Designing persistent player narratives in digital game worlds

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Designing Persistent Player Narratives in Digital Game Worlds

La conception de récits persistants de joueurs dans les mondes numériques des jeux vidéo

Thèse de doctorat de l'université Paris-Saclay

École doctorale n°580, Sciences et technologies de l'information et de la communication (STIC)
Spécialité de doctorat: Informatique
Unité de recherche : Université Paris-Saclay, CNRS, Laboratoire interdisciplinaire des sciences du numérique, 91405, Orsay, France.
Graduate School : Informatique et sciences du numérique
Référent : Faculté des sciences d'Orsay

Thèse présentée et soutenue à Paris-Saclay, le 2 décembre 2021, par

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NNT : 2021UPASG102

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Abstract

Persistence is an implicit property ruling how worlds and objects last from one moment to another. Unlike the physical world, digital game worlds, such as Massively Multiplayer Online games (MMOs) have limited persistence since they require game designers to specifically decide how any object and state should persist, and carefully calculate how the lasting effects influence players' experiences. Nevertheless, players generate rich and unique stories every time they play, but due to low persistence, they leave few traces behind and cannot share their narratives as part of the game. I explore the role of persistence and player narratives in MMOs to understand how game designers can build digital game worlds that persist and turn elements of players' narratives into meaningful content.

I argue that by combining three powerful concepts — persistence, narrative theory and co-design — we can create digital game worlds that offer novel meaningful modes of play through players' narratives. To achieve this, I develop theory and design my own game environments based on gathered narratives of players' experiences and iterative playtesting over several years.

This research required robust and innovative methodology to achieve deep understanding of players' and game designers' needs. I combine several methods to gather player stories, with existing theory and design of game artifacts, offering an approach to balance the methodological trade-offs and maintain high ecological validity. After preliminary interviews, I found it most useful to gather many short, specific stories of players' experiences. I introduce a variation of *Story Questionnaires* which asks players to respond with their own stories inspired by pre-written examples related to persistence. I also demonstrate how to use Reddit for gathering large sets of player-written accounts of their in-game experiences. To facilitate co-design and story analysis, I develop Virtual Tabletop Role Playing Games (VTTRPG) and introduce *Play Traces*, a method for structuring traces of player activity in graphical representations to design new narrative content together with players. Lastly, to illustrate and test my findings, I develop my own Massively Multiplayer Online Game *We Ride* and use it as research environment, demonstrating how to conduct quick iterative testing as well as longitudinal studies of different game technologies with consistent player feedback.

The research approach includes six qualitative studies to understand players' experiences, their relationships to persistence and how to support co-design and content generation through player stories. From the stories I gathered, I show that players seek unique gaming experiences and that their narratives are highly influenced by first-time moments and achievements. However, the lack of persistence in digital game worlds fundamentally affects players, lowers their sense of unique experiences and instead promotes *meta-persistent* activities, i.e. leverage persistent features of the web for telling stories or collaborate, which can disrupt gameplay and reduce the rate at which game worlds remain relevant and interesting to players. In *We Ride*, I show how *Narrative Substrates* help game designers address these challenges and that players successfully generate new content both as story artifacts that persist past events over time and through the co-design of their own stories with *Play Arcs* while adding to an embedded history of the game world. I show that players are productive co-designers of persistent narratives through Virtual Tabletop Role Playing Games and *Play Traces*, that they find it meaningful to engage in co-design as well as contribute with high quality content for other players to interact with.

This thesis contributes several different technologies related to co-designing and persisting player narratives. I built *We Ride* as a research environment for developing game systems that can persist and reify players' in-game activities, with relevant game mechanics such as items that show how players interacted with them and evolve accordingly, Non-Playing Characters in towns that talk about player activity, or enemies that remember you from past encounters. I also designed functionality such that players can co-design story content inside of *We Ride*, research player-made history in the world and re-discover heirlooms from older times. In exploring how to support players as co-designers, I produced several VTTRPG prototypes as well as *story monitoring interfaces*, both inside *We Ride*, and as an web application that let Game Masters search for persisted events to compose new narratives based on player stories.

I introduce novel theories that are grounded in players' experiences, pre-existing theories and testing in real game environments. *Narrative Substrates* is a theoretical framework that help game designers architect game systems that represent, manage and persist traces of play activity as unique, interactive content. With *Play Arcs* as an additional component, the concept further supports both co-design and reification of complete and coherent persistent narratives embedded within digital game worlds. This broadens the scope of instrumental interaction and co-adaptation by demonstrating how the theories apply to game design as well as in handling a temporal aspect of information substrates.

Acknowledgments

I want to express my deepest gratitude to my supervisor, Wendy Mackay, who through her teaching introduced me to hers and Michel Beaudoin-Lafon's ways of thinking about interaction design in such an inspiring way that I could muster up the courage to ask if she thought it might be interesting to apply the philosophy in game design. Thank you for everything I have learned over the past four years, through the workshops, PhD seminars and in particular our weekly, buzzing conversations on the research.

I am forever grateful to my brother, Benjamin Holme, who with great patience taught me Unreal Engine and with endless passion developed and will always continue develop *We Ride* with me. Thank you for believing in, but also challenging my ideas, making us think together and find clever solutions as per our own co-brother design philosophy.

I thank the jury members, Brigitte Gauthier, Alan Dix, Andruid Kerne and Mirjam Palosaari Eladhari for taking their time to carefully review my work, providing guidance and inspiring discussions. Special thanks to Mirjam for meeting with me at Södertörns Högskola and introducing me to the INDCOR network. And, Anastasia Bezerianos for your teaching and feedback during the masters and mi-parcours.

I want to thank all my lab colleagues at Ex)Situ for the so very important chats while getting coffee in the library, for the insightful feedback and constructive discussions around my work. Thank you Andrew Webb, John MacCallum and Philip Tchernavskij for showing me the ropes around the office when I was a masters intern and helping me frame my research problem from the very beginning. Thanks to Carla Griggio, Germán Leiva, Stacy Hsueh, Marianela Ciolfi Felice, Jessalyn Alvina, Janin Koch, Niolas Taffin, Benjamin Bressolette, Fanis, Antoine Loriette, Julien Gori and Yujiro Okuya for always being so caring, sharing, helpful and to me, strong role models in the office. Thank you Miguel Renom, Han Han, Jean-Philippe Rivière, Téo Sanchez, Elizabeth Walton, Arthur Fages, Alexandre Battut and Martin Tricaud for sharing all what we have been through together these years, from stressful deadlines to good times in Paris.

Thank you Robert Falcasantos for truly believing and understanding my work. I cannot wait to explore further with you.

My heartfelt thanks to all the people participating in the studies and especially the players in *We Ride* for their engaging discussions, bug-finding & invaluable feedback.

None of this would ever have been possible without my family. Thank you Mom and Dad for being the best parents in the world, offering unconditional support and truly believing that I can achieve anything I put my efforts into, and especially for always being curious and wanting to be involved. Thank you, eldest brother, Anton Gustafsson for being the most intelligent person I know and taking your time to share countless of hours of discussions about MMOs and research.

My love and everything, Selen Ünaldi, thank you for picking me up when life goes down. For being my safety and security and always giving me advice and confidence when I need it the most.

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Introduction

This thesis explores how to leverage persistence, a property of physical worlds and objects which makes them continue over time, for capturing and realizing the narratives which emerge from players' actions in online digital game worlds. I argue that by understanding the role of persistence and how player narratives emerge in digital game worlds, we can design novel systems and tools that increase players engagement and support game designers in producing content.

Narratives emerge from human action, but are shaped and told through persistence. In the physical world, persistence is absolute and continuous, described as *"a quality of actual life"* (Lankoski et al., 2004). There are no states to save or load from any database and interaction produce outcome and effects, from particles colliding to human touch. This yields an infinite *narrative potential* (Eladhari and Lindley, 2004) that is only limited by our own imaginations. Consider a walk in the forest: I leave a trail of ruffled vegetation and might accidentally step in an ant mill or disturb a pair of nesting birds while curiously investigating an abandoned house. With a sprinkle of fantasy I can write the story of how I throw myself through the window of an old shack to escape the angry birds, but as I lie there, flat on my back gasping for air, I notice the roof and walls turning darker, crawling with revengeful ants hungry for blood, and just as they are about to swallow me whole, a hunter suddenly crashes through the door and pulls me out to safety. Persistence defines the possible consequences of our actions and our brains continuously weave them into narratives. The environment binds information to itself, moulds traces of change and not only inspires us to write fiction stories from plain strolls in the

forest, but also generates an embedded collection of events which we interpret[1], understand and share as narratives of our human pasts. By contrast, digital game worlds such as those in Massively Multiplayer Online Games (MMOs) have limited persistence. They are defined as persistent if they evolve, at least to *some* degree, and continue to exist even with no further interaction (Bartle, 2003). Game designers need to explicitly specify how any object and state should persist, and carefully calculate how the lasting effects continuously influence players' experiences. While this is just one of the many challenges in simulating engaging game worlds (Bartle, 2016b), persistence fundamentally affects players' abilities to meaningfully interact and contemplate the narratives of past experiences. In this thesis, I explore the role of persistence to understand how game designers can build digital game worlds that include players' narratives as meaningful content.

[1] The hunter had tracked the traces I left behind

Game designers of MMOs also increasingly struggle to develop sufficient game content that keep players engaged over long periods of time (Bartle, 2016b; Yannakakis and Togelius, 2018). Most modern MMOs, e.g. *World of Warcraft* (WoW), are 'theme parks' that limit players' influence and structure content as pre-written narratives linked to character progression (Bartle, 2016a). They persist *character* data, but not the environment (Koster, 2009a), resulting in more static worlds where players cannot leave traces or history behind, so when they log out it as if they never have existed in the game (Tychsen and Hitchens, 2006). As a result, game designers need to keep players engaged by adding new content—players in non-persistent worlds cannot contribute, nor can the environment grow by itself. Unfortunately, developing content takes far more time than consuming it and Debeauvais et al. (2014) report that designers can no longer fully satisfy these *WoW* players' needs: Even when they plan strategically and distribute patches with new content over long periods of time, they still lose players.

Game designers develop Procedural Content Generation (PCG) tools, i.e. algorithmic computer software that create content by itself, to meet this accelerating demand for new and engaging game content (Shaker et al., 2016). They use different methods to generate content such as maps, levels, terrains, textures, and foliage (Hendrikx et al., 2013; Liapis, 2020; Yannakakis and Togelius, 2018), and save game developers time and resources. However, Short and Adams (2019) note that saving time is not guaranteed since designing procedural systems can end up harder than expected. They also suggest that PCG is sometimes unsuitable for competitive multiplayer and authored experiences such as WoW, when designers want high control of game balance i.e. equal conditions for players, and linear narratives for players to follow. At

the same time, PCG for storytelling is a relatively new field of research and Hendrikx et al. (2013) highlight opportunities for future work in techniques that derive new content based on players' generated stories.

Taylor (2006) urges game designers to consider including players' contributions *inside* of games and acknowledge MMOs as *'vibrant lifeworlds in which productive player engagement is central'*. Players actively grow and shape the cultures around games (Huizinga, 1955) and are *productive agents* (Lindtner and Dourish, 2011; Pearce, 2006) who generate unique stories (Eladhari, 2018), construct social artifacts (Pearce, 2011) or even modify games to their own liking (Sotamaa, 2010). Earlier so called, 'Sandbox' MMOs e.g. *Ultima Online*, are *malleable* worlds where players have more agency to interact and change the environment (Bartle, 2016a; Koster, 2009b). The resulting changes persist in the world, so players collectively contribute to an evolving, *unofficial* narrative that emerges from their actions. While this lets them contribute to relatively persistent, evolving worlds, they still lack the explicit narratives that immerse and acknowledge them as part of a culture and history.

Considering the fundamental qualities of persistence, the challenges of game designers and players' productive behavior, I explore how to design digital game worlds that embed player narratives in their environments and become a continuous source of meaningful content. I study how to truly leverage persistence i.e. *reification, which turns user actions into first class objects that act as tools* (Beaudouin-Lafon, 2000), to capture traces of players' activities and produce novel content. What if games could persist traces of players' stories and reify them into interactive gameplay elements? What if players' past actions could generate 'legendary' artifacts with additional powers? What if locations could adapt themselves, according to past events, enabling real histories to appear in the environment? Players would become real legends, remembered and influential, and contribute to narratives that enhance rather than restrict players' influence.

1.1 Thesis Statement

I argue that by understanding the role of persistence and how player narratives emerge in digital game worlds, we can design novel systems and tools that let people leave behind and shape the stories they generate by playing as well as continuously contribute new unique game content. This can help game designers build worlds that, not only keep players engaged over longer periods of time and mitigate the needs for

successive updates of pre-written content, but also acknowledge players through the histories embedded in the environment.

1.2 Research Approach

Researching and designing novel game systems requires deep understanding of game designers' challenges and players' experiences. Eladhari and Ollila (2012) highlight game design as a 'wicked problem space' (Rittel and Webber, 1973) where achieved solutions change how the problem is understood and argue that it is crucial in game design research to develop and test prototypes for understanding different play dynamics and experiences. For MMOs, this is particularly difficult due to the significant time and effort it takes to develop their large-scale and complex systems (Eladhari, 2009) while also evaluating the effects on players' experiences over long periods of time. This presents a number of methodological problems. I use a triangulation approach (Mackay and Fayard, 1997) to balance the trade-offs across methods by gathering multiple types of empirical data, develop theory and generate novel designs (see Fig. 1.1). I combine theory from Human-Computer Interaction (HCI) with empirical studies and the design of my own MMO *We Ride* (We Ride, 2018) together with another developer.

The theory is rooted in the generative principles of Instrumental Interaction (Beaudouin-Lafon, 2000) and the concept of co-adaptation in Human-Computer Partnerships (Mackay, 2000). *Reification, Polymorphism and Reuse* (Beaudouin-Lafon, 2000; Beaudouin-Lafon and Mackay, 2000) guide me in exploring how to leverage persistence, where *Reification* turns user actions into first class objects that act as tools; *polymorphism* lets users manipulate multiple objects with a single tool; and *reuse* captures prior user input and system output and turns them into objects for subsequent interaction. I further explore how to make players co-designers through co-adaptation (Mackay, 1990), which accounts for how users over time *adapt to* interactive systems and *appropriate* their functionality to meet their own needs (Mackay, 2000).

I begin by gathering and analyzing stories from players' experiences from which I develop and introduce *Narrative Substrates*: a concept for designing game architectures that persist and manage elements of players stories in game worlds. Then, in order to clearly demonstrate the theory and gather first-hand feedback from players, I design the MMO *We Ride* and run a year-long technology probe study. I con-

tinue to build upon the *Narrative Substrates* concept by exploring how to include players as storytellers i.e. co-designers of game content who directly contribute and shape their stories as part of gameplay. I design and playtest three VTTRPGs to develop novel research methodology and present *Play Traces*, an instrument for co-designing with traces of players' activity, which I use in a following structured observation study leading to four design implications for how to design systems that support player-created narratives in MMOs. Last, I introduce *Play Arcs*, further developing *Narrative Substrates* to reify player stories, in addition to single events, and demonstrate the design in *We Ride* with another two-phase technology probe lasting five weeks. I conclude that players successfully generate new story content and that *Play Arcs* offers several directions for future work involving players as storytellers of persistent narratives in digital game worlds.

Semi-structured Interviews

My first approach was to gather stories related to particular game artifacts, using a variation of the *critical incident technique* (Flanagan, 1954) called *critical object interviews* (Mackay, 2002,1). I ask interviewees to recall and reflect on past experiences and describe meaningful objects they have interacted with in the past. The results highlighted the importance of gathering many *short* specific stories, rather than a few very long, detailed ones, when trying to understand the role that persistent objects play in enhancing the user experience.

Story Questionnaires

In order to collect more, shorter stories, I designed my own *story questionnaires* (Griggio, 2018), which combine the critical-object interview technique with a short-answer questionnaire. I prepare sample stories, derived from the interviews, to encourage participants to remember, reflect and respond back with similar stories. I iterate on the design three times, tweaking the structure of the questionnaire's follow-up questions to receive more stories.

