elements. Coyne suggests that functionality of paradoxes in gameplay is to subvert player's expectation of the outcome, requiring them to relearn the new freedoms and limitations granted to them by this new, alternative magic circle comprised of paradoxical elements. Coyne explains this phenomenon by using *Portal* (Valve Corporation, 2007) (Figure 15) as an example, where the game's manipulation rules are based around the player's ability to instantaneously traverse the game world using portals. *Portal*'s game system functions through a combination of paradoxical and non-paradoxical manipulation rules utilised to achieve non-paradoxical goals. Coyne's previously mentioned example of *Monument Valley* (ustwo studio Ltd., 2014) also

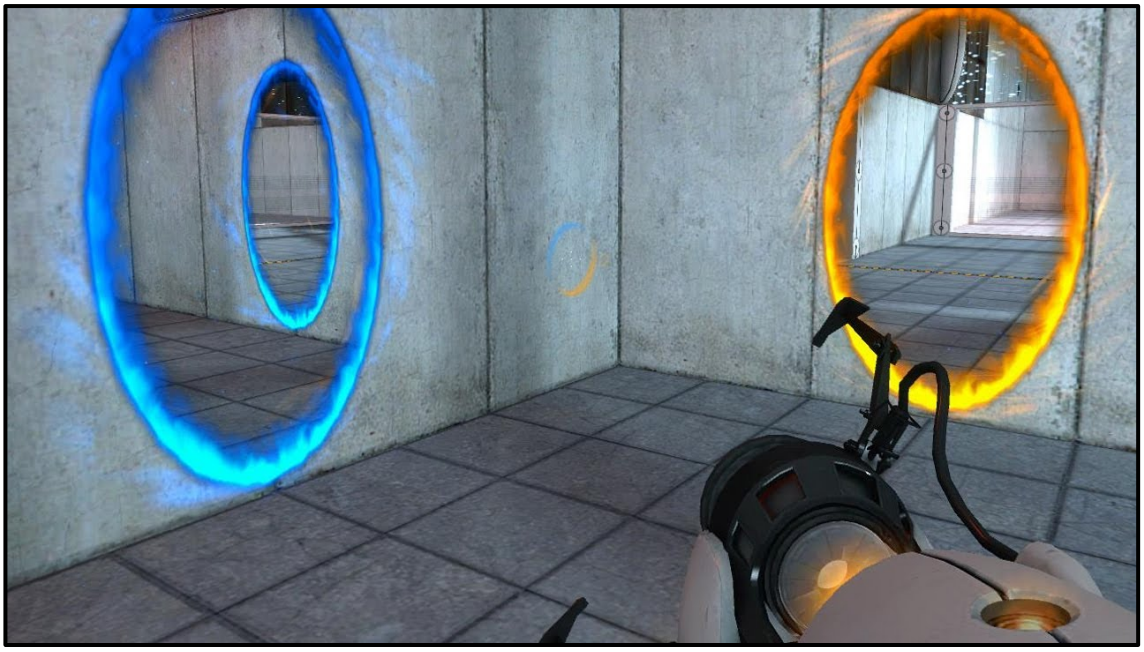

Figure 13 Portal (Valve Corporation, 2007)

indicates the application of paradoxical objects and spaces as gameplay elements, where adept utilization of perspective and programming allows for spatial impossibilities within the game. As observed with *Portal*, *Monument Valley*'s game system is also a combination of paradoxical and non-paradoxical manipulation rules utilised to achieve non-paradoxical goals.

An important aspect of paradox-based game design suggested by these examples are that none of the games contain paradoxical goals. A potential reason for this being the case might be due to the 'viciously circular' and 'infinitely regressive' of paradoxes. As a result, if these attributes are applied to a game system's goal rules, then the system would transform into an infinite loop with no possible choice for the player to progress further.

3.4.3 **Game Narrative**

Narrative, in games, defines a series of events that the player can experience. It is a medium through which game experience is framed for the player, either through a voluntary player agency or from a series of pre-scripted events (Zimmerman, 2004). The fact to note here is that games represent through player's voluntary participation: in other words, player's choices reflect their experience of a game narrative. Zimmerman further suggests that the game as a singular entity is not the only medium through which a narrative is experienced by the player. He also considers the means through which games are played,

such as an arcade machine or a computer as well as the controllers used to move the player's character in the gamespace.

To exemplify, Zimmerman presents the case of *Ms. Pac-Man* (Namco, 1981) played on an arcade machine, he proposes that the while the elements and rules of the game system are identical, the unravelling of the narrative varies for each player. While the previous statement focuses more on gameplay's impact on the narrative, Zimmerman suggests that the entire narrative experience commences with the arcade machine itself: its mechanical aspects such as the 'sound of the quarter dropping', the texture of the joysticks as well as the social dynamics of how the functions. While Zimmerman's approach to game narratives is based on the relationship between player and the experience of play, this research will focus more on games as a system and the manifestation of play behaviours due to the interaction between the game elements.

In game narratives, the existence of paradoxes occurs within the nature of narrative as a structured series of pre-authored events offering the flexibility to choose among a multitude of options (Louchart & Aylett, 2003). Zoning in on the functionality of paradoxes in game narratives, similar to literature, they are utilised as literary devices to present unexpected insight through contradictory ideas (Rescher, 2001). The 'freedom of choice', a trait unique to games, quickly becomes redundant as all choices lead the player back to the same position they started from. To exemplify, causal paradox (*Smith*, 2013), effectively provides 'beats' to convey the uncanny behaviour of not only of the game narrative as an infinitely regressive sequence of events but also of the gamespace through spatial impossibilities and gameplay as a subversive 'magic circle'.

These applications of paradoxes as literary devices are observed in games such as *Portal 2* (Valve Corporation, 2011) where the Liar Paradox (Eubulides, 4th century BCE) is used as an attempt to defeat Wheatley, a "naive artificial intelligence". An example of redundant, paradoxical choice-based scenarios in games is *Stanley Parable* (Wreden, 2013) where the "Narrator" recites Stanley's account of the day. Here, the player can choose to contradict the "scripted" narrative, although doing so doesn't change the outcome of the game and leads the player back to their original position. The choices are structured and are based on the concepts from the 'Theatre of the Absurd', which essentially suggests that the human situation is essentially devoid of purpose

(Esslin, 1966). This concept is utilised to present the player with ambiguous questions lacking any possible ‘right’ solutions (Sarian, 2018).

3.5 **Disparities in the Literature**

To summarise, paradoxes in media other than games are utilised as metaphors to convey a hidden meaning the creator wishes for the audience to decipher themselves rather than presenting it in a straight-forward manner such examples of this includes *Animal Farm* or *Drawing Hands*.

On the other hand, from the literature, it is observed that paradoxes in games do not follow the laws of paradoxes. They are often utilised as a method to present contradictions or contradictory choices to the player while also to subvert player’s expectations by presenting unrelated outcomes to player choices. Additionally, in each instance, the paradoxical gameplay system becomes ‘solvable’ or ‘progressable’ as observed with the case of ‘Endless Stairs’. In this case, even though the stairs are suggested to be endless, they do come to an end when the player fulfils the required goal, resulting in transforming into a non-paradoxical system. This indicates that designers misinterpret almost-paradoxical concepts such as ‘Subversion of Expectation’ and ‘Contradiction’ as paradoxes, suggesting that an appropriate framework laying the structure for the definition of paradoxes and non-paradoxes may aid designers in developing truly paradoxical gameplay system.

4. Research Design

4.1 Theoretical Framework

To understand how games can be paradoxical, it is imperative to understand where and how paradoxes are observed in the different stages and layers of a game as well as to discern how a game functions at a microscopic level. Accordingly, this composition would divide the game into interdependent layers, which would, in turn, serve as a basis for designing paradoxical subsystems inside the game system.

4.1.1 Game System Composition

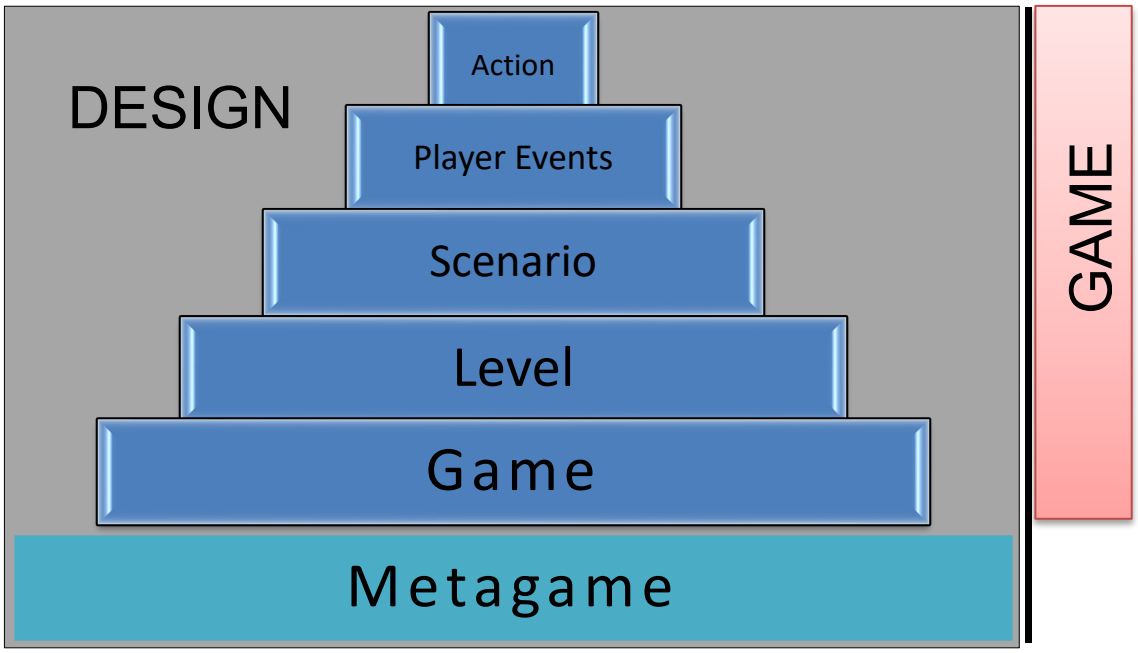

Figure 14 Game Layers Breakdown

A game system, in the context of this research, is divided into two halves, 'Design' and 'Game Code'. Figure 16 presents a visual representation of varying layers of a game. The pyramid indicates the 'Design' component, which illustrates all the systems and subsystems which are readily accessible and inter-actable by the players. Explanation of each layer of the pyramid is presented in Table 2.

The 'Game Code' component indicates the programmable components of the game, which enables the functionality of the game layers. It is autonomous of the dependencies of the game layers and can be manipulated in ways without developing conflicts within itself. This component is purely logic-based which is isolated from any form of player participation, while the 'Design' manufactures

how a system interacts with the higher and lower layers as well as their respective system components such as the player, enemies, score system. As a result, it is possible to develop a viciously-recursive and self-contradictory game state[4] in the 'Game Code' supporting each layer. For a game layer to truly present a paradox, its 'design' components such as interactions between game elements through player-agency, must be paradoxical as well.

TERM	DESCRIPTION	SOURCE
Metagame	A set of external aspects which do not directly interact with the game rules, yet influence the experience of the game.	Sicart, 2015
Game	A system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.	Zimmerman and Salen, 2003
Level	The amount of space available to the player in the game to achieve their current major objective. Completion of these objectives progresses the player to the next level	Rogers, 2014
Scenario	A series of events taking place in the game world, which may or may not conclude to a finite outcome. The player may or may not be a major participant in this layer.	Kremers, 2009
Event	A series of actions which collectively converge towards a temporary goal. Similar to 'scenario' these events can be carried out by the player as well as the game system.	Kremers, 2009
Action	An action represents the individual processes carried out by the game components (including the player) to achieve their interim objective.	Lankoski and Björk, 2015

Table 2 Description of Game Layers

[4] A game state is a combination of game elements and their respective values. (Lankoski and Björk, 2015)

Moreover, as observed in Figure 16 (p. 32), ‘Metagame’ is excluded for the purpose of this research, as the layer represents a system which does interact with the game rules defined by the designer and is developed completely by the players themselves. From a purely systems-design perspective, removal of the ‘Metagame’ layer does not influence the game system in any shape or form. Furthermore, this layer exists in a user-centred role regarding experience, perception and other unaccountable human factors.

4.1.2 Interpretation of Paradoxes in Games

As observed in previous chapters, for a game to be considered paradoxical, it must contain paradox-based subsystems within it, which follow the three laws of paradoxes ‘Self-Reference’, ‘Self-Contradiction’ and ‘Vicious Circularity’.

Utilising this knowledge of paradoxes and game system composition, two games are momentarily considered which refer to themselves as paradoxical. The first being *Antichamber* (Demruth, 2013) as the game’s representation of paradoxical gameplay is based on subverting player’s perception of space as observed in Figure 13 (p. 26), allowing for a more accessible understanding of the systems. At the same time, a second game to consider is *Stanley Parable* (Wreden, 2013). This game was specifically selected as it showcases a higher frequency of paradoxical gameplay systems within each of their individual game layers as seen in Figure 29 (p. 54). Furthermore, in this game, there exists a higher amount of systems based on the player’s decisions rather than their spatial perception.

Beginning with *Antichamber*, the game suggests non-progressable, ‘infinitely circular’ levels to the player. Although, on further inspection, it is observed that these levels are completely solvable through repetitive, non-conventional measures. This indicates that the game causes the player to build expectations of a level being incompletable, but this expectation is subverted by the existence of an eccentric solution which the player does not foresee. For this reason, it can be concluded that *Antichamber* utilises the concept of ‘Subversion of Expectation’ instead of paradoxes to portray a paradoxical approach to level design.

While in the case of *Stanley Parable*, the game presents a conundrum with two or more contradictory approaches to it while presenting an illusion to the player of their ability to choose both the option simultaneously, while in fact, the player can only choose one or the other option with their respective varying results. This results in the game utilising 'contradiction'-based approach instead of a paradoxical approach towards decision making.

Consequently, this introduces two new concepts, 'Contradiction' and 'Subversion of Expectations', which are misinterpreted as paradoxes. This results in a requirement to define these concepts in the context of the game and understand how and why the misinterpretation occurs.

4.1.2.1 Subversion of Expectation

'Subversion', as an independent concept, is defined as, "The undermining of the power and authority of an established system or institution" (Oxford Dictionary, 2019). By this definition, 'Subversion of Expectation' is defined as undermining of the power of an established (or reinforced) expectation, through the introduction of an entirely unrelated idea. Subversion of Expectations could be experienced in literature or entertainment where the audience's expectation is built around a situation prompting them to infer a probable conclusion but is later subverted when an unexpected outcome is presented to them (Subverted Trope, n.d.).

Subversion is often used to challenge frequently observed design paradigms shared between games. These new outcomes to an existing situation cause the players to overcome their routines to progress through the game. Designing a game based around subversion requires the player to follow a pattern through a recursive learning process (Mitgutsch & Weise, 2012) as suggested by Figure 17.

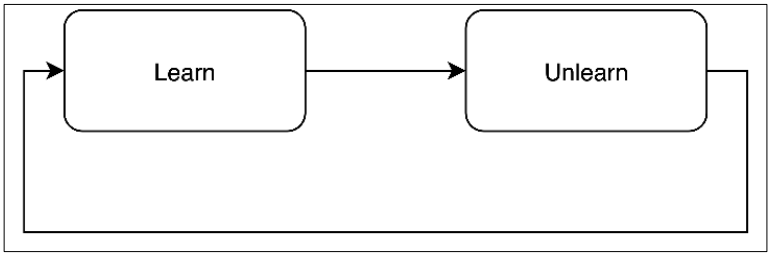

Figure 15 Recursive Learning

This process of, ‘learning’, ‘unlearning’ and ‘relearning’ is similar to Piaget’s theory of cognitive development (Piaget, 1936). As such when both the theories are compared, it becomes clear that the introduction of ‘subversion’ causes the player to reach a state of ‘disequilibrium’ as the new and unexpected information fails to fit into their existing schema. During this moment, as observed in Figure 18, the process of assimilation occurs to fit the new, contradictory information in the existing scheme, thereby developing the knowledge database (Mitgutsch & Weise, 2012) (Piaget, 1936).

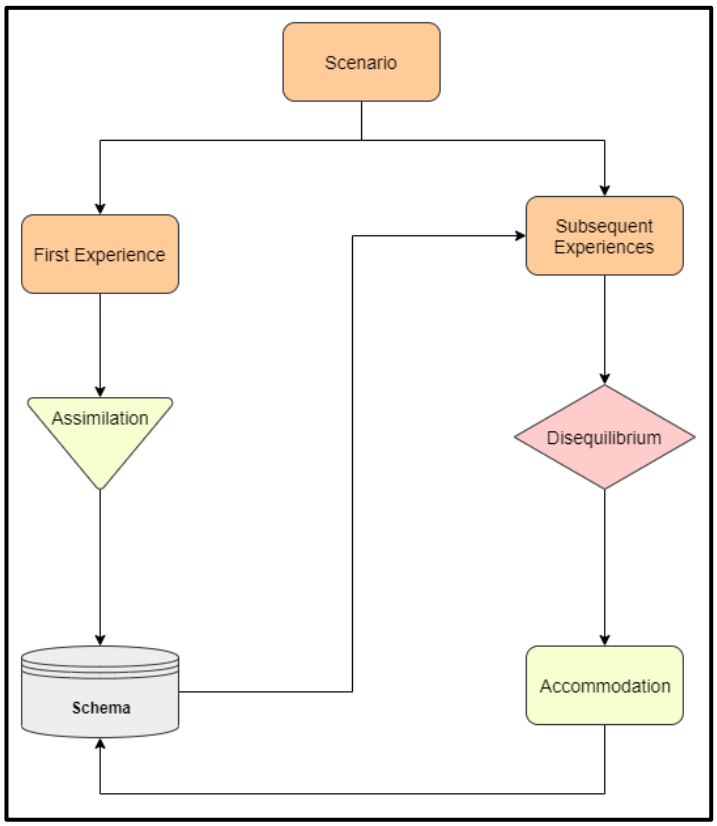

Figure 16 Assimilation-Accommodation

Correspondingly, to achieve a successful subversion the player is required to be affiliated to a common pattern in a game’s design. This means that a less experienced player will find it easier to learn a subverted trope while an experienced player would be required to reconfigure their understanding of a mechanic or a game’s design and learn again. This phenomenon occurs as the more experienced player is prone to certain patterns which occur frequently in game design, placing them in a state of disequilibrium. On the other hand, a lesser experienced player encountering these design systems for the first time,

allows them to forgo the ‘disequilibrium’ and assimilate the new information immediately (Mitgutsch & Weise, 2012).

From a systems-perspective, successful implementation of ‘Subversion of Expectation’ would be a result of a conflict in logic between the available information and the actual outcome of a scenario. In this case, the ‘Subversion of Expectation’ occurs as the available information results in the development of an expected outcome, which is eventually contradicted and negated by the actual outcome. Furthermore, as this forgoes the human element, there is no requirement for the development of a pattern

On the other hand, from a ‘player perspective’ successful implementation of ‘Subversion of Expectations’ requires the utilisation of ‘Rule of Three’ (Crossfield, 2009). In this scenario, a feedback loop needs to be reinforced at least three times before the subversion is introduced. This ‘Rule of Three’ is required as that is the minimum number of instances required to establish a pattern, which could be instantaneously recognisable by the player (Crossfield, 2009). This process begins with ‘introduction’ when a new mechanic is introduced to the player. This is followed by ‘speculation’ where the player develops a theory about the feedback loop of the system. And final step being ‘affirmation’, where the player develops subservience to this new pattern.

Correspondingly, an earlier introduction of subversion, that is before the three-instance mark would prevent the player from familiarizing themselves to the pattern, diminishing the impact of the subversion. Consequently, to successfully utilise a ‘Subversion of Expectation’, its occurrences need to be spare as well as random to prevent the subversion from becoming a pattern itself. The subversion must also be ‘apparent’, meaning it should be easily recognisable by the player as a convolutedly setup subversion would lose its impact as the player may spend more time reaching the subversion rather than experiencing it. Additionally, the subversion should also be ‘abrupt’, which means that the introduction of the subversion should be completely unexpected by the player, otherwise, a leisurely application of subversion would allow the player to expect it before, resulting in a diminished impact. Taking this into consideration and returning to ‘systems perspective’, it needs to be noted that this aspect of ‘diminishing impact’ does not follow as experience becomes a non-factor in a system-based design.

Taking into consideration a previously discussed game but through the lens of Subversion, Antichamber (Demruth, 2013) presents a corridor which loops the player's position if they try to move through in a 'Default' manner whereas if the player disregards the norms and walks into a wall, it disintegrates and presents an exit. This subversion is caused due to the player's expectation of being directed with signs and symbols as opposed to the absurd idea of walking into a wall. Uniquely, this mechanic is used on several occasions, as a result by the previously discussed 'Rule of Three' the subverted mechanic effectively becomes the default as the player learns through their actions, losing its element of surprise. Although, this new default is again subverted when the player experiences a non-passable wall. As such, this random and sparse utilisation of subversion results in a potent impact on the player's experience.

