Exploration through video games

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5 Design Patterns for Exploration

This chapter describes the formulation of development strategies, referred to as "design patterns", that elicit curiosity and lead to exploration. The formulation of these patterns is motivated by the desire to operationalize the findings on what games elicit curiosity (see Chapter 4) and use them as a guide for hypothesizing testable design patterns that can be validated empirically.

> The research question that guides the work in this chapter is:
> **What design patterns can be hypothesized for games that elicit exploration?**

As will be discussed as part of this chapter, addressing this question necessitates choosing a focus for the kind of exploratory behavior that is investigated. Based on the survey results in Chapter 4 and the practicalities of validating player behavior in future steps, the aim is to define design patterns for *spatial exploration*.

In contrast to conceptual exploration, spatial exploration is the expression of curiosity in wondering about features and landmarks in an environment. In the case of video games, this exploration takes place in a virtual environment that otherwise mimics how a space can be understood: by traversing it and creating a mental model of the surrounding topography. This traversal, which can include the simple behavioral expression of "looking around", operationalizes curiosity by measuring the space covered by a player within a virtual game world.

The chapter first examines how the use of design patterns has guided creative endeavors in the real world and aided the analysis and development of video games. It then discusses examples of game titles and genres from the previous chapter's study to narrow down aspects that can inform testable design patterns.

These are the basis for formulating five design patterns, hypothesized to elicit the desire to …

1. Reach “extreme” points in the environment
2. Resolve visual obstructions
3. Investigate elements that appear out of place
4. Understanding how spaces connect
5. Forage for something in the environment

The chapter ends with concluding remarks on the hypothesized design patterns for spatial exploration and outlines the next steps for validating them in an empirical study.

5.1 Design Patterns: A Conceptual Tool for Analysis and Development

Before going into detail on strategies in video games that may motivate spatial exploration, it is crucial to understand the value and limitations of defining design patterns. *In this work, a “design pattern” is defined as the purposeful and repeatable implementation of creative decisions that lead to a pre-determined outcome.* Within this definition, there is an inherent tension between how successful a design pattern is in delivering an outcome and its repeatability in related but functionally distinct contexts. The more specific a pattern is to an individual use case, the less likely it is to be repeatable across different use cases. On the other hand, the more repeatable a pattern is, the more it runs the risk of being overly broad and not leading to the most optimal outcome. Alternatively, it may lack sufficient descriptive detail to support the analysis or development of creative decisions.

Nevertheless, supporting the analysis or development of such decisions is precisely the purpose and value of formulating design patterns. Any creative endeavor, be it the development of virtual environments or the writing of prose and code, includes a multitude of decisions that are taken throughout. Mapping out every decision of such endeavors would neither be practical nor be directly instructive for future work. Design patterns aim to formalize heuristics to learn from previous work and provide generalizable instructions.

A limitation of design patterns is that they do not provide detailed procedures. Design patterns need to be interpreted and re-contextualized when informing creative decisions for their specific use case. This makes it difficult to assess design patterns in terms of efficacy, as there is generally a large design space of possible implementations. As with all patterns, the interplay of seemingly connected aspects may be coincidental or less connected than hypothesized. A pattern may describe a set of circumstances and decisions but not have the outcome it is thought to have, even if well implemented. This is further complicated by the potential interaction between multiple design patterns within a designed artifact or space.

These limitations should not detract from the value that design patterns provide, as has been shown through their use in different fields and disciplines. Instead, they are a conceptual tool for dealing with "wicked problems" (Lönngren and Van Poeck 2021), challenges that are difficult to solve due to incomplete or changing requirements or solutions.

5.1.1 Origins of Design Patterns

Although the individual circumstances of design work can be highly idiosyncratic, they tend to involve similar problems encountered repeatedly in slightly different contexts. This understanding has been taken in formulating "patterns" in the seminal architecture book *A Pattern Language* (Alexander 1977).

In the book, the authors describe 253 patterns of architecture, urban design, and matters of community living. Each pattern addresses a strategy for dealing with a human need or problem related, in some form, to the design tools provided by the field of architecture. The patterns propose practical solutions at multiple scales, ranging from rooms and buildings to neighborhoods and cities. The formulation of patterns is not based on optimal solutions but on "best practice" hypotheses formed by heuristics in architecture.

One example, pattern number 62, "High Places", states:

> "The instinct to climb up to some high place, from which you can look down and survey your world, seems to be a fundamental human instinct."

This pattern is discussed as a need that should be kept in mind in the context of another pattern, the "Four-Story Limit" (pattern 21), which argues that a thriving community does not build beyond four stories on a large scale. The "High Places" pattern suggests that society has a need for dominating landmarks. The pattern suggests:

> "Build occasional high places as landmarks throughout the city. They can be a natural part of the topography, or towers, or part of the roofs of the highest local building — but, in any case, they should include a physical climb."

The pattern's description features a sketch that provides a good sense of the level of detail the authors aim for in the book. Although patterns are described with explicit solutions, how a solution should be implemented is left to the interpretation and sensibilities of those who put them into practice. Detail varies between individual patterns. Where "High Places" is described over three pages, "Connected Play" (pattern 68), which argues for the importance of shared play spaces, covers six.

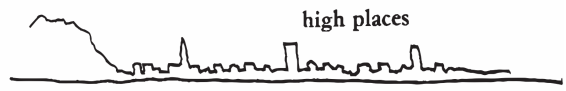

Figure 5.1: Sketch of the "High Places" pattern from *A pattern language*, as it appears in the book.

It should be evident from this example that the authors were less interested in the optimal solution of individual architectural problems but rather provide a lexicon of possible tools. The authors frame this as the creation of a "pattern language".