Reddit Posting & Story Gathering

I also use *Reddit* to ask for and gather stories from players. *Reddit* is a website that hosts thousands of different communities where every month millions of people post, vote and comment on topics organized around their interests (Redditinc.com, 2021). I create a *Reddit* post to gather examples of games that inspire creation of long-lasting narratives. I specifically ask about narrative persistence, including any

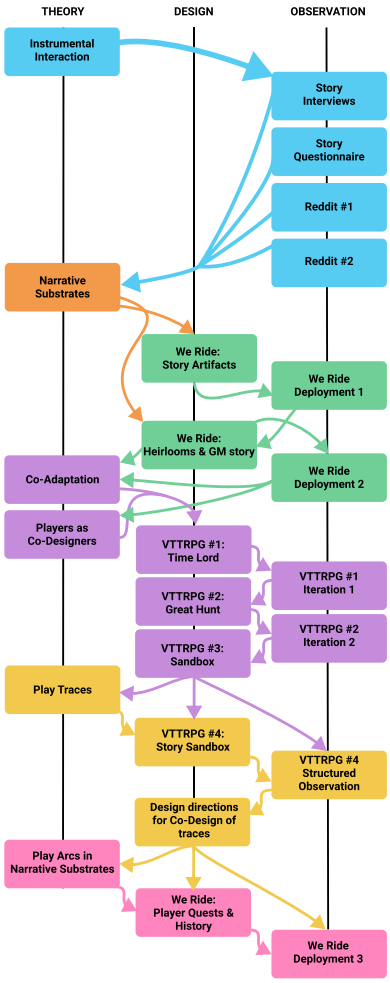

Figure 1.1: Triangulation in this thesis: combining theory, empirical studies and design of artifacts to balance the trade-offs between different methods.

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barriers to implementation of such features. I also extract and analyze comments from an independently created *Reddit* post (Reddit, 2019a), entitled: *"Gamers of Reddit, what gaming experience will you never forget and why?"*.

Technology Probes

I deployed features in *We Ride* as *technology probes* (Hutchinson et al., 2003). Technology probes are simple, flexible and adaptable technologies that are implemented for co-designing—in process—with end users in real-world setting. This method let me iterate through a series of design ideas with continuous player feedback, while preserving ecological validity. In the first probe, I focus on developing base technology for capturing and reifying stories based on the *Narrative Substrates* concept and gathering first impressions from players. One year later, I revise the probe based on players' feedback and extend the technology with additional features to support long-term relevance and GM authored narratives. In the third and fourth iteration two years later, I design *Play Arcs* alongside game mechanics that let players create their own quests and research player histories for a chance of finding legendary heirlooms through treasure hunting.

Virtual Tabletop Role-Playing Games

I designed *Virtual Tabletop Role-Playing Games* (VTTRPG) to explore how to turn players into story co-designers. VTTRPGs offer collaborative, open-ended narrative generation where players actively shape the game. The advantage of virtual games allowed for quick gathering of participants and planning, facilitating a flexible process that let us iterate over multiple prototypes and test designs to develop appropriate methodology combined with an structured observation approach.

Structured Observation Studies

Structured observation (Bousseau et al., 2016; Garcia et al., 2014a; Koch et al., 2020), is designed to let us observe real-world interaction and compare variables over time, while preserving ecological validity. Unlike controlled experiments that are designed to test quantifiable hypotheses, this approach takes advantage of experimental design practices, but does not require an explicit hypothesis and emphasizes qualitative findings and design insights. In the VTTRPG studies, the first iterations provided insights from which I created a procedure where each group can respond to their own traces and roughly the equivalent numbers of traces from other groups, with corresponding reflection

points throughout the four-session period of the game.

1.3 Contributions

In this section, I list the empirical, methodological, theoretical and technological contributions of this dissertation.

Empirical

From an empirical perspective, I conducted six different qualitative studies to understand players' experiences and their relationship to persistence, as well as their roles in co-design and content generation. I show that:

- Players highly value unique gaming experiences and that their narratives are significantly influenced by first-time moments and achievements.

- Lack of persistence in digital game worlds fundamentally affects players in ways that lowers their sense of unique experiences and cause them to revert to *meta-persistent* activities, i.e. leverage persistent features of the web for telling stories or collaborate, which in some cases also disrupts gameplay and reduce the rate at which game worlds remain relevant and interesting to players.

- Game Masters produce content from players' activities in different games and how *Narrative Substrates* supports them in *directly* co-designing new game narratives based on persisted events in *We Ride*.

- Players are productive co-designers of narrative content through persisted traces of their activity, and find it meaningful to engage in co-design as well as contribute with high quality content for other players to interact with.

- Players generate four main types of traces: environment, build, memory and object, and that they prefer to let traces emerge organically in play, and then reflect on them as part of potential narratives in retrospect, as opposed to directly co-design in the moment of play with specific game mechanics.

- Players can successfully generate new content through the co-design

of their own stories and that they indirectly contribute to an embedded history of the game world, as a result of persisted player narratives.

Methodological

In order to maintain high ecological validity in my studies, I needed to develop novel methodology that let me understand a broad spectrum of players' experiences and observe how they interact with entirely new interactive concepts for the first times.

- I combine multiple different methods to gather player stories, with existing theory and design of novel artifacts, offering an approach where researchers can balance the methodological trade-offs and maintain high ecological validity.

- I introduce a variation to *Story Questionnaires* (Griggio, 2018) which quickly gathers different stories of play through specific follow-up questions.

- I develop *Play Traces*, a method for structuring traces of player activity in graphical representations to facilitate story analysis and co-design of new narrative content together with players.

- I develop my own MMO as research environment and demonstrate how to conduct quick iterative testing as well as longitudinal studies of different game technologies with consistent player feedback.

Theoretical

In terms of theory, I derive design principles from players' real experiences to develop conceptual frameworks for designing persistent players narratives and broaden the scope for existing theories across multiple different disciplines.

- I introduce *Narrative Substrates* as a theoretical framework for designing game architectures that represent, manage, and persist traces of player activity as unique, interactive content.

- I extend *Narrative Substrates* with the *Play Arcs* component which supports both co-design and the reification of coherent persistent stories in digital game worlds.

- I broaden the scope of instrumental interaction and co-adaptation

by demonstrating how they can be applied in game design and interactive digital narratives.

Technological

I design and build game technologies for exploring my empirical findings, evaluating their technological viability, and for further studying the resulting effects on players' behavior. I build:

- The MMO *We Ride* as research platform and develop systems for persisting and reifying data of players' in-game activities through relevant game mechanics e.g. items that show how players interacted with them and evolve accordingly, Non-Playing Characters in towns that talk about player activity, or enemies that remember you from past encounters.

- *Story monitoring interfaces* both inside *We Ride* and as an web application that let Game Masters search for persisted events to compose new narratives based on player stories.

- Game mechanics that: let players co-design story content; research player history in the game world; re-discover items from the past; and generate new content through dynamic parameters for how long time they spend outside town and the number of monsters they defeat.

1.4 Thesis Overview

Chapter 2 presents the background and context related to persistence, player narratives, co-design and procedural generation techniques, discussing how the literature ground my theory and methodology as well as the opportunities and limitations of related work.

Chapter 3 describes how I gathered and analyzed the stories of players' experiences in four different empirical studies, finding that players highly value first-time and unique events, and often externalize their experiences to the Web to collaborate and socialize, but unintentionally also disrupt some aspects of in-game play. I conclude that current MMOs lack necessary infrastructure to represent players' stories and let them influence the world, and propose four key implications for the design of persistent game worlds.

Chapter 4 introduces *Narrative Substrates*, a design concept for game architectures that can persist and reify elements of player narratives in digital game worlds.

Chapter 5 demonstrates and tests the theory of *Narrative Substrates* in *We Ride*, a medieval sandbox MMO and study how real players interact with the system as a two-phase technology probe lasting one year. I found that Game Masters can directly reify player stories and create custom events based on player histories; that *Narrative Substrates* can maintain the relevance of stories over time; suggested new ways to reify meta persistent efforts, and finally argue that future work should explore how to support more detailed narratives and how players can co-design their own stories.

Chapter 6 explores methodology for researching co-design of story content based on players' own traces of activity persisted in game environments. I designed and playtested three VTTRPGs and found: that players prefer to reflect on their narrative in retrospect; how structured, graphical representations of players' traces support co-design and narrative analysis; and identified four main categories of traces. I introduced *Play Traces*, a novel analysis method for representing and co-designing narratives with players and conclude that open sandbox environments (the third VVTRPG) are most suitable for exploring co-design with traces.

Chapter 7 describes a structured observation study including *Play Traces* and the third VTTRPG from chapter 6, and show that players successfully (and enjoyably) can co-designed novel narratives. I identified three themes for how traces can affect and support players in shaping new narratives and proposed four design implications of how player-created narratives in MMOs should first *Reveal & Pull* Attention from other players, *Invite & Push* further exploration, *Guide & Assist* toward endings, and optionally *Show & Hide* traces.

Chapter 8 combines the work from all previous chapters and present *Play Arcs*, an extension to *Narrative Substrates* that support the reification of stories in digital game worlds and demonstrates it's implementation in *We Ride*, together with novel *history game mechanics*. In a two-phase technology probe, the playtests show that players successfully generate new content through co-design of their own stories and that persisted player narratives offer several opportunities for more engaging and sustaining digital game worlds.

Chapter 9 discusses contributions and limitations of the work, reflect-

ing on the approach and research problem in relation to the presented findings and previous related work. I also propose several directions for future research and probable ways to address my identified challenges.

Chapter 10 concludes this thesis by summarizing the contributions and main findings in relation to previous theories in HCI and game design.

2

Background & Related Work

In this chapter, I describe the context of my work by giving background to persistence and narratives in digital game worlds, how previous work define and research co-design as well as use procedural content generation techniques for games. Finally I discuss three games with inspiring features related to persistence and narrative.

2.1 Persistence in Digital Game Worlds

In defining persistence with respect to digital game worlds, I adhere to Bartle's (2003) description of MMOs as *virtual* worlds that are persistent if they inherently evolve and continue to exist online even without players. He also distinguishes between *social* worlds such as *Second Life*, that have persistence but no built-in gameplay and *game* worlds e.g. *World of Warcraft* that people primarily *play* in (Bartle, 2016a). I refer to MMOs as the latter and define them as *digital* game worlds, excluding persistent tabletop or live-action role playing game worlds. I also define players' traces[1] as the outcome of their actions i.e. potential events or parts of stories, which eventually, through players' storytelling become narratives.

[1] Note: I shorten 'persisted traces of player activity' to *traces* throughout the thesis.

A Brief History of MMOs

The history of MMOs spans roughly 40 years in which I highlight some of the milestones in the progression of the genre.[2] The first MMO was built 1978 by Richard Bartle and Roy Trubshaw (Bartle, 2003). It

[2] For a more detailed account, I recommend (Bartle, 2003), (Bartle, 2016a), (Pepe, 2020).

Figure 2.1. MMO Timeline: a non-exhaustive overview of the release history for popular and milestone MMOs mentioned in this thesis.

was a text-based Multi-User Dungeon (MUD) which let many players explore the same world simultaneously and grew in popularity with university students who had networking access in a time before home computers and established internet service providers (Pepe, 2020). The following years produced many interesting variations of MMOs, but it was not until two decades later the genre gained real exposure. In 1997, Ultima Online (UO) released with design led by Raph Koster, an experienced MUD developer (Bartle, 2003), who expanded and transformed the concepts of MUDs into large-scale graphical computing, producing one of the first major MMOs with commercial success. He later moved on to design *Star Wars Galaxies* (SWG) released in 2002, another open-ended sandbox MMO praised for high player agency and intricate social mechanics e.g. player-run towns and mayor elections. Today, he is renowned game designer and writer of many books and articles on MMOs.

One year after UO (1998), Lineage was released and attracted millions of active subscribers primarily in Asia. The same year, *Everquest* also came out to become the first commercially successful MMO with *full 3D graphics*. *Asheron's Call* released in 1999 but featured a *seamless* 3D world, as opposed to Everquest, which had different instantiated zones meaning that players had to wait for a loading screen when they reached the 'seams' of the world map. In 2001, *Runescape* launched as a web browser MMO and has since then registered hundreds of millions player accounts. *EVE Online* (2003) introduced similarly sophisticated systems as SWG, only at larger scale and set entirely in space and has resulted in different player alliances plotting against each other, forming some of the largest wars in MMO history with several books and articles written about them[3].

[3] https://us.macmillan.com/series/eveseries

World of Warcraft entered the stage in 2004, blowing the MMO genre up to a global mainstream phenomenon by offering an unprecedented, stable, streamlined quality experience with pretty graphics and pre-

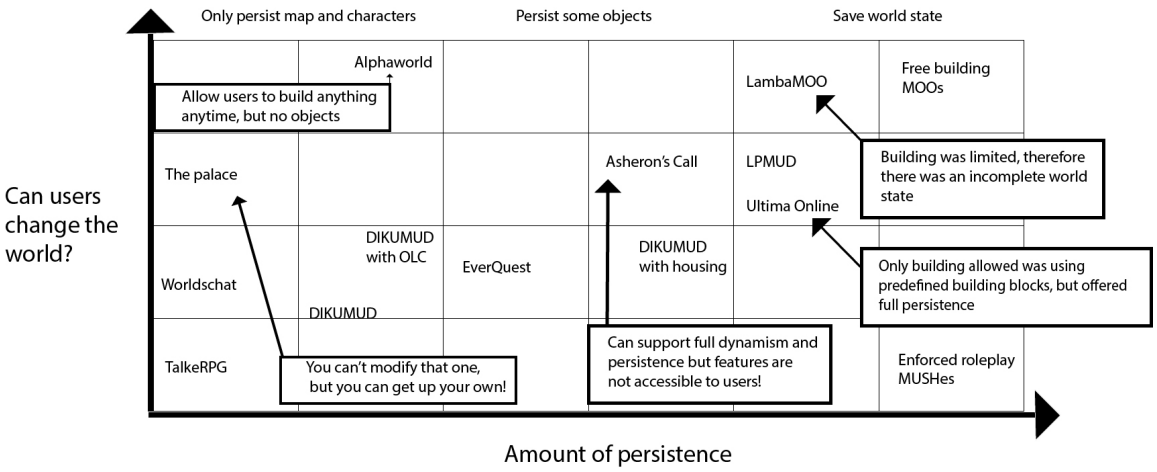

Figure 2.2. Koster's illustration where MUDs and early graphical online worlds are mapped corresponding to change players can do in the world and how much of their consequences that persist. Image redrawn from (Koster, 2009b).

existing lore already praised by fans playing the single-player *Warcraft* series. Thereafter, following new releases of MMOs more or less continued building upon the themepark concept, with big titles such as *Guildwars* (2005), *Final Fantasy XIV* (2010), and *Black Desert Online* and *Elder Scrolls Online* in 2014. Since 2004, WoW has released eight major expansion packs and in 2019, a separate re-release of an early version of the game called *WoW Classic*, running alongside the main game, after much demand from their fans to revert back and let them play the way they did before.

What began with open-ended, text-based persistent worlds has evolved into a full universe of different games offering their inherent characteristics and variations, yet trending towards the themepark rather than a sandbox approach, with less persistent worlds compared to their predecessors. In the following sections, I will discuss how Koster and other scholars reason about designing with persistence with examples from HCI researchers.

Persistence and Change

Koster (2009a) describes the typical process of persistence in two steps: First, designers set up definitions and game rules in a *static* 'read-only' template database, for example, defining new characters' starting states. Next, players play according to these rules, causing them to accumulate items and evolve skills that are communicated to a server and saved to a *dynamic* runtime database. The stored data persists as the server continuously recommunicates data to the client. Although still widely used, this solution forces reliance on a single server, or splitting the world into different zones, each with a server. Moving into a different zone causes a screen reload, which disturbs the

illusion of a large, seamless world. New solutions, such as *SpatialOS* (Improbable, 2019), offer a cloud-based framework that combines and enables several servers to work together *spatially* as one, i.e. they divide the world into sections that each communicate and synchronize with players. The goal of *SpatialOS* is to support persistence at scale for the next generation of multiplayer games, and should provide new opportunities for exploring novel interaction techniques related to persistence (Improbable, 2017).