From this, it can be devised that 'subversion of expectation' in games relates to the conflict between the expected outcome, as a product of available knowledge, and the actual outcome. Being a result of conflicting logic between the expected and actual outcome, from a systems-perspective, subversion does not require prior reinforcement of patterns. On the other hand, with experience being a major factor, from a 'player-perspective' a pattern needs to be established to provide a persuasive subversion.

4.1.2.2 Contradiction

A non-contextual 'contradiction' is defined as, "A combination of statements, ideas, or features which are opposed to one another." (Oxford Dictionary, 2019). In contradiction, two or more conflicting outcomes related to a single situation or a problem are presented at the same time. When presented in the form of a question a contradiction becomes nothing but a choice between two or more antithetical options.

By the interpretation of 'contradiction as a choice', when this concept is applied to games, 'Contradiction' develops into a system where there exists a logical incompatibility between two or more propositions, with each proposition yielding contradictory outcomes. Likewise, when this 'Contradiction' is observed from a player-perspective it morphs into a decision-based scenario where a system contains multiple, contradictory options each with their own impactful and

far-reaching consequences. This phenomenon is also known as ‘meaningful choice’ (Morrison, 2013).

Furthermore, this idea of ‘meaningful choice’, indicates that each choice in the system is perpetual, with no means of multiple choices being selected simultaneously. To further elaborate on the topic Morrison proposes the four components of a ‘meaningful choice’: Awareness, Consequences, Reminder and Permanence**.**

Awareness

Awareness is the knowledge of the situation, where it is explicitly made clear by the system, that there exist several choices, each with some form of consequence. This awareness of a product of available information in a system, namely the game elements, emphasizes the fact that a choice needs to be made to progress further into the game.

Consequences

Consequences are the outcomes of the choices in a system. These consequences impact attributes such as its aesthetics or its gameplay behaviour as an observed outcome of the choice. As a result, from a systems-perspective, the impact of the consequence is consequential as long as an outcome exists. This means that from a systems-perspective a ‘choice’ is a logic-based, binary scenario with input and outputs. It does not take into account if the outcomes of these choices overlap or how these outcomes are distinct from one another.

As a result, there exists a need for a user-centric element, which would gauge the value of the outcomes to perform a measured choice. In this case, the user would be required to weigh the impact of the choice to analyse how it would affect their experience. Correspondingly, observing the concept of ‘meaningful choice’, the impact of these consequences need to be emphasised to the player. These reminders will allow the player to experience pride or regret when observing how their choices impacted the other elements in the game. This indication could be immediate, where the impact of the outcome is showcased instantaneously after the choice is made. Or the indication could be delayed, where the impact is observed gradually throughout the game.

Permanence

Permanence is the quality of a choice to be unchangeable. This means that certain choices in the game resulting in far-reaching consequences must be irreversible. Consequently, at no point in the game should a system be allowed to return to a previous state, to negate the outcome of a choice.

An example of contradiction in games is the ‘class choice’ provided to the player in role-playing games. The player is prompted to choose between selections of classes and must stick with it until the end of the game. Here the player’s class of choice influences their future decisions how they proceed throughout the game. While these games contain meaningful choices with contradictory consequences, some games utilise the concept of ‘illusion of choice’. In these games, the choices may seem meaningful but the consequences of these choices are identical. An example of this class of games is *The Walking Dead* (Telltale Games, 2012). In *The Walking Dead* game, the player is warned frequently that each of their different options has different consequences. Although, this proves to be inaccurate as observed when Lee, one of the protagonists, is infected and the player is prompted to choose between saving him or letting him die. Regardless of the player’s choice, the outcome is identical, which is Lee’s death. In this scenario, the player is provided with an ‘illusion of choice’, where it is suggested to them that their choices are impactful although this expectation is subverted when the choices prove to be redundant.

To summarise, a contradiction in games is a scenario where the players are required to perform a choice to progress further, regardless of their ability to infer the probable outcome of their respective choice. This also implies that the player’s choice, as well as their respective unique outcomes, are permanent and irreversible while a lack of choice will impede further progress.

4.1.3 Analysis of Concepts

To further analyse and differentiate between the previously mentioned concepts, a distinguishing property is associated with each of the concepts. These attributes (Table 3) were derived based on how the concepts interact with the previously mentioned game layers. The table below provides a visual representation with the same.

CONCEPTS	ATTRIBUTE
Paradox	Viciously Circular
Subversion of Expectations	Lack of Inference of Probable Outcome
Contradiction	Forced Choice

Table 3 Concepts and Attributes

The attributes associated with their respective concept, as observed in Table 1, are derived from how these concepts are interpreted when observed through the 'lens' of game design (Schell, 2008). As observed in Table 3, paradoxes are related to 'vicious circularity' or being 'viciously circular'. From the literature review (p. 9), it is suggested that paradoxes are inconclusive, as the process of generating an outcome leads back to the original premise of framing the idea itself. Consequently, if this 'viciously circular' process is applied to games, it would result in a system where the game elements are stuck in an infinite loop, preventing them from accomplishing an outcome. This suggests that 'paradoxes' in games design, function to indicate 'viciously circularity' of a system, where the system reinforces itself through an infinite feedback loop, impeding it from achieving any form of outcome.

Next, in the case of 'Subversion of Expectations', as observed previously (pp. 35-38), cues are utilised to build an expectation around an idea, prompting the audience to infer a probable conclusion. But this expectation of the outcome is subverted when an entirely unrelated or a contradictory outcome is presented to them. Accordingly, if this understanding of 'Subversion of Expectations' is applied to games it would result in a scenario where the design cues in the game world would result in the development of an expected outcome. Although, these expectations of an outcome would be later when a completely unrelated outcome is realised. This suggests that 'subversion of expectation' is the product of a 'lack of inference of the probable outcome', as the actual outcome is out of the spectrum of all possible conceptualised outcomes.

Finally, in 'Contradiction', as observed formerly (pp. 38-40), two or more contradictory outcomes to an idea, are presented simultaneously. As a result, it becomes imperative to perform a 'choice' which would result in these outcomes. Consequently, when said 'contradiction' is observed in a game, it results in a situation where there exist multiple, contradictory outcomes to a scenario.

Furthermore, a choice is forced upon the system to choose one, among many alternatives to progress. Correspondingly, the system registers this choice as permanent and irreversible, with no means to go return and choose a different option. This implies that a contradiction, in game design, is essentially a condition where a system contains multiple, contradictory options and a 'forced choice' is required to overcome this scenario.

4.1.4 **Permutations of Attributes**

Through the presence and absence of each of these attributes, it is determined how the previously mentioned concepts are formed while producing six new hypothetical concepts. Table 4 presents a visual representation of the proposed concepts. The table also introduces two new non-paradoxical concepts, 'Default' and 'Subversion & Contradiction', while breaking down paradoxes into four subsequent subclasses based on the absence and presence of the attributes.

PRINCIPLES	**ATTRIBUTES**		
	Viciously Circular	Inference of Probable Outcome	Forced Choice
NON-PARADOXICAL			
Default	N	Y	N
Subversion of Expectations	N	N	N
Contradiction	N	Y	Y
Subversion-Contradiction	N	N	Y
PARADOXICAL			
Default Paradox	Y	Y	N
Subversion Paradox	Y	N	N
Contradiction Paradox	Y	Y	Y
Subversion – Contradiction Paradox	Y	N	Y

Table 4 Paradoxical and Non-Paradoxical Principles

Depending on if the concepts are progressable, they can be divided into two divisions:

a) Non-Paradoxical
b) Paradoxical

4.1.4.1 Non-Paradoxical

These principles always result in a quantifiable outcome. Regardless of the outcome itself being non-inferable, it always exists, enabling the progression of a system.

Default

'Default' (Figure 19) is a non-paradoxical, progressable concept where the inference of the probable outcome is the logical conclusion of all the available information in a system. This concept is primarily linear, as it remains consistent with the laws of time and space with an expected and quantifiable outcome. Furthermore, this concept is considered as default or baseline for other non-paradoxical principles.

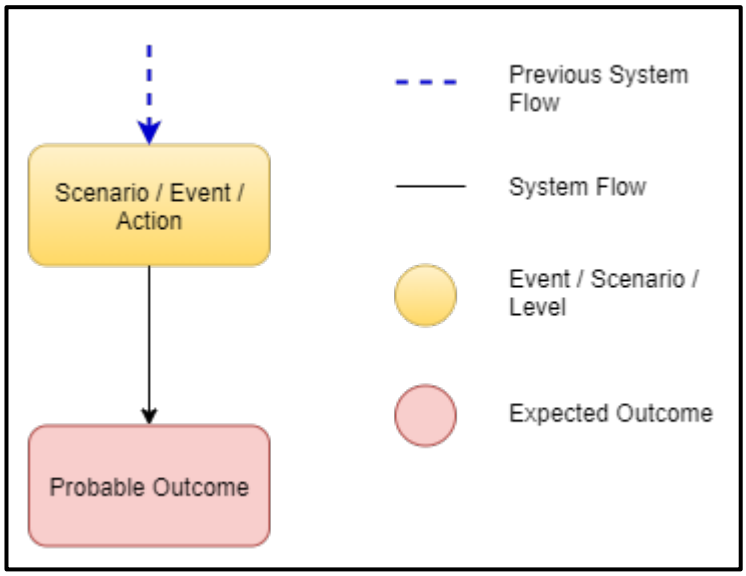

Figure 17 Default

Subversion of Expectations

'Subversion of Expectations' (Figure 20) is a non-paradoxical, solvable concept where all the information in the system results in a probable outcome. Although, the introduction of 'subversion', results in an actual outcome which is completely unrelated and logically incompatible with the information available prior to the scenario/event/action.

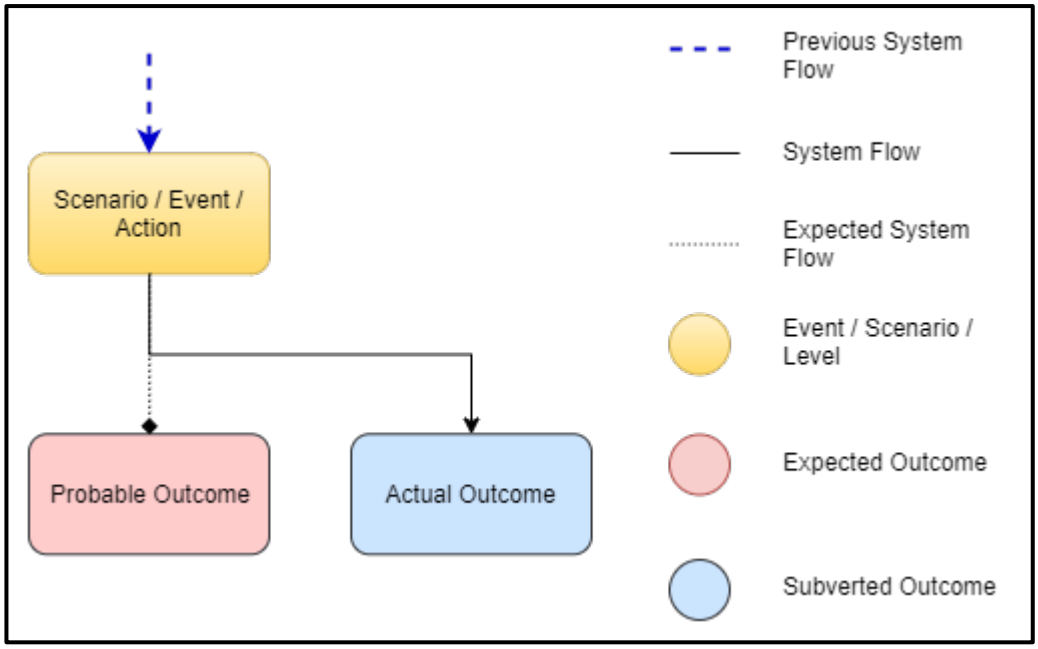

Figure 18 Subversion

Contradiction

'Contradiction' (Figure 21) is a non-paradoxical, solvable concept where two or more choices exist in a system, each with their own probable outcomes. Although, to achieve progression only one choice and its subsequent singular outcome is compatible with the system. Furthermore, when the choice processes, it would remain absolute and finite, with means of achieving an earlier state of the system.

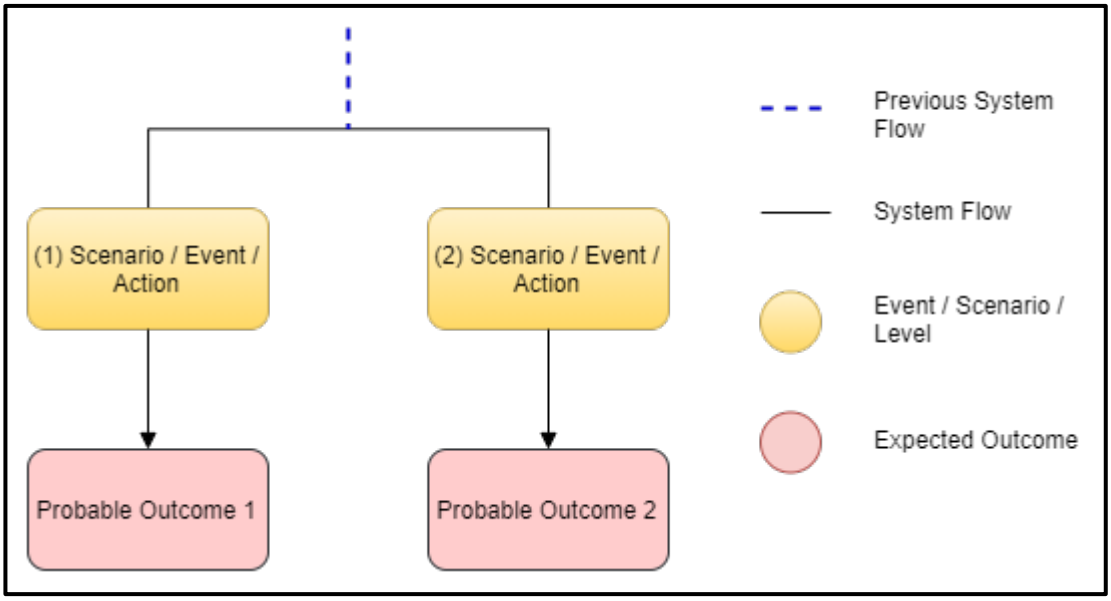

Figure 19 Contradiction

Subversion-Contradiction

A combination of previous two concepts, 'Subversion-Contradiction' (Figure 22) is a new non-paradoxical, solvable concept where two or more choices exist within a system. Along with the probable outcome of each of these choices being the product of the available information in the system. Although, when any of the choices are processed, the introduction of 'subversion', results in an actual outcome which is completely unrelated as well as incompatible with the information available prior to the scenario/event/action. Furthermore, the processed choice is absolute and irreversible.

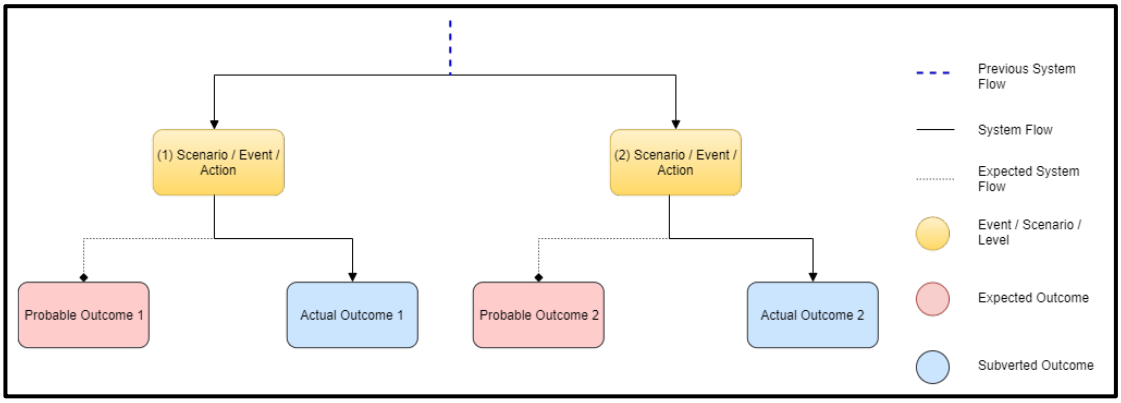

Figure 20 Subversion-Contradiction

4.1.4.2 Paradoxical

Paradoxical principles are viciously circular and unsolvable in nature, as a result, they always impede player progress leading the player back to their original states. These principles are a product of a series of non-paradoxical systems which converges onto a singular, paradoxical scenario, event or action which loops the player back to their original states. In these principles, due to the viciously circular nature of paradoxes.

Furthermore, with the introduction of Subversion and Contradiction, paradoxes can be subdivided into four sub-categories.

Default Paradox

'Default Paradox' (Figure 23) is a viciously circular, unsolvable concept where regardless of the available information in the system there is no inferable outcome. In this case, the actual outcome of the system is the same as the beginning of the process of achieving the said outcome.

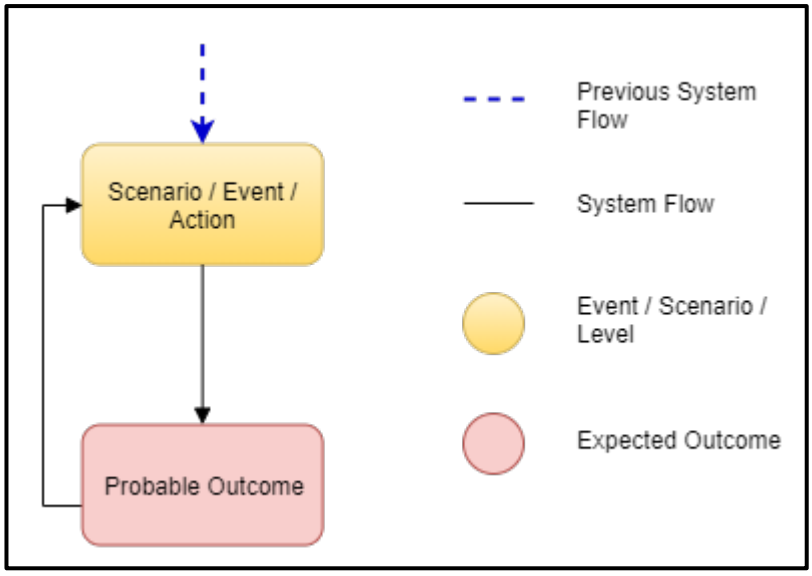

Figure 21 Default Paradox

Subversion Paradox

'Subversion Paradox' (Figure 24) is a viciously circular, unsolvable concept 'Default Paradox' (Figure 23) is a viciously circular, unsolvable concept where the available information allows for the inference of an interim yet circular outcome. Although, the actual development of the scenario/event/action results in an unexpected paradoxical outcome which is incompatible with the prior information, reversing the system to its original state.

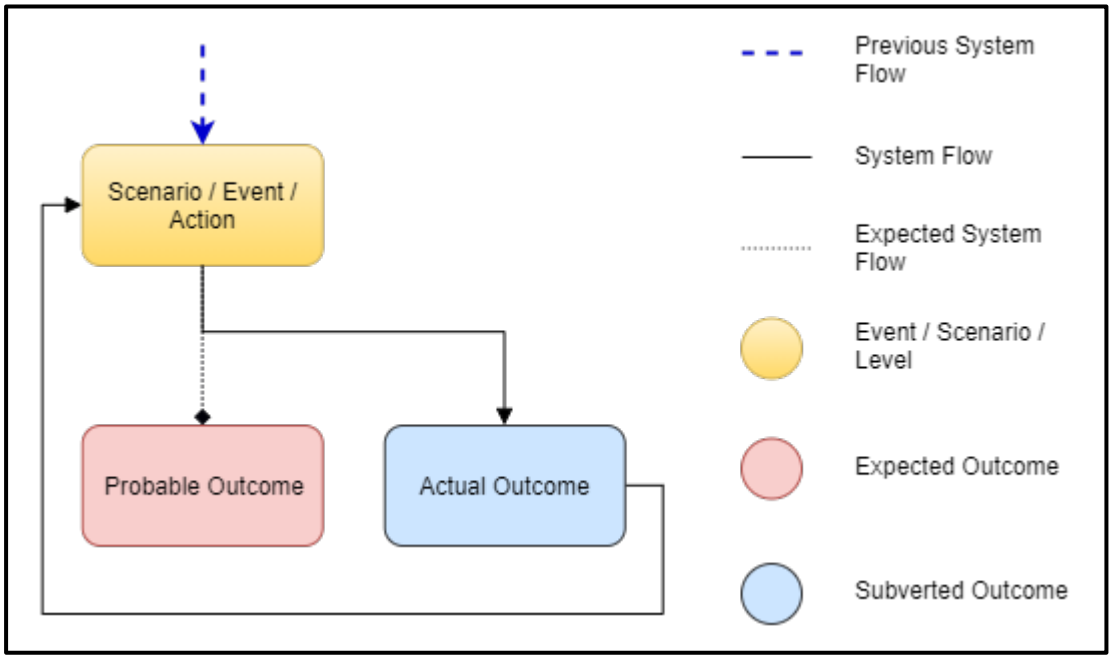

Figure 22 Subversion Paradox

Contradiction Paradox

'Contradiction Paradox' (Figure 25) is a viciously circular, unsolvable concept where there exist two or more choices. Similar to 'Default Paradox', the processing of the available information results in an interim and contradictory, yet circular outcome for each of these choices. As a result, both choices, while contradictory, reverses the system back to its original state.