This approach of documenting common design challenges and solutions has been pursued under the same monicker in other areas outside of architecture. One of the more well-known examples is the book *Design Patterns: Elements of Reusable Object-Oriented Software* (Gamma et al. 1995), which deals with design challenges in software development. One of the discussed patterns is, for example, the "Singleton" pattern:

> "Ensure a class only has one instance, and provide a global point of access to it."

This is followed by a description of the structure, consequences, implementation, known uses, and related patterns. The “Singleton” pattern refers to the concept of defining a programming class so that only a single implementation of it can exist simultaneously. Its implementation is a deliberate design choice to deal with a specific problem. That problem is that, in software development, it can be necessary (or at least beneficial) to create a single point of reference and ensure that no additional copy (referred to as instance) can exist at the same time.

Similar to the example of “High Places”, the “Singleton” pattern is not described as a strategy that must be used but as a tool that can serve a need in specific circumstances while keeping other requirements in mind.

Before describing the use of design patterns in video games, it should be noted that the strategies considered to be patterns are rarely invented by the authors who describe them. Design patterns are efforts to formalize common strategies used within a field for a longer time. They stem from the observations of practices that have resulted in predictable outcomes, either beneficial or not. Indeed, patterns can also be described as anti-patterns, as strategies that should be avoided when designing for a beneficial outcome.

5.1.2 Design Patterns in Video Games

The area of video games presents a field in which architecture and software development intersect. As such, the aforementioned examples have served as inspirations for defining patterns in game development (as well as analyzing games). One example from the book *Game Programming Patterns* (Nystrom 2014) shows that design patterns may change over time or require additional consideration specific to the domain in which it is formulated. On the aforementioned “Singleton” pattern from software design (formulated by the “Gang of Four”), the author of *Game Programming Patterns* writes:

> **Singleton** “This chapter is an anomaly. Every other chapter in this book shows you how to use a design pattern. This chapter shows you how not to use one. Despite noble intentions, the Singleton pattern described by the Gang of Four usu-

> ally does more harm than good. They stress that the pattern should be used sparingly, but that message was often lost in translation to the game industry."

Aside from drawing from related fields, there have been efforts to formulate patterns concerning the design of games: the rules that govern how a game operates and how it is created. One example has been formulated in a game developer blog (Kreimeier 2002) under the label "Paper-Rock-Scissors" [sic]:

> "Avoid a dominant strategy that makes player decisions a trivial choice."

This pattern (or rather anti-pattern) describes the problem of players losing interest in a game if the choices they can make are realized as being obvious and lacking meaningful cognitive effort. It is worth noting that the analogy of "Tic-Tac-Toe" (or "noughts and crosses", "Xs and Os") might have been a better fit, given that Rock-Paper-Scissors involves an element of randomness that players have to consider. This makes the choice somewhat less trivial than if moves in the game were taken in order. Nevertheless, the pattern describes a relatively specific problem to game design.

Similar to the formulation of architectural patterns, game design patterns vary in specificity and require some interpretation for the individual use case. In the case above, the pattern requires the involvement of other design strategies for building the intended game experience without defining how a dominant strategy should be avoided.

Game design patterns can also be formulated in relatively neutral terms as strategies that may be beneficial or to establish terminology that has become used in the analysis and development of games. The book *Patterns in Game Design* (Bjork and Holopainen 2005) largely follows this approach, establishing terms such as "Boss Monsters" ("A more powerful enemy the players have to overcome to reach certain goals in the game.") or "Downtime" ("The player cannot directly affect the outcome of the game for a period of time.").

One of the examples in the book also shows that patterns have been formulated over time through the habits and customs of both developers and game players:

> **Easter Eggs**
> "Surprises in the game that are not related to the game. Easter Eggs are surprises put in games that do not necessarily advance the game story or even fit within the reality of the Game World. The design of Easter Eggs started as programmers' and game designers' ways of protesting against management but soon turned into a gameplay value, encouraging exploration and people to replay the games."

This example also shows that elements in the game that were initially not explicitly created to motivate exploration can become patterns that elicit curiosity in players. In this case, this happens through the known possibility that an *Easter Egg* might potentially exist and could be discovered by looking for it.

Game design patterns such as the *Easter Eggs* pattern hold the potential of being specifically valuable to elicit curiosity in games. While they lack specific instructions on how they should be implemented to lead to that outcome, they focus design attention on strategies that increase the likelihood of exploration.

5.2 Strategies for Eliciting Curiosity and Motivating Exploration

This section looks at strategies (i.e., design patterns) for exploration that can be formulated based on prior work and the results of Chapter 4. The starting point for this effort is based on the work of To et al. (2016), who reviewed the intersection of curiosity and uncertainty in game design.

The work of To et al. (2016) discusses existing game design strategies across multiple games and five factors of how exploratory behavior is exhibited, as formulated by child psychologists before (Kreitler, Zigler, and Kreitler 1975b). These factors should not be confused with the Five-Dimensional Curiosity Scale (5DC) of Kashdan et al. (2018), described in Chapter 4, which focuses on a person's general propensity for developing curiosity (i.e., their overall trait curiosity).

The work of these authors builds the foundation for the formulation of three types of curiosity-based exploration in this thesis: *conceptual exploration, social exploration,*

and spatial exploration. These types will serve as design goals for discussing different design patterns in video game titles and genres.