Koster (2009b) also discusses how the changes users make to the world can produce consequences that persist in the world. They argue that persistence is best understood as a spectrum, with a relationship between degrees of persistence and players' ability to change the world (See Fig. 2.2). They highlight a key challenge for designers: How to choose the *'granularity and sophistication'* of what persists? (Koster, 2008). For example, persisting positions of blades of grass requires high granularity, but may have no relevant effect on the player's experience. Tychsen and Hitchens (2006) narrative analysis explores how MMOs rely on traditional storytelling techniques to manipulate time, but struggle to provide players with meaningful consequences. Their model for time-based consequences (see Fig. 2.3) compares *internal consequences*, affecting the character itself, with *external consequences*, affecting the environment and other characters, in terms of *temporal duration* and the *magnitude*—non-permanent, limited permanence or permanent—of these consequences. They argue that designers can bypass some of these issues and support a wider range of storytelling techniques with *instances*—confined areas that replicate themselves for the players or groups that enter them. This entitles players to that space's content and separates the consequences of their actions from the rest of the game world. However, this solution disrupts the ability to form coherent *world* narratives as Sullivan (2012) describe and I seek long-term solutions where players influence each other through shared stories, not just rich, but independent activities.

Persistence in HCI Research

Researchers in Human-Computer Interaction (HCI) have explored persistence as a means of reusing past user activity to navigate digital interfaces. For example, *History-Enriched Digital Objects (HEDO)*, based on *Distributed Cognition* (Hollan et al., 2000), highlights the potential benefits of persisting and representing activity traces, especially for ethnographic studies. Hill et al. (1992) apply this concept to customized scrollbars that capture the idea of *computational wear*. Users see a representation of their interaction history, including previous *ed-*

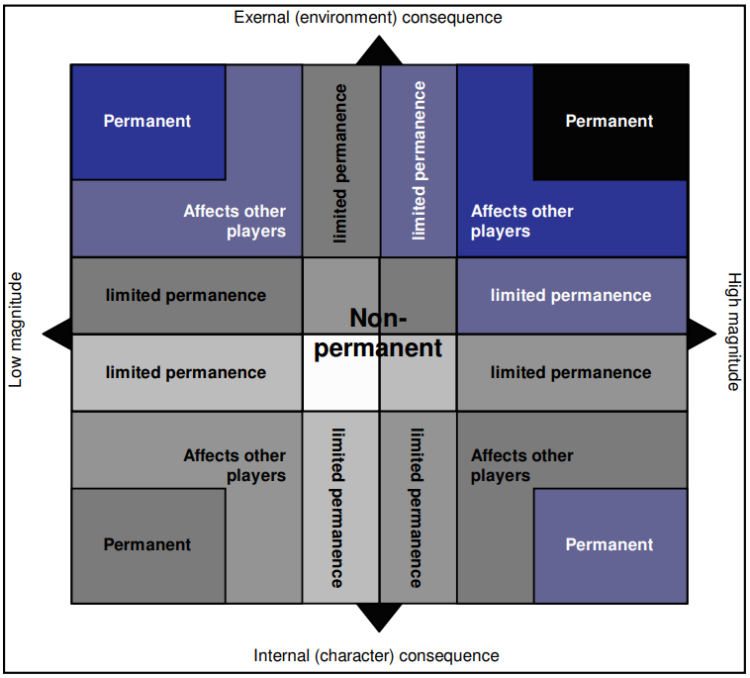

Figure 2.3. Tychsen et al.'s model of character-based consequences in MMORPGs. Darker shading indicates more difficult implementation.

its and the parts of a document they *read*, which reveals their past actions and helps collaborate more effectively. Schütte (1998) presents *PatinaMap*, a web-based image map for capturing history of use, and demonstrate the benefits of various methods of representing *wear*. For example, they generate noises depending upon a location's popularity; create *visual filters* that actively adapt to meta-data; and support annotations of *synchronous interaction*, e.g. by displaying icons of user's mouse-clicks to create awareness of each others' presence. Wexelblat and Maes (1999) explore how such functionality can aid navigation in information-rich spaces. They describe *Footprints*, a set of tools for visualizing users' web-browsing histories based on user-frequency data, location-visit maps, annotations, and graphs of navigation paths. A year-long longitudinal study of *Footprints* showed that the same amount of work can be accomplished with significantly less effort. Dieberger et al. (2000); Dourish and Chalmers (1994) introduce the concept of *Social navigation*, where persisted traces mediate between past and present user navigation of a location. They suggest that users can indirectly help each other navigate by leaving traces of their activity, thus potentially reshaping the space's structure without direct involvement by designers. I believe that we can and should adopt similar approaches in game design to explore new playful tools and further support the important social qualities of persistence.

2.2 Game Narratives

I refer to Genette's definition of a *story* as a sequence of events in time; *Narrative* as how a story is told, and *storytelling* or *narration* as the act of producing a narrative from a story (Genette, 1983). Additionally, we refer to Eladhari's description of Interactive Digital Narratives (IDN) in four layers (Eladhari, 2018). The first three layers concern 1) code and system architecture, 2) content provided by game designers and writers, and 3) the discourse of players' unique experiences when they traverse sequences of events. The fourth layer is the *retellings* of play experiences, e.g. telling friends what happened or streaming gameplay online, etc. and that these retellings can indicate value or be used for critiquing games and IDNs (Eladhari, 2018).

By the above definitions, persistence does not only relate to change, but also to the role of narrative within games. Most modern games, e.g. *World of Warcraft* (WoW), are 'theme parks' and low on persistence, but feature sophisticated pre-written narratives. Bartle (2016a) describes them as static environments designed for plot-driven events linked to persistent character progression. Older games — so called 'sandboxes' such as *Ultima Online* — are *malleable*, persistent environments that promote gameplay-driven events by giving players tools and freedom to act as they wish (Bartle, 2016a; Koster, 2009b).

Theme Parks and Quests

In theme parks, designers control the official narrative with pre-written content, typically in the form of *quests* that all players can interact with. They simulate the importance of players' characters and that the outcome of their actions causes change, although any subsequent players will engage in exactly the same encounters. Tosca (2003) argues that quests often become repetitive or 'meaningless' and therefore, inspired by Juul's exploration of *Emergence* and *Progression* (Juul, 2002), she proposes what she calls *hard* and *soft* rules for examining and analyzing quests. Hard rules are 'the rules making up the game-world, namely, object properties, behaviors and gameplay dynamics, including the final goal of the game'. Soft rules define 'concrete objectives in smaller strings of actions' or 'how the hard rules are particularly implemented in short sequences that the play can take individually'. She suggests that defining such rules helps us analyze quests at the semantic and structural levels to evaluate how the causality between the two are balanced towards each other (Tosca, 2003).

Sullivan (2012) builds on Tosca's methods and suggests several tools for designers to create more playable and meaningful quests. They propose dividing stories into four different categories: world, game, quest and player, which separates the focus related to different application areas when designing quests. They introduce *The Grail Framework* based on these categories to increase player agency and give meaningful choices to players. One goal is to direct story focus, structure and quests around the player's own history with details such as different relationships, conversations and previous quests. Sullivan highlights the problem that since many quests in MMORPGs are designed to be repeatable by following players and thus not unique, it complicates the *world* narrative point of view. For example, a player who just finished helping a chef (NPC) collect carrots for his stew can still see how other players keep lining up to solve the same task, i.e. it seems as if the chef has an endless demand for carrots. Pita et al. (2007) also argue that MMORPGs lack unique quest experiences, and explore how to generate adaptive quests based on player input. They present the *TRUE STORY* framework for reusing history and use the relationships between objects to procedurally form unique new quests. They develop guidelines to help designers define how they want to generate content within subjects such as memories, attributes, actions, layers and proximity. However, they only demonstrate the framework in an offline, text-based persistent game world to show how to reuse past player activity to generate new quests, which leaves the multiplayer aspect unexplored.

Both Sullivan and Pita et al. want to improve quests for players by designing more intelligent systems that make use of player input. However, they do not focus on exploring elements that include players as co-designers in the process. By contrast, my goal is to design persistent multiplayer game worlds that support continuous generation of new quests, not only as content, but also for players to recognize their own narratives as part history. This requires new solutions that *both* support reification of player histories, i.e. transforming them into interactive objects, and integration of tools that let players shape and express their lived experiences inside the game itself.

Sandboxes and Emergent Narratives

Narrative in sandbox games is treated differently. Here the focus is on letting players produce stories of their own, with many tools and a high degree of *agency*, *"the satisfying power to take meaningful action and see the results of our decisions and choices"* (Murray, 1997). Researchers study sandboxes' *'narrative potential: the accumulation of meaningful ex-*

perience as a result of agency [that] allows users to construct their own appropriate narratives' (Fencott, 2001). Eladhari and Lindley (2004) describe it as the possible narrative outcome of a designed environment and players' interaction within it, which enables possible 'histories of play' to emerge as stories are retold.

Ryan (2018) defines the outcome of narrative potential as *emergent narratives*. His dissertation explores the differences between successful and failing storytelling games, and argues that it depends on how the design of the game world's content supports players in *curating* their own stories. They suggest that emergent narratives' effect on players' experiences is closer to reality than fiction, where emerging events *really happen*, unlike pre-written narratives where every consequence is a calculated part of the design. Madden and Logan (2007) describe a framework for persisting emergent stories and generating reports based on their content. They deploy *witness-narrator-agents* as Non-Playing Characters (NPC) that follow players in the game and gather information to compose reports from events involving players based on a dedicated narrative ontology. This approach is aimed at fostering a sense of community and motivating players since the reports are designed to support sharing on the Web or in other media. This use of agents lets players participate in and help control story generation, rather than letting the game do it for them automatically. Players are also aware that they are observed, and can explicitly direct the agent's attention to certain events. While this work contributes an important foundation and functionality for giving players some control in generating story, I am more interested in how players can actually produce new content and reshape how their narratives are presented to other players. The goal is also to enrich the game world, rather than encourage storytelling outside of the games by combining elements of knowledge from persistence, narrative theory and co-design.

2.3 Co-Designing Narrative Content

The aforementioned work contributes important insights to the roles of persistence and narrative in game worlds. In this section I describe how previous work approach co-design with players through different theories and methods.

Co-Creative Game Design

Considering co-creation in game design requires a fundamental understanding of the different aspects of play and player behavior in games. Back et al. (2017) suggest that play is shaped continuously through players' ongoing interaction, and is not based solely on how designers set up the initial rule structures. They propose a four-faceted model for understanding the structures of play and designing 'transformative' games. *Conformant* is 'normal' play according to the designers' original vision and set of rules; *explorative* is curiosity-driven, where players purposefully explore the structure and are either unaware of or ignore the intended rules; *creative play* arises when the dialog between game designers and players change the structures of play, much like role-play and sandbox games; and *transgressive play* is when players directly challenge the game's structures.

More Than Troublemakers

With creative and transgressive play in mind, Taylor (2006) explores the relationship between players and the producers of MMOs. They outline how owners of MMOs perceive players' transgressiveness in terms of 'cheating' or 'griefing', as something that needs to be managed so as to not disrupt the overall game experience. This 'David and Goliath' relationship leaves player communities powerless to shape the game worlds in which they are in fact the most crucial components. They argue that owners should recognize players as active, creative and engaged agents within games and further explore participatory design methods to include them in development processes for enhancing creative play in MMOs. We want to add to Taylor's vision by enabling co-design through players' self-generated narratives.

Prax (2015) addresses players' authorship and control in games and proposes a transgressive model for co-creative design as alternate media. This model requires players to design interfaces that let them change properties of game rules that affect a considerable group of players in a way that challenges the original game design. They exemplify this by studying how the player community in World of Warcraft (WoW) customizes their interfaces with the help of a built-in application programming interface (API) which lets them build 'add-ons', i.e. user interface plugins to the game. Players have heavily adopted these customizations and since WoW's launch in 2004, many add-ons have become part of the official user interface. Prax concludes that players should hold stronger claims on authorship and control over their creations and that institutional game authorship as a concept will become progressively more difficult to justify. While this work illustrates the

importance and benefits of supporting players' transgressive behavior in games, add-ons only affect the individual players' user interface and does not address how to directly let players affect each other in the game worlds. We need integrated solutions that support persistent transgression in the *shared* game space and acknowledges players by letting them contribute content that helps designers grow the game.

Back's transformative model applies well to work on co-design in Alternate Reality Games (ARGs), interactive transmedia narratives that strives to blur the lines between real and fictional worlds (Davies, 2017). Dena (2008) describes a novel form of participatory culture emerging in ARGs where game designers intentionally leave gaps in the game narrative for players to collaborate and fill in, which entertains yet another 'spectator audience' with narrative content. This phenomenon is explored through a theory of *'tiers'* among participants: first-hand producers initially design play for creative, transgressive players, who in turn produce content for yet another audience who is explorative, conformant and less likely to actively search for gaps in the narrative. Dena (2008) argues that while participation comes at a cost for players, the appeal of game designers stepping down as primary content creators to instead become initiators, opens up unprecedented and diverse benefits and opportunities for all parties involved. This work highlights how ARGs leverage the web's ecosystem of freely available tools to invite players in the co-design of games. The potential is rich and illustrates co-design in *open* game spaces that is spread across multiple different media. However, the game spaces in MMOs are confined and the tools are decided by the developers, which presents a different set of problems and complexity to agency and co-design.

Volk (2008) suggests another potential way to bridge the gap between players and game designers by deploying the 'serious game'-concept directly into game worlds. Serious games are digital games that extend beyond entertainment (Susi et al., 2007). The idea is that co-creative practices, although situated in a game context, are not simply play, but rather production or work, implying that they should be treated seriously. They propose that quests can act as progression mechanisms that, instead of leveling up from a narrative, can serve to educate players about how to actually build and implement features into the game. Although no concrete guidelines for how to design such mechanics are presented, the idea suggests new opportunities for building upon quest structures to foster co-creation through players' generated narratives. I am inspired by these approaches to harnessing transgression in play and seek to offer such players support *within* the game, includ-

ing fun features and mechanics that enable them to completely realize their characters' histories and contribute with meaningful content.

Tabletop Role-Playing Games

Researchers and game designers study and build Tabletop Role-Playing Games (TTRPGs) to take advantage of their open and collaborative storytelling capabilities (Eladhari and Ollila, 2012). Players gather face-to-face to co-create stories by playing or 'acting out' different character roles (Cover, 2014). One player assumes the role of Game Master (GM), whose main responsibilities are constructing the world and facilitating the generation of narrative during the game (Tychsen et al., 2005). Although the open-ended nature of TTRPGs means that their tasks vary, GMs typically also role-play Non-Player Characters (NPC) during their encounters with players, and define, discuss and enforce the agreed upon rules of the game (Tychsen et al., 2005).

Eladhari and Ollila (2012) study iterative design methods for experimental game prototype development in TTRPGs. They highlight game design as a 'wicked problem space' (Rittel and Webber, 1973) where achieved solutions change how the problem is understood. They describe how game-mastered physical prototypes, for example *Dungeons & Dragons* (D&D) games, are particularly fit for more holistic testing and for focusing on environments and social acceptability, in addition to flexible core game mechanics and narrative design.

Webb and Cesar (2019) explore how the increasingly popular *virtual*, as opposed to *co-located*, TTRPGs affect the way players engage in *frames* of narrative, ludic and social aspects of play. They identify intersections in virtual tabletop environments where players' activities, media and technology let players shift between social interaction, collaborative storytelling and define game rules and mechanics. The ideas from these virtual TTRPGs help expand our understanding of how to let players co-design in digital environments, with the emphasis on exploring how it contributes to more content, while sharing the benefits of prototyping with TTRPGs.