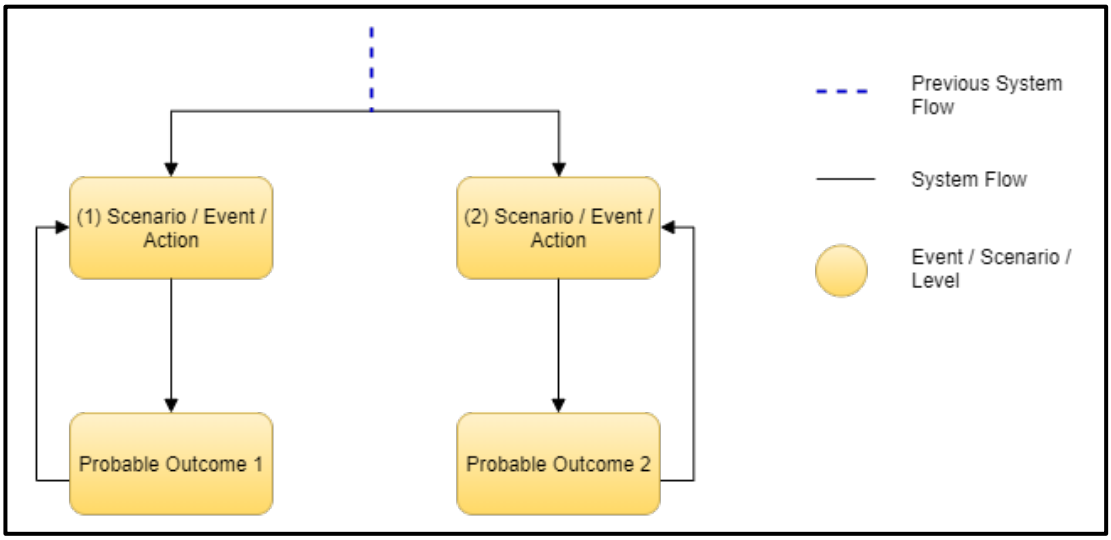

Figure 23 Contradiction Paradox

Subversion – Contradiction Paradox

'Subversion – Contradiction Paradox' (Figure 26) is a viciously circular, unsolvable concept where there exist two or more choices with the available information in the system allowing for the inference of an interim and contradictory, yet circular outcome for each choice. Although, the actual development of any of the choices results in a logically incompatible, circular interim outcome., which reverses the state of the system.

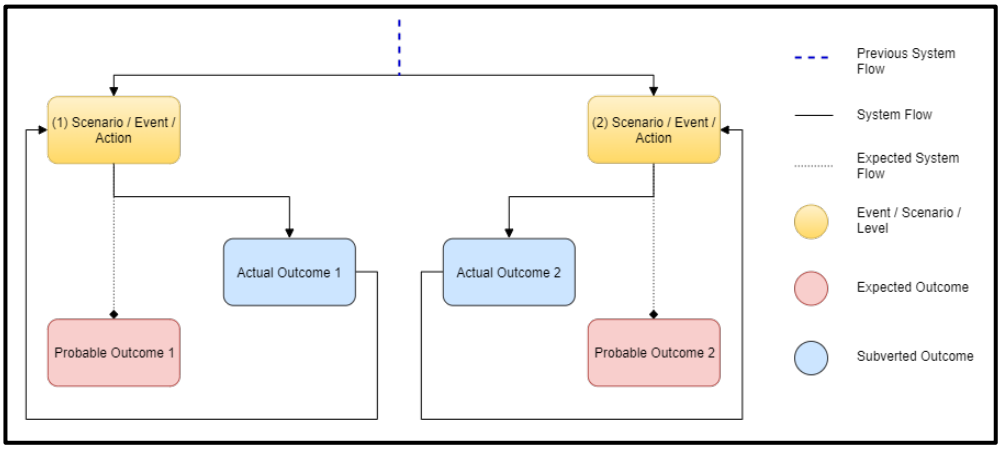

Figure 24 Subversion-Contradiction Paradox

4.2 Methods

In order to better understand the feasibility of applying paradoxes in games, this project adopted two research methods that were used to test the framework.

Firstly, a comparative analysis was carried out to examine the application of paradoxes in existing games utilising the above framework. Following this, new gameplay systems based on the framework were designed and developed in a game engine through a process of practice-based research. This prototyping process was carried out to gain new insights on the application of paradoxes in games as well as to test the framework's capability to develop new gameplay systems.

4.2.1 Game Comparative Analysis

The initial stage of the research utilised a mixed-methods comparative analysis approach by applying the framework on existing games which referred to themselves as paradoxical, to determine the interpretation of how paradoxes are defined in games. This approach was selected as it allowed the theoretical framework to be tested against existing paradoxical games.

In this method, a quantitative approach was utilised to analyse games' 'key phrases' against the theoretical framework to compare their paradoxicality. Alongside, a qualitative approach was utilised to interpret the appearance of paradoxical and non-paradoxical principles within each of the game's layers.

4.2.1.1 Selection Criteria

For the purpose of this research, nineteen games were selected where the developers indicated that these games are paradoxical or contain paradoxes within them. The selection criteria of these games were based on the occurrence and utilisation of key terms within their marketing and branding, which promoted the presence of paradoxes in their game design.

Table 5 presents a visual representation of these key terms and what do they represent in the context of paradoxes.

LAW OF PARADOX	KEY TERMS
Self-Contradiction	Paradox, Impossible, Non-Euclidean
Vicious Circularity	Infinite, Never-Ending, Endless, Loop, Vicious Cycles

Table 5 Key Phrases and Laws of Paradoxes

Furthermore, reviews from game journal outlets were also considered to determine the selection criteria. To authenticate the validity of the game design's as well as to alleviate personal bias, only those reviews were selected where the game's developer provided direct insight upon the design decisions and reasoning behind the incorporation of paradox-based systems. Correspondingly, developers' accounts such as development diary or conference talks played an integral part in the selection of games.

A list of sources utilised for the selection criteria can be found in Appendix - A.

4.2.1.2 Data Analysis

The aim of the analysis was to determine the paradoxicality of the selected games while understanding the mannerisms through which paradoxes exist within game layers. Consequently, to evaluate the paradoxicality of each game layer, the analysis observed the interim objective of all the systems in each of these layers. If all of these interim objectives, caused the system to reset, then the layer was determined as 'paradoxical'. On the other hand, if at least one system failed to reset, then the said layer was determined as 'non-paradoxical'. In a similar manner, if all the layers in a game were 'paradoxical', then the game was classified as 'paradoxical', otherwise, the game was classified as 'non-paradoxical'. Furthermore, an analysis criterion was determined based on the application of the framework, where the framework was utilised to verify how paradoxical and non-paradoxical principles exist within game layers.

To carry out the analysis, the games were either played or gameplay was observed. The decision to play or observe a game through other media depended on its availability. As such the games which were free or pre-purchased were played, while the remaining were observed through pre-recorded playthroughs. Table 6 presents a breakdown of each of these games.

FORM OF ANALYSIS	GAMES
Analysis Through Play	Alto's Adventure, Antichamber, "Dude, Stop", Fragments of Euclid, Infinitris, Loop Runner, Monument Valley, Stanley Parable, That Level Again, The National Library of Geometric Impossibilities, Triforce, We Become What We Behold
Analysis Through Observation	Bit Blaster XL, "Dr. Langeskov, The Tiger, and The Terribly Cursed Emerald: A Whirlwind Heist", Induction, Project Temporality, Super Time Force Ultra, The Misadventures of P.B. Winterbottom, The Sexy Brutale

Table 6 Games and their Form of Analysis

Furthermore, during the analysis, the framework was applied to each of the games' layers to determine how paradoxical and non-paradoxical principles were applied to the gameplay systems embedded within them. These observed principles were recorded, to determine if a game was paradoxical or non-paradoxical.

4.2.2 **Practice-Based Research**

The second stage of the research utilised a practice-based method to develop new forms of gameplay by applying the developed framework. Moreover, these gameplay prototypes were utilised to develop insights into the methodology of application of paradoxes in games, by analysing them against the question of whether a game may act as a container for paradoxical gameplay within a game's layers.

This method was utilised to explore how the framework functions in practice as opposed to theory while observing the stability of the framework to withstand different gameplay system each with their own varying attributes.

4.2.2.1 Prototyping

In the prototyping phase, to incorporate paradoxes in game layers, existing game mechanics were distilled into core gameplay systems. Furthermore, these systems lacked uncontrollable variables such as unpredictability in player agency or instability in the game's physics, which may generate noise in the results. In

each of these systems, a game agent (here on referred to GA) was introduced which would take on the role of an ideal player, so as to interact with the developed systems.

A brief explanation of each of these systems is presented in Table 7.

MECHANIC	DESCRIPTION
Destination	Destination is a system comprised of movement-based actions with a starting point and a defined endpoint, allowing the GA to traverse the gamespace to reach a particular location in a two-dimensional plane or a three-dimensional space.
Shooting	'Shooting' is a point-and-click system where an agent, player or system-controlled, can interact with other game elements in the gamespace through projectiles.
Death	'Death' in the context of this research, represented end-state or the conclusion of a system, where a series of events converged onto towards finality. For the purpose of this research, 'Player Death' was used for prototyping purposes, where the end-state concluded the player's existence within the virtual world.
Collection	'Collection' is a combination of player-gamespace collision and inventory system. It represents a system where the player, through collision, is able to collect and store items in their inventory space.

Table 7 Key Phrases and Laws of Paradoxes

After the selection of a system, non-paradoxical and paradoxical principles were to evaluate the feasibility of the developed framework which aided in the development of new gameplay systems. With the design of a new paradoxical or non-paradoxical system, they were transferred and programmed in Unreal Engine 4 to develop a playable prototype. A visual representation of this process can be observed in Figure 27.

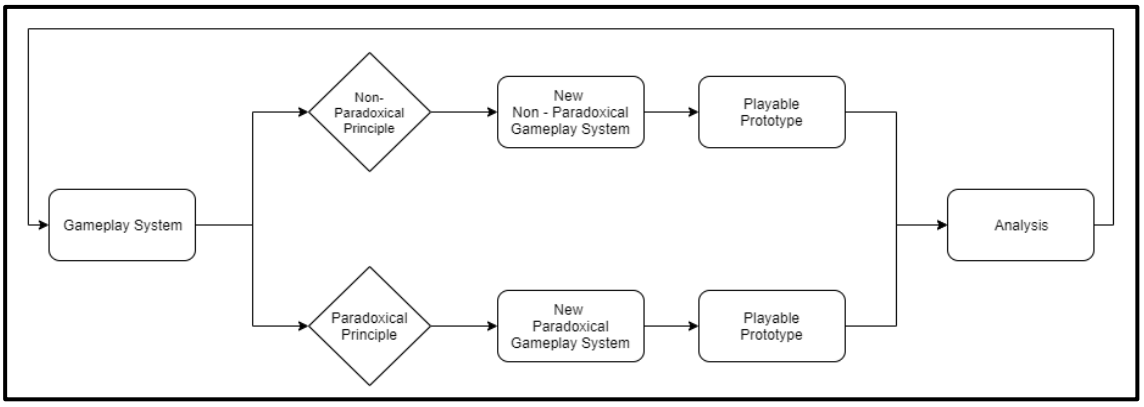

Figure 25 Prototyping Process

4.2.2.2 Prototype Analysis

The primary aim of this analysis was to interpret how the new paradoxical gameplay system, fit within the definition of paradoxes in game design. To achieve this, an analytical procedure for consistently analysing the output of each prototype was developed. Furthermore, a reflective analysis approach was utilised to define the applicability of these systems in the broader field of game design.

Firstly, the analysis criterion primarily consisted of the 'Paradoxical Games Framework', where this framework was utilised to test paradoxicality of the developed systems. After the development of each new prototype, an individualised flowchart was designed for the gameplay systems, which imitated the flow of the paradoxical and non-paradoxical systems in the framework as seen in section '4.1.4 Permutations of Attributes' of the Research Design chapter (pp. 42-47). This process allowed for a one-to-one comparison of each new gameplay system and its respective base concept. Secondly, the reflective analysis observed these prototypes through a systems-centred as well as user-centred perspective to observe applicability of these systems in games.

Keeping in mind the caveat of 'unconscious bias', rigour was achieved through the application of the literature and the previously defined theoretical framework, for a consistent analysis and interpretation of the developed prototypes. Furthermore, to support this interpretation, established design methodologies and design principles were applied, in conjunction with the supporting arguments observed from the Practitioner's Statement (p. 5).

5. Results - Comparative Analysis

The results of the comparative analysis indicate the existence of paradoxical and non-paradoxical gameplay systems within each of the individual layers of the analysed games, effectively determining whether the game is paradoxical or non-paradoxical.

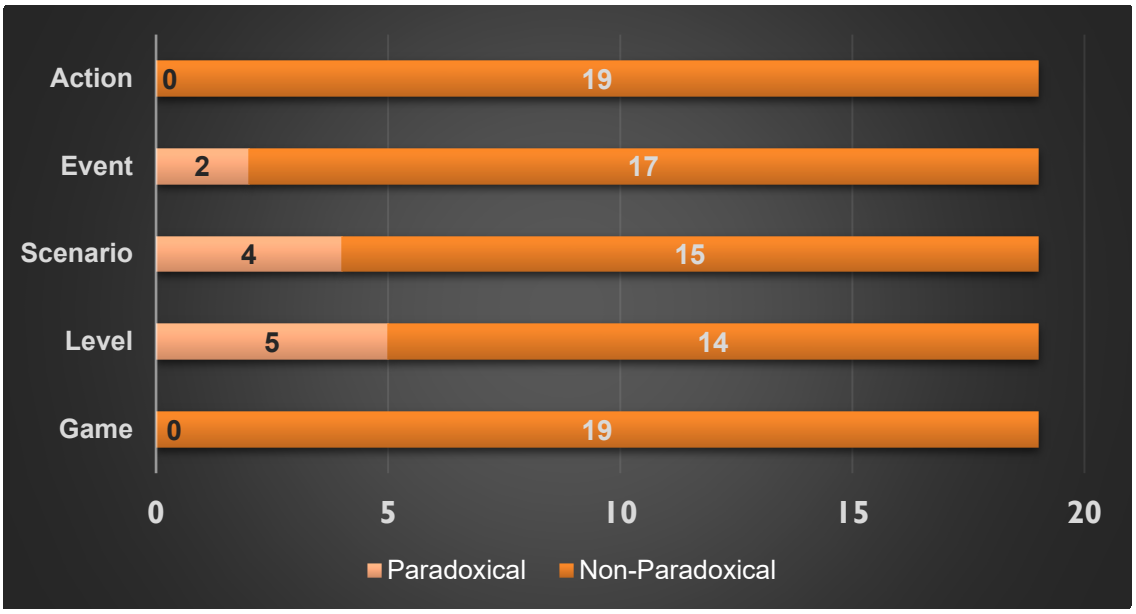

Figure 26 Frequency of Principles

From Figure 28, it is observed that paradoxical gameplay systems exist within the individual layers of the nineteen analysed games. Furthermore, a trend to be noticed is that these paradoxical systems only exist within the three middle layers of the spectrum, within no occurrence of the systems in the extremes of the spectrum, namely ‘Game’ at the most macro level and ‘Action’ at the most micro level. Additionally, in each of these three middle layers, the frequency of non-paradoxical systems is significantly higher than that of paradoxical gameplay systems.

Expanding upon this, while overall there is a larger majority of non-paradoxical systems observed in each game layer, there exist paradoxical system among the three middle layers namely, ‘Event’, ‘Scenario’ and ‘Level’. As seen in Figure 28, two of nineteen games showcase paradoxical systems within the ‘Event’ layer. This number increases to four, in the case of ‘Scenario’ layer and further increasing to five in the instance of ‘Level’ layer. As such, a trend is observed where there is an incremental discrepancy in the layers from micro,

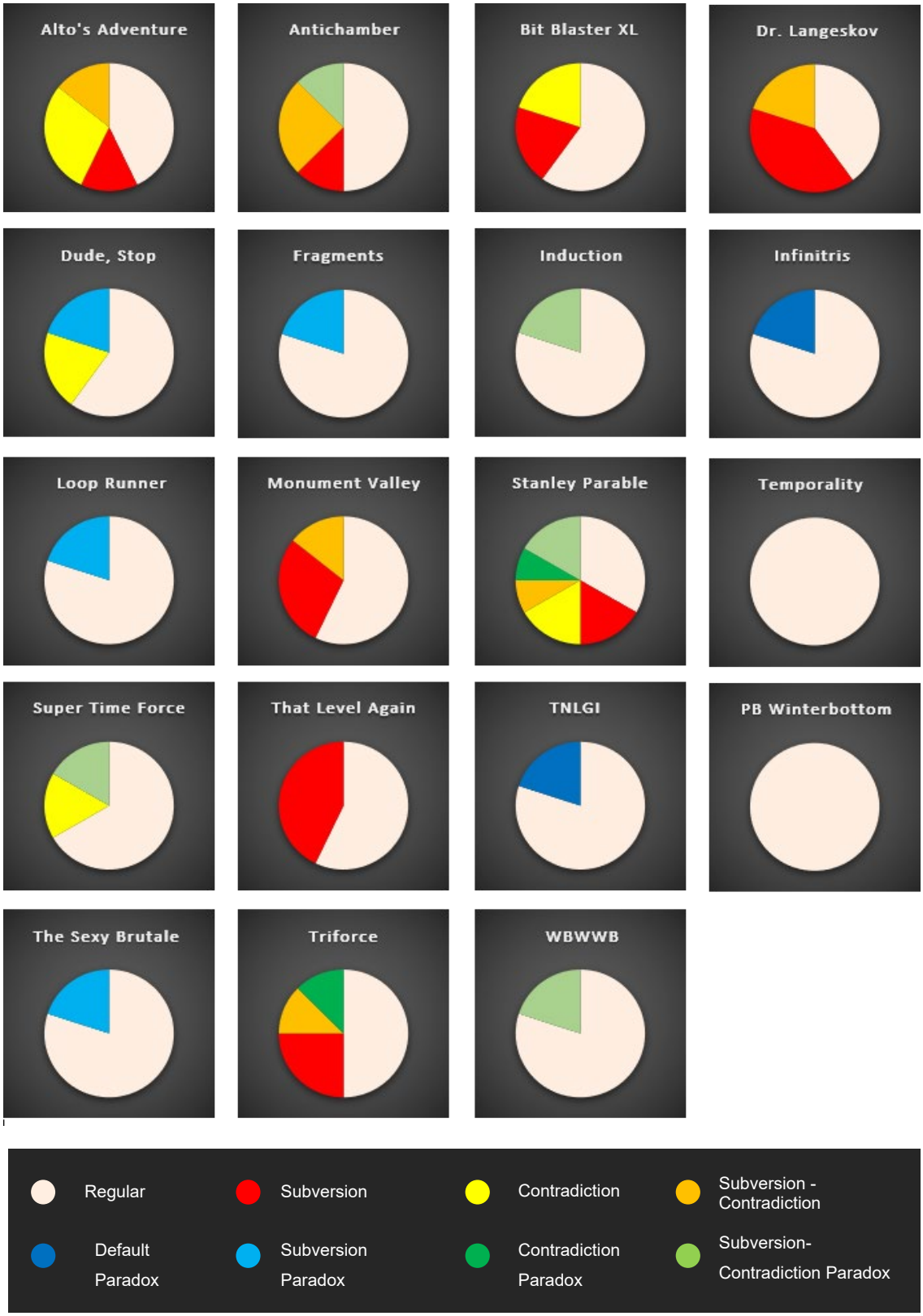

Figure 27 Paradoxical and Non-Paradoxical Gameplay Systems in Level/Scenario/Event Layers

‘Event’, to macro, ‘Level’.

While Figure 28 presents results of the occurrence of paradoxical gameplay systems among the different layers of a game, Figure 29 focusses on the three middle layers namely Event, Scenario and Level, where the paradoxical systems primarily exist. An extensive table detailing the areas where the paradoxical and non-paradoxical systems exist in these analysed games can be found in Appendix C.

The results, as shown in Figure 29, indicate that seven of the nineteen games do not contain any paradoxical systems. While the remainder of the games presents a combination of paradoxical and non-paradoxical principles, none of the games is comprised of only paradoxical gameplays systems. Furthermore, in each of the games, non-paradoxical gameplay contributes to more than 75% of the overall gameplay systems.