The sources of these patterns are based on the highest ranked game titles in terms of eliciting curiosity in Chapter 4; *Zelda:BotW, Elder Scrolls: Skyrim*, and *Portal*. Each design goal further discusses the potential of game genres that are part of these games (*Exploration*, *Puzzle*, *RPG*, and *Reflex*), as well as the genres that were ranked highest by survey participants (*Social Sim* and *Collecting*). The *Exploration* genre is, by the definition given in section 4.1.7, a genre involving either conceptual or spatial exploration (or, indeed, both).

Following the discussion of conceptual, social, and spatial exploration patterns, the following section focuses on developing design patterns for spatial exploration through the topography of a game's environment (i.e., level design). For this reason, the subsection concerning strategies for spatial exploration is also going into more detail than the others.

This focus is chosen to enable an empirical investigation for hypothesizing design patterns. Spatial exploration is easily measured and less dependent on prior knowledge (as would be the case for conceptual exploration) or the involvement of multiple players (as would be the case for social exploration). As will be discussed later in the chapter, the formulation of spatial exploration design patterns is likely to overlap with other types of curiosity-based exploration (conceptual or social). It is intended to act as the primary motivation and is hypothesized to be the reason for expressed player behavior.

5.2.1 Strategies for Conceptual Exploration

Related survey genres: *Puzzle*, *Strategy*
Related survey titles: *The Witness* (Thekla, Inc. 2016), *Portal* (Valve 2007), *Elder Scrolls: Skyrim* (Bethesda Game Studios 2011)

Strategies for motivating conceptual exploration in games invoke the notion of being able to and tasked to solve a given problem. The *Puzzle* genre is perhaps the most literal implementation of this, presenting players with both a problem that must be overcome through cognitive effort, as well as rules and tools to do so. Conceptual exploration here means mentally navigating through the possible solution space, considering possible

implementations of a solution given a set of rules and circumstances. Curiosity to engage in this form of exploration is elicited by the information gap of whether the given problem can be solved and whether a person is capable of solving the problem. Consistent with the information gap theory (Loewenstein 1994), curiosity will be felt stronger if the gap appears surmountable. In other words, if a puzzle appears not too challenging to solve.

Games that focus on conceptual exploration tend to be direct in pointing out to players that there is a problem to solve. The task is straightforward, and so is the implication that a solution is possible with the tools a game provides its players. Rules are similarly stated outright and tend to be what frames or complicates a given problem.

A typical design strategy of puzzle games is to introduce tools and rules connected to a problem incrementally. New rules can add complication to previous rules and thus intentionally limit the conceptual space of possible solutions to increase the difficulty. Curiosity for conceptual exploration can wane if the cognitive challenge reduces. This can happen even in a series of similarly challenging problems, as players likely learn to navigate the possible solution space more quickly, having learned from what worked in the past. With a decrease in difficulty comes a reduction in the information gap, as even if a player might not solve a problem immediately, they become more confident in their ability to do so. At this point, even a cognitive challenge can become a repetitive (but possibly still enjoyable) task rather than eliciting curiosity for conceptual exploration.

Figure 5.2: Screenshots of the game *The Witness* (left and middle) and *Portal* (right).

Video games such as *The Witness* and *Portal* are examples of games that stand out within the puzzle genre, as illustrated by their frequent suggestion from many participants for games that have elicited curiosity for solving things. Both games present play-

ers with a series of problems that are similar in nature. In the case of *Portal*, players can create wormhole-like connections between spaces to complete tasks, e.g., to reach a button opening the door to the next level. As players progress in the game, they are made aware of a meta-narrative that re-contextualizes what they have been doing so far in the game. The game narrative has players see behind the machinations of previous puzzle levels, giving them a sense of "breaking out of the game world", despite the "behind the scenes" environment of the game, of course, also being part of the game's design. In doing so, the game further elicits curiosity by suggesting to players that there is an information gap in the nature of what the game has presented itself to be. In the process, the game opens up an unforeseen, new possibility space that players had not considered, given that expectations had been set for a more narrowly defined possibility space before.

In *The Witness*, players solve a series of line puzzles presented within a larger virtual world that they can roam. For the most part, the game points players to where the individual puzzles can be found. Over time, however, the game provides hints that line puzzles can be found as part of the wider virtual world. This gives players a sense that more puzzles could be found within the environment's geometry, extending their understanding of what in the game can be considered a puzzle.

This strategy of starting with simple cognitive challenges that grow into raising questions about the very nature of the game has been part of several games; such as *Frog Fractions* (Twinbeard Studios 2012), a mathematics game that changes into several different types of games, or *Inscryption* (Daniel Mullins Games 2021), a card game that requires players to use ostensibly decorative elements in the environment to succeed.

Conceptual exploration in games can also originate from tasks that change depending on circumstances in the game. This is typically the case for strategy games where the overall goal is clear, but individual challenges within that goal are a matter of player choice. In strategy games, curiosity is elicited by the information gap of how player decisions will impact future game states, given a response of such decisions through the game's systems (often in the form of other players, whether automated or driven by human intelligence).

It should be noted that conceptual exploration can be a significant component in games that are not primarily about it. In the survey, participants considered *Elden*

Ring: Skyrim as a game that involves conceptual exploration, likely due to the choices that can be made within the game. As a role-playing game, the properties of the player character can be modified and impact how the game unfolds. Furthermore, choices made by the player can impact the game's narrative, thus leading players to wonder how their choices will impact other characters and events.