2.4 Procedural Content Generation in Games

Procedural Content Generation (PCG) is algorithmic computer software that create content automatically (Shaker et al., 2016). In games, designers use different methods to generate content such as maps, lev-

els, terrains, textures, and foliage (Hendrikx et al., 2013; Liapis, 2020; Yannakakis and Togelius, 2018), and save game developers time and resources. For example, the levels generated in *Diablo* (Blizzard Entertainment, NetEase Games, 1996), the maps in *Civilization* (MicroProse, Activision, Firaxis Games, 1991) and the vegetation in many modern games come from tools such as *SpeedTree* (Interactive Data Visualization, Inc. (IDV), 2015). Togelius et al. (2011) aim to clarify more precisely what PCG is by contrasting different forms of content generation techniques in games. They suggest that *'if the human input to the content generator is part of a game, and the player directly intends to create content in the game, it is not procedural content generation.'* By this definition, no intentional or strategically generated content from players is PCG, but rather part of normal game features or mechanics. This distinction is an interesting and helpful guide in the modern landscape of procedural content since I contemplate and design with both cases: traces that appear naturally from player interaction and generated stories for content co-design with players.

One area of PCG is concerned with *procedural storytelling*. Without discussing strict definitions of precisely what procedural storytelling is, the book put together by Short and Adams (2019) offers a comprehensive description of the connection between PCG and storytelling, with examples from industry professionals. I will refer to procedural storytelling as the way in which games compose stories out of interactive elements with the output as the emergent narratives experienced by the player. Horneman (2019) discuss how storytelling in games typically follows two main approaches, either using traditional narration techniques to segment the player experience for controlling phasing (top-down) or let players create their own stories from dynamic environments with greater agency (bottom-up)[4]. They argue that the most fruitful approach to procedural storytelling is combining bits of precreated, generated and systemic content based on dynamic contexts. Kreminski and Wardrip-Fruin (2018) outline an approach with what they call *Storylet* systems and explore it as a design space. Storylets are scenes or segments of story which together form into a larger narrative. They consider a 'storylet model' where games' narratives are generated from a database of discrete, arrangable parts or snippets of story. This type of segmentation is helpful and inspiring for compartmentalizing narratives, although how storylets relate to persistence and support emergent narratives in MMOs remains for future work.

[4] In MMOs, themepark are top-down and sandboxes bottom-up

Adams (2019), famous game designer of Dwarf Fortress describe how they design procedural storytelling. They emphasize that if you aim to simulate worlds with strong narrative potential, you need to focus on

player stories from the start, or else it is easy to get lost in unnecessary details that might anyway be overseen or overload players with information. At the same time, they argue that *'narrative potential is tied to simulation potential'* and that it is crucial to design systems that form relationships and can provide plot points that connect to each other.

> *'It is not sufficient sufficient to add a tangle of mechanics, throwing everything in a jar and hoping a story comes out. You must pay attention to the kind and density of connections, and it's important to both design and expose these connections in terms that both you and the player can understand. (Adams, 2019).*

Narrative and simulation potential is closely linked with persistence as I argue in the introduction of this thesis, but the key point from Adams (2019) is that successful procedural storytelling design requires careful balance of the types and proximity of relationships between different story elements.

2.5 Games with Persistent Narrative Mechanics

I review three games that are often recognized for their unique features by the gaming community. Neither provide fully persistent online game worlds, but they introduce relevant concepts related to persistence and reuse of player history which are unique and inspiring for supporting persistence and emergent narratives.

Dwarf fortress (Bay 12 Games, 2006) is a procedurally generated fantasy world where players can control either an outpost or adventurer. The player chooses how long they want the world to last and generates recordings of historical events, items, characters and changes accordingly, also forming chronicles of the gameplay when the game is finished (dwarffortresswiki.org/, 2016; Sorens, 2008). Adams explains how they repeatedly wrote plots to another game, and then realized that they could break it down into core elements and have the computer do it instead, The vast number of features supported by the game is impressive and has generated thousands of vivid stories with a richness of detail that seems only available in real world storytelling (Dfstories.com, 2008). Although *Dwarf fortress* has some features that conflict with our goal, such as being single player and implemented with *ASCII* graphics, I am inspired by the 'legends' mode that persists semantic text-data, potentially useful for an MMO infrastructure that supports persisted player history, which would become that world's lore.

Bloodborne (FromSoftware, 2015) is an *Action Role-Playing Game* (ARPG) where players not only try to progress in the game, but can also leave each other notes that persist and are distributed to other players' instances of the game. These notes function as warnings or clues to upcoming events. The content of each note is restricted to a pre-defined, one-sentence template, to which players can add phrases and selected words, or even a gesture to be performed by a ghost avatar (Wiki, 2019). Since everyone play in identical worlds, the game simply sends a location's coordinates over the network, and implements it with the other player client. Although *Bloodborne* is not an MMO, it still offers an interesting example of persistence, with an underlying semantic structure. Players have tools that lets them affect other players' gameplay, and the mechanics of this form of persistence could be implemented for a large audience.

Middle-earth: Shadow of War (Monolith Productions, 2017) is an open-world Action Role-Playing Game set in the *Lord of the Rings* universe and features what they call the *Nemesis System*. It is designed to let NPCs evolve based on player's actions and re-appear in different encounters, creating *'...unique personal stories with every enemy and follower...'* (Francis, 2017). When players encounter high-ranking enemies in Sauron's army, their actions influence how enemies develop and change, affecting their personality, traits and rivalries. Enemies can develop various characteristics, such as unique names, appearance, ranking within the army and even special fighting styles (IGN.com, 2018). If players are defeated, their enemy grows stronger and becomes the player's 'nemesis', able to hunt down the player anywhere in the world, and reference previous encounters. The implementation of this system proved challenging to developers, requiring them to work with multiple departments simultaneously and think *'three to four steps ahead all the time'* (De Plater, 2015). The game is not multiplayer, but shows how another kind of system, focused on an environment that responds to and evolves from players' actions, could generate novel storytelling features (Kroon, 2016).

2.6 Chapter Summary

In this chapter, I describe the context of my work and begin by presenting how early research defines 'persistence' with respect to players' ability to change the game world and examine the narrative potential offered by game worlds. Then I discuss how previous work defines players' co-design practices in games as well as examine how game

designers use tabletop role-playing games for prototyping and as an instrument for including players in the design process. Finally, I reflect on the role of procedural content generation in games and narrative and describe three games with unique features related to persistence and procedural storytelling. Throughout the review I highlight the lack of understanding for how online multiplayer game worlds can combine persistence and player narratives or including players as co-designers of novel content based on their self-generated stories.

Part I

PERSISTENCE AND PLAYER NARRATIVES

3

Understanding Player Narratives and Persistence

This chapter describes four studies which explore players' relationships to persistence in games and how it affects their narratives and experiences. The goal is to understand how to increase players' influence through persistence and how to selectively choose and reuse narrative elements that emerge from their actions.[1]

Players in Massively Multiplayer Online games (MMOs) interact with not just one, but many different systems when they play (Bartle, 2003). Play sessions vary between a few minutes to several hours and people often engage in multiple modes of play e.g. solo, with groups of friends or strangers, etc. For example, in one moment players can be alone fishing in the harbour and just minutes later, gather by the tens of people to slay dragons up in the mountains. Researchers suggest that we can group players in different types depending on their preferences in games (Bartle, 1996), however, such taxonomies do not provide detailed insights to players' experiences as they transition between activities. Moreover, if the goal is to better understand the role of persistence and narrative, MMOs such as sandboxes and themeparks, further complicates such models, since they are inherently different in the how they are designed. While previous work offers some insights and perspectives on persistence with respect to narrative theory and games, it does not offer concrete guidelines for designing massive online systems where players' activity directly influences the game world. The latter requires a deeper understanding of players' complete experi-

[1] This chapter contains written material published in [(Gustafsson et al., 2020)] and was a collaborative effort conducted with Benjamin Holme and Wendy Mackay. I was the lead and corresponding author on the paper.

Gustafsson, V., Holme, B., and Mackay, W. E. (2020). Narrative substrates: Reifying and managing emergent narratives in persistent game worlds. In International Conference on the Foundations of Digital Games, FDG '20, New York, NY, USA. Association for Computing Machinery.

ences, and raises a number of challenging methodological issues. I conduct preliminary interviews and then construct *story questionnaires* to gather a large set of shorter but specific stories and then combine the results with two different approaches to gathering data from Reddit.

3.1 Method

Different methods offer different trade-offs: Interviews provide rich detail about play activity, especially if the interviewer probes for problematic or surprising occurrences. Unfortunately, interviews are time consuming, rely on the person's memory and are necessarily limited in scope. By contrast, questionnaires are easy to deploy and reach a larger audience, but usually focus on demographic and opinion data, rather than useful insights about the user experience. We can also learn general characteristics of players through quantitative analysis of open game databases (de Castell et al., 2012). Eladhari (2018) proposes another approach, where examining the stories players *retell* offers valuable insights into their experiences, since they took the time to write and share them. Kreminski et al. (2019) evaluate AI-based games by gathering players' stories from *Reddit*[2], and interviewing their authors. They calculated the frequency of various game elements, and drew conclusions about different aspects of the game. I ran four studies, using interviews, story questionnaires and *Reddit* posts, to understand the current role of persistence in games.

[2] *Reddit* hosts user-moderated communities, where users post, comment, and vote "up" or "down" each others' contributions.

Participants

For the *interviews*, I recruited five men using my personal network and referrals. Participants were male, 21-34 years old, from Sweden and the Netherlands with occupations as sound designer, engineers, usability tester and one university student.

The *Story Questionnaires* participants were recruited from both gaming specific online spaces, e.g., *MMO-champion.com* and *Discord*, to more general subgroups on larger social networks, e.g., *Reddit*, *Facebook* and *Twitter*. One fourth of respondents were female and the rest male. Ages varied between 19-58 years old and their occupations were Writer, Sound Designer, Marketing manager, Engineer, Student, Sales, Art Gallery Director / Artist, Business Owner, Carer, Fundraiser, Game developer, Computer, Programmer, Graphic Designer, Content

Creator, Technical Producer/ UX designer and Software QA.

The *Reddit studies* did not disclose participants' information other than their nicknames on the forum.

Setup

Online interviews, using *Discord*, lasted approximately 60 minutes. Questionnaires were created using *Typeform*[3]. I used PRAW[4] to create a script that extracted comments from Reddit and parsed them for keywords related to MMOs, including full titles, abbreviations, and expansion packs.

[3] www.typeform.com

[4] https://praw.readthedocs.io/en/latest/

Procedure

I asked participants to recall a recent MMO session and describe a meaningful object they owned in the game. I probed for contextual information about how they obtained it and why it was meaningful. If they had an active account in the game, we asked them to share their screen and show us the relevant object. The results highlighted the importance of gathering many *short* specific stories, rather than a few very long, detailed ones, when trying to understand the role that persistent objects play in enhancing the user experience.

I learned from the interviews and developed *story questionnaires* (Griggio, 2018), which combine the critical-object interview technique with a short-answer questionnaire. I prepared sample stories, derived from the interviews, to encourage participants to remember, reflect and respond back with similar stories. Versions one and two of the questionnaire asked for a story about a meaningful or memorable game experience, then presented the sample stories as potential triggers. I asked follow-up questions after each story, to determine the level of impact on the game, and if they shared the story with someone else. Version three removed the initial question and only presented sample stories, with new follow-up questions that focused directly on persistence. Specifically, I asked if any traces remained in the world from the story; the importance of those traces for enjoying the game; if the participant would like others to find those traces; and if so, why and how? Each participant responded to only one version of the questionnaire.

I created a *Reddit* post to gather examples of games that inspire creation of long-lasting narratives. I was especially interested in narrative persistence, including any barriers to implementation. I published a post (Reddit, 2019b) on the *truegaming*[5] sub-community, which facili-

[5] https://www.reddit.com/r/truegaming/

tates elaborate discussion around games. Under the title: *"What games foster players to create their own legends?'* I asked: *"Are there any MMOS out there that allow players to create and share their own epic legends based on in-game experiences?"* I said I knew of persistent games such as *EVE Online* (CCP Games, 2003) and *UO*, and asked specifically for *generative* features, that capture and let narratives evolve as the game proceeds. I also probed users for follow-up comments if I thought it might lead to more information. Respondents could comment and vote (once) on the original post or on each other's comments.

I extracted and analyzed comments from an independently created *Reddit* post (Reddit, 2019a), entitled: *"Gamers of Reddit, what gaming experience will you never forget and why?"* At the time of data extraction on 12 June, 2019, the post was 89% upvoted and had approximately 15000 comments. I used PRAW[6] to create a script that extracted comments and parsed them for keywords related to MMOs, including full titles, abbreviations, and expansion packs.

[6] https://praw.readthedocs.io/en/latest/

Data Collection

In addition to voice recordings from the interviews, I collected a total of 434 text-based stories from 380 respondents over the four studies (see Table 3.1).

Study	Method	Stories	Respondents
1	Interview	5	5
2	Story Questionnaire	65	40
3	Published *Reddit* Post	71*	47
4	Independent *Reddit* Post	293	288
		434	**380**

Table 3.1. Total stories and respondents per study.
***Total comments selected that relate to persistence in game play.**

Data Analysis

I analyzed the stories using Thematic Analysis (Braun and Clarke, 2006), with a mix of bottom-up (inductive) and top-down (deductive) approaches. First, I read through each story and developed an initial coding for all words and concepts we deemed relevant to 'meaningful experiences' and 'persistence'. Then, I filtered the codes by eliminating synonyms and grouping closely related concepts to generate an initial set of themes. I iterated this process several times while counting codes, themes and their prevalence in a spreadsheet. I also analyzed the follow-up questions from study two, then summarized and cross-referenced the answers in relation to the stories. I ran a bottom-up

analysis of studies 1 & 2 and selected two key themes, *uniqueness* and *meta persistence*, which guided our top-down analysis of studies 3 & 4.

3.2 Results & Discussion

I present the findings with their corresponding prevalence in the dataset and discuss how they relate to persistence and player influence. I conclude with four design implications which are then developed into the theory of *Narrative Substrates*.

All four studies indicated that the lack of world persistence lowers player's sense of uniqueness and that they leverage persistent features of the Web to such extent that it also disrupts game play. I also found that, in relation to uniqueness, players' stories are significantly influenced by first-time experiences and that persistence affects the rate at which game worlds remain relevant and interesting to players.

Unique and First-Time Experiences

'MMO' is a broad term that includes two key subgenres. Most modern games, e.g., *WoW*, are 'theme parks'—static environments designed for plot-driven events linked to character progression (Bartle, 2016a). Older games, e.g., *UO*, are 'sandboxes'—*malleable* environments that promote gameplay-driven events by giving players tools and freedom to act as they wish (Bartle, 2016a; Koster, 2009b). *Hybrids* combine the two, with some plot and a somewhat-persistent environment.

The most upvoted MMO-related comment in study three (S_3) highlights the difference between theme parks and sandboxes:

> *"Most MMORPGs are just theme parks. If you remove competitive play and grinding from the games, they'd work better as a simple online co-op RPG. The illusion of a living world is usually paper-thin. Sandboxes [...] tend to favor freedom over story, and it shows. Any stories and legends coming out of these games are written entirely externally." (Participant 8, Study 3) (P_8, S_3).*

The comment illustrates a key gap between MMO genres: Each has advantages and disadvantages, with different relationships to persistence. I use this distinction to structure our discussion of how players' unique experiences are affected by different design choices involving persistence.

Uniqueness is Difficult to Control & Represent. Players want unique content, but designers lack viable ways to offer it. In study 4 (S_4), I saw that players are most likely to remember events from the first time they experienced them. This was especially common in theme parks where 61% of all stories were characterized by the thrill of *achievement* and *discovery*.

Memories of first-time achievements are far more common in theme parks (88%) than in hybrid games (9%) and sandboxes (3%). They signify predefined feats within the game or goals created by the players themselves. Examples include defeating bosses, reaching the final level, retrieving special items and defeating rival players.

One benefit of pre-written narratives is their ability to communicate and prepare which achievements are available within the game. Theme parks offer separated modes of Player-versus-Player (PvP) and Player-versus-Environment (PvE), each with their own systems of rewards that *nudge* players toward pre-defined, discernible goals:

> *"Getting Wrecking ball achievement in WoW battlegrounds more than 10 years ago. The achievement requires killing 20 or more players from opponent team without dying once. I finished the match with 30:0 kills/deaths."* (P_{108}, S_4).