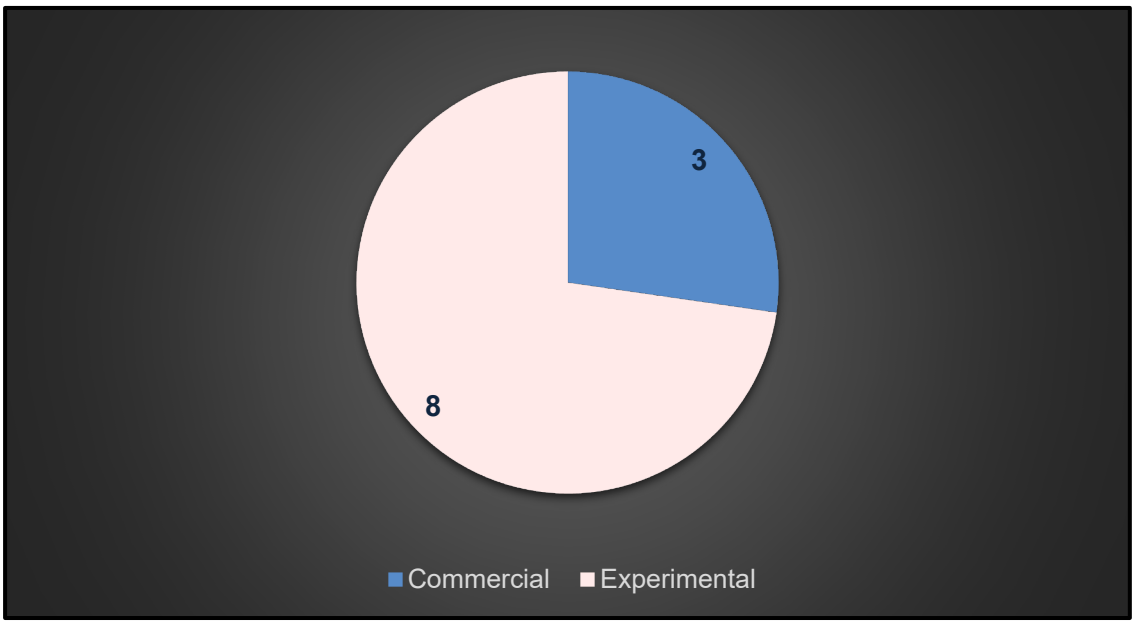

Figure 28 Disparity in Frequency of Paradox-based Games

While the previous results showed paradoxical systems within games, Figure 30 showcases results which observe eleven games with paradoxical systems in them. It presents the frequency of paradox-based games among two categories, ‘Experimental’ and ‘Commercial’. In this case, ‘Experimental’ games grant more creative freedom to the developer due to the lack of a focussed audience. On the other, the ‘Commercial’ games are revenue-oriented with their design being focussed on catering to a certain audience. As observed in Figure

30, among the eleven games based around paradoxes, eight of them are experimental while only three are commercial.

6. Results – Practice-Based Research

While the previous results presented the application of the ‘Paradoxical Games Framework’ to analyse existing games, this section focuses on the utilisation of the framework to develop new gameplay systems with the help of paradoxical and non-paradoxical principles.

These systems include “Movement”, “Death”, “Shooting” and “Collection”. Playthroughs of each of these systems, paradoxical and non-paradoxical, can found in Appendix B.

6.1 Destination

6.1.1 Default

In ‘Default’, the GA is presented with a singular open doorway, allowing them to accurately interpret their intended destination. This gameplay system (Figure 31) could be considered the most basic and common form of non-paradoxical ‘destination’ gameplay system. As in this case, the GA possesses complete and accurate information of their intended path with no hidden caveats hindering them from achieving their goal.

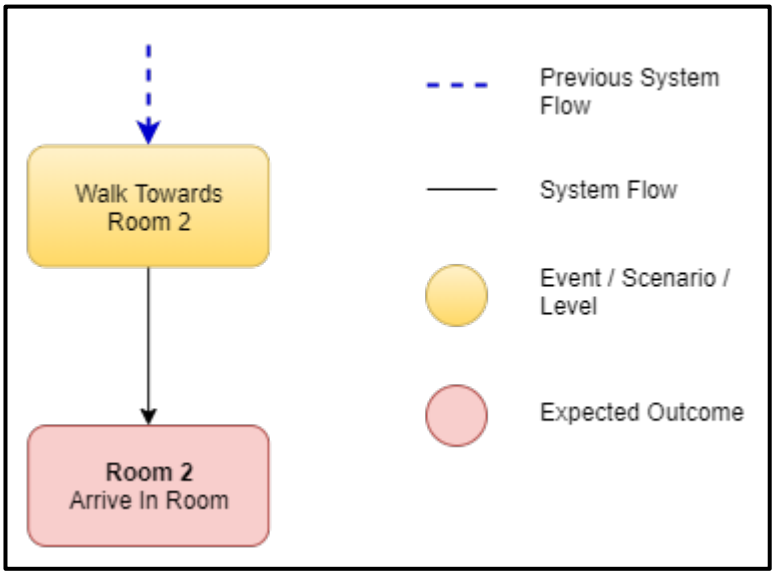

Figure 29 Destination - Default

6.1.2 Subversion

Similar to ‘Default’, in ‘Subversion’ the GA is presented with a singular doorway opening into a seemingly empty room. In this gameplay system (Figure 32), after the GA walks into the room, they are presented with a ‘win screen’

congratulating them. But immediately their expectations of victory are subverted when the floor disappears, causing them to fall into flames, die and lose the game.

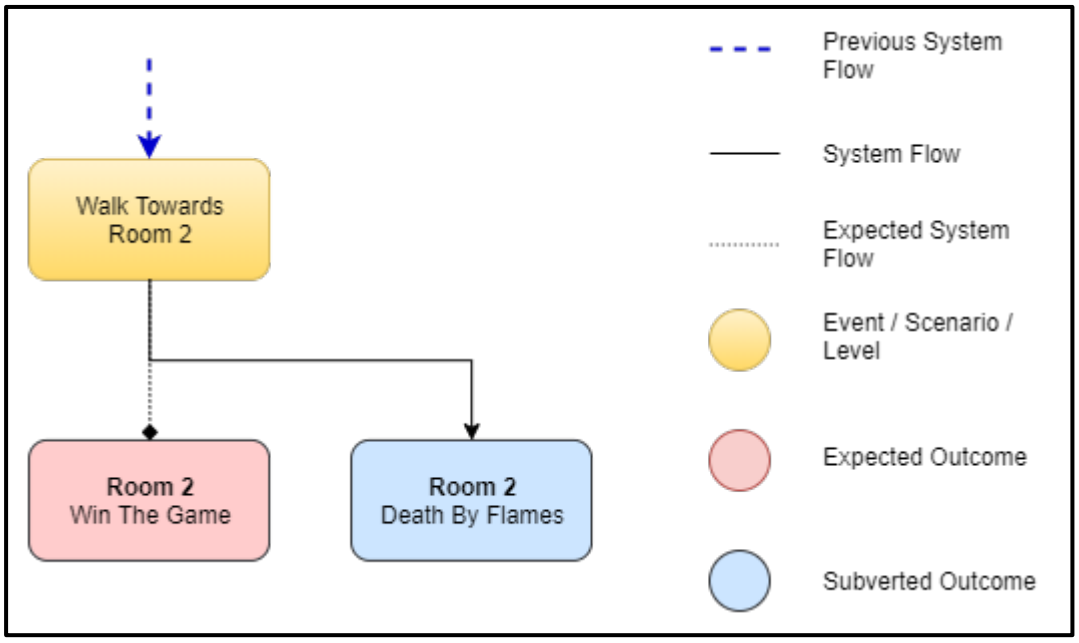

Figure 30 Destination - Subversion

6.1.3 **Contradiction**

In a 'Contradiction'-based system the GA is presented with two contradictory choices, Left Door leading to Room 1 or Right Door leading to Room 2. In this non-paradoxical gameplay system (Figure 33), the GA is presented with two doorways, requiring the GA to perform a choice between two contradictory outcomes, 'Room 1' or 'Room 2'. Regardless of the options, the choice is permanent as the GA is prevented from heading back to pick a different door.

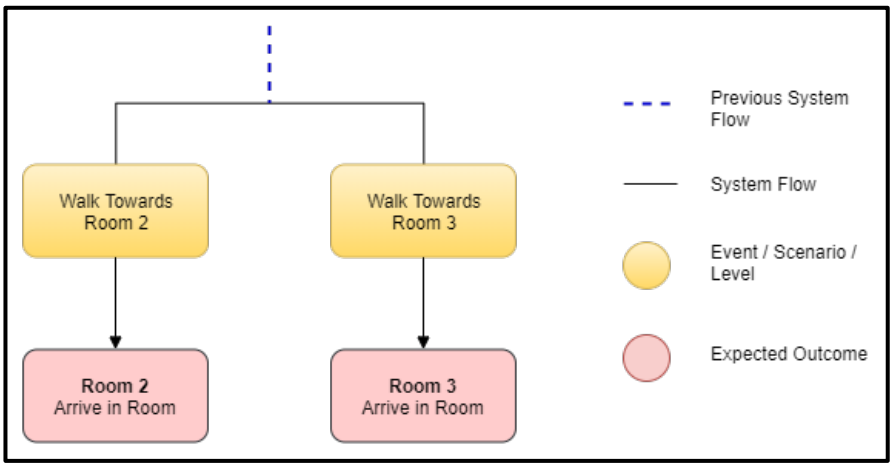

Figure 31 Destination - Contradiction

6.1.4 **Subversion – Contradiction**

Being a combination of ‘Subversion’ and ‘Contradiction’, in this system the GA is presented with two contradictory yet subversive choices, where two doorways seemingly lead the GA towards two ordinary rooms. In this gameplay system (Figure 34), the GA is presented with two doorways leading towards two contradictory choices. The doorway on left lead towards a room engulfed in flames presenting a sense of danger while the room on right is seemingly empty prompting a better choice. Although, when the GA chooses the room on the left, they are presented with a ‘win screen’ congratulating them on achieving victory, while the room on right restarts the game causing the player to complete all the objectives again.

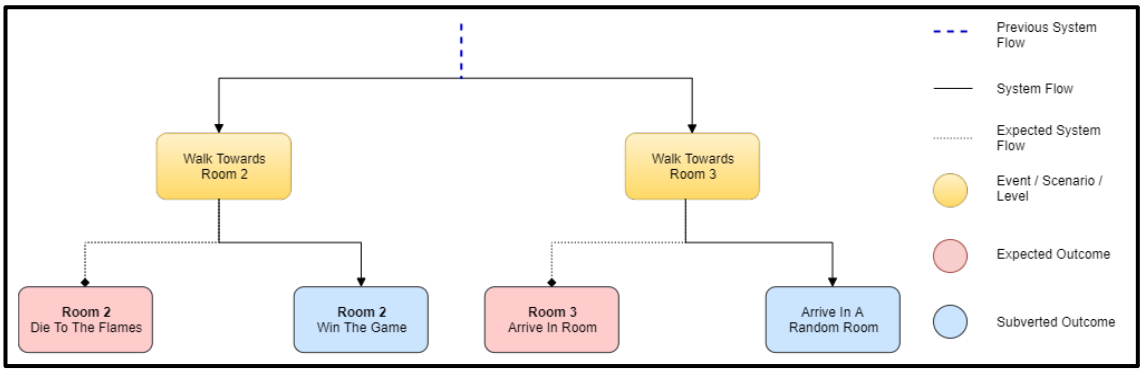

Figure 32 Destination – Subversion-Contradiction

6.1.5 **Default Paradox**

In ‘Default Paradox’, the GA is presented with a singular doorway leading into another room. As observed in Figure 35, when the GA moves exit through the doorway, they find themselves entering the same room they exited from.

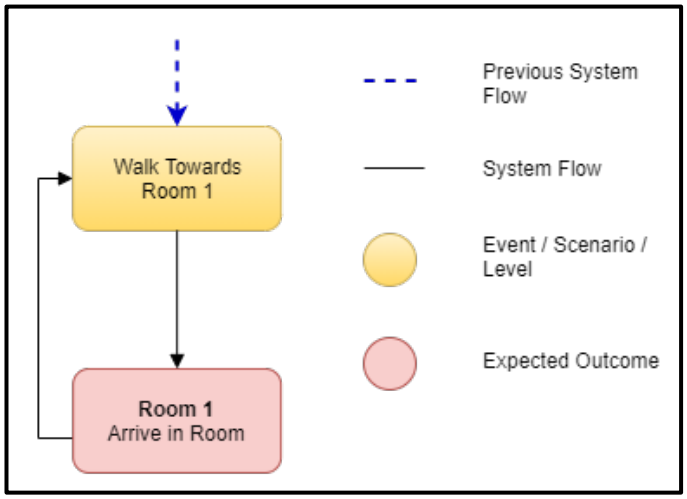

Figure 33 Destination – Default Paradox

6.1.6 **Subversion Paradox**

In ‘Subversion Paradox’ the GA is presented with a singular windowed-door leading towards a room with blue wall. Although as seen in Figure 36, when the GA moves towards the doorway, the door shifts upwards leading the player into an entirely different room with a red wall. In this case, the GA’s expectation of the perceived destination is subverted when they arrive in an unexpected location.

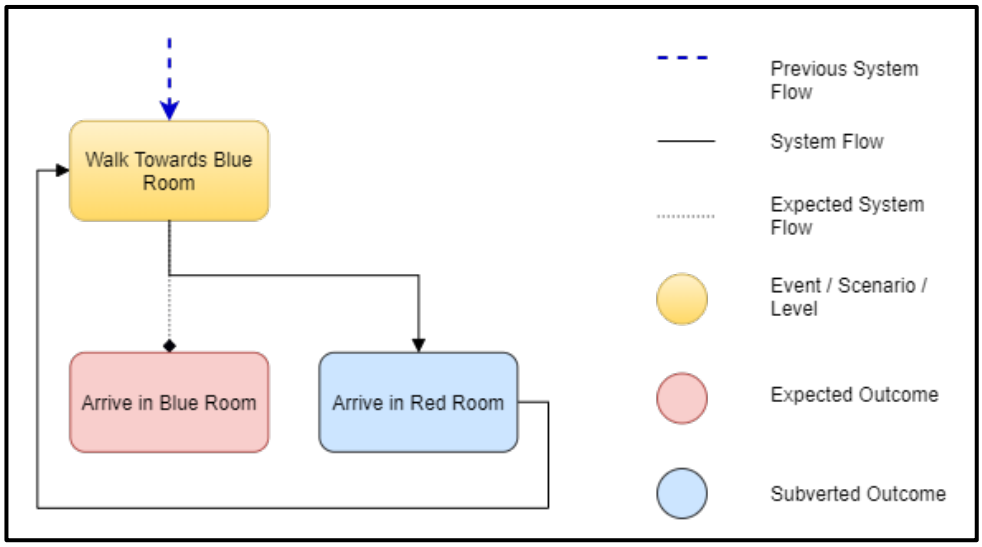

Figure 34 Destination – Subversion Paradox

6.1.7 **Contradiction Paradox**

In ‘Contradiction Paradox’ (Figure 37), the GA is presented with two doorways, with the first doorways presenting a view of an upward leading staircase and the second doorway showing a downward staircase. In this gameplay system, when the GA chooses the door on the left and head upwards, they arrive at the same location they started. Similarly, choosing the door on the

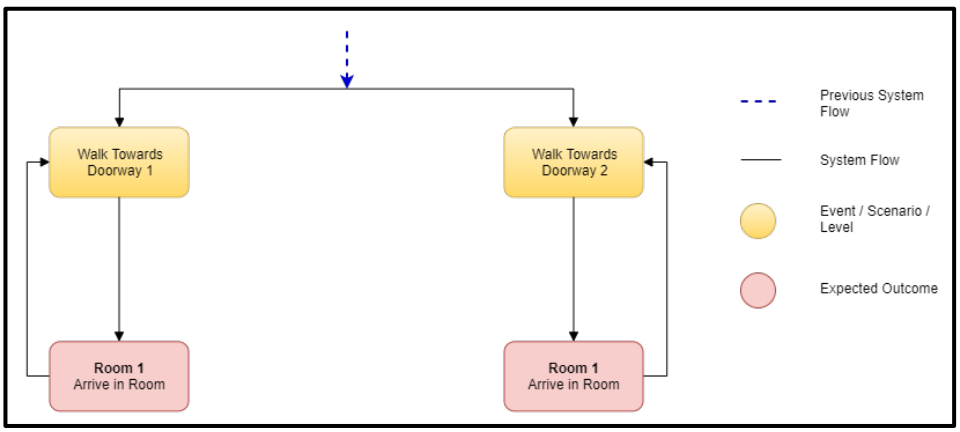

Figure 35 Destination – Contradiction Paradox

right leads them downwards although looping them back to the same location they started from. Consequently, it is observed that regardless of the GA's choice there is no outcome to the system.

6.1.8 **Subversion – Contradiction Paradox**

In 'Subversion – Contradiction Paradox', the GA is presented with two doorways with a window situated between them. As observed in Figure 38, the window presents the GA with the intended outcome of their action which is to move forward through one of the doors to reach the exit. Although, in actuality choosing either door causes the GA to loop back into the same room exited from. As a result, GA's expectation of the situation framed for them is subverted as the actual outcome vastly differs than the perceived outcome.

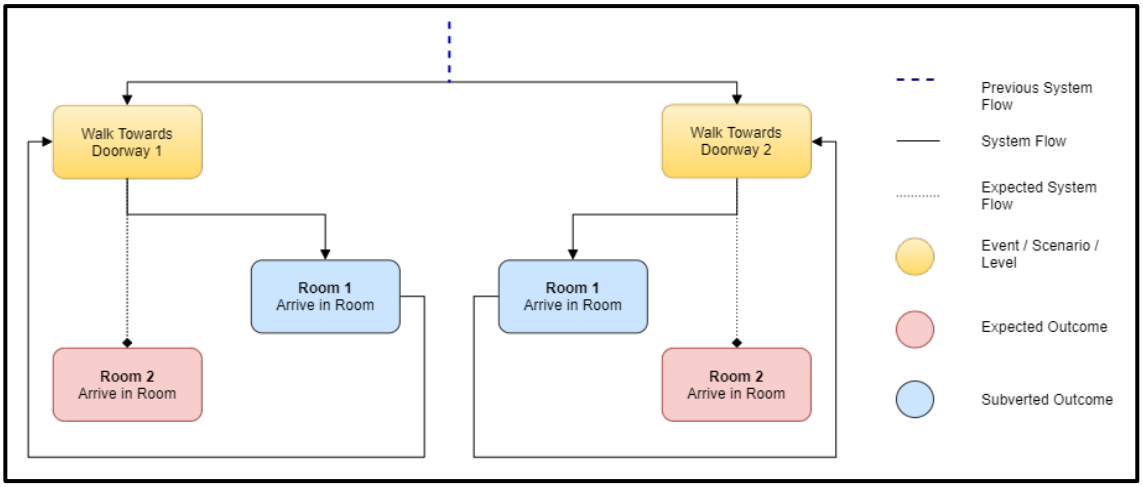

Figure 36 Destination – Subversion-Contradiction Paradox

6.2 **Death**

6.2.1 **Default**

In 'Default', the GA is presented with a singular option, through which they can die and achieve victory. As observed in Figure 39, the outcome of the scenario is the same as the one perceived by the GA. As a result, when the GA collides with the chainsaw, they die and win the game.

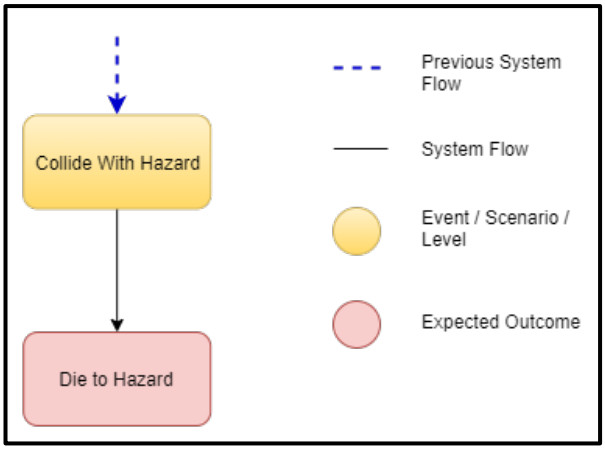

Figure 37 Death - Default

6.2.2 **Subversion**

In Subversion, the GA is presented with a tree through which they could achieve victory. In this gameplay system (Figure 40), the GA attempts to die by colliding with a tree. The first and the second attempt causes the avatar to collide with the tree, dropping a fruit. A third attempt to collide and die, instead causes the avatar to go through the tree without experiencing any form of collision.