5.2.2 Strategies for Social Exploration

Related survey genres: *Social Sim*, *RPG*
Related survey titles: *The Sims* (Maxis 2000), *World of Warcraft* (Blizzard Entertainment 2004), *Journey* (Thatgamecompany 2012)

Social exploration in games can be understood as the interaction between human players, as well as interactions with virtual characters that act as projections of social motivations and behaviors. Games that are said to be character-driven, meaning that the narrative deals with the desires and motivations of its characters involve social exploration in the player's imagination. The information gap is in the uncertainty of how events impact the emotional state of characters in the narrative. It can also point players toward circumstances for which they do not know how they would respond to in their own lives. This allows players to experiment with social variables in a somewhat controlled manner, allowing them to learn more about how they would interact with others outside of the game environment.

The *Social Sim* genre invokes social exploration through the involvement of everyday tasks and actions. Not all such actions are necessarily connected to another character. It might involve mundane activities, such as getting out of bed or cooking food, as actions that players can take. By having players control the events of seemingly minute actions, they are more likely to identify and relate with a character. Like the characters in the game, players have thousands of small tasks throughout the day that often do not appear influential but make up most of the events in a day.

A straightforward implementation of this strategy is found in *The Sims*, a game series in which players control the everyday actions of multiple characters in a virtual world. The game does not have a predefined narrative. Instead, it gives players possible career paths (with in-between goals) and everyday tasks. Characters in *The Sims* make decisions themselves but can be instructed more directly by the player. This gives *The*

Figure 5.3: Screenshots from the games *The Sims* (left), *World of Warcraft* (middle), and *Journey* (right).

Sims a sense of playing with a virtual doll house in which the player creates the narrative. At the same time, characters in *The Sims* have their moods and reactions to events that are not fully controllable by the player, including how they will react to discussion topics. This keeps players invested in the game as their actions can only partially steer the virtual lives of *The Sims* while remaining curious about whether decisions that have been taken play out as players would expect them to.

Another form of social exploration can be found in multiplayer games, where the information gap is in the uncertainty of how other people react and respond to game situations. Multiplayer games exist throughout all game genres but can also fundamentally define the overall game experience in a way that could be seen as constituting a genre of its own. Some multiplayer games put players into competition with one another, thus putting the social exploration in a strategic realm of extrapolating how an opponent will respond to actions. While an opponent's play style can reveal their personality and emotions, social curiosity within competitive play is more likely to be restricted to exploring rational and strategic choices rather than emotional impacts.

Multiplayer games can also be collaborative by working together to accomplish a task or experiencing events alongside another player. For example, the game _Journey_has players wandering through virtual landscapes and coming across other players seemingly by chance. Here, a strategy to elicit curiosity for the "other" is restricting communication. In *Journey*, players can only use simple sounds and character movements to communicate, making any encounter with another player a game of signaling intentions. In this sense, *Journey* encourages reflection on the other player's intentions due

to its design — something that would be lost if a more direct form of communication was made available.

Games that connect many players, so-called "massively multiplayer online" games, tend to involve both competition and collaboration. Social exploration in such games runs a wide range of motivations inherent in the design of such games to create large communities. Games such as *World of Warcraft* (*WoW*) involve tools that support communication among players as well as ways to establish organizational structures. Tasks in the game are intentionally designed to either functionally or practically impossible to complete without the combined efforts of multiple players. This requires effective communication in real-time to coordinate efforts. In contrast to *Journey*, *WoW* attempts to make communication between players as straightforward as possible and implements challenges that require a high level of communication. The game further provides players with many opportunities for social interaction that are not immediately in service of overcoming a given task (Chen and Duh 2007).

Another form of social exploration is motivated by games in the *RPG* genre. Roleplaying games have players assume a character that grows over time. This growth is usually rooted in the game's narrative but also expressed through game systems, such as learning new actions that can be carried out in the game. This is exemplified in MMO games, such as *WoW*, where players' interactions are mediated through player avatars. *RPG* games provide space for social exploration even in the absence of other players, as is the case in *Elder Scrolls: Skyrim*. Non-player characters in the game can respond differently depending on how players develop their player characters. *RPGs* often emphasize different outcomes based on the player character's actions, including the possibility to act out dark or potentially uncomfortable personality traits in a safe environment. In such cases, the information gap that is addressed is, in part, in the self-exploration of players. As a result, roleplaying games are more likely to elicit curiosity if they provide players with unusual situations to act in.

5.2.3 Strategies for Spatial Exploration

Related game genres: *Exploration*, *RPG*
Related survey titles: *Zelda: BotW* (Nintendo EPD 2017), *Elder Scrolls: Skyrim* (Bethesda Game Studios 2011), *Minecraft* (Mojang 2011)

Games that elicit curiosity for spatial exploration provide players with a virtual environment that they can navigate in. This navigation is typically anchored in a player character, providing a third-person or first-person perspective relative to the player character. The information gap that motivates spatial exploration is not knowing what players might find at different locations in the game. Connected to this lack of information is the perception that something of value could be found in the environment. This could be either an object that is beneficial to the player through game mechanics (i.e., acquiring a resource in the game), gaining a better understanding of the environment's topography, or eliciting a sense of awe for discovering aesthetically pleasing locations.

Colloquially, the label "exploration games" is perhaps most directly connected to games in which players can roam freely within a large virtual environment and are encouraged to do so as part of the game's design. Players might be tasked to visit specific locations but are likely to find alternative paths or interesting elements. Alternatively, they might be called to forage for resources that are hidden within the environment. Such games might also be referred to as "open world" games, indicating that the game provides a significant degree of freedom in player movement. Although the scale of a virtual environment has a significant impact on the perceived exploration potential (i.e., how much space can be explored), this perception is impacted by how much of the environment a player can perceive at a given time, how fast they can move in the world, and how detailed the environment is. In addition, players are more likely to remain curious (or become curious repeatedly) if the environment continuously provides meaningful novelty. A very repetitive game world is easily confusing, as it becomes difficult for players to orient themselves. Meaningful novelty refers to the possibility that environments may involve factually unique locations that, although distinct, do not stand out as attractive to players.