In hybrids and sandboxes, PvP and PvE often mix, and are spontaneous and consequential, stirring up conflict among players that lead to surprising outcomes. However, such moments are more difficult for designers to define and formalize as achievable goals, although they may represent valuable moments for players.

Game designers offer players greater agency at the cost of decreased control over the consequences, making it harder to predict which achievements players will enjoy and how to represent and reuse them. Theme parks actively prevent players from influencing the world, to avoid exposing players to uncontrolled conditions and complicating their ability to predict outcomes and manage player expectations. Instead, they use narrative to give everyone the same *illusion* that they can influence the world.

Non-Persistent Worlds 'Shrink' With Time. I found that many players (11% of all posts, S_4) enjoy *discovering* vast worlds together, especially for the *very* first time, e.g., when the technology was new to support thousands of players simultaneously:

> *"First time I played World of Warcraft right before Burning Crusade came out. The world was huge and filled with so many people"* (P_{248}, S_4).

Players also remember their journeys traversing different locations of the world:

> *"Friend showed me how to make a NE and run to Darnassus, portal to Rut'theran, boat to Darkshore - Auberdine, boat to Wetlands - Menethil Harbour, run to Loch Modan, then run to Iron Forge and get the tram to Stormwind then run to the keep. That was a wild few hours." (P_{280}, S_4).*

Such journeys are typical early in the game, when players want to play with friends at another starting location or just prefer a different environment, but want to be a special type of character. In theme parks however, once players reach the *elder game*; what comes after they have finished leveling; e.g., raiding, PvP, daily quests or 'instance grinding' (Bartle, 2016b), exploration declines and players can only progress by repeating old content.

Since the world neither persists nor changes when players interact, nothing new or interesting can emerge. Players' motives to explore and reside in areas decline with time. They do not want to spend time travelling over areas that they already know. Instead, they simply teleport to instantiated locations that benefit their progress, shrinking the 'open-world' aspect of the game.

Control Leads to Repetitive Content. If events are easy and repetitive, they become ordinary and not unique. Yet making difficult, custom-made events requires too many development resources for too few players, making it hard to manage players' expectations. Two respondents mentioned modern MMOs, *Guild Wars 2* (ArenaNet, 2012) and *Final Fantasy XIV* (Square Enix, 2013), where events are designed to shape the world. However, they occur too often and instead break the illusion when players realize they are not unique:

> *"Having them be on a loop and always happen really does diminish how fun they are. Instead of being a cool event that changes the world, they're just business as usual. [I prefer] events like that be much less frequent..." (P_{10}, S_3).*

Players learn that they are the hero of the narrative and expect that other players have the same opportunities if they spend the same amount of time.

> *"The problem with MMORPGs is that you have to maintain a status quo. You can't make the player experience unequal, unless you're hardcore like EVE Online...What do people whine about the most when it comes to the granddaddy MMO of them all, World of Warcraft? Balance patches..." (P_{44}, S_3).*

Sandboxes offer unique content that emerges from players' actions, but lack ways to represent them and are considered *hardcore* because they offer *'unequal'* player experiences. By contrast, theme park designers balance systems and produce controlled new content, which lets every player achieve hero status in the official narrative, even if the illusion often breaks down.

Meta Persistence

I found that 30% of all stories in S_4 involve accounts of the real world and that persistence plays a particular role in 'meta gaming', i.e. what players consider play between the game and the real world (Carter et al., 2012; Salen et al., 2004). Players consistently externalize their stories and observations to the Web. This *'meta persistence'* lets players share, socialize and collaborate around games. I also found that the magnitude of players' voluntary efforts to contribute often disturbs play in theme parks and hybrids, although less so in sandboxes, since GMs can curate 'meta-persisted' stories into new content without conflicting a set official narrative.

Knowing Too Much Spoils The Fun. The open relationship between a game world and its surrounding culture can have a negative impact on gameplay. Players collaborate to create rich, web-based information resources and tools to help them optimize and finish gameplay tasks. However, games are not always designed to sustain such efforts:

> *"Meta gaming has fundamentally altered the reality of MMOs...all the details are online, mined, extracted, analyzed and published, usually before the content patch is even live..."* (P_{37}, S_3).

One participant in S_1 did not enjoy playing with these 'knowledge hubs': being aware that everyone was using them made him feel like he was the only one *not* playing with cheat codes (P_2, S_1). P_{45}, S_3 argued that even if game legends emerge organically, players still mine data, optimize and write walk-through-guides for such processes. However, I also found that only 17% of all meta gaming related to retelling stories featured sandboxes, but was much more common in theme parks (34%) and hybrids (40%).

Meta persistence affects sandboxes less since the gameplay is open-ended and less structured. Pre-written and linear narratives are easier for players to reconstruct and optimize, hence game designers who already struggle to supply enough content, compete against large communities who specialize in consuming it.

Players Retelling Stories Outside The Game Players not only create knowledge hubs and tools outside games, but also share stories of their in-game experiences. One respondent suggested that strategy games most easily facilitate player-created legends:

> *"The more popular forms of Let's Play before YouTube really took off was the [...] After-Action Report, [...] basically a piece of fiction incorporating screenshots of gameplay, which act as the skeleton of a plot. One of the biggest forums for the Total War games even had a whole sub forum dedicated to these" (P_{33}, S_3).*

Gameplay generates stories, but if the game world is not persistent, these cannot be shared or built upon *within* the game. In Study S_2, 71% of respondents could not find any traces of the stories they told, even though a majority wanted to. Instead, they captured play-based artifacts and retold their stories *outside* the game. By contrast, those who did find traces (29%), appreciated them:

> *"I really like the fact of leaving trace in the world. That reinforce[s] the idea of a world with a real time and background" (P_{20}, S_2).*

They are also interested in how it works and how they could control such functionality:

> *"I'm not sure how a world could actually show traces of players individual stories in an MMO without cluttering up the world. How do we figure out which stories are worth making a permanent part of the world and which are not?..." (P_8, S_2).*

This raises an interesting question about *relevance* with respect to players' stories. Clearly not all traces of players' stories should persist, since they could *'clutter'* the world with potentially uninteresting details. This suggests that we need ways to detect and filter narratives that both fit the world and are of interest to other players.

In MMOs, theme parks cannot let player narratives affect overall gameplay, since they conflict with the promise of an equal player experience. By contrast, sandboxes *do* let players create their own narratives, but lack ways of representing them in the game. Although it affects the genres in different ways, both player communities externalize their stories to the web which lets them persist and grow rather than leaving traces *inside* the game.

Game Masters Curate Player Stories Into Content I found that *Game Masters* (GMs) take on various roles, and actively 'morph' or contribute to players' experiences to fit within game world narratives. Tychsen

et al. (2005) suggest that MMO GMs work more with control, community support and runtime updates, whereas GMs in *Table-Top* and *Live-Action Role Playing Games*, curate a higher degree of narrative involvement. Five respondents in Study S_3 describe the positive impact of GMs who interact with players in-game. In *Elite Dangerous* (Frontier Developments, 2005), GMs track what happens and report it back through in-game press releases, or take on the role of an actual character but with extended abilities.

> *"People within the dev team [...] write in-game press releases based on actions within star systems or overarching events in the in-game political, system which is based around affiliated player actions."* (P_{14}, S_3).

They highlight positive aspects of player-designer interaction and how the game allows each to generate visible and important consequences from their actions.

In *The Matrix Online* (Monolith Productions, 2005), one participant noted that GMs manage the main characters, who randomly appear to interact directly with players (P_{32}, S_3). This is also common in *UO*:

> *"The GMs would constantly interact with the community, putting on events with lore daily, always custom designed and fun to take part in" (P_{38}, S_3).*

GMs can access player input both from runtime and externally persisted resources, which lets them continuously craft new unique events and represent players' actions, to curate a collaborative narrative out of artifacts of players' experiences.

3.3 Implications for Design

These four studies indicate that players value unique experiences and would like to persist traces of their actions. Current MMOs lack the necessary infrastructure for representing players' actions and real influence, causing players to revert to online communities where they persist stories and share information. Based on the above results, I identify four key implications for the design of persistent game worlds.

1) *Design Space For Managing Narratives:* Designers must manage and understand data to maintain control over the game and ensure that traces remain relevant. This requires an infrastructure that persists and exposes elements of players' narratives where designers can detect and manipulate relationships among events.

2) *Structured Persistence:* Designers need a *structure* for persisted data that directs which types of narratives emerge. This requires predefining events that record basic information, e.g., time, location and characters, so designers can construct threads of traces based on when, where and how players interact.

3) *Relationship Detection:* Designers should take advantage of the fact that each player is unique, and so are the consequences of their actions during play. This requires a data structure that can be searched for similarities and relationships, and has the potential for generating unique new content.

4) *Representation and Discoverability:* Designers must know how to represent player narratives in meaningful ways. This requires a strategy for attracting players' attention and guiding them towards exploring their history in a way that suits each player's context.

3.4 Chapter Summary

This chapter describes how I developed a novel research approach to understand players' experiences with respect to persistence and narrative in MMOs. Over four studies, I combined multiple different methods: semi-structured interviews, a variation to story questionnaires and extract data from Reddit to gather stories of players' gaming memories, offering an approach to balance methodological trade-offs while maintaining high ecological validity. This led to results that show how players' narratives are highly influenced by first-time moments and achievements and that they seek continuously seek unique play experiences. I also show that lack of world persistence reduces uniqueness and that meta persistence significantly affects gameplay, causing players to increasingly leverage the web for telling stories and collaborate to such extent that they disrupt gameplay and reduce the rate at which game worlds stay interesting. I conclude with four implications for design which address modern MMOs lack of necessary infrastructure to persist players' stories and let them influence the game worlds.

4

The Concept of Narratives Substrates

I introduce Narrative Substrates, a concept which lets game designers build game worlds that persist and reify elements of players' activities into interactive content.[1]

Despite players' demonstrated desire for uniqueness and persistence, current MMO architectures make it difficult to incorporate and manage them. I argue that designers need an underlying design space to help balance the inherent trade-offs when deciding which and how traces of players' activities persist, with different levels of access that include game masters and even players.

I introduce *Narrative Substrates*: a theory for designing game infrastructures that support persistence, management and reuse of player narratives. Elements of players' past experiences are preserved and turned into first class objects that the player, other players, and game masters all can interact with. This offers a growing source of meaningful new content, with the goal of generating unique, but interconnected play experiences.

[1] This chapter contains written material published in [(Gustafsson et al., 2020)] and was a collaborative effort conducted with Benjamin Holme and Wendy Mackay. I was the lead and corresponding author on the paper.

Gustafsson, V., Holme, B., and Mackay, W. E. (2020). Narrative substrates: Reifying and managing emergent narratives in persistent game worlds. In International Conference on the Foundations of Digital Games, FDG '20, New York, NY, USA. Association for Computing Machinery.

4.1 Theoretical Background

I am inspired by the theoretical principles of *Reification, Polymorphism and Reuse* (Beaudouin-Lafon and Mackay, 2000) from *Instrumental Interaction* (Beaudouin-Lafon, 2000), where *Reification* turns user actions into first class objects that act as tools; *polymorphism* lets users manipulate multiple types of objects with a single tool; and *reuse* captures prior user input and system output and turns them into first class objects for subsequent interaction.

For example, *StickyLines* (Ciolfi Felice et al., 2016) reifies the alignment command into a persistent interactive object that users can control, manipulate and reuse to align and distribute graphical objects. This technique offers a simpler, yet more powerful tool with significantly enhanced performance. I use a similar strategy to reify traces of user activity into interactive narratives within a persistent game world.

The concept of 'substrates' builds upon these principles, and has been explored in various contexts, including *Polyphony* (Garcia et al., 2014b), for music composition, and *Webstrates* (Klokmose et al., 2015) which creates an environment for 'shareable dynamic media'. I build on Beaudouin-Lafon's definition of a substrate as a:

> *"digital computational medium that holds digital information, possibly created by another substrate, applies constraints and transformations to it, reacts to changes in both the information and the substrate, and generates information consumable by other substrates. Substrates are extensible, composable with other substrates, and can be shared. They provide the fabric of the digital world." (Beaudouin-Lafon, 2017)*

For example, *spreadsheets* are substrates consisting of a flexible grid of cells that structure user input data; support different types of representation, e.g., text, numbers, graphs, images and equations; and define relationships across cells. These principles offer designers *generative power* (Beaudouin-Lafon, 2004; Beaudouin-Lafon et al., 2021) to create richer and more varied design spaces from which to develop innovative solutions. I combine them with related research on *History-Enriched Digital Objects* (Hollan et al., 2000) and *Social Navigation* (Dieberger et al., 2000; Dourish and Chalmers, 1994), which highlight the benefits of reusing user-created traces.

4.2 Principles

Structure

Narrative Substrates persist and structure traces of interaction in digital environments. They let designers and content curators detect and manage relationships across individual narratives that can be composed into meaningful collective histories.

- *Story Events* are the smallest elements in *Narrative Substrates*, defined as persistent snapshots of events that occur in play and carry information about *actors*, *objects*, *location*, *time*, and *event type*. My previous studies highlighted the importance of *event types*, i.e. achievements, first-time experiences and unique encounters, to ensure meaning and relevance in captured narratives. Since any actor, object or location can persist story events, designers should consider which ones best suit the style of their game. The structure of story events ensures that coherent stories are formed regardless of how events persist, but the amount of available data may be low, e.g., if only weapons carry story events in a game focused on character interaction. This structure provides a starting point for individual or local narratives that is simple enough to grow large, without jeopardizing the designer's ability to discover and formalize new and global narratives.

- *Story Artifacts* are actors or objects affiliated with a set of story events. e.g., if a player uses an axe to chop down the world's largest tree it can trigger a story event which is written to the axe, and makes it a story artifact. Designers and game masters may also synthesize relationships across separate story events and reify them into new, but historical content. For example, a GM who noticed that a previous player had helped Elves grow that tree could write a letter (story artifact) from them to the player, asking for revenge.

Relationships

Once data flows into the *Narrative Substrates*, designers and game masters gain access to a semantic interface where they can identify *relationships* among story events and manage possible new story strands. This is similar to an advanced form of the 'detective board' in films, where detectives track suspects, event timelines, and the relationships among them. Persisted story events can be filtered and displayed to help players discover *new* relationships and stories. Relationships can also be reified into *links* and *chains* of story events that can be grouped

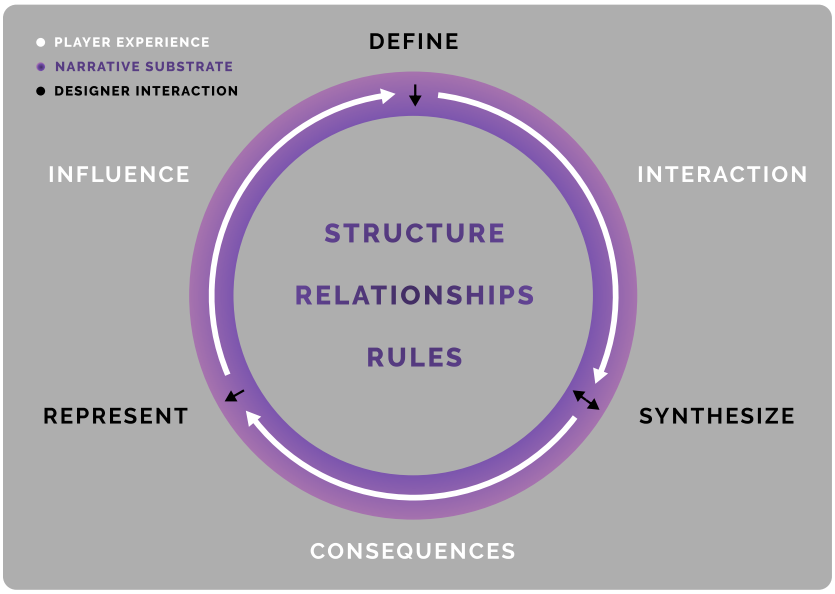

Figure 4.1. Narrative Substrates Process: Designers *define* the *structure* and *synthesize relationships* which, supported by *rules*, are reified into *story artifacts* that *represent* players' past actions and *influence* in the game world. Players' *interaction* produces *consequences* as raw data that is *structured* and persisted into *story events*.

and manipulated together, equipping designers with powerful tools to conditionally spawn events or more easily manage prospective stories. Our study results suggest the following relationships are important, but additional, more sophisticated relationships should emerge as *Narrative Substrates* grow over time:

- *Co-occurrences* create new relationships among story events that happen at the same time or place. For example, a character (actor) who visits a location wearing a sword (object) that had been found there earlier represents a historical connection or co-occurence.