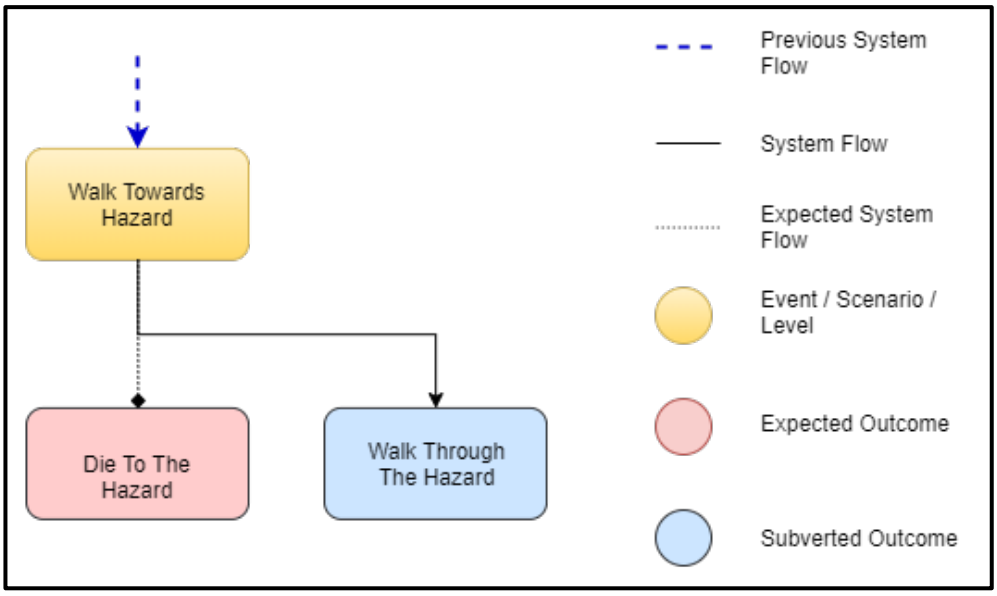

Figure 38 Death - Subversion

6.2.3 **Contradiction**

In contradiction, the GA is presented with two different options through which they could achieve victory. As observed in Figure 41, when the GA can choose between the colliding with the chainsaw or the tree to die and achieve victory.

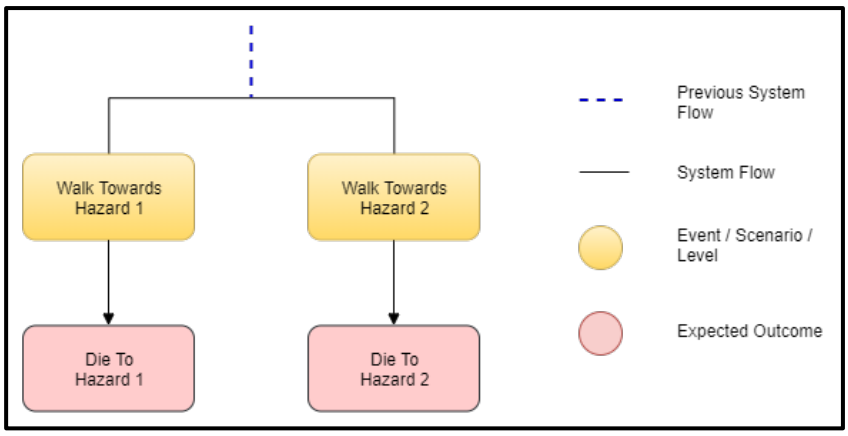

Figure 39 Death - Contradiction

6.2.4 **Subversion – Contradiction**

A combination of previous two systems, in 'Subversion-Contradiction', the GA is provided with two (subversive) options through which they could achieve victory. In this gameplay system (Figure 42), firstly GA attempts to die by colliding with a tree but after three attempts the GA tries a different approach. In the second attempt, the GA tries to collide with the chainsaw to achieve death but instead breaks down the chain saw into two pieces. In its third attempt, it tries to achieve death by colliding with the tree but after two attempts the tree becomes intangible. As a result, in all the attempts the GA's expectation of death of death-via-collision are subverted through unexpected outcomes.

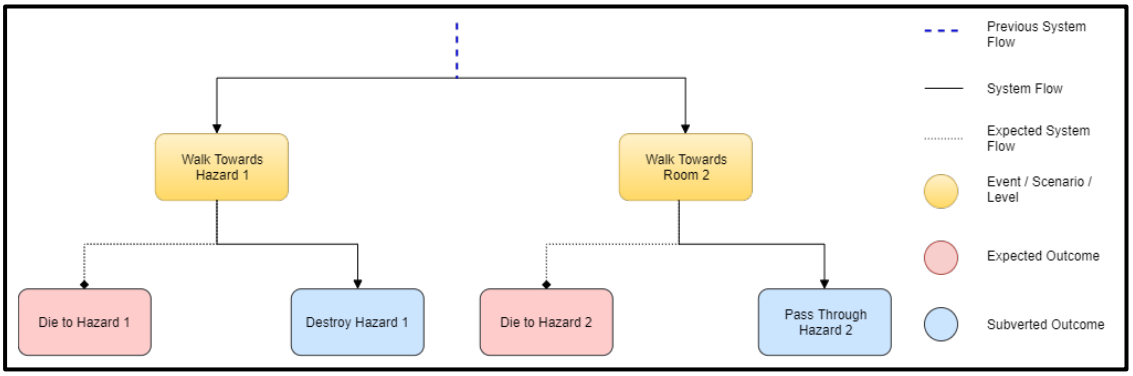

Figure 40 Death – Subversion-Contradiction

6.2.5 **Default Paradox**

In 'Default Paradox', the GA is presented with a singular option, through which they could start the circular system of death, possession, death. In this gameplay (Figure 43), the GA attempts to die by colliding with the chainsaw. Although, instead of achieving victory on death, the GA relinquishes control of the

humanoid and possess the chainsaw, causing the GA to search for a new method to die.

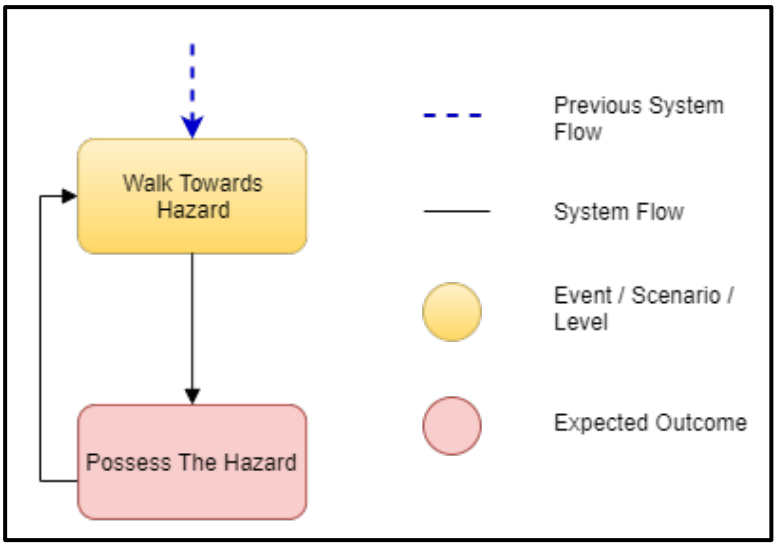

Figure 41 Death – Default Paradox

6.2.6 **Subversion Paradox**

In ‘Subversion Paradox’, the GA is presented with a singular option, with an expected outcome of achieving death. But as observed in Figure 44, when the GA collides attempts to die by colliding with the tree. Their expectation of possessing the tree is subverted when the GA possesses an animal in a cage instead. Furthermore, there is no way for the GA to escape the cage resulting in an unexpected failure.

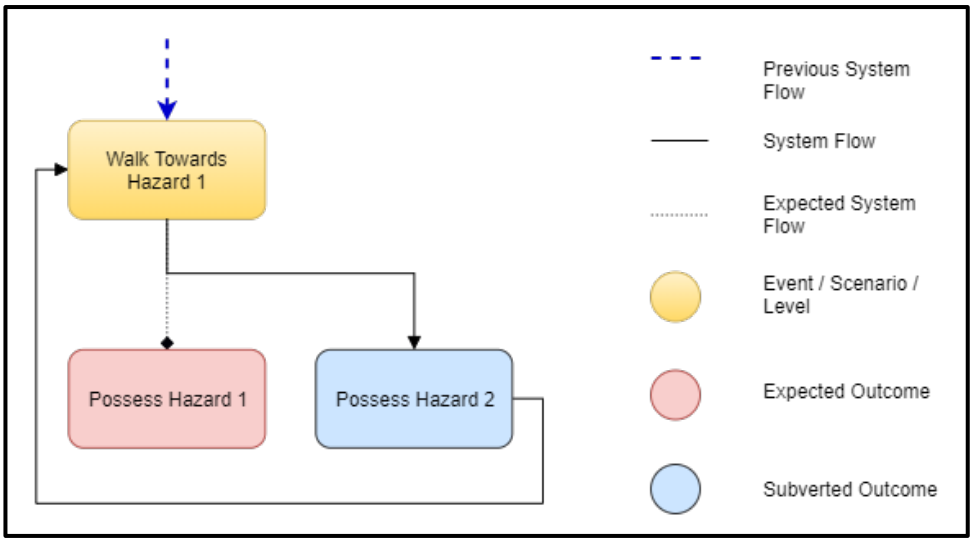

Figure 42 Death – Subversion Paradox

6.2.7 **Contradiction Paradox**

In ‘Contradiction Paradox’ the GA is presented with multiple options, through which could start the circular system of death, possession, death. In this gameplay, the GA is offered with choices to achieve death. Firstly, as observed in Figure 45 the GA attempts to kill themselves by colliding with the chainsaw, although instead of dying they take possession of the chainsaw. On the other hand, in the second event, the GA takes possession of the tree by dying to it and additionally, the tree dies to the chainsaw. Although, after possessing the chainsaw the GA attempts to kill themselves by jumping in the lake of acid. As a result, after taking possession of the pool of acid all other game objects are destroyed, causing the GA to keep floating in a limbo.

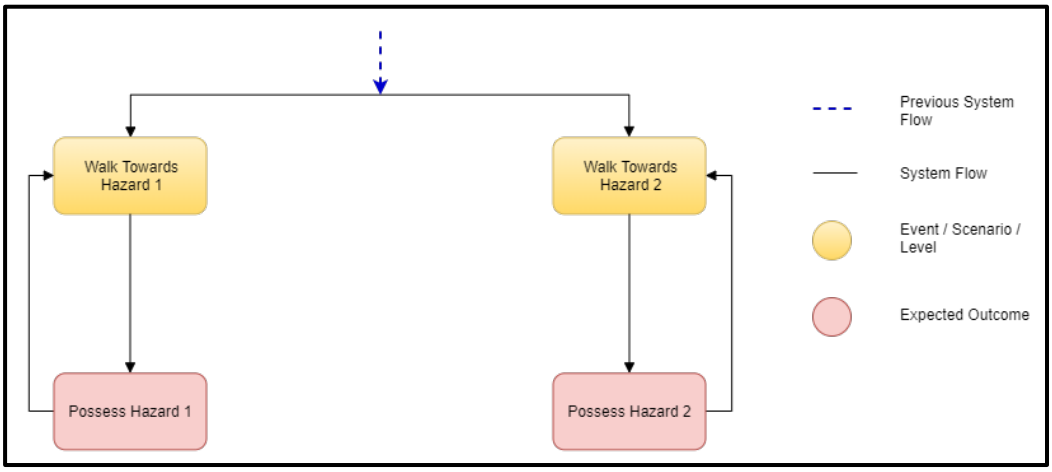

Figure 43 Death – Contradiction Paradox

6.2.8 **Subversion – Contradiction Paradox**

In ‘Subversion – Contradiction Paradox, the GA is presented with multiple options, each with an expected outcome of achieving death. As observed in Figure 46, the player collides with either the chainsaw or the tree with the expectation of possessing either object respectively. On the contrary, when the GA collides with the chainsaw, they take possession of the tree and vice versa.

In this event, the GA's expectation of possessing the same object they were killed by, is subverted when they take possession of a completely different object.

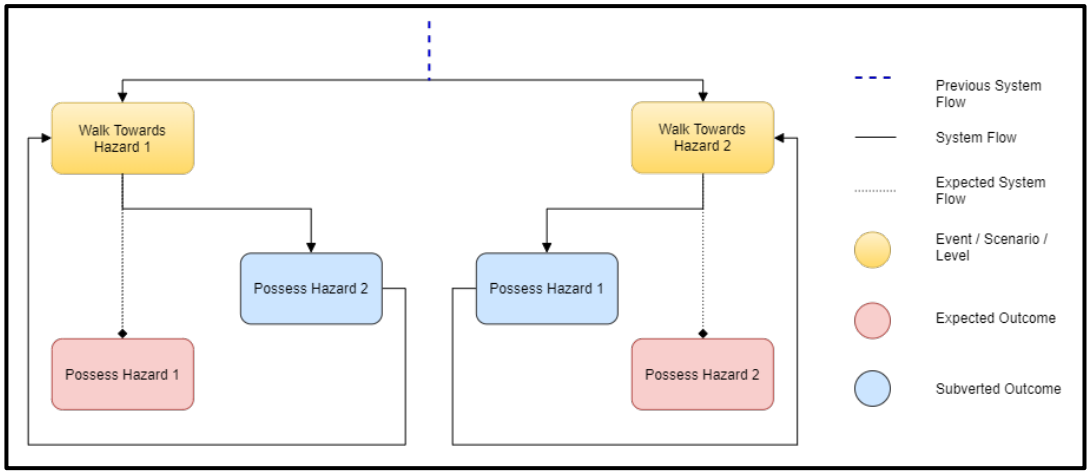

Figure 44 Death – Subversion-Contradiction Paradox

6.3 **Shooting**

6.3.1 **Default**

In 'Default', the GA is instructed to shoot the targets, to reach the goal. As observed in the previous instances of 'Default', in this system (Figure 47), the outcome of the chain of events is exactly the same as the one perceived by the GA. As a result, when the GA shoots and the projectile collide with the target, the target is destroyed and the goal becomes accessible.

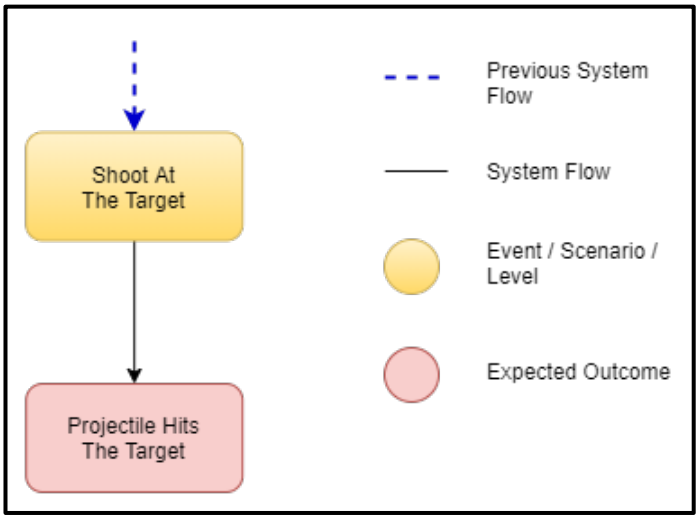

Figure 45 Shooting - Default

6.3.2 **Subversion**

Similar to ‘Default’, in ‘Subversion’ the GA is instructed to shoot the targets, to reach the goal. Although, as observed in Figure 48, contrary to ‘Default’ when the GA shoots the target, the projectile passes through it without any manner of collision. This subverts the GA’s expectation of the projectile hitting the target and progressing towards the goal. As a result, the GA is required to search for a different approach of reaching the exit, which is, in this case, to simply traverse through the barrier and towards the goal without experiencing any manner of collision.

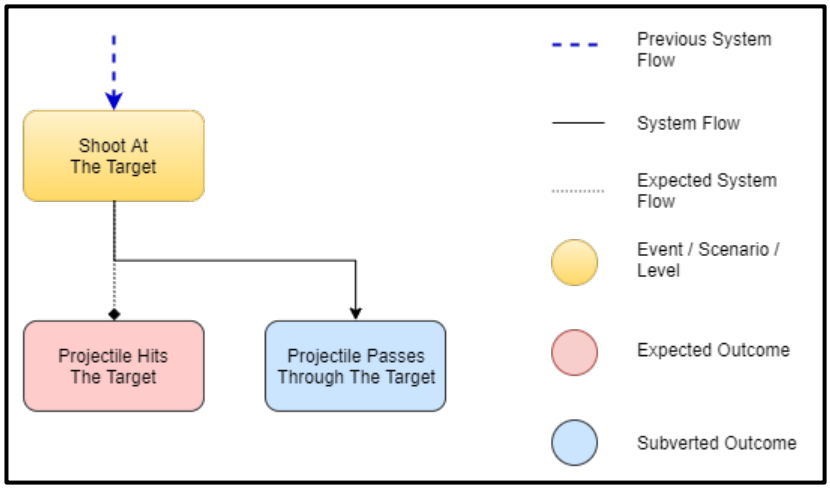

Figure 46 Shooting - Subversion

6.3.3 **Contradiction**

In ‘Contradiction’, the GA is presented with two sets of instructions, each one guiding the GA towards two exits by shooting two different sets of targets. As observed in Figure 49, when the GA destroys all the red targets, they gain access to the red goal, while also causing all the blue targets to become non-collideable.

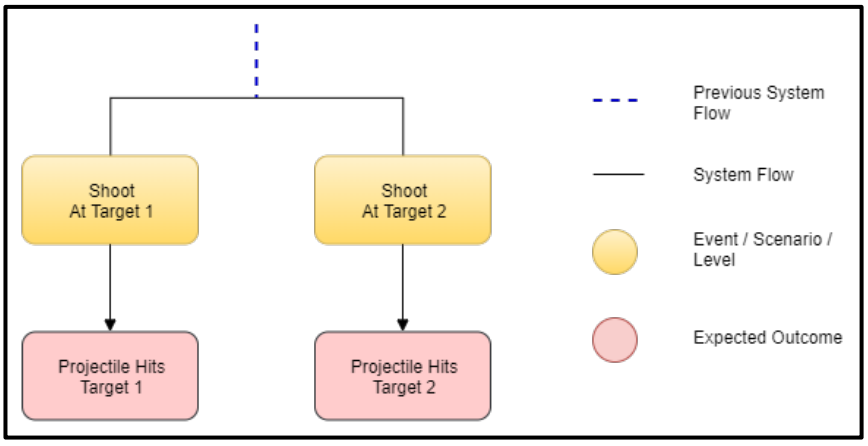

Figure 47 Shooting - Contradiction

In a similar manner, when the GA destroys all the blue targets, they gain access to the blue goal, while also causing all the red targets to become non-collideable.

6.3.4 **Subversion – Contradiction**

In ‘Subversion – Contradiction’, similar to ‘Contradiction’, the GA is presented with two sets of instructions, each one guiding the GA towards two exits by shooting two different sets of targets. Although, in Figure 50 it is observed that the GA’s attempt to shoot the red target, fails, as the projectile passes through it. Additionally, when the projectile collides with the blue target, it morphs into a red target.

To break it down, in the case of the red barrier, the GA’s expectation of a collideable target is subverted when the projectile passes through. As a result, they are required to find an alternative method, which is for them to shoot the blue target. When the projectile collides with the blue target, it morphs into a red target, resulting in the GA gaining the knowledge of shooting the blue targets to destroy the red barrier.

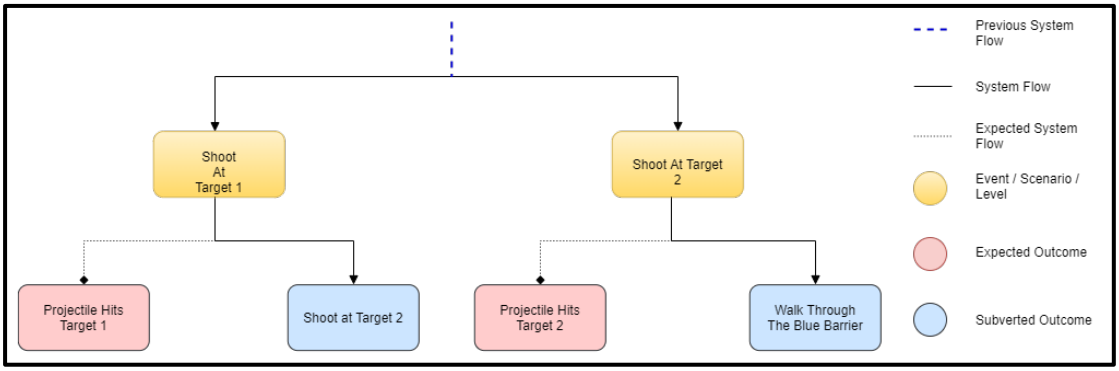

Figure 48 Shooting – Subversion-Contradiction

On the other hand, in the case of the blue barrier, when the previously mentioned process of ‘target shooting’ is carried, the GA’s learns that the shooting the targets is irrelevant to unlocking the blue barrier, and likewise they must find an alternative method of reaching the goal. When the GA’s projectile passes through the barrier, their expectations of a collideable barrier are subverted, allowing them to reach the goal by passing through the ‘non-collideable’ blue barrier.