Zelda:BotW is a noteworthy example of a game focused on motivating spatial exploration. Players are free to make their way through the environment early on in the game. The game provides the players with directions as to the overall goal of the game but does not restrict their movement should they go elsewhere. The game's design assumes and encourages players to venture throughout the environment before heading to their final destination, not only to gain experience and valuable game objects in the process but because the vast majority of the game's designed content is distributed

throughout the game world. If players were to head to their goal as fast as possible, they would miss most of the game's narrative and gameplay experience.

Figure 5.4: Screenshots of Zelda:BotW (left and middle) and Minecraft (right).

Zelda:BotW furthermore encourages spatial exploration by giving players a rare ability within video games: the ability to climb on almost any surface. Typically, video games are keen to restrict player movement in areas that are not designed to be part of the gameplay experience. Detailed environments take a long time to create, and implementing interaction possibilities within such environments takes longer still. Even in large virtual worlds that are freely explorable, games typically restrict the kinds of actions players can take within them. Vertical locomotion (e.g., jumping, flying, or climbing) adds to the amount of space that players can reach, as well as see from higher vantage points, and thus adds to the amount of effort of creating such worlds. Climbing is rare even within these modes of locomotion, as it requires taking the surface of climbable environments into account. This requires further development considerations, such as determining what parts of a surface are climbable or using appropriate animations for different stages of climbing. Video games will frequently use predesignated objects as simulated climbing actions. In such a case, players cannot move freely but can decide which object to move to next. In *Zelda:BotW*, however, players can climb freely, primarily restricted by their stamina, a resource that can be extended through actions in the game. Overhangs and slippery surfaces remain off-limits to players and allow the designers to restrict some areas. However, for the most part, *Zelda:BotW* communicates to players that most of what they see in the game world is within their reach.

Although the vastness of the traversable space increases the boundaries of what can be explored, it can also be experienced as overwhelming for players. Even if games implement a high degree of interactive detail throughout a game world, there will always

be areas with more or less for players to do. A large environment can thus feel disorienting if any direction for them to take seems to be as good as any other. Video games that motivate spatial exploration often introduce unique locations that provide information about their immediate surroundings. Such navigation nodes tend to stand out within the environment through tall structures or unusual objects. Visiting these nodes often provides players with a more detailed game map, allowing them to understand the surrounding environment with a bird's-eye view. It can also trigger the display of new game tasks and thus point players more directly to other things to do as a result of their exploration. By supplementing freedom of movement with smaller in-between goals that introduce new focus points, games such as *Zelda:BotW* or *Skyrim* aim to focus players' attention on where to explore next as a strategy for eliciting curiosity. Without this focus, players would still retain the freedom of movement but would be less aware of specific gaps in information.

A different approach to spatial exploration can be seen in *Minecraft*, a game that creates a practically infinite virtual environment for players that can be modified and reshaped at will. Although the game provides players with a goal, the means of getting to it is by mining for resources in the environment and using them to craft helpful tools. The way how players achieve that goal is left entirely up to them. As a result, the game environment does not promote a specific location within the created environment. Instead, it is a simplified representation of patterns found in nature. Mountain ranges, for example, are sloped and shaped realistically, if only at a much lower resolution. Flora and fauna in the game are roughly grouped into biomes, such as fields, forests, and deserts, that follow individual patterns for environment creation. The knowledge that the environment holds resources of interest anchors players to a specific task amidst all the freedom for exploration. Much of the spatial exploration in *Minecraft* can be considered foraging behavior. Players are not driven to specific destinations in the game but to any destination that might harbor a desired resource. Through ongoing foraging, players learn the game's patterns to distribute resources and thus become more targeted in their foraging efforts. Using such patterns allows the game to provide centers of attention for players relatively independent from their exact amount or location. This perception and successful recognition of spatial patterns can motivate spatial exploration.

Zelda:BotW also involves a foraging strategy, although to a smaller extent. The game hosts 900 so-called “korok seeds”; collectible objects that involve finding a small creature that holds it. These creatures tend to be hidden in the environment but feature distinct patterns that point to their presence. Some of these patterns also follow the convention of the aforementioned *Easter Egg* game design pattern by hiding creatures in seemingly hard-to-reach places or making them appear through seemingly unrelated unusual actions at specific locations.

With these examples in mind, the next section of the chapter delves deeper into how patterns in the game environment can motivate spatial exploration.

5.3 Formulating Testable Design Patterns for (Spatial) Exploration

This section presents the formulation of five design patterns for spatial exploration. More specifically, these design patterns are framed from the level design perspective, shaping the topography and architecture that make up the game environment. This still requires taking more general game design into account, as the abilities and challenges of a game directly impact its level design. It should be noted that the amount of formulated patterns is not meant to be exhaustive of all level design patterns that could be described. Instead, it is meant to exemplify the process, with some variations, of defining testable level design patterns based on prior work.

The patterns are formulated on the basis of work by Björk and Holopainen (2005), who cataloged a wide range of patterns in their book *Patterns in Game Design*. The descriptions include game titles discussed in the previous sections and similar game titles. Similarities come from how the environment is presented and strategies guiding players through a free-roaming world. The resulting patterns are thus also formulated for games with similar overall game design systems, i.e., that focus on an individual player character where most designed activities are distributed throughout the game environment in a non-linear manner.