- *Deviations* mark unusual events or relationships as 'first-time' occurrences. For example, a legendary sword switching owner for the first time, or a player robbing the server's strongest player-guild.

- *Similarities* organize similar or intersecting events into groups, which reduces clutter and detects linear or repetitive patterns in the game design. For example, players who often visit the same locations or items that share event type in a certain time period can be hidden to emphasize other events.

Rules

Narrative Substrates apply *rules* to *story artifacts*, so that players first discover, and then can interact with them in meaningful ways. I provide two basic categories of rules and encourage designers to add their

own, as appropriate.

- *Interactivity:* Story artifacts are *inspectable*, so players can learn why they exist; *expandable*, so the narrative continues to evolve as players interact with it; and *shareable*, so stories spread and players receive recognition and acknowledgment.

- *Discoverability:* Designers must consider how to *reveal* story artifacts so as to *attract* players' attention, *invite* interaction, and *encourage* players to explore their meaning further.

5

Reifying and Managing Emergent Narratives in We Ride

I demonstrate the design and implementation of Narrative Substrates in the MMO We Ride and its year-long deployment as a technology probe. I conclude with a discussion of the potential benefits and challenges of Narrative Substrates, and highlight future work including story co-design and procedural content generation tools.[1]

[1] This chapter contains written material published in [(Gustafsson et al., 2020)] and was a collaborative effort conducted with Benjamin Holme and Wendy Mackay. I was the lead and corresponding author on the paper.

Gustafsson, V., Holme, B., and Mackay, W. E. (2020). Narrative substrates: Reifying and managing emergent narratives in persistent game worlds. In International Conference on the Foundations of Digital Games, FDG '20, New York, NY, USA. Association for Computing Machinery.

5.1 We Ride: Technology Probe

Together with independent game developer Benjamin Holme, I built *We Ride* (We Ride, 2018), a live, running early-stage 2.5D sandbox MMO, to explore how *Narrative Substrates* can persist player activity in an actual game world. *We Ride* offers a rich testbed for research, with a flexible, dynamic environment where I can test these concepts, and have players who are willing to experiment with it. I deployed it as a two-phase *technology probe* (Hutchinson et al., 2003) which let us iterate through a series of design ideas with continuous player feedback, while preserving ecological validity.

5.2 Deployment 1: Setup and First Impressions

Deployment D_1 was designed to demonstrate how to implement *Narrative Substrates* with *objects* as story artifacts and basic *event types* focused on first-time experiences. It also provided an opportunity for observing and capturing players' first impressions of the game.

Game World Description

Players share a seamless open world in a medieval fantasy setting, where they train to become a warrior, mage, ranger, or crafter. The world has no safe zones, and PvP is allowed everywhere, so if players die, they become ghosts. Everything they wear, plus inventory, stays on the ground for anyone to loot, until the player returns to the corpse after resurrection.

Participants

114 players played during deployment D_1; four players continuously provided detailed feedback on *Discord* and responded to a questionnaire after the deployment.

Setup

We built *We Ride* with *Unreal Engine 4* (UE4) and its *blueprint visual scripting* system. A server hosted in Sweden communicates with a MySQL database using PHP and the VaRest plugin[2]. I designed *story artifacts* as persistent objects that: record players' actions in the game; act as representations of historical records of personal player experiences in the context of the game world; and can be shared with other players, who can both expand its story as a new author and learn from it by reading its records. This illustrates how *Narrative Substrates* capture 'story events' that represent and form 'relationships', which in turn can be structured into 'links' and generate new 'story artifacts' based on 'rules'.

[2] https://github.com/ufna/VaRest

Figure 5.1. A *We Ride* player-character sits on a horse next to an *honor banner*, wielding a *historical staff* whose narrative lists: kills, chapter, age in real time, karma and story events in chronological order (upper left panel). Right panel shows the Character portrait.

Players generate story artifacts by finding or crafting a high-quality item, with a message displayed below their character explaining its historical relevance and ability to capture information (see Fig. 5.2). Players can inspect any story artifact to see its history (see Fig. 5.1). If a story artifact is a weapon, it counts how many enemies it has killed. One *kill* corresponds to 100 hit points, which rewards defeating more difficult enemies. Inspired by the *Nemesis System*, it also secretly tracks how many of each *enemy race*, e.g., 'orc' have been defeated, which signals the substrate to trigger conditionally spawning events based on that information. For example, if a weapon kills 100 orcs, it triggers and generates a new *story event* where orc assassins spawn and come to attack the player.

Figure 5.2: The notification displayed when players find a historical item in the world.

I defined the following story event types; *owner change*–a weapon is traded or looted, *player kill*–a player kills another player, and *boss kill*–player kills a boss. I also implemented a *custom event type*, so that GMs can organize scripted events that will persist.

Story artifacts evolve in levels or *chapters* where each new increment unlocks more functionality and visual characteristics. For example, a

sword might change color and take on its owner's name, based on its number of kills, player kills and age. To encourage players to evolve weapons rather than just abandon them when they find a more powerful one, we built *Pearl of Power*, a rare item that transfers the damage modifier of any weapon to a story weapon.

Inspired by Madden and Logan (2007)'s work on *witness-narrator-agents*, we created *Town criers* (See. Fig 5.3), in-game journalists who automatically pick up story events from anywhere in the world, and shout them in the city square. They also hold information about who carries the most evolved story artifact in the world.

Figure 5.3: Town crier reporting on story events captured in the world.

Technical infrastructure

Story events in *We Ride* contains information about type, primary player, secondary player, support, location, data and extra information (see Fig. 5.4). *Type* holds the event identifiers for each of event i.e. owch, pkxx, bkxx and cust. *Primary* and *secondary* player translates to the IDs of players, for example in an ownerChange, with one player currently holding an item and trading it to the second player. *Support* contains IDs from a function detecting players that are helping out during the fight (but not making the final blow in a boss fight for example). *Location* is a string describing where the event occurred and gets extracted from predefined zone entities that holds the information. *Date* is a string description generated as soon as the event has occurred and *special* a string to put descriptive names related to the event that the town crier should include in the story or to say what type of ownerChange that occurred.

Variable	Type	Example
Type	*string*	*(event type identifier, i.e. bkxx)*
Primary player	*integer*	*(ID, i.e. 24)*
Secondary player	*integer*	*(ID, i.e. 25)*
Support	*array*	*(IDs, i.e. [26, 27])*
Location	*string*	*(location, i.e. Orc Camp)*
Date	*date*	*(date, 2018-07-11-10-15)*
Extra	*string*	*(Extra information, i.e. the orcish boss)*

Table 5.1. Story Events: the base structure for persisted player stories

All items holds a string-value called 'special' which is used to quickly pass story events between UE4 and the database. The special string can hold several different properties by concatenating strings separated by #. It should be noted that the special-string is a temporary, but flexible solution for quick prototyping.

Creating story items. When story items are created they have Boolean 'isStoryItem' and calls the function item.makeStoryItem() which assigns the special chapter property chap:0 and a special date stamp property bday:[date string]. The SQL special field typically results in a string as show in Table 5.2.

Special string
#chap:2#bday:2018-07-10-11-18#stev:owch,520,224,0,Tann,0@bkxx, 522,0,0,Tann,The orcish boss@/stev

Table 5.2. Special String: a string variable that holds story data and is quickly passed between UE4 and the database.

Storing story events. Story items can record a number of story events and persist it in the item's special string as an event array where @ separates events and /stev closes it.:

Story events array
stev[event1]@[event2]@[event3]/stev

Table 5.3. Story events array: an array structure within the special string that lists story events.

Getting story items. As mentioned before, a story item has the flag isStoryItem, a date stamp from the moment it was first created, and chap:0. When a player enters the world, the server checks each item's special for #chap and turns on isStoryItem if it is present. A typical story item might have a special-field that looks something like in Table 5.2 in the database. So now when the player returns, the server can recreate this item with all of its properties.

Caching story item data. In order to be able to re-tell the stories of these items, the server needs data on all the story items in the world, even if their owners are logged out, however, items does not physically exist in the game world if players are logged out. So, on server restart and on each world save, the server gathers all the story items from the SQL inventory table and stores them as cachedItems translating the #stev special array back into storyEvents.

Variable	Type	Example
name	*string*	*katana of power*
special	*array*	*#chap:2#bday:2018-07-10-11-18#stev:owch[...]*
storyEvents	*array*	*[storyEvent1, storyEvent2]*

Table 5.4. Cached items ensure that the world has access to story events if when players are logged out.

Now the server can support town criers with whatever data about story items, their owners and locations they may require. Currently, all story events are sorted to find the ten most recent ones and give

them to the town criers to randomly select and talk about every ten to thirty seconds. We illustrated the data flow as seen in Fig. 5.4.

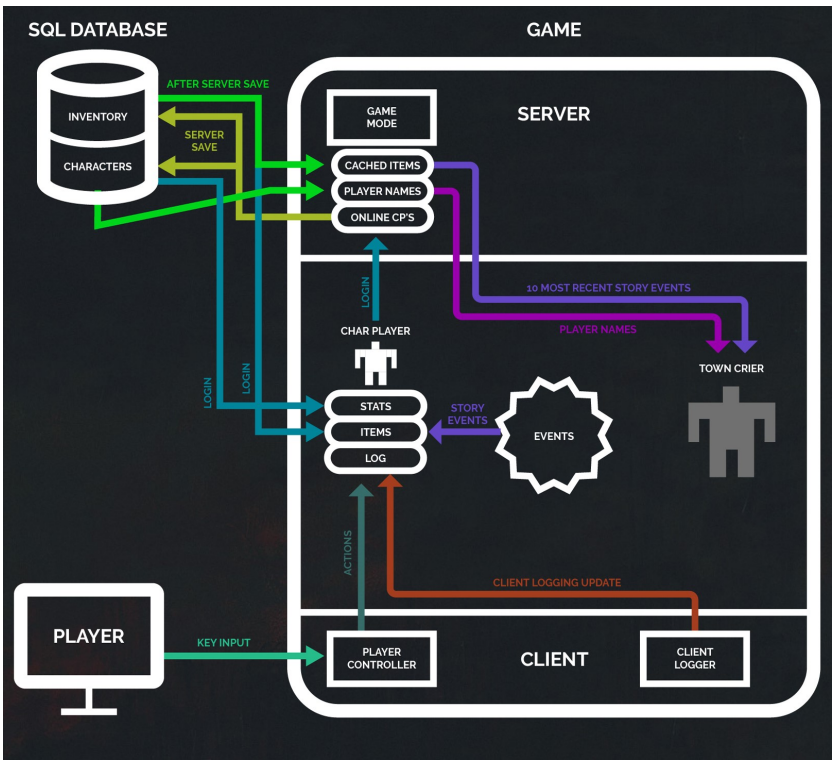

Figure 5.4. How data flows in *We Ride*: Player interact with the game world and produce events in the world. Data is sent to the server and saved to the database every fifteen minutes. Town crier is updated with the 10 most recent story events and outputs them in the world.

Procedure

To prepare the game for official testing, we wanted the world to quickly appear populated and offer players clear, early goals to achieve. We scripted two custom events featuring blockades that sealed off the world and shrank the play space. One blockade to the main city could only be opened by defeating a difficult boss, while the other event set up several walls that blocked different paths, only breakable by a sufficiently skilled crafter player.

We announced the game's first official phase on the dedicated *Discord* channel, *Facebook* page and on the MMORPG subreddit[3]. We described all features of the game, but indicated that we primarily wanted feedback on story artifacts. As players started to join the game, we switched between playing with them, observing them, and fixing bugs. The game ran for 11 days, after which we asked four continuously active players to answer a questionnaire about how they liked story artifacts and town criers, and whether they felt that they had influenced the world.

[3] www.reddit.com/r/MMORPG

5.3 Results

The *We Ride* technology probe demonstrated how to implement *Narrative Substrates* and provided first-impression feedback from players. They said they enjoyed interacting with player-generated histories, and generated numerous ideas for supporting persistence in multiplayer game worlds. However, they also highlighted several design challenges, such as how to identify which events should remain relevant over long periods of time.

Players' Initial Thoughts

The four players who answered the questionnaire liked story artifacts: *"[it] gives an element of story making" (P1)* and *"Holding a certain weapon that is known for its power [...] gives a unique feel to every character" (P4)*. They are *"...really different from 'common items" (P3)* because *"you can develop some affection with a weapon that had been with you for lots of adventures" (P3)*. They felt that town criers: *"make the world seem more alive and like actions matter" (P1)* and *"increase the feeling of immersion and make players feel like they had a true adventure " (P4)*. One player enjoyed seeing what other players had achieved, but wished that town criers *"shared more notable achievements" (P2)*.

Challenges To Long-Term Relevance

Identifying events that remain relevant to players over longer periods of time is challenging. For example, we highlighted first-time experiences, and defined 'slaying a cave troll' as a story event, since these are relatively dangerous creatures. However, players became strong more quickly than expected: Once a player can repeatedly defeat a cave troll, it gets boring and only clutters up the story artifact's history description. Another limitation was the lack of accumulated past history. We had to generate each story artifact for the first time, which diminished player's ability to establish long-lasting influence.

5.4 Deployment 2: Revisions and Extensions

The first deployment demonstrated an initial approach to integrating *Narrative Substrates* in a real MMO environment. However, we also wanted to see how the concept perform over time and in which ways we can extend the functionality to fully support long-term relevant narrative content. We incorporated our findings from deployment D_1,

and developed new functionality to better support the *rules* of *Narrative Substrates*, with *discoverability* of *old* story artifacts. We also built an in-game interface for designers and GMs to generate new content by exposing and managing relationships among story events. Finally, we added *location-centered* story events to enable richer, more dynamic play and increase long-term relevance in stories.

Game World Changes

Over the course of a year, we completely overhauled the game, including two major changes: switching the camera view from 2.5D to 3D, which provides greater visual depth and potential interaction techniques; and using UE4's built-in 'level streaming'-technique[4], which significantly increases the size of the world and extends content, with only minor performance costs. The new version provided a more stable and scalable environment, with the potential for running sophisticated longitudinal studies and including game masters as potential co-designers.

[4] Asynchronous loading of content based on distance at runtime.

Participants

63 players played during deployment D_2; six provided continuous and detailed feedback on *Discord*.

Setup

We kept the story artifacts that were generated in D_1 and built support so they could be re-found as *heirlooms*. This marked the beginning of a new era and highlighted the fact that heirlooms are from a different time. When players first encounter an heirloom, its real name and story is concealed with a title of *unsung, forgotten, mysterious, historical, chronicled,* or *ancient*, to hint at how 'story rich' it is. To reveal the name and story, players must purchase or find a *history book* that corresponds to the correct title and look up the heirloom.

We enabled GMs to access *Narrative Substrates* by building an *in-game story monitor* that let them search and filter events based on character, item and location and directly reify events on runtime (see Fig. 5.5). For this first implementation, GMs could specify an event and spawn an *honor banner* to acknowledge a player's past deeds (see Fig. 5.1). Acknowledged players can interact with the banner to temporarily increase their health, mana and hit rate. Other players can destroy the banner, but at the cost of becoming a criminal and reducing their karma. We also added basic functionality for GMs to directly spawn

enemies that run out to attack players.

Deployment D_1 generated the idea of helping players use locations to create more dynamic stories. We wanted to simulate a sense of feeling 'at home' in friendly cities, and wariness after staying out in the wild too long. We named this concept *astray* and defined it as a variable between 0 and 1 that is multiplied by other factors in the environment. Each player character also continuously tracks how much 'impact' it has with the race of non-playing characters (NPC), such as orcs. If a player is seen by or slays an orc, their 'orc race impact' will increase by a base value that is then multiplied by *astray*. Depending on the current impact level, the system will spawn waves of NPCs of the same race, who will hunt and attack the player until their impact is zero again.