6.3.5 **Default Paradox**

In ‘Default Paradox’, similar to previous cases, the GA is instructed to shoot the target to reach the goal. In this gameplay system (Figure 51), GA fires a projectile towards the target, causing the projectile and the target switch positions where the projectile becomes the new target while the target returns to the gun as a projectile.

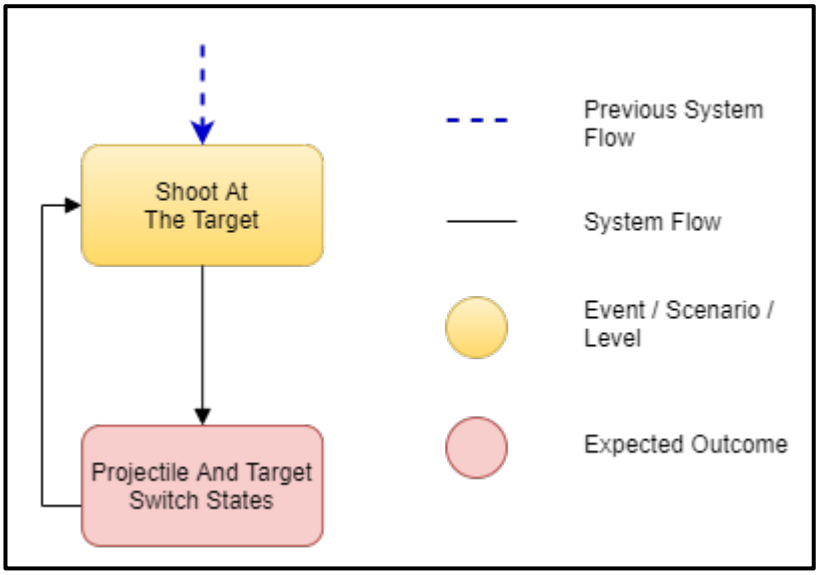

Figure 49 Shooting – Default Paradox

6.3.6 **Subversion Paradox**

In ‘Subversion Paradox’, as per the gameplay system, the GA is instructed to shoot the target, to reach the goal. Although, as observed in Figure 52, when the projectile reaches the target, it slows down and returns to the gun. In this event, the player’s expectations of the project-target repositioning are subverted due to the introduction of a new phenomenon. Regardless, the system remains cyclical as the GA is unable to hit the target and is situated back to the same position they started from.

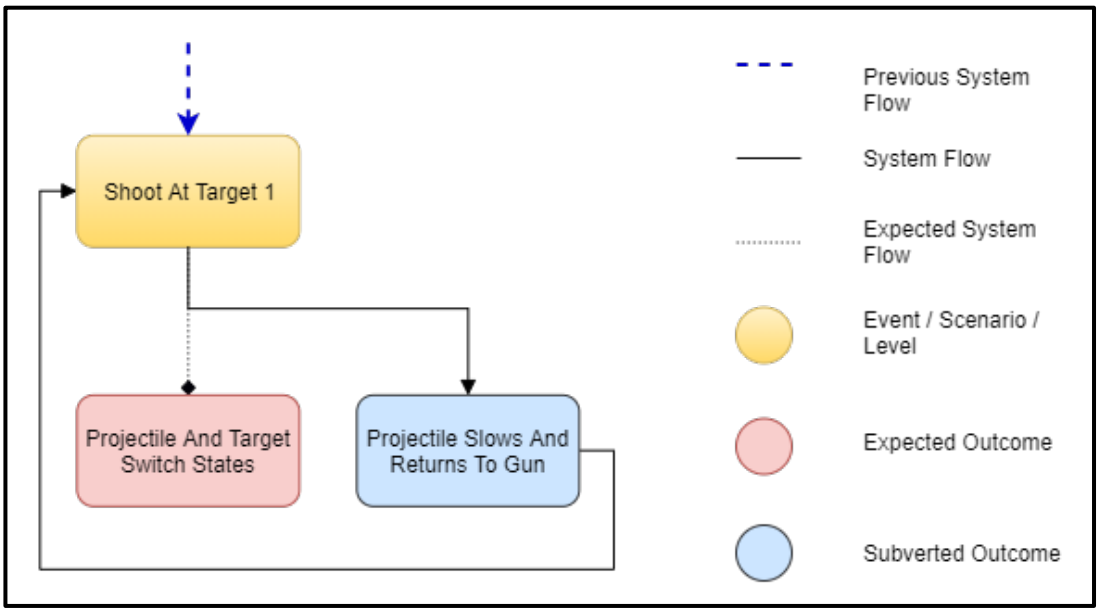

Figure 50 Shooting – Subversion Paradox

6.3.7 **Contradiction Paradox**

In 'Contradiction Paradox', the GA is presented with two sets of instructions, each one guiding the GA towards two different exits by shooting two different sets of targets. In this gameplay system, (Figure 53) when the GA shoots the attempts to shoot the red target the projectile-target repositioning occurs. A contradictory event occurs when the GA attempts to shoot the blue target. As a result, in both cases, the GA is stuck in a paradoxical loop regardless of their choice of targets.

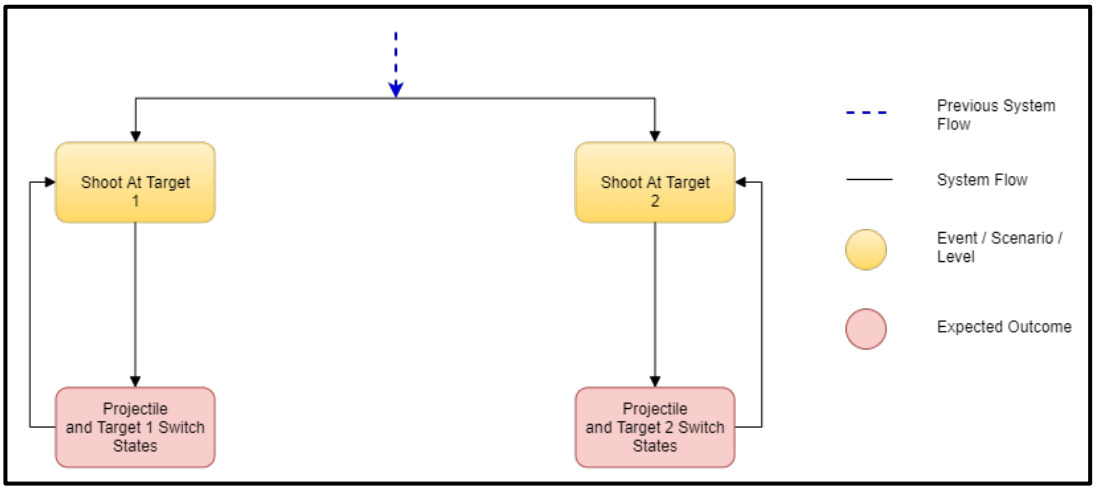

Figure 51 Shooting – Contradiction Paradox

6.3.8 **Subversion – Contradiction Paradox**

In ‘Subversion – Contradiction Paradox’, the GA is presented with two sets of instructions, each one guiding the GA towards two exits by shooting two different sets of targets. As observed in Video 30, when the GA attempts to shoot at the red target the projectile passes through the target and returns back to the gun. On the other hand (Figure 54), when the GA attempts to shoot at the blue target the GA switches position with the target itself. In both cases, the GA’s expectations of previously experienced paradoxes are subverted, while still being situated in a paradoxical gameplay system.

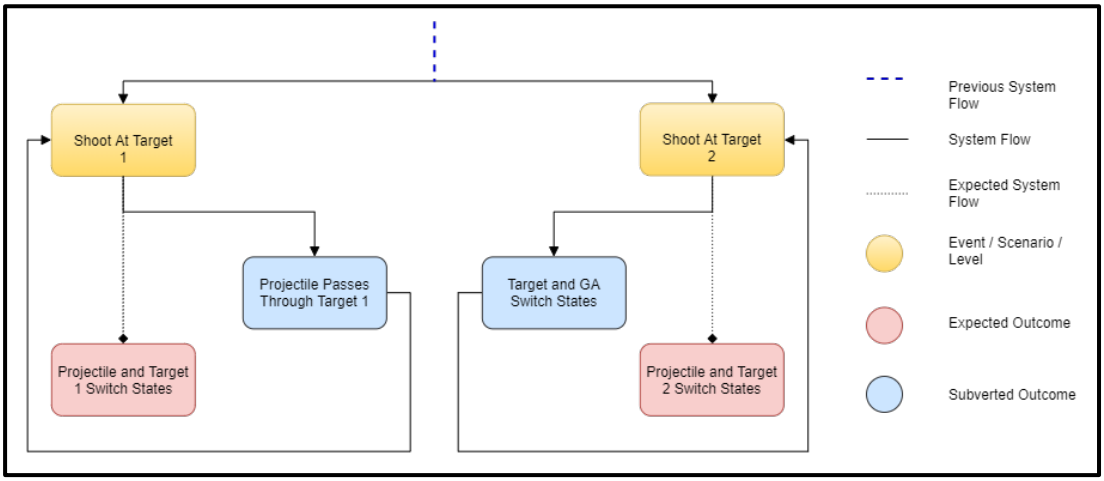

Figure 52 Shooting – Subversion-Contradiction Paradox

6.4 **Collection**

6.4.1 **Default**

In ‘Default’, the GA is required to collect the key, to unlock the door and progress. As observed in Figure 55, the outcome of the chain of events is exactly the same as the one perceived by the GA. As a result, when the GA collides with the cube or key, it disappears, causing the door to open and allow the GA to progress further.

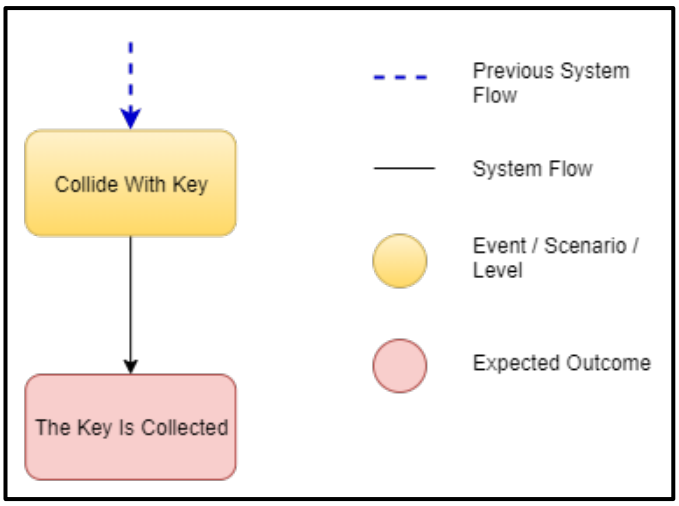

Figure 53 Collection – Default

6.4.2 Subversion

Similar to ‘Default’, in ‘Subversion’ the GA is required to collect the red key to unlock the door and progress. Although, as observed in Figure 56, when the GA attempts to collect the key they pass through it. Furthermore, when the GA applies this knowledge to the door, they are able to pass through without experiencing any collision. In this system, the GA expectations are subverted when the understand that the key is irrelevant to progress through the door.

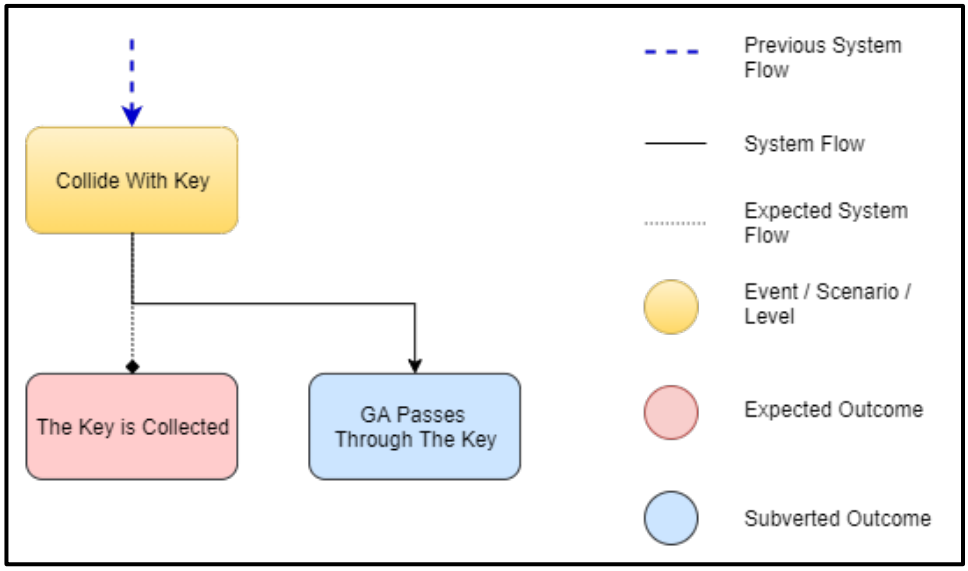

Figure 54 Collection - Subversion

6.4.3 Contradiction

In ‘Contradiction’, the GA is required to collect either a red key or a blue key to open their respective red or blue door, to progress through the level. As seen in Figure 57, when the GA collects the red key, a wall appears preventing

the GA from accessing the blue door. On the contrary, when the GA collects the blue key and the red door becomes inaccessible. In this system, the GA is required to make a choice between the red and the blue door, as they cannot experience both choices simultaneously.

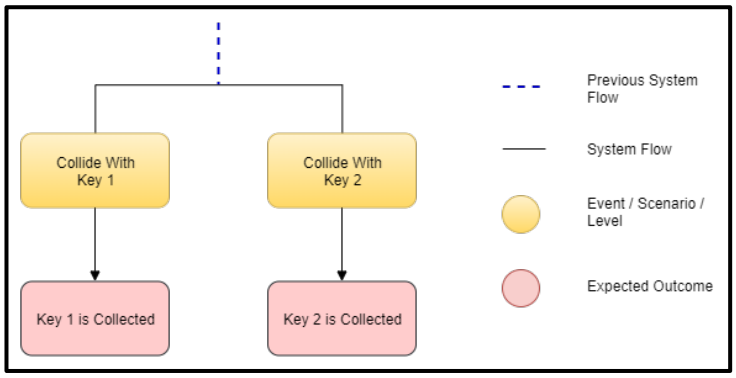

Figure 55 Collection - Contradiction

6.4.4 **Subversion – Contradiction**

In 'Subversion – Contradiction', the GA is required to collect either a red key or a blue key to open their respective red or blue door, to progress through the level. In this gameplay system (Figure 58), when the GA attempts to collect to the red key, they pass through it. As a result, they find an alternate method of progress which is by walking through the door without experiencing any collision. On the other hand, a similar case occurs when the GA attempts to collect the blue key. Although, they are unable to pass through the blue door. During this, the GA finds that looking directly at the door enables the door while looking away from it causing to open, leading them to achieve progress by turning their back against the door and walking back through it.

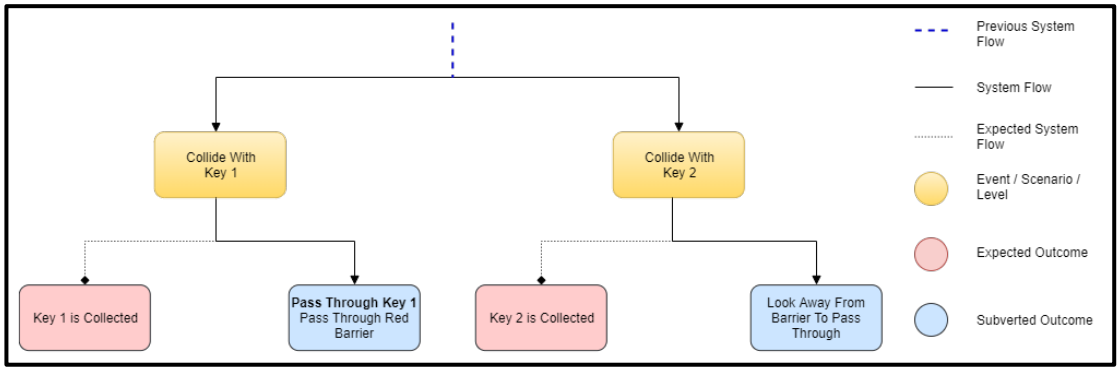

Figure 56 Collection – Subversion-Contradiction

6.4.5 **Default Paradox**

In ‘Default - Paradox’, the GA is required to collect a key to unlock the door and progress further, to win. As observed in Figure 59, when the GA attempts to collect the key, they are instead ‘collected’ by the key. This causes the ‘key’ becoming the new game world, with its own set of inner gameobjects. Furthermore, subsequent attempts to escape the gameworld yields similar results, trapping the GA further into the chain of gameworlds.

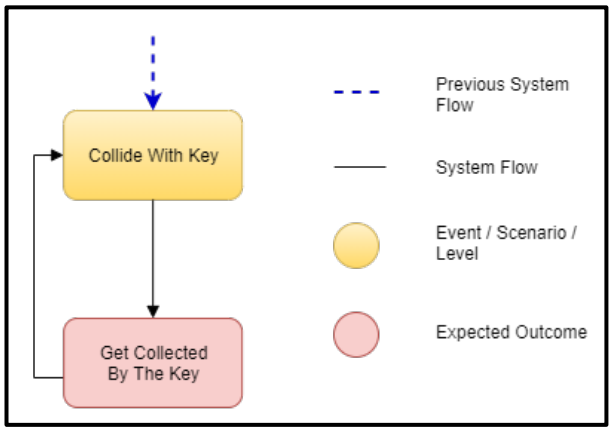

Figure 57 Collection – Default Paradox

6.4.6 **Subversion Paradox**

In ‘Subversion - Paradox’, the GA is required to collect a key to unlock the door and progress further, to win. As observed in Figure 60, in the first three cases when the GA attempts to collect, instead they are ‘collected’ by the key. Although on the fourth occasion, when the GA attempts to collect the key, they are instead transported to the ‘first’ world they started from. As a result, the GA

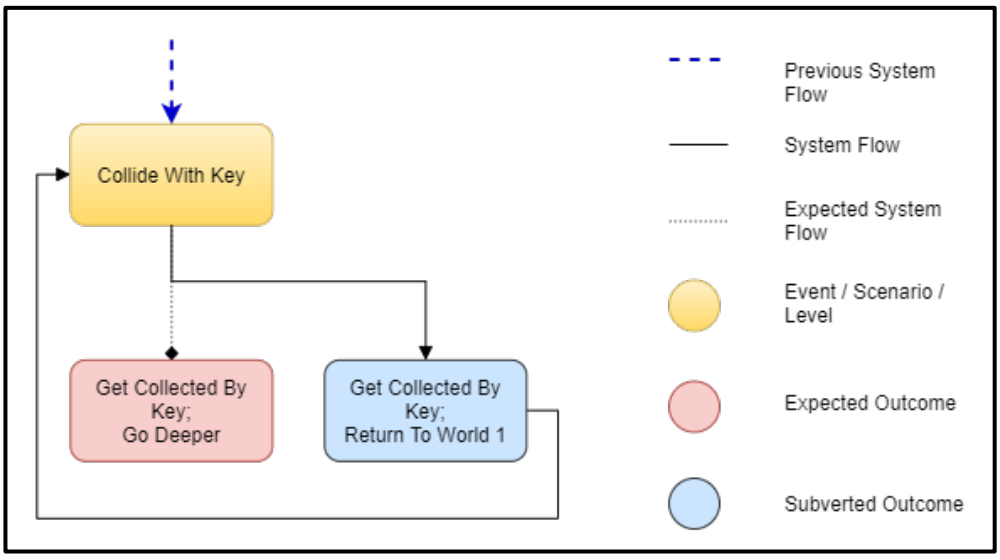

Figure 58 Collection – Subversion Paradox

expectations of an infinitely regressive event are subverted when instead they are presented with a viciously circular loop.