Before discussing individual patterns, it is essential to note that design patterns are not necessarily strategies that compete against one another. Strategies can exist in parallel

or interact with one another. Video games discussed in this section typically use several strategies to elicit curiosity for spatial exploration.

5.3.1 Pattern: Reaching Extreme Points

Video game environments may feature locations that are difficult to reach. Tall mountains might require long and arduous travel through challenging terrain. While reaching extreme points often involves covering a long distance, they can also be implemented on reasonably even ground if other obstacles make reaching a desired location more difficult.

Related game design patterns (Bjork and Holopainen 2005) include:

Outstanding Features — This pattern describes areas or elements in the game world that convey information to players by their appearance. *Reaching Extreme Points* are designed to stand out within the larger game environment, both in their aesthetic and in how challenging they are to reach for players. While not all *Outstanding Features* represent patterns of *Reaching Extreme Points*, the reverse is generally the case, as the degree of "extremeness" needs to be communicated to the player. Mountains, towers, and other tall structures are typical examples of outstanding features, especially when they are located far away from the boundaries of a game world. This keeps the pattern visible from most locations in the environment. *Zelda:BotW* features both tall mountains and observation towers that stand out in the game world. Even in a game with many mountains, unusual details can further emphasize specific instances. In *Zelda:BotW*, for example, one such instance is a prominently placed mountain that appears split in half, with a canyon leading through the center. The game *Horizon: Zero Dawn* (Guerilla Games 2017) features an example of a somewhat dynamic version of such an *Outstanding Feature*. In the game, so-called "Tallnecks" (large dinosaur-like robotic creatures with similarities to gigantic giraffes) roam at pre-defined locations in the game world. These creatures can be climbed and provide players with an overview of the environment.

Strategic Locations — This type of pattern refers to the advantage that players might have in reaching and staying at such locations. In the context of spatial exploration, 'control' can be understood as simply inhabiting a space with the player character. *Reaching Extreme Points* frequently involves reaching a location that is not only diffi-

cult to reach but also valuable once players have done so. Reaching a very high point in the environment allows players to see a large part of the surrounding environment, thus providing them with a lot of knowledge. They might also provide game items that improve the player character's abilities as a reward, thus providing a strategic advantage. Temples in *Ghost of Tsushima* (Sucker Punch Productions 2020) are both strategic in providing players with a high vantage point and new skills that players can subsequently use throughout the rest of the game. This aspect of *Reaching Extreme Points* can overlap with a pattern discussed later: *Foraging for Desired Objects*. Video games tend to combine patterns, and desired objects are frequently found at locations that are challenging to reach.

Overcome — This game design pattern involves defeating an opposing force. When *Reaching Extreme Points*, some form of opposing force must be overcome. With tall mountains, this force can be as simple as gravity, as any misstep by the player results in falling to the ground. Even when the game does not include a negative consequence in the form of simulated injury (i.e., damaging the player character), players lose time as they have to navigate back to where they fell. In the video game *Subnautica* (Unknown Worlds Entertainment 2018), the extreme point is to dive into the ocean depths that provide players with new resources. Instead of considering gravity, players need to be mindful of their oxygen level, which depletes over time and thus restricts how far they can get before returning to the surface. Just like in real life, this makes it dangerous to make mistakes in navigation when trying to leave an underwater chasm in time. Challenges can also come from making exact maneuvers to prevent the player character from getting injured. In *Zelda:BotW*, and many other games, spikes may surround a location, allowing players to overcome them through precise jumps or other forms of locomotion. Such "spikes" can be literal in indicating a clear danger to players, such as a moat of lava or acidic liquid, or metaphorical, via an increase in the challenge through game mechanics.

Based on these game design patterns, *Reaching Extreme Points* involve the combination of localized challenges that need to be overcome, providing strategic advantages for reaching the location, and having a distinctive appearance that signals to players that challenges will need to be overcome. In practice, this pattern is most prominently

implemented through tall structures, indicating that the "High Places" pattern from *A Pattern Language* also applies in game worlds.

5.3.2 Pattern: Resolving Visual Obstructions

Within the game environment, individual game objects can obstruct the visibility of what lies beyond. Games may feature such obstructions deliberately and prominently to motivate players to discover what is being deliberately obstructed. Implementing this pattern requires signaling that something of interest could be found while maintaining ambiguity about whether that is the case or what could be found.

Related game design patterns include:

Fog of War — This pattern refers to the deliberate obfuscation of the game environment resolved by spatial exploration. *Fog of War* reduces visibility and represents a conceptual implementation of spatial knowledge of the environment. Typically, this pattern is more commonly found in games where players do not perceive the world through the viewpoint of a player character, e.g., real-time strategy games that are played from a bird's eye perspective. In such games, *Fog of War* is thus a representation of spatial information (or lack thereof) of characters with more limited information than players have given their vantage point. However, it can also be implemented as an area where visibility is temporarily obstructed, such as fog, heavy rain, or lack of light. In such cases, players must closely approach objects in the environment to see them clearly. The open-world game *Elden Ring* (FromSoftware 2022) can illustrate both forms of this pattern. The game map is initially blank and is only made visible as the player finds its pieces in a specific location in the virtual environment. While exploring the game world, players will also often enter areas (e.g., catacombs) with limited visibility, where the use of spells or items is required to proceed.

Imperfect Information — This pattern describes a deliberate withholding of information or an intentional decrease in the accuracy of the information provided to a player. In the context of the *Resolving Visual Obstructions* pattern, game elements (including a game's topography) are used to obscure parts of the game that could be of interest to the player. To provide *Imperfect Information*, players need to suspect that obstructions could result from deliberate implementation. In other words, the information that "something might be there" is communicated ambiguously. In *Elden Ring*, this is fur-

thermore illustrated by the game map. In addition to starting out blank, the size of the finished map is not initially communicated to the player. This means that the potential map space expands as more pieces are collected, making the player realize that the game world is more extensive than they initially thought and wonder how large it will become.