Impact is also connected to a 'raiding system'. If players accumulate a high impact level by consecutively defeating a race's dispatched hunters, the system will generate an 'outpost' which marks the player's last known location with a banner from where NPCs then continue to spawn. If the outpost is close to a friendly city and left undefeated, it triggers a raid. NPCs will gather and start to march on the city from two opposite directions. They will seize the city, unless players collaborate to defend it. If the city is besieged, friendly NPCs despawn and are replaced by the attackers. A city can only be reclaimed by defeating the race's leader.

Procedure

One week prior to deployment D_2, we posted a message via *Discord, Reddit,* and *Facebook* saying we planned to reset players' inventory and trained skills in a new 'season'. We said we would introduce a new game environment, test story features, and host organized GM-led events followed by feedback sessions.

As players started to join the game, we switched between playing with them and fixing critical bugs they reported via *Discord*. We wanted to introduce players to heirlooms directly, so we added an NPC in the tutorial who describes a quest: "Look for an NPC in the first village you come to. If you complete the quest, you will receive an 'unsung' heirloom and a history book."

Nine days after the launch, we hosted a GM-led event created from players' activities and heirlooms from D_1. When we searched the *Narrative Substrates* for interesting story events, we found that a D_1 player

Figure 5.5. Story monitoring interface: Filtered story events with output log below (left). A worldmap (right) with buttons for placing an honor banner based on a story event. Searchbox and parameters for filtering (top).

had killed many witches. This became the plot of our main story: *The Revenge of the Witches*. In three scripted acts, we spawned NPCs who verbally referred to past events and placed related heirlooms on their corpses. Eleven days into deployment D_2, we asked players to give us feedback on our *Discord* channel, about what they liked and disliked about the event, the game, and how it could be improved.

5.5 Results

Deployment D_2 helped us assess the value of the *Narrative Substrates* concept, which: helps GMs directly reify stories and create events based on player histories; maintains the relevance of stories over time; and suggests new ways to reify meta persistent efforts, adding depth and meaning to their stories and game experiences.

GMs actively instrument Narrative Substrates

Designers and GMs take advantage of these powerful tools to filter and identify relevant story events, which in turn inspires new stories and the organization of narrative-driven events. For example, in D_2, we

wrote a story that summarized and highlighted D_1's main characters and events. Players enjoyed this: *"The overall storyline of the event was fun and made it easy to blame unexpected hiccups on the bad guys."* (P2), even though they encountered several technical limitations, including lag and teleportation problems.

The process of searching and writing a script from the substrate led to new research questions: How can heirlooms that reference past narratives be associated with a specific main character's loot? How can we ensure that events are neither too easy nor too difficult? How can we spawn NPCs at runtime? Although we designed functionality for the last question, we dealt with the first two 'manually' during the D_2 event. We identified relevant heirlooms and relocated them to a GM's inventory by changing their IDs in the database. When a main character was defeated, the GM remained hidden and placed that character's heirlooms on the corpse. This functionality can be integrated directly into a story monitoring interface, with additional techniques for handling links and relationships, to improve how *Narrative Substrates* adapt to characters, heirlooms, and their narratives.

Narrative Substrates Support Long-term Story Relevance

We addressed the challenge of long-term relevance by introducing story artifacts generated by players in D_1. Although this did not directly address the issue of repetitive cave troll stories in deployment D_1, it offered players a new perspective, where history is present as an active element of the game: *"This unsung item I mean, checking the history of a weap[on] is a feature that I've never seen before" (P1)*. Implementing heirlooms also revealed a flaw in D_1: if a story artifact decays or is destroyed, all of its narrative content is permanently erased. This crucial but hidden problem led to a new insight: story events should always persist in the database, even if not currently visible in the game.

We also found that exploring location-based story events with astray, impact and raids revealed further need of functionality to let designers and GMs *set and tune* the rates at which different story events and artifacts *grow* and *decay*, to help sort out relevance issues. e.g. an honor banner's effect can decay with time.

Narrative Substrates Reveal Ideas to Reify Meta Persistence

One direct benefit of our approach is the close relationship we established with the game's player community. Since deployment D_1, a number of players have expended extraordinary efforts to explore

every aspect of the game. They voluntarily provided us with multiple examples of meta persistence, including spreadsheets and graphs that track output values such as skill gain and damage; wikis and walk-through videos; discussions surrounding changes; and comparative analysis of *We Ride* with similar games. Their examples prompted ideas for extending *Narrative Substrates* by reifying players' research activities, e.g. creating in-game wikis for players to submit information, or offering unique items to players to acknowledge their bug reports.

After announcing deployment D_2, the *Unreal Engine 4* developer community recognized *We Ride*. One person wrote on *Discord*: *"Awsome. Really like your conceptualization of persistence. So lacking in modern games, not just mmo's"* (P6). We were featured in *UE4 community spotlight*[5], a weekly *Youtube* series that highlights developers who use *Unreal Engine*. They also provided a link to the game on the front page of the *Epic Games Launcher*. This level of interest is encouraging feedback about the benefits of using *Narrative Substrates* to create persistent game worlds.

[5] Community spotlight: https://youtu.be/TygjPe9XHTw?t=433

5.6 Visualizing Generated Story Events

To better understand how *Narrative Substrates* can support persisting player histories, I supervised three master students in a data visualization course to develop a web application for visualizing persisted data from players' in-game activity. In particular, we wanted to learn how to visualize persisted events from the game world to detect and reify new relationships between characters and items; players' different relationships with items, locations and characters within a specified time frame; and history from a particular location.

I supplied the students with a map of the game world and three SQL tables of data generated in *We Ride*: story events, characters and their inventories. They wrote SQL queries to merge the tables and extract information that were meaningful to visualize the relationships. Finally, they imported the data into OpenRefine[6] for cleaning and reformatting. The final interface was built using HTML, CSS and NodeJS[7] with the end-result as seen in Fig. 5.6[8].

[6] https://openrefine.org

[7] https://nodejs.org

[8] https://infoviz-wr.herokuapp.com

This work demonstrates how *Narrative Substrates* as a concept generates new opportunities for tools that build on persisted player stories. Once the infrastructure is built, heirlooms emerge from players' actions without any extra effort required form game developers. This

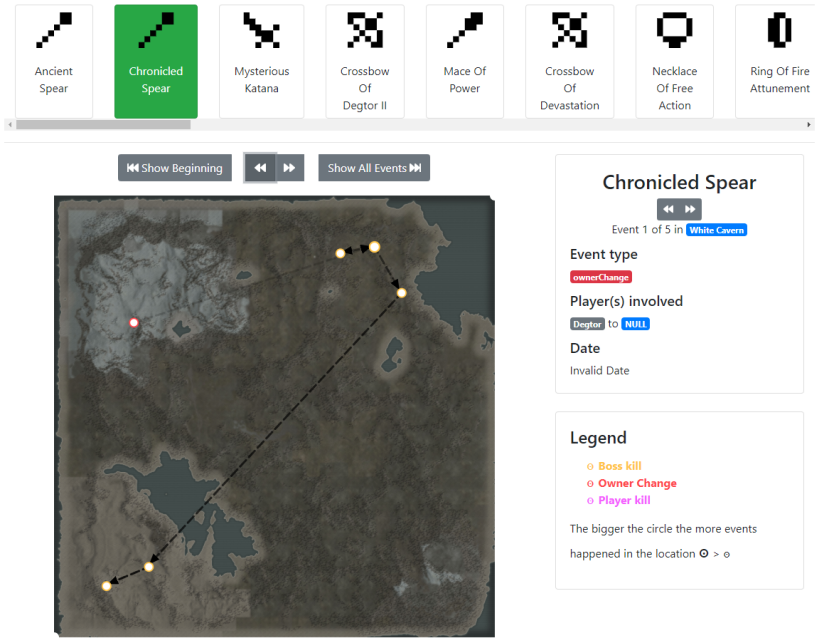

Figure 5.6. Visualization Interface: Top bar shows a list of heirlooms to filter on age or most story events. The user clicks an heirloom to display it's location history on the map as circles to depict events with details in the sidebar. The buttons above the map let users toggle events back and forth on the map in chronological order.

proof-of-concept 'history-interface' highlights opportunities to visualize and further extend players' agency of the narratives they generate, allowing game masters to better understand and curate them into new story content. Another interesting direction would be how such a tool can directly let *players* customize and add more details to the stories of their heirlooms.

5.7 Discussion

The goal of this study was to demonstrate and test how *Narrative Substrates* operates in a real MMO and understand how persisted player narratives affect the game experience. In the first deployment, players provided positive first-impression feedback and ideas for developing the concept further. The system procedurally generated stories embedded in items based on players' activities and persisted them as part of the world narrative. We also identified challenges to long-term relevance of the generated stories in the way that they quickly became similar and repetitive. In deployment two we tried to mitigate this issue by letting players re-discover old story artifacts as heirlooms. This feature uses persistence to remind players of old, long lost or forgotten stories and attempts to enhance the narrative with the feelings that can emerge with stories over time e.g. mysteriousness, epicness

or even nostaliga. It gives additional perspective to the game where players are not always the start of *new* stories, but can continue to build on previous historical events. We also built an interface for GMs to access the generated stories in-game as a way to produce and act out new unique scenarios in the game together with players. While this allowed GMs to generate unique content inspired by the history, it still required manual work and rely on traditional storytelling techniques to compose the final scenario. Future work should strive to include players as co-designers of their own narratives, to maximize the uniqueness of narratives and give players higher sense of agency and influence over the game. Finally, we built several systems to facilitate more dynamic simulation with astray, impact and their resulting components e.g. raiding and outposts. From the players' perspective and as per Togelius et al. (2011) definition, these systems procedurally generated new content which leads to more dynamic stories. However, further testing and evaluation is needed to meaningfully incorporate all the new possible branches from the added simulation potential and consider the connections between the possible events leading up to the player stories as Adams (2019) emphasize.

In order to better understand the stories that *Narrative Substrates* and the players generate, I worked with data visualization students to create an interactive tool that can illustrate the life time trajectories of certain heirlooms. We found that the simplicity of story events supports building such tools, and that future applications can provide insights into how to develop *Narrative Substrates* further in particular games, not just *We Ride*, and as potential extra game features where players get to explore and research the histories of their game worlds. Although the complexity of visualizing these narratives demand expertise in data handling and visualization techniques, it indicates promising future work in generating engaging game mechanics from persisting and representing player narratives.

Narrative Substrates clearly shows the benefits of persisting traces of player activity, without generating conflicts between players' individual experiences, designers' control of the world, and overarching narratives. Currently, *We Ride* simply demonstrates *some* of the potential for a *Narrative Substrates* approach to building MMOs. Future work will investigate how capturing player's activities and representing them in the world leads towards our long-term goal of making players truly feel like legends who are remembered and influential in the game world and beyond, while supplying designers with an almost infinite stream of meaningful new content.

5.8 Chapter Summary

This chapter builds upon the previous empirical work, narrative theory and instrumental interaction, and introduces *Narrative Substrates*, a theory for designing game infrastructures that support persistence, management and reuse of player narratives. I develop the MMO *We Ride* as a research environment and technology probes to conduct quick iterative testing within larger-scoped longitudinal studies of different game technologies while supported by consistent player feedback. In two separate deployments spanning a period of one year, I develop and test systems for persisting and reifying data of players' in-game activities through relevant game mechanics e.g. items that show how players interacted with them and evolve accordingly as well as *story monitoring interfaces* both inside *We Ride* and as an web application that show how game masters can produce content from players' activities in and how *Narrative Substrates* supports them in *directly* co-designing new game narratives based on persisted events. We reify the stories that emerge from players' actions into *Story Artifacts*, which are directly represented and interacted with in play. This provided a continuous stream of feedback from the player community, and revealed both the benefits and challenges of the approach, as well as generating valuable design insights for future work with generative and co-design features.

Part II

PLAYERS AS NARRATIVE CO-DESIGNERS

6

Exploring How to Research Players as Narrative Co-designers

I argue for the benefits of including players as co-designers and describe how I designed and tested three Virtual Tabletop Role-Playing Games to develop new methodology for researching co-design of player narratives in MMOs.[1]

Players are active and expressive agents who grow and shape the cultures in and around games (Nardi, 2010; Pearce, 2006; Salen et al., 2004). Outside games, their contributions are invaluable to proprietors, who benefit from free advertising as players voluntarily produce content from their experiences and broadcast it to the world (Taylor, 2018). Players also answer questionnaires or discuss their opinions on upcoming game features in online forums. However, when it comes to what is actually represented inside the game, their efforts seem to fade away, and are ignored in the design process (Taylor, 2006).

In the worlds of Massively Multiplayer Online games (MMOs), the histories that emerge from players' activities over time are transient: They do not exist unless players themselves persist and narrate their stories in a medium where they are permitted to do so. Players resort to the web not only for expressing and sharing their in-game experiences, but also for building knowledge hubs and organizing their communities as described in Chapter 3.

Taylor (2006) argues that the owners of MMOs should do more to inte-

[1] This chapter contains written material published in [(Gustafsson et al., 2021)] and was a collaborative effort conducted with Lilly Arstad Helmsersen and Wendy Mackay. I was the lead and corresponding author on the paper.

Gustafsson, V., Arstad Helmersen, L., and Mackay, W. E. (2021). Co-designers Not Troublemakers: Enabling Player-Created Narratives in Persistent Game Worlds. Proc. ACM Hum.-Comput. Interact.5, CHI PLAY, Article 273 (September 2021)

grate players directly into the design process. She urges game designers to consider a participatory design approach and to view MMOs as *'vibrant lifeworlds in which productive player engagement is central'* (Taylor, 2006). While this raises fundamental challenges to the field, both methodologically and from a design perspective, I want to address Taylor's call-to-action and build upon recent work. Although players are not included as co-designers, I have previously demonstrated potential strategies for addressing these concerns through *Narrative Substrates*, a design space for game designers and game masters to manage and transform elements of players' stories into new interactive narrative content. However, the concept is still limited in terms of Co-adaptation (Mackay, 1990). I also want to support human-computer partnerships (Beaudouin-Lafon and Mackay, 2018) between the players and the system, not only designers and GMs. This can increase engagement for players as they get to learn new tools over time giving them more agency and expressiveness through their experiences.

I am interested in how game designers can let players design and implement narratives as content that is based on persisted traces of their own play activity. The goal is to provide a theoretical foundation and strategies for designing in-game tools that offer players greater influence by contributing their stories as narrative content. This provides new opportunities for players to express and repurpose their unique experiences, while reducing the stress game designers face to continuously create more content, allowing them to spend more time on novel game mechanics and concepts.

6.1 Research Methodology

I am interested in (1) how players interact with *traces* i.e. persisted traces of their own activity, and (2) how designers can support the creation of player-made narratives. In order to achieve this, we first had to develop a suitable research methodology that supports both players and designers as they engage in creative yet generative play. The approach further makes use of the triangulation framework (Mackay and Fayard, 1997), (see Fig. 6.1), which lets us balance trade-offs between methods, build upon existing theory and generate new designs throughout the research process.