6.4.7 Contradiction Paradox

In ‘Contradiction - Paradox’, the GA is required to collect either ‘Key 1’ or ‘Key 2’ to open the door. In this gameplay system (Figure 61), when they GA attempts to collect ‘Key 1’, they are collected by the key instead, with subsequent attempts yielding similar results to Default Collection Paradox. A similar sequence of events occurs when the GA attempts to collect ‘Key 2’

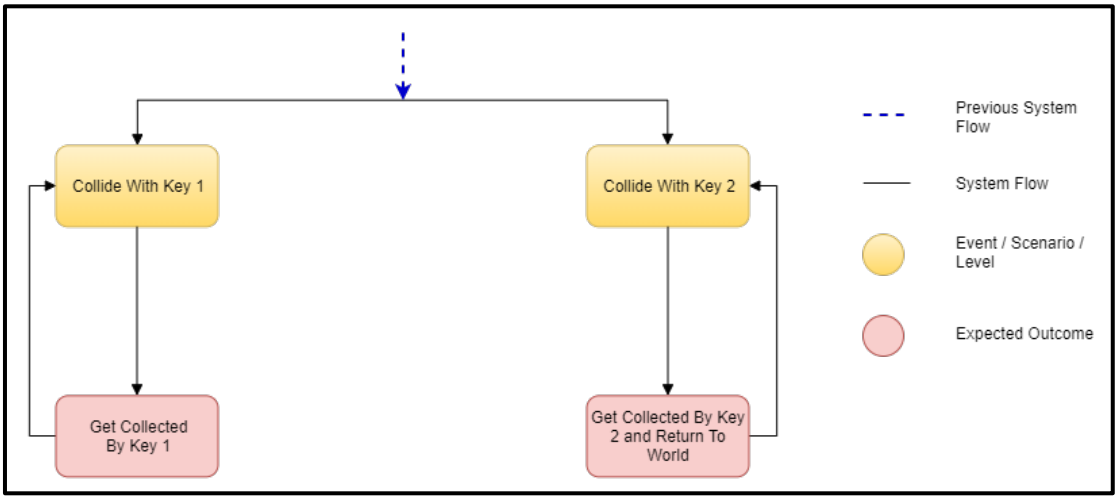

Figure 59 Collection – Contradiction Paradox

6.4.8 Subversion – Contradiction Paradox

In ‘Subversion-Contradiction - Paradox’, the GA is required to collect either ‘Key 1’ or ‘Key 2’ to open the door. As observed in Figure 62, when the GA attempts to collect the ‘Key 1’, instead of getting collected by ‘Key 1’ they are collected by ‘Key 2’.

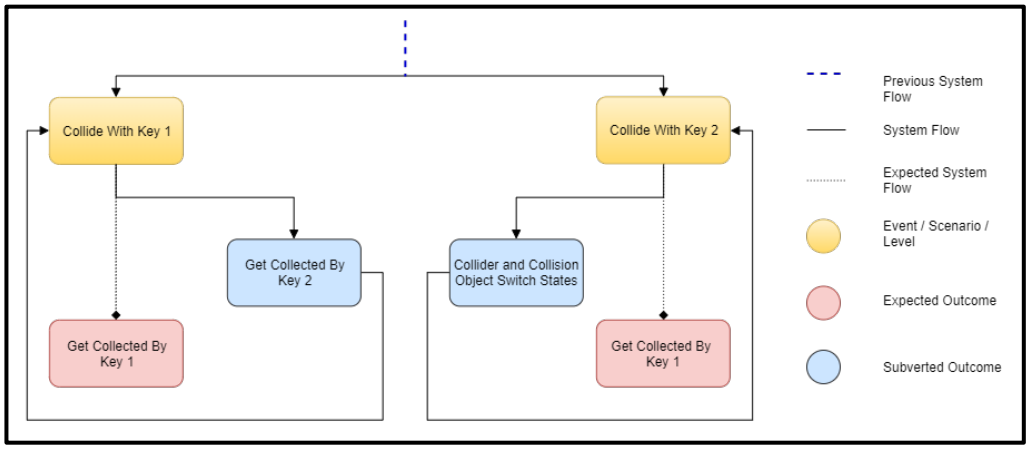

Figure 60 Collection – Subversion-Contradiction Paradox

Furthermore, there is no change in the properties of ‘Key 2’ but instead the properties of ‘Key 1’ change.

On the other hand, when the GA attempts to collect ‘Key 2’ they are transported to the same world they came from, although, the properties of ‘Key 2’ change.

7. Discussion

The findings of this research aided in answering the following research questions as previously defined in the “Introduction” (p. 6):

1. What approaches are utilised by developers to represent paradoxes in games?
2. How can a self-contradicting implicit idea, a paradox, be represented as an explicitly rigid structure - or rules - within a game?
3. What is the appropriate design methodology required to develop a paradox-based game?
4. What are the challenges and limitations in the development of a paradox-based game?

7.1 Misinterpretation of Non-Paradoxical Principles as Paradoxes

Observing the results of the comparative analysis, it is suggested that developers utilise two approaches to interpreting and representing paradoxes. Firstly, developers apply a practice where a game, comprised completely of non-paradoxical gameplay systems, is presented as paradoxical (Figure 29) (p. 54). For instance, in the case of *Alto’s Adventure* (Snowman, 2015), it is observed that the game is completely comprised of only non-paradoxical gameplay systems, for instance, restart level on player death or spending in-game currency to resume to continue playing even after dying. Both of these systems, are finite as in the first example the ‘play cycle’ restarts and renews on player death and in the second instance, the resumability is limited to the in-game currency available to the player. These systems share glaring similarities with the non-paradoxical gameplay systems developed utilising the ‘Paradoxical Games Framework’. In both of these cases, four non-paradoxical systems namely ‘Default’, ‘Contradiction’, ‘Subversion of Expectation’ and ‘Subversion-Contradiction’ are observed.

Although, another approach was observed in the results of the comparative analysis where the developers utilise a combination of paradoxical and non-paradoxical gameplay systems to represent paradoxes (Figure 29) (p. 54). This methodology is observed in the case of *Stanley Parable* (Wreden, 2013), where gameplay systems, based on two paradoxical principles and four

non-paradoxical paradoxical, are utilised in conjunction to represent paradoxes as presented in Table 4 (p. 42).

These two approaches, observed in nineteen different games, suggests that there might exist an inaccuracy in how paradoxes are interpreted by developers. In both of these approaches, it is realized that non-paradoxical principles play a vital role in how paradoxes are represented in games. Furthermore, as indicated by the framework, with the difference between paradoxical and non-paradoxical systems only being 'vicious circularity', it could be asserted that developers misinterpret the two drastically different types of gameplay systems.

Likewise, another possible reasoning for this misinterpretation could be due to the influence of other forms of media and their representation of paradoxes. Although, from the literature review it is observed that other forms media such as films and music present paradoxes by following all the 'Laws of Paradoxes'. On the other hand, in the case of games, paradoxes are represented in the form of non-paradoxical principles such as 'Subversion of Expectation' and 'Contradiction' none of which portray the defining law of paradoxes, which is 'Vicious Circularity'.

This conjecture complies with Coyne's (2016) portrayal of the representation of paradoxes in games. In both cases, the attribute of 'vicious circularity' is excluded when developers design paradox-based games. The reasoning behind this exclusion might be a result of how paradoxes are perceived when viewed through the lens of game design, as a paradoxical game would produce a non-progressable, circular scenario contradicting the definition of a game as a system with a quantifiable outcome (Zimmerman & Salen, 2003).

7.2 Games Are Not Paradoxical

While the previous text emphasized the representation of paradoxes as non-paradoxical gameplay systems, an observation to note is that in twelve of the nineteen cases a combination of non-paradoxical and paradoxical gameplay system was utilised to represent paradoxical games. Focussing on these paradoxical gameplay systems, Figure 28 (p. 53) suggests that although these systems are observed in games, none of them exists within the 'Action' layer, which is also the most microscopic layer constituting of core process being the

building blocks for a game. Furthermore, there is no record of paradoxes within the ‘Game’ layer, which represents the most macroscopic layer comprising all the other subsequent layers. This indicates that paradoxical gameplay systems only seem to exist within the confines of these two extreme layers, namely within ‘Event’, ’Scenario’ and ‘Level’ layers.

The lack of paradoxical gameplay systems in ‘Action’ layer, maybe a result of what this layer represents. As an action represents the core process of a game component (Lankoski and Björk, 2015), an infinitely circular iteration of such process may not be possible. On the other hand, a paradoxical ‘Game’ layer would contradict the definition of game being a system with a quantifiable outcome (Zimmerman & Salen, 2003). In this case, a paradoxical game would indicate a ‘feedback loop’ system, where the outcome is essentially the beginning and the ending of a game. Furthermore, from this, it could be theorised that, as long as the ‘Game’ layer remains non-paradoxical, its subsequent layers namely ‘Event’, ’Scenario’ and ‘Level’ could exist paradoxically.

Ultimately, this means that while a game itself cannot be paradoxical, it can act as a container for paradoxical gameplay systems within its subsequent layers.

7.3 Games as Containers for Paradoxical Gameplay Systems

From the previous section, it was theorised that games can act as a container for paradoxical gameplay systems. To test this conjecture in practice, I applied the ‘Paradoxical Games Framework’ to four basic and regularly observed types of gameplay, to develop four paradoxical and non-paradoxical game systems. During the development, I noticed each of the new paradoxical gameplay systems coexisting with other non-paradoxical systems.

Additionally, during development I experienced that these gameplay systems existed in two forms: ‘Event-based Paradoxical Systems’ and ‘Scenario-based Paradoxical Systems’.

7.3.1 Event-Based Paradoxical Systems

These type of paradoxical gameplay systems are composed of a series of non-paradoxical actions converging up towards a paradoxical event. Being particular event-based, their purpose is better served when used in conjunction

with other gameplay systems, as independently they contain no pursuable goal for the game agent. Consequently, a larger non-paradoxical gameplay system may allow these systems to thrive as they would introduce finite, quantifiable goals for the GA to pursue toward utilising these new paradoxical sub-systems. Accordingly, in a practical scenario, these systems could be considered more modular offering a large amount of flexibility to developers as they can coexist with other non-paradoxical gameplay systems.

From the results, it was observed that three gameplay systems are 'event-based' namely Destination, Shooting and Collection. In all three of these systems, the GA pursues an infinite sequence of action-based goals ultimately leading towards a paradoxical-event upon which they are looped back and being the sequence again.

7.3.1.1 Destination

In the Destination gameplay system, the game agent utilises a sequence of non-paradoxical actions, walking, to reach a particular destination by passing through doorways. Although, as they are reaching the seemingly new location, they experience a paradoxical event where they are looped back to the same location they started from. Additionally, this 'Destination' system could be considered a prime candidate for a one-to-one visualisation of the 'Paradoxical Games Framework', as it is a result of the rooms and the doorways serving as a direct comparison to the flowcharts observed in Research Design chapter (pp. 43–47).

7.3.1.2 Shooting

This paradoxical gameplay system involves the game agent utilising two non-paradoxical actions, 'aiming' and 'launching the projectile'. The sequential occurrence of these actions leads towards paradoxical events involving cyclical displacement of the 'launched projectile', 'intended target' and the game agent. In the first case, the projectile and the 'intended target' switch position upon collision, with the former target morphing into a projectile and returning to the launcher. In the second case, the projectile passes through the intended target, returning to the launcher after a short period of time. And lastly in the third case, when the projectile collides with the target, the game agent switches position with

the target, effectively representing ‘Ouroboros’ or ‘snake eating its own tail’ in the form of gameplay.

7.3.1.3 Collection

The ‘Collection’, similar to ‘Destination’, utilises a sequence of paradoxical actions, walking, to reach and collect the ‘target object’ by colliding with it. This sequence eventually leads towards paradoxical events, where in the first case the GA is displaced from the current gameworld and teleported inside the ‘target object’. Furthermore, each successive attempt escape repeats the previous events, causing the GA to get trapped deeper into consecutive gameworlds. Although in one of the cases, the attempt at ‘key-collection’ causes the GA to return to the first world they came. As a result, the GA is provided with a decision of whether to choose ‘infinite regression’, travelling towards infinite gameworlds or to choose ‘vicious circularity’, where they loop back to the same gameworld they started from.

7.3.2 Scenario-Based Paradoxical Systems

The second type of gameplay system observed within the results is a ‘scenario-based’ paradoxical gameplay system. These types of systems are composed of a sequence of non-paradoxical events converting towards a paradoxical scenario. Consequently, it is observed that this system could be considered more complete as opposed to the event-based systems, as it contains a fixed, final goal for the GA to pursue. Although, this also means that being relatively more complete, it is also quite inflexible in nature. To integrate this system in a game, either the core gameplay needs to be designed around this system or it could be broken down into smaller event-based systems which would coexist with other systems regardless of the core gameplay.

From the results, it is observed that ‘Death’ is the only system which could be considered scenario-based. In this system, GA pursues several interim event-based goals, all of which finally converge onto a larger scenario-based goal.

7.3.2.1 Death

The primary goal of this gameplay system is for the GA to die. As a result, the GA experiences a sequence of non-paradoxical events such as walking

towards and colliding with an object or following the onscreen instruction to interact with gameobject, to achieve death. Although as observed from the results, these death event leads towards a paradoxical scenario, where the GA possesses the object which caused its death. As a result, the GA is trapped in a paradoxical loop where each time their avatar dies, they take possession of another gameobject causing them to repeat the previous cycle.

While this system turned out to be successful from a design standpoint, as observed from section 6.2 Death (pp. 61–66), it also suffered from further development as a result of technical knowledge limitation. In this system, a dilemma can be observed when the GA gains controls of the 'pool of acid', causing the destruction of all the other gameobjects, remaining as an undying entity in an empty space. This abruptness is actually a result of limited technical knowledge of implementation of fluid-based inputs to control the pool of acid rather than a design limitation. Consequently, this also means that the system itself is only limited by the developer's creativity as a greater element in the hierarchy could 'kill' the pool of acid allowing the GA to gain control of it and pursue a greater threat.

7.3.3 User-centred Perspective and Its Relationship to Systems

While the previous section observed the gameplay systems from a purely 'systems-perspective', it is vital to understand what role did the GA perform in these systems. The reasoning for this being that GA, effectively represents a player, even though it considered to be ideal. Likewise, potential future implementation of these systems in game design would require the knowledge of what role does the player play in these systems.

7.3.3.1 Paradoxical Gameplay System with Game Agent as Observer

In this type of gameplay systems, the GA plays the role of the observer, where they witness the paradoxical activity happening around them rather than actively determining the operation of the system. In these systems, regardless of the GA participation, the system being a self-feedback loop it would continue to exist. From the results, it is observed that two systems namely 'Destination' and 'Collection' are observer systems. In both of these systems, regardless of the GA's intention to walk through the doorway in case of 'Destination' or their plan

to collide with the key in the case of ‘Collection’, the paradoxical gameplay system would still exist.

7.3.3.2 Paradoxical Gameplay System with Game Agent as Participant

In this type of gameplay systems, the GA plays the role of a participant, where they experience the paradoxical activity, being an active contributor in how the system operates itself. From the results, it is observed that ‘Death’ is the only participant-based system, with GA being the primary instigator of the paradoxical loop of death and repossession.

7.4 Prevalence of Paradoxical Gameplay Systems in Games Industry

While the previous section focused on paradoxical gameplay systems through a ‘systems-perspective’, a by-product of the comparative analysis was observed in terms of how paradoxical gameplay systems are perceived in commercial and experimental game design. In this case, experimental games are the ones which allow for a greater degree of creative freedom, enabling the developer to explore outlandish design concepts due to the lack of catering to a particular audience. On the other hand, the primary goal of commercial games is the generation of revenue through sales. As a result, their core design is governed by the currently popular trends among the audience, and as such are restricted by certain constraints.

A visual representation of the observed trends between the frequency of paradoxical gameplay systems in commercial and experimental games can be observed in Figure 63. From the graph, it is observed, experimental games inclined heavily towards the utilisation of paradoxical systems, while commercial games hover near a middle ground, utilising a combination of paradoxical and non-paradoxical gameplay systems. This indicates that due to the creative freedom and lack of audience expectation, experimental games are more likely to incorporate paradoxical gameplay systems in their design. On the other hand, while commercial games do utilise paradoxical gameplay systems, they are often in conjunction with other non-paradoxical systems to mitigate the risky gambles caused due to the unexplored, non-established design territories of paradoxes.

As of now, the complex and anomalous nature of paradoxes prevents commercially inclined developers from developing purely paradoxical gameplay due to the potential commercial risk. This opens an area of future research, which could explore design methodologies to facilitate paradoxical gameplay towards commercially-inclined game design.

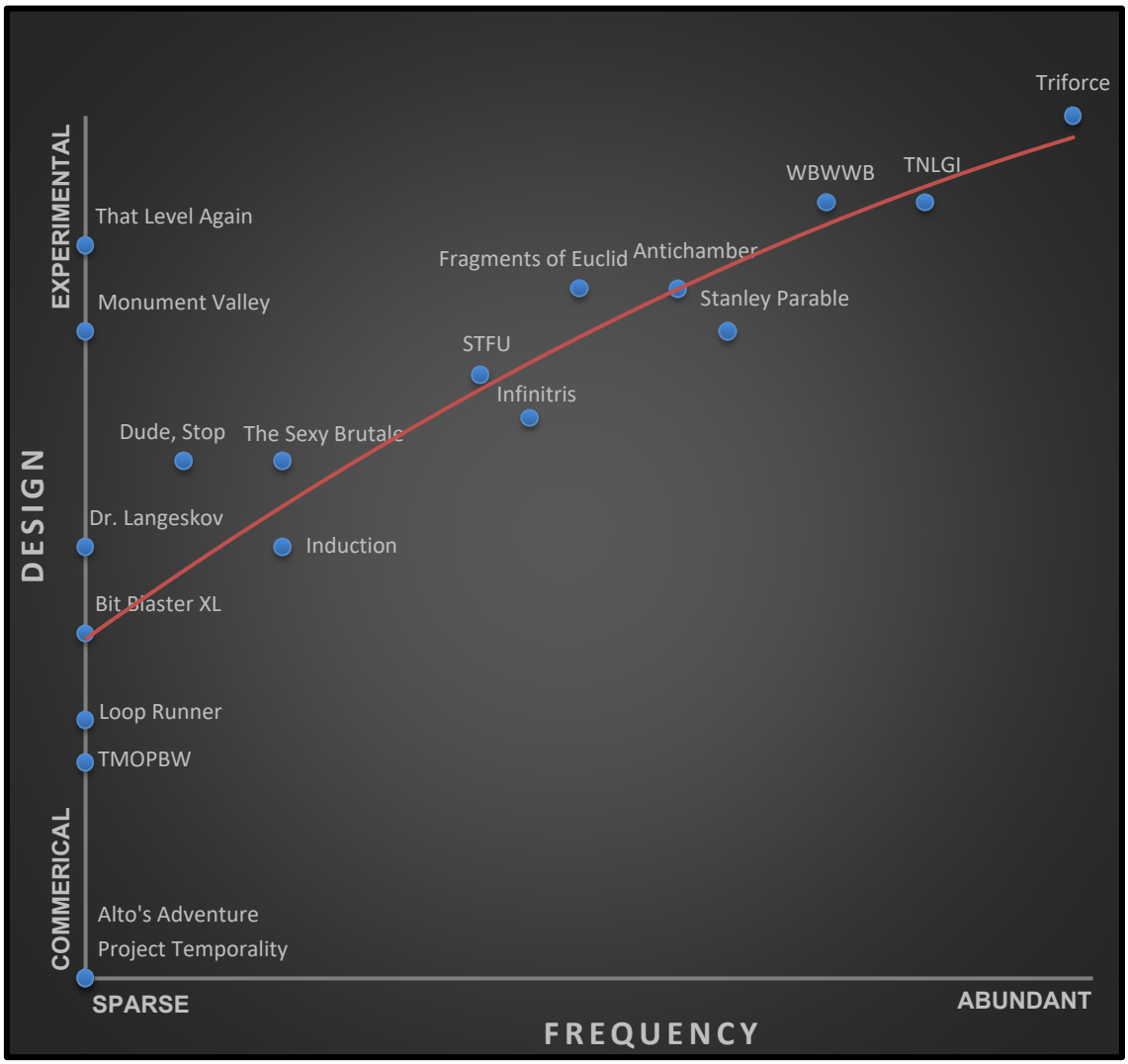

Figure 61 Frequency of Paradoxical Gameplay Systems in Forms of Game Design

8. **Conclusion**

This research primarily aimed to identify design methodologies utilised to represent paradoxes in games. It initially introduced a definition of a ‘paradox’, by observing the core constituents of paradoxes. Next, it observed the role and functionality of paradoxes in objective fields such as maths and sciences, where the paradoxes acted a catalyst in the expansion of knowledge of the subject. On the other, it also observed their functionality in subjective fields such as art and literature, where paradoxes acted as subtle metaphors to convey the thoughts and ideas of the creator.

Furthermore, in the case of games, it was recognised that ‘Subversion of Expectations’ and ‘Contradiction’, were purported as paradoxes. As such, to define the boundaries between these non-paradoxical principles and ‘paradox’, a framework was developed by extracting the game-related attributes from these three concepts. This ‘Paradoxical Games Framework’ was utilised in the comparative analysis of nineteen existing games. Based on the qualitative and quantitative analysis, it was observed that a game is not paradoxical, but it can act as a container for paradoxical systems within it. This assertion was further observed during the development of new paradoxical systems through the application of the ‘Paradoxical Games Framework’, where these systems independently existed within the ‘event’ or the ‘scenario’ without impacting the paradoxicality other game layers.