Secret Resources — The *Secret Resources* pattern refers to the involvement of rare resources that are seemingly not meant to be discovered by the player. Such resources are ultimately still designed to be found but are sufficiently hidden to require closer investigation to be localized. The game *Ghost of Tsushima* has many different types of world elements or collectibles to be found, most of which are marked on the map. One exception is the placement of hidden altars, of which the game does not inform the player that they exist. They do not look like altars and are identifiable in the game environment only by a wooden sign that signals the player should perform a bow. This is done by making an appropriate gesture, which, when done correctly, results in a visual effect surrounding the player.

Easter Eggs — As mentioned earlier, the *Easter Egg* design pattern refers to surprising elements in the game that are not directly related to the overall gameplay. *Easter Eggs* can range widely in implementation, and players will look for them, partly because they may expect them from a particular developer. Developers may, for example, include references to their previous games, e.g., an arcade machine of *Crazy Taxi* (Hitmaker 1999) in *Two Point Campus* (Two Point Studios 2022) (both published by SEGA) or multiple references in *Grand Theft Auto V* (Rockstar North 2013) to the protagonists of the studio's previous games, pop culture, and real-life people and events.

With these game design patterns in mind, the pattern of *Resolving Visual Obstructions* involves discernible obstructions within the game environment that suggest that something might be found upon closer inspection. Such obstructions are generally easily resolvable through spatial exploration and do not involve additional challenges. Instead, the challenge is in recognizing that there are resources in the environment that are intentionally hidden and discerning which areas in a game might harbor such resources. Exploration motivated by this pattern may also result from looking for *Easter Eggs* in the environment that are often found at similar locations as *Secret Resources*.

5.3.3 Pattern: Out-of-Place Elements

Video games can motivate spatial exploration with game elements that appear out of place in the context of their surrounding environment. In contrast to elements explicitly indicated as locations of interest by the game, *Out-of-Place* elements elicit a sense of uncertainty. Their appearance is unusual enough to be noted by the player but often does not inform them what they might find upon closer inspection.

Locations of Korok seeds in *Zelda:BotW* are indicated by a variety of *Out-of-Place* elements in the game environment. Players rarely see Koroks directly. Instead, they can notice elements in the environment that hint at their presence close by. An example of such an element is the placement of three identical-looking trees, where one tree has an extra apple hanging from a branch. However, players manage to do it once they remove the extra apple, and thus make the three trees look identical, a Korok appears to reward players with a Korok seed.

Related game design patterns include:

Outstanding Features — This pattern, mentioned earlier, refers to areas or elements in the game world that convey information by their appearance. In contrast to its involvement in the *Reaching Extreme Points* pattern, *Outstanding Features* can stand out on a small scale. Areas in the game might be intentionally lit in a slightly different way. Players could also encounter game elements that are either entirely unfamiliar or encounter familiar elements in an unusual environment. Drawing on the example of the three trees in *Zelda:BotW*, a golden tree could have elicited curiosity as representing something entirely unfamiliar. However, a familiar tree can appear unusual when accompanied by two other identical (or close to identical) trees close by. The artifice of these trees in an otherwise more natural-looking environment makes them appear unusual.

Clues — This game design pattern refers to elements that provide information about how a goal can be reached. Games frequently feature *Clues* close to the game elements that need to be interacted with to progress. *Clues* are defined by communicating some information to players while also maintaining a degree of uncertainty to not act as an outright solution. In the example of the three trees in *Zelda:BotW*, the apple that is only on one of the trees acts as a clue by being in proximity of an *Outstanding Feature* and

also being an object that players can interact with. *Clues* do not always require actions from the player. They might also provide information that can be useful at a different location in the game or lead toward a specific location. A dynamic implementation of this pattern can be found in the game *Ghost of Tsushima* where the player can encounter foxes and tropical birds that, if followed, lead players to locations of interest.

The combination of these design patterns, or, in other words, the use of outstanding features as clues for the player, communicates that there is something of interest for players to discover. Video games frequently involve this pattern to integrate small cognitive challenges that yield some reward when solved. *Out-of-Place* elements are used to lead players to such challenges and cause players to be mindful of other instances of the pattern in the environment to discover more of such activities. It might also lead players directly to resources, thus rewarding players for recognizing that an element stands out against the environment.

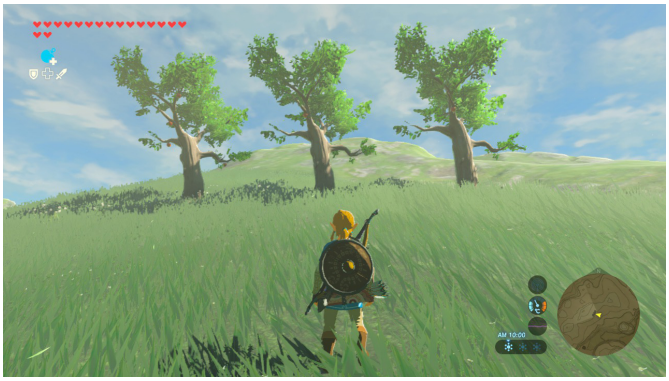

Figure 5.5: Screenshot of *Zelda:BotW*, showing three identical-looking trees but with one carrying more apples than the others. Players can pluck the extraneous apples to make the trees identical and thus receive a reward from the game.