Rationale. Researching and evaluating novel game mechanics in MMOs is complicated due to the significant time and effort it takes to develop such large-scale and complex systems (Eladhari, 2009). Although study-

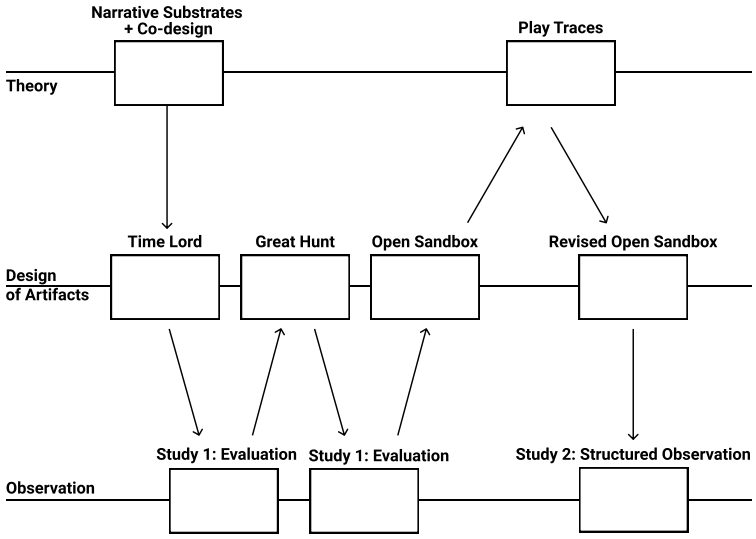

Figure 6.1. Triangulation (Mackay and Fayard, 1997): The theory of *Narrative Substrates* influenced the iterative design and testing of early prototypes, which led to the *Play Traces* method, that we tested in the final *Structured Observation* study.

ing players in existing MMOs can provide specific insights about how players interact with traces, we are limited to one set of established game mechanics without the possibility of iterating designs and comparing different alternatives. If we are to establish fundamental new mechanics within the game architecture, we must first create a flexible research environment that let us quickly adjust rules and mechanics during and between play, while retaining a direct dialog with players.

Methods. We chose *Virtual Tabletop Role-Playing Games* (VTTRPG) as a research testbed, since they offer collaborative, open-ended narrative generation where players actively shape the game. This study takes advantage of virtual games, allowing us to quickly gather participants and adapt schedules to facilitate a flexible process, letting us iterate over multiple prototypes and test designs to develop methodology.

The goal of this study was to develop research methodology that specifically supports players and game designers in co-creating new narratives while permitting quick changes to game rules and mechanics, with transferable results to MMOs. We also explored which types of narrative structures might emerge from open, collaborative play, and how traces can support players in shaping new narrative content for themselves and others. To achieve this, we followed Eladhari and Ollila (2012) guide for experimental prototyping and playtesting, which resulted in the design and testing of three VTTRPG prototypes over nine sessions (see. Fig. 6.2).

6.2 Method

Participants

We recruited 8 participants (one woman, 7 men; aged 21-37) by reaching out to people we knew and used a snowball technique (Handcock and Gile, 2011). We specifically looked for people who already knew each other and played together regularly, resulting in five different group constellations, e.g. 'group' 1 included one participant and one researcher and was also part of group 2 (see 6.5). Their occupations include: Ph.D. students, Masters students, a Psychologist, a UI Design producer and an unemployed person. All but one had extensive experience with digital online games and six out of eight had played tabletop games before. Participants were not compensated for their participation.

Setup

All participants played remotely from their own computer. We created a dedicated *Discord* server to divide players into groups and separate communication channels. We used the online tabletop environment *Roll20.net* to roll dice and display game maps.

Procedure

Two researchers discuss and revise the game according to the players' activity and comments, yielding an iterative design process where each session builds upon the previous one (see. Fig. 6.5). One researcher acts as Game Master (GM) and another as administrator who can also play as a stand-in if group members are missing. The administrator begins by sending each player a document with step-by-step instructions for how to setup the game environment *before* the first play session. First they need to download, read, sign and send us an informed consent form. Then they join the dedicated *Discord* channel, game on *Roll20*, and finally read the brief game world description and chose if they want to play one of the prepared characters or create their own. If they chose the latter, the character has to be validated by the GM so that it fits with the group and the scenario. Before playing, we review the instructions to ensure that everyone is ready. We discuss and evaluate each game session after playing and quickly iterate with new features and prototypes to adjust the approach.

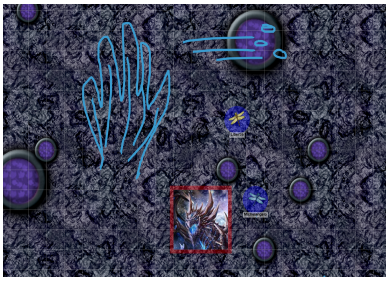

Figure 6.2: Players seek to slay the time lord dragon who disrupts time. Players save their progress in a linear narrative by designing traces *while* playing based on what they have recently done. The idea was to make leaving traces an integral part of the game, and easy for us to analyze.

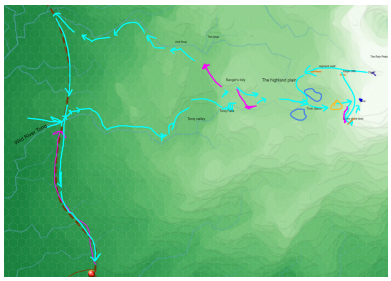

Figure 6.3: Two separate groups (but as one team) try to retrieve treasure from a dragon in shortest time possible. Groups only communicate by leaving traces in the game within their individual play sessions.

Figure 6.4: Players freely explore their own objectives in a dynamic environment. We focused more on capturing the outcome of their actions rather than trying to incentivize them to plant traces on their own.

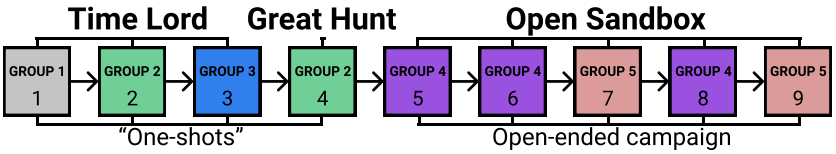

Figure 6.5. Over nine iterations we developed two 'one-shot' and one open-ended VTTRPG prototype. Color indicates group: Groups 1-3 participated in separate one-shot games (1-4). Groups 4-5 participated in the remaining multi-session games (5-9).

Data Collection

We recorded audio from everyone and one author's screen using *OBS Studio*[2]. We also collected the map and traces players drew on it, e.g., items, notes, bodies, flags, graves, characters. We saved all diagrams drawn in *Figma*[3] with corresponding notes, modifications and comments.

[2] https://obsproject.com/

[3] https://www.figma.com/

Data Analysis

The administrator noted players' traces in a spreadsheet and categorized them by character, session, and included contextual data describing who, what, when, where and how the traces were generated. Both authors took reflective notes during observation, which together with the spreadsheet, the maps, diagrams and screen recordings served as a basis for discussion by the end of each play session. In the discussion, both authors compared their notes for how each prototype let players leave traces, how they fit in other players' stories and how it affected players' overall experiences. The next session was prepared after reaching consensus for how to design or tweak the next prototype. The first four 'one-shot' sessions were iterated quickly since the prototypes were rough and clearly exposed problems with the approach, whereas sessions 5-9 required more rigorous discussion and fine-tuning before advancing with the design.

6.3 Results

Over the course of two months (March 31st to June 1st, 2020) we designed and tested the three VTTRPG game prototypes (Fig. 6.2). We identified three key aspects for developing a VTTRPG approach with transferable results to MMOs. 1) Players prefer to generate traces organically, as part of play, and then reflect on their narrative in retrospect. 2) Players produce four main categories of traces: *environment* signify outcome of players' interaction with nature, *build* are explicitly constructed traces, *memory* persisted information with characters and *object* refers to any items left behind by players. 3) Structured, graph-

ical representations of players' traces support co-design and narrative analysis.

Studying Traces Requires Open Play & Retrospection

The first four sessions with the two VTTRPG prototypes, *The Time Lord* and *The Great Hunt*, let us explore and push the boundaries for the level of detail and control as players interacted with and designed traces as *explicit* components of their play experiences. These 'one-shot games' (Bernier, 2020) – adventures that finish in one session – guided players toward predefined goals and let them share and design with persisted traces in the world while playing.

Players Prefer Reflecting on Narratives in Retrospect

The Time Lord and The Great Hunt highlighted severe challenges for incentivizing players to leave relevant traces for each other. We found that players enjoy reflecting, discussing and designing their narratives *in retrospect*, rather than directly contemplating their traces while still engaged in the experience. They also prefer to let traces emerge 'organically', as if the environment reacted to their actions as in the real world, and then consider modifications or additions to their narrative when they are no longer immersed in the experience. We concluded that the most feasible approach for studying how players interact with traces is to create an open sandbox environment where we keep track of and organize players' traces. This lets players' stories emerge organically, without direction towards any particular objective, and reinforces players' control over their authorship as they get a chance to review their traces afterward.

Players Leave Diverse Types of Traces

We identified four key categories of traces: *environment*, *build*, *memory* and *object*. *Environment* traces simulate the consequences of players' interactions with nature, such as leaving footprints in the snow or blood on the ground. *Build* refers to constructed objects left behind by players, such as a statue commemorating a king or carving initials in the bark of a tree. *Memory* traces persist as information that can be retold by NPCs, who can report if they saw a player do something. *Object* traces include any items that players own or interact with in the course of the game, such as a sword or a cloak.

Game Type Affects Quantity of Traces

Another finding involved a major difference between VTTRPGs and MMOs, in the phasing of how players progress through the game. Encounters with an ordinary enemy NPC in, for example *World of Warcraft*, last for about a minute, whereas a similar encounter can last for an hour or more in a VTTRPG. This suggests that we should adjust for different types of phasing in games, since this affects the number of traces players can generate and their capacity to shape the environment.

Co-Design & Narrative Analysis Need Structured Capturing of Traces

Based on these results, we ran the fifth session as an 'Open Sandbox' where players were completely free to explore their own objectives in a dynamic environment. We focused more on capturing the outcome of their actions rather than trying to incentivize them to plant traces on their own. We found that players are far more intrigued by traces if they are explicitly represented on the map, in addition to being described orally by the Game Master. This sparked the idea of drawing diagrams to represent players' traces as part of their whole narrative that can then used for reflection and discussion after play sessions.

Play Traces Support Continuous Structuring of Traces

We ran four additional test sessions to further develop the diagram concept and found that they were not only useful as a research tool for capturing players' activities, but players also reported that they enjoyed seeing the visualization of their traces during the reflection period after the game. In a small pilot test, we also found that players could successfully co-design new narratives based on their own traces illustrated in the diagram. Players discussed among themselves how to turn their traces into goals for others to discover and follow. They combined what Tosca (2003) calls soft rules and then negotiated the final outcome with the GM to verify that it works in terms of the hard rules of the game.

We concluded that the most useful process structure was to continuously draw diagrams as the game progresses, a method we call *Play Traces*. We illustrate the traces players generate, and then show them to players, so they can reflect on and review their complete narratives. This let players and designer to collaboratively design new narratives that fit into the world and proved intriguing to other players.

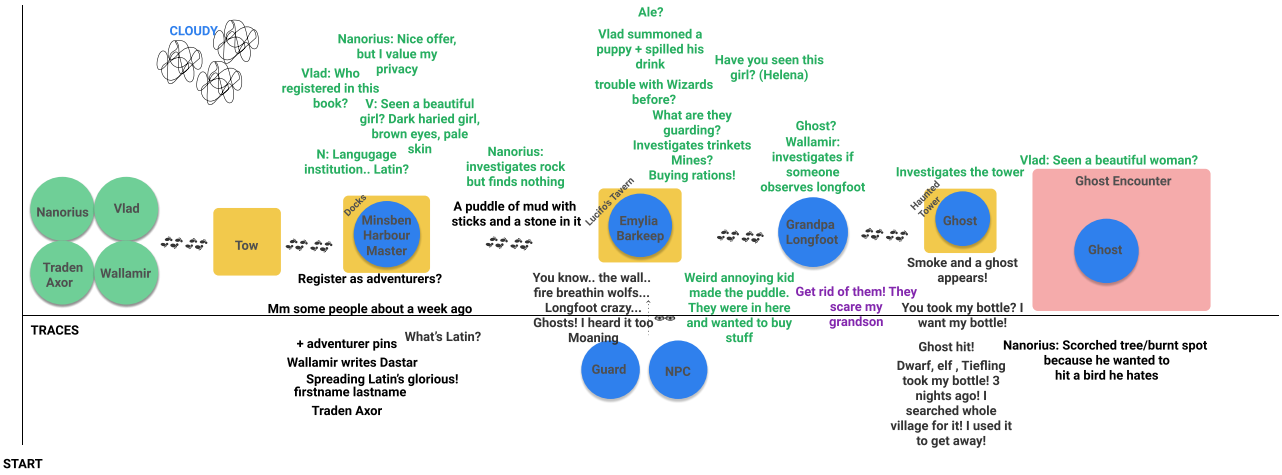

Figure 6.6. Play Traces: a continuous representation of players' encounters, traces and dialog.

6.4 The *Play Traces* Instrument

We designed *Play Traces* (see Fig. 6.6) to explicitly capture players' stories in an easy-to-understand format that helps players remember details, better reflect on their activities by the end of the game, and design new narratives for other players to follow. The idea is for designers to capture and illustrate events as they happen during play in an easy, structured format.

Context

Illustrated user stories have many names, e.g. 'journey maps', 'experience maps' and 'story maps'. (Howard, 2014) describes journey maps as 'personas with a third dimension' graphically visualizing the outline of a user's experience over time. Journey maps are typically used by experts to study and discover longitudinal phenomena and patterns in user behavior. For example, (Keith Norambuena and Mitra, 2021) developed *Narrative Maps* for representing and extracting underlying graph structures with information stories e.g. news stories. In an evaluation study, they reveled specific implications where intelligence analysts, computational journalists, and misinformation researchers could benefit from considering visual metaphors similar to physical maps, or monitoring developing stories in social media. (Murray et al., 2012) introduce *Story-Maps*, a tablet application for viewers of long lasting TV series that keep track of character and story world developments.

We are particularly inspired by *Story Portraits* (Maudet, 2017), a method for studying designer practices that includes interviewing, synthesiz-

ing and visualizing designers' stories into a format that supports later analysis and inspires new design ideas. Our findings in study one suggest a similar process where studying play artifacts (traces) is central to understanding the play process. However *Play Traces* expand the scope beyond researchers, providing players with an additional medium for co-design of new narratives. *Play Traces* let players retrospectively reflect on and understand their stories by visualizing their traces on a map. They can synthesize and identify new potential relationships from the different components of their stories.

Description

Play Traces are created by drawing event-specific icons from a toolbox. Each represents a common action, encounter or traces they leave behind based on the categories we identified in Study one: 'environment', 'build', 'memory' and 'object' (Fig. 6.7). In the Open Sandbox VTTRPG, the administrator used *Figma* to draw the diagrams by combining icons from the toolbox, continuously observing and depicting the stories from left (start) to right (end) in each game session. Over multiple sessions, we placed a "session stop" icon (Fig. 6.7) where you stop playing to segment the diagram and then simply continue drawing from there when you begin the next session. The end result is a timeline of the complete story, available at the end of the play session, generated by the players, with notes that segment the sessions. This provides a space for discussion, review and design.

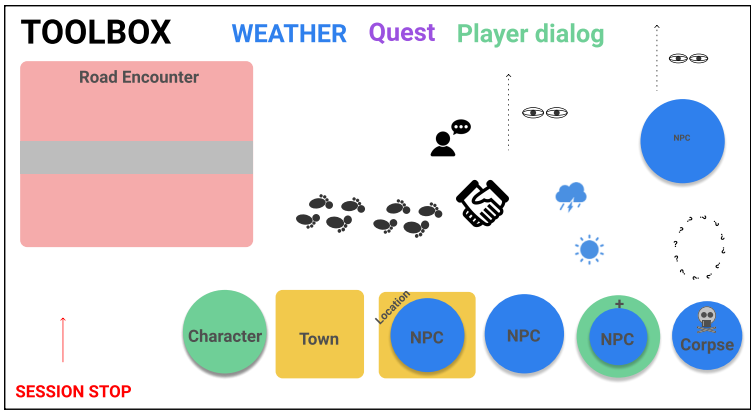

Figure 6.7. Play Traces Toolbox: a collection of icons for characters, encounters, dialog, actions and circumstances, such as weather.

6.5 Discussion

Our goal was to design games such that players can leave traces of their own play activity and thus contribute to historical events in the game world. The resulting narratives can influence future game play for all players, not only by expanding the game world's content, but also by letting each player leave their personal mark on the game, and even, in a few cases, become a legend. This raises several key challenges: First, we must establish strategies for capturing relevant elements of game play, and allowing players to co-author the resulting narrative content. We must also motivate players to, through their own game play, generate interesting traces and create narratives that they and other players would enjoy interacting with