Comparatively, in the comparative analysis, it was also noticed that developers utilised two methods of practice, to develop paradoxical games. Firstly, a game comprised of only paradoxical systems is portrayed as paradoxical and secondly, a combination of non-paradoxical and paradoxical gameplay systems is utilised to present paradoxical games. In both cases, non-paradoxical gameplay system composed the majority of the game’s design, emphasising on the misinterpretation of paradoxes. Furthermore, in the case of games with paradoxical gameplay systems, a discrepancy was observed in how commercial games and experimental games introduced paradoxes within their design. The results indicated that commercially-inclined developers showcased hesitancy in utilising paradoxes while experimental games frequently utilised

paradoxes. As such, paradoxes, due to their enigmatic nature, were considered by commercial games as a high-risk design which may not appeal to the masses.

Ultimately, by defining paradoxes in the language of game design, this research developed the ‘Paradoxical Games Framework’ which categorised paradoxical and non-paradoxical principles. As such this framework provides a potential solution to alleviate the misinterpretation of paradoxes as non-paradoxical principles in the games industry. Furthermore, the framework implicitly suggested a design methodology through which non-paradoxical elements, could be identified and converted into their paradoxical counterpart. This was further emphasised with the development of new paradoxical systems developed through the application of ‘Paradoxical Games Framework’. Observing its practical application, paradoxes with their adaptable and infinite nature can provide a rich, inexhaustible creative space for game designers to explore.

9. Appendices

Appendix A

Game	Mode of Observation	Platform	Source
Alto's Adventure	Played	Android	Google Play Store
Antichamber	Played	Microsoft Windows	Steam
Bit Blaster XL	Watched	YouTube	Steam
Dr. Langeskov	Played	Microsoft Windows	Steam
Dude, Stop	Played	Microsoft Windows	• Itch.io • Steam
Fragments Of Euclid	Played	Microsoft Windows	Itch.io
Induction	Watched	YouTube	• Itch.io • Google Play Store
Infinitris	Played	Microsoft Windows	Itch.io
Loop Runner	Played	Microsoft Windows	Itch.io
Monument Valley	Played	Android	Google Play Store
Project Temporality	Watched	YouTube	Steam
Stanley Parable	Played	Microsoft Windows	Steam
Super Time Force Ultra	Played	Microsoft Windows	Steam
That Level Again	Played	Android	Google Play Store
The National Library of Geometric Impossibilities	Played	Microsoft Windows	Itch.io
The Misadventures of P.B. Winterbottom	Watched	YouTube	Steam
The Sexy Brutale	Watched	YouTube	Steam
Triforce	Played	Microsoft Windows	Itch.io
We Become What We Behold	Played	Microsoft Windows	Itch.io

Appendix - B

SYSTEM	ASSOCIATED CONCEPT	PAGE	LINK
Destination	Default	57	https://youtu.be/UFZCF4rvelI
Destination	Subversion	57	https://youtu.be/-frGu_mWLzk
Destination	Contradiction	58	https://youtu.be/WlfuWM-a1sY https://youtu.be/YDqVCi_p6k8
Destination	Subversion-Contradiction	59	https://youtu.be/2QIK0dehYPY https://youtu.be/SGXI2gO-FyA
Destination	Default Paradox	59	https://youtu.be/4uTmQY_rzYc
Destination	Subversion Paradox	60	https://youtu.be/Nv3xTL5ovUg
Destination	Contradiction Paradox	60	https://youtu.be/Msqrbv8jwuI
Destination	Subversion-Contradiction Paradox	61	https://youtu.be/HodtXaWFmys
Death	Default	61	https://youtu.be/DDF21xg3yGg
Death	Subversion	62	https://youtu.be/idV3cWJvqTU
Death	Contradiction	62	https://youtu.be/Lqt2qZ3VuGM https://youtu.be/QoRW-GSZTLU
Death	Subversion-Contradiction	63	https://youtu.be/f8c8JryKgDk
Death	Default Paradox	63	https://youtu.be/VC3tlwH2VqY
Death	Subversion Paradox	64	https://youtu.be/_LOwWq9_MiM
Death	Contradiction Paradox	65	https://youtu.be/5bHqHxFn03E https://youtu.be/MgEe5KwrmhQ
Death	Subversion-Contradiction Paradox	65	https://youtu.be/6GasqFuNYCM https://youtu.be/3uwWLsUeun8
Shooting	Default	66	https://youtu.be/x6aIIc8AGCI
Shooting	Subversion	67	https://youtu.be/-Q6AT3690kg
Shooting	Contradiction	67	https://youtu.be/oJuW1MQKoO0
Shooting	Subversion-Contradiction	68	https://youtu.be/CvmdiACM9l8
Shooting	Default Paradox	69	https://youtu.be/MEg9HUAnLTs
Shooting	Subversion Paradox	69	https://youtu.be/xr53JBA40Ik
Shooting	Contradiction Paradox	70	https://youtu.be/puSMjki5_qk https://youtu.be/u7bLCZE9OWs
Shooting	Subversion-Contradiction Paradox	71	https://youtu.be/z7XiOUWvZsI https://youtu.be/1K709r_7sJI
Collection	Default	71	https://youtu.be/RMUgk9Fwlgw
Collection	Subversion	72	https://youtu.be/jct1PCrExEM
Collection	Contradiction	72	https://youtu.be/m-QnQm8JhsI https://youtu.be/VblFnTA0Log
Collection	Subversion-Contradiction	73	https://youtu.be/UKlf1cb6R9k https://youtu.be/tikb1yXpYsg
Collection	Default Paradox	74	https://youtu.be/jgQz-j_FJbk
Collection	Subversion Paradox	74	https://youtu.be/ajo9XosDy4k
Collection	Contradiction Paradox	75	https://youtu.be/ENUgsPVhf7Y https://youtu.be/0OJUy-K21VQ
Collection	Subversion-Contradiction Paradox	75	https://youtu.be/51oGaF627uo

Appendix C

Game Comparative Analysis											
SR. NO	**GAME**	**TYPE**	**CONTINUITY**	**Observed Play Time (HH:MM)**	**KEY PHRASES**	**STAGE**	**VALUE OF ATTRIBUTES**			**OBSERVED CONCEPTS**	**CONCLUSION**
							Inference of Probable Outcome	Forced Choice	Progressable		
1	Alto's Adventure	Commercial	Recursive	02:13	Endless Snowboarding Odyssey	Level	N	N	Y	Subversion	Non-Paradoxical
						Scenario	Y	N	Y	Regular	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
2	Antichamber	Art-turned-Commercial	Non-Recursive	05:27	Infinite Looping Levels	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	N	Y	Y	Subversion - Contradiction	
						Event	N	N	Y	Subversion	
						Action	Y	N	Y	Regular	
3	Bit Blaster XL	Commercial	Recursive	02:33	Endless survival	Level	N	N	Y	Subversion	Non-Paradoxical
						Scenario	Y	N	Y	Regular	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	

4	Dr. Langeskov, The Tiger, and The Terribly Cursed Emerald: A Whirlwind Heist	Commercial	Non-Recursive	01:14	Player-Designer Identity Paradox	Level	N	N	Y	Subversion	Non-Paradoxical
						Scenario	N	N	Y	Subversion - Contradiction	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
5	Dude, Stop	Commercial	Non-Recursive	01:49	Main rule/goal is to not follow the rules	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	Y	N	N	Paradox B	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
6	Fragments of Euclid	Art	Non-Recursive	02:49	Non-Euclidean Environments	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	Y	N	N	Paradox B	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
7	Induction	Art-turned-Commercial	Non-Recursive	01:52	A game about Time-Travel and Paradoxes	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	Y	N	Y	Regular	
						Event	Y	Y	N	Paradox D	
						Action	Y	N	Y	Regular	

8	Infinitris	Art	Recursive	01:06	never-ending Tetris in an infinitely large world	Level	N	N	N	Paradox A	Non-Paradoxical
						Scenario	Y	N	Y	Regular	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
9	Loop Runner	Art	Recursive	00:35	One looped Level	Level	Y	N	N	Subversion	Non-Paradoxical
						Scenario	Y	N	Y	Regular	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
10	Monument Valley	Commercial	Non-Recursive	02:51	Impossible architecture	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	N	N	Y	Subversion	
						Event	N	Y	Y	Subversion-Contradiction	
						Action	Y	N	Y	Regular	
11	Stanley Parable	Commercial	Non-Recursive	07:42	The game will end, the game will never end	Level	Y	Y	N	Paradox D	Non-Paradoxical
						Scenario	N	Y	Y	Subversion-Contradiction	
						Event	N	N	Y	Subversion	
						Action	Y	N	Y	Regular	
12	Project Temporality	Commercial	Non-Recursive	01:13	Paradox-based puzzles	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	Y	N	Y	Regular	

						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
13	Super Time Force Ultra	Commercial	Non-Recursive	05:07	Causality Paradox	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	Y	Y	Y	Contradiction	
						Event	Y	Y	N	Paradox D	
						Action	Y	N	Y	Regular	
14	That Level Again	Commercial	Non-Recursive	03:04	A game where all levels are the same	Level	N	N	Y	Subversion	Non-Paradoxical
						Scenario	N	N	Y	Subversion	
						Event	N	N	Y	Subversion	
						Action	N	N	Y	Subversion	
15	The National Library of Geometric Impossibilities	Art	Non-Recursive	01:45	Non-Euclidean Environments	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	N	N	N	Paradox A	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
16	The Misadventures of P.B. Winterbottom	Commercial	Non-Recursive	01:18	Create your own paradox	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	N	N	Y	Subversion	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	

17	The Sexy Brutale	Commercial	Non-Recursive	04:03	A never-ending masked ball	Level	Y	N	N	Paradox B	Non-Paradoxical
						Scenario	Y	N	Y	Regular	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
18	Triforce	Art	Non-Recursive	04:29	Non-Euclidean Environments	Level	N	Y	N	Paradox C	Non-Paradoxical
						Scenario	N	Y	Y	Subversion - Contradiction	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	
19	WE BECOME WHAT WE BEHOLD	Art	Non-Recursive	00:41	A game about news cycles, vicious cycles, infinite cycles	Level	Y	N	Y	Regular	Non-Paradoxical
						Scenario	Y	Y	N	Paradox D	
						Event	Y	N	Y	Regular	
						Action	Y	N	Y	Regular	

Alto's Adventure									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	**X**	✓	✓	**X**	**X**	**X**	**X**	**X**	**Subversion** Whenever the player dies and the level ends, it subverts the player's expectation of a never-ending level. **Contradiction** The player has to make a choice of spending in-game currency to revive themselves and continue from the point where they died.
Scenario	✓	**X**	✓	**X**	**X**	**X**	**X**	**X**	**Contradiction** After receiving the wingsuit, the player can choose to fly or snowboard in the level. Each type of movement allows the player to collect certain pickups which would be otherwise difficult or impossible to collect.
Event	✓	**X**	**X**	✓	**X**	**X**	**X**	**X**	**Sub-Cont** When the player bounces off a rock and continues playing instead of dying.
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

Antichamber									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	X	X	X	
Scenario	✓	X	X	✓	X	X	X	✓	**Sub-Cont** In "Don't Look Down" the player is provided with a blind instruction with two possible choices of either looking down and falling into a pit and other being trusting the game and keep looking. In either choice, the player is not able to infer the outcome of the choices and needs to perform a choice to progress throughout the stages. **Paradox D** In many areas of the game, a "wrong" choice will lead the player back to the beginning of the puzzle. This is observed in "Many Paths to Nowhere" where the player can choose between red and blue stairs but both lead the player back to start. Another example is "Finding The Seams" where the wrong path leads the player back to the start. As a result, the player needs to find the right path through a trial-and-error method, effectively circumventing the loop and moving forward.

Event	✓	✓	X	✓	X	X	X	X	**Subversion** i) Most common subversive techniques utilized by Antichamber is hidden walls. The player can walk through walls in certain parts of the game, mainly at the start after reaching the "eye on the wall". These walls disintegrate to make a path as the player moves through them. Due to their gradual disintegration, the player has no inference as to how long they need to walk so as to reach the exit. ii) Another occurrence of subversion occurs in the "art museum" room where the player inspects various pieces of art form contained in boxes with transparent viewing glass on each side but the art piece changes depending on which side of the cube the player is looking in. **Subversion-Contradiction** In "A Jump Too Far" the player expects to jump over the platform but ends up falling down while walking ahead without jumping creates platforms for the player to move across. Here, in both options player's expectations are subverted with no inference of either of the outcomes.
Action	✓	X	X	X	X	X	X	X	

Bit Blaster XL									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	**X**	✓	**X**	**X**	**X**	**X**	**X**	**X**	**Subversion** Whenever the player dies and the level ends, it subverts the player's expectation of a never-ending level.
Scenario	✓	**X**	✓	**X**	**X**	**X**	**X**	**X**	**Contradiction** The player can choose how they approach combat in the sense that the game provides the players with different ships and projectiles each with their own varying abilities
Event	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

Dr. Langeskov									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	**X**	✓	**X**	**X**	**X**	**X**	**X**	**X**	**Subversion** The player expects to play a game of heist but this expectation is subverted when they are required to act as 'helper crew' for another player.
Scenario	**X**	✓	**X**	✓	**X**	**X**	**X**	**X**	**Subversion** The player is unable to infer the reasoning behind the narrator's instructions but they are able to defy them and choose a different path. This is experienced at certain points in the game as mentioned below: Backstage room where the player expects to play the game, except the player is helping the narrator function the game. **Sub-Cont** The narrator asks the player not to cut the ringing phone in the 'Misc. Interaction Room' The player can choose between two actions but is given no information as to the outcome of these actions.
Event	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

Dude, Stop									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	X	X	X	
Scenario	X	X	✓	X	X	✓	X	X	**Contradiction** The player is given the choice of solving a puzzle two ways, right and wrong. Both choices allow the player to infer their outcomes while progressing the game forward. **Paradox B** In each part of the level, the main goal of the game contradicted when the player 'follows' the primary rule of not following any rules. This is an example of self-contradiction and self-reference where the main rule is self-contradicted while following infinite regress.
Event	✓	X	X	X	X	X	X	X	
Action	✓	X	X	X	X	X	X	X	

Fragments of Euclid									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	X	X	X	
Scenario	✓	X	X	X	X	✓	X	X	**Paradox B** As the game is based on spatial paradoxes, the loop is experienced when the player moves through two face-to-face portals, causing the player to be stuck in an entry/exit loop.
Event	✓	X	X	X	X	X	X	X	
Action	✓	X	X	X	X	X	X	X	

Induction									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	X	X	X	
Scenario	✓	X	X	X	X	X	X	X	
Event	✓	X	X	X	X	X	X	✓	**Paradox D** The paradox only occurs in the instance where the player is required to create multiple timelines. In this, the player is stuck in a seemingly non-progressable loop, with the only way out converge all the timeline back to their original states.
Action	✓	X	X	X	X	X	X	X	

Infinitris									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	✓	X	X	X	**Paradox A** The tetrominoes can potentially be stacked on top of each other as well as expand on either side infinitely with no worry of facing a loss. The game only faces a technical limitation but from a pure design point of view, the game is infinite.
Scenario	✓	X	X	X	X	X	X	X	
Event	✓	X	X	X	X	X	X	X	
Action	✓	X	X	X	X	X	X	X	

Loop Runner									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	✓	X	X	**Paradox B** The entire game is one looped level. The progression process ends when the player dies (effectively choosing to end the loop).
Scenario	✓	X	X	X	X	X	X	X	
Event	✓	X	X	X	X	X	X	X	
Action	✓	X	X	X	X	X	X	X	

Monument Valley									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Scenario	✓	✓	**X**	**X**	**X**	**X**	**X**	**X**	**Subversion** Each outcome of the puzzles scattered in a level allows the player to transition over seemingly impossible architecture.
Event	✓	✓	**X**	**X**	**X**	**X**	**X**	**X**	**Subversion** The player's expectation of "walking over a platform to reach a destination" is subverted when they experience an unexpected collision, diverting their movement in a different direction. This subversion is observed in multiple aspects depending on the player's location in the level.
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

Project Temporality									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	X	X	X	Every layer of the game is explained to the player in the tutorial, leaving no evidence of subversion, a situation of forced or a paradox.
Scenario	✓	X	X	X	X	X	X	X	
Event	✓	X	X	X	X	X	X	X	
Action	✓	X	X	X	X	X	X	X	

Stanley Parable									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	X	✓	✓	**Paradox C** Players expect the game to end after following Narrator's instructions, but the game restarts in Stanley's office. **Paradox D** The player (purposely) jumps off the staircase and starts from the beginning**.** Similarly, all the "endings" lead the player back to the beginning in Stanley's office with none of them declaring the game was over.

Scenario	✓	✓	✓	✓	X	X	X	✓	**Subversion** i) Dark pathway after the looping corridor leads to the space-room. **Paradox D** i) Looping corridor after the red-blur door room. **Sub-Cont** The player is allowed to choose between several options throughout the game with no inference of outcome. The most common scenario is a choice between a set of two doors with the narrator directing Stanley's future actions and the player is allowed to defy them and choose another option
Event	✓	✓	✓	X	X	X	X	X	**Subversion** Achievement 430: The player clicks on door 430 expecting to gain the achievement but this expectation is subverted when they start a sequence of events where they have to follow the narrator's instructions to complete the achievement. **Contradiction** The player is given a choice to turn off the mind control machine or to keep it going.
Action	✓	X	X	X	X	X	X	X	

Super Time Force Ultra									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Scenario	✓	**X**	✓	**X**	**X**	**X**	**X**	**X**	**Contradiction** The player can create multiple scenarios while fighting enemies by developing a different timeline. Each timeline preserves the player's past actions while also executing the current actions.
Event	✓	**X**	**X**	**X**	**X**	**X**	**X**	✓	**Paradox D** Within the limit of the time travel duration, each time the player dies they care able to rewind themselves to an earlier state and start again so as to choose a different path.
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

That Level Again									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	X	X	X	**Regular** The objective of each level is to open the door, to progress to the next level. This remains unchanged regardless of the architecture or the perquisites required to open the door.
Scenario	✓	✓	X	X	X	X	X	X	**Regular** In 52% of the levels, the process of opening the door is to press the red button, as instructed by the game. **Subversion** In the 48% of the levels, players expectations are subverted as the methodology of achieving varies from level to level and it is up to the player figure out the strategy either from trial-and-error or through the title of the level.
Event	✓	✓	X	X	X	X	X	X	
Action	✓	✓	X	X	X	X	X	X	**Regular** In 51% of the levels, the controls are as instructed on the screen with no deviation. **Subversion** In 49% of the levels, the functionality of the controls is scrambled and is expected of the player to figure them out.

The National Library of Geometric Impossibilities									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Scenario	✓	**X**	**X**	**X**	✓	**X**	**X**	**X**	**Paradox A** Extensive application of non-Euclidean spaces and perspective-based spatial paradoxes throughout the library.
Event	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

The Misadventures of P.B. Winterbottom									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	Every layer of the game is explained to the player in the tutorial, leaving no evidence of subversion, a situation of forced or a paradox.
Scenario	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Event	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

The Sexy Brutale									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	X	X	X	X	✓	X	X	**Paradox B** The player is stuck in a loop where at the end of the level, the player is returned back to the beginning of the loop. The time gameplay differs from a standard death-respawn mechanic in a manner where the player can rewind snippets of time as opposed to the completely restart the level from the beginning. This could be considered as sub-levels of one large level which the player is restarting, in this way the gameplay is no different to standard death/respawn mechanic.
Scenario	✓	X	X	X	X	X	X	X	
Event	✓	X	X	X	X	X	X	X	
Action	✓	X	X	X	X	X	X	X	

Triforce									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	✓	X	X	X	X	✓	X	**Subversion** The player is given directional instructions in each (down) staircase level transition, where the player expects to arrive at a 2D map except are transported to a Torus-shaped transitional sub-level. **Paradox C** Every level (except the starting two-dimensional level) is mapped onto a non-Euclidean three-dimensional shape where Link will loop back to the place he started from if he keeps moving in one direction. To break the loop, the levels contain a transitional area in the form downward-staircase eventually leading to the Triforce.
Scenario	✓	✓	X	✓	X	X	X	X	**Subversion** The player is given directional instructions in each (down) staircase level transition, where the player expects to arrive at a 2D map except are transported to a Torus-shaped transition level. **Subversion-Contradiction** Taking into account the above subversion, there are multiple such staircases which lead to a non-Euclidean transitionary phase.
Event	✓	X	X	X	X	X	X	X	
Action	✓	X	X	X	X	X	X	X	

WE BECOME WHAT WE BEHOLD									
GAME LAYERS	**CONCEPTS**								**NOTES**
	REGULAR	SUBVERSION	CONTRADICTION	SUBVERSION-CONTRADICTION	PARADOX A	PARADOX B	PARADOX C	PARADOX D	
Level	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Scenario	✓	**X**	**X**	**X**	**X**	**X**	**X**	✓	**Paradox D** The paradox occurs when the play captures an "interesting" event which starts a temporary trend, causing a vicious cycle of that event occurring all over the level. After a certain amount of time, the trend becomes the new "regular" and the player is required to capture another event.
Event	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Action	✓	**X**	**X**	**X**	**X**	**X**	**X**	**X**	

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