5.3.4 Pattern: Understanding Spatial Connections

Games may involve complex paths to motivate spatial exploration, either through intricate interconnectivity or through obfuscating the endpoint of a path (e.g., in a labyrinth). They might also explicitly query a player's understanding of a specific loca-

tion, for example, through a simplified treasure map that requires players to determine a location in the virtual environment.

Games that motivate spatial exploration frequently implement a single, coherent game world. That is in contrast to games that use several game environments and transport the player character between them. In practice, most games involve several environments, but games that present a single coherent world involve strategies for loading and unloading unseen areas without players noticing.

If players understand themselves to interact within a coherent game world, they become aware that most of what they see in the environment is potentially accessible. The challenge is finding out how to reach locations for which it is not apparent how they can be reached. This challenge is generally lower in *Zelda:BotW*, where players can climb on most surfaces and thus can reach most locations by taking the shortest route. A contrasting example is *Dark Souls* (FromSoftware 2011), in which players explore a large castle with many interconnected passages. Locked gates separate many areas in the castle that players can see through. This gives players an idea of how spaces connect, even when they do not yet know how to reach them. The limited visibility into a neighboring but unreachable space can still provide information as to how it may be reached or make players aware that there is a space that could be discovered.

Related game design patterns include:

Traverse — This game design pattern refers to the goal of relocation from one position to another. The challenge of reaching the new location is either in the distance that needs to be covered or in overcoming elements that keep players from reaching it. *Traversal* can also result from unstated, player-driven goals to investigate environmental elements. Games in large coherent worlds frequently require players to visit new locations far from where they are. In doing so, players extend their mental map of the environment, providing them with a more focused sense of uncertainty for locations that have remained unvisited between the places they did visit.

Obstacles — The *Obstacle* pattern involves game elements that hinder the player from taking the shortest route between two places. Such *Obstacles* can be in the shape of topographic features that impede movement at specific locations or moving entities that threaten the player. In practice, video games tend to feature both to provide a va-

riety of challenges. *Obstacles* are generally visible to the player and are meant to cause a change in behavior by the player to overcome them.

Inaccessible Areas: This pattern deals with areas in the game that players can perceive but cannot enter. *Understanding Spatial Connections* does not require players to access all areas, as long as they can perceive enough of an area to add it to their mental map of the environment. However, *Inaccessible Areas* might also not be inaccessible forever, and players might be motivated to consider such areas as explorable in the future.

Eliciting a desire for spatial exploration through *Understanding Spatial Connections* involves mapping out an environment by traversing it and coming across seemingly inaccessible areas. Such areas might appear inaccessible due to topographic obstacles or other elements that hinder a player from reaching the area.

5.3.5 Pattern: Desired Objects Foraging

Games frequently feature objects that offer either beneficial effects or are otherwise desirable to obtain. In many cases, these objects are placed in such a way that their discovery is a challenge in itself. Players are made aware of the existence of objects or are even prompted to look out for them as the game progresses. The collection of such elements can be a motivation in itself that has more to do with amassing beneficial resources than the process of looking for them. However, players might also enjoy the activity of potentially finding something of value in the environment. Games may also task players to gather a certain amount of objects, thus reducing the importance of individual items.

When players know that the environment might hold specific objects of interest, they are likely to look for locations that indicate the presence of such objects. The word "object" might suggest a relatively small size, but it includes structures that can be entered by the player, as is the case with shrines that can be hard to find in *Zelda: BotW* while also being frequent enough to be seen as part of a collection.

Related game design patterns include:

Collection — This pattern refers to completing subgoals that form a coherent unit. Subgoals can be as simple as acquiring an object. Indeed, *Collections* are often presented by physical fractions of a larger whole, such as shards that can be assembled into a

crystal or image fragments that form a bigger picture. While collected items might be beneficial to players, the focus is on the task of acquiring more of them. As a result, games often reward players not for collecting a piece of a collection but for completing it.

Pick-Ups — This pattern refers to the ability to acquire items in the game environment, typically close to the player character's location. Individually, such items are referred to as *Pick-Ups* and often impart a benefit to players for being picked up. In contrast to *Collection*, *Pick-Ups* focus on individual items and their relevance to the player. Such items will often come in the form of equipment (e.g., weapons or clothing) or consumable items (e.g., potions, food, arrows) that the player can use.

Desired Object Foraging motivates exploration by the awareness that something of value can be found in the environment without a specific indication of where such objects might be found. As a result, exploratory behavior is less directed but occurs with heightened awareness about details in the environment. Games involve object foraging as a strategy to put players in a state of being more aware of their surroundings and thus also more likely to notice other design patterns for more targeted exploration.

One challenge of considering object foraging a strategy for motivating spatial exploration is that ongoing foraging can be due to requiring a resource that can be found rather than the conceptual hunger that curiosity represents.

5.4 Conclusion

This chapter discussed design patterns in different fields and in the context of video games. A short list of five design patterns has been described in detail to formulate testable patterns for spatial exploration. For each of these, a description of related game design patterns (based on Bjork and Holopainen 2005) outlines how spatial exploration is motivated.

The five design patterns directly address the research question stated at the beginning of the chapter as to what design patterns can be hypothesized. As mentioned in the chapter, these five are not formulated to provide an exhaustive list of design strategies but as a step towards the empirical study that can assess the efficacy of hypothesized pat-

terns. The theory presented in this chapter can form the basis for further formulation of design patterns for different types of exploration.

The next step to conducting an empirical evaluation of the design patterns formulated in this chapter is to develop specific instances of these patterns in a playable game. This process is described in the next chapter in the context of developing and piloting a case study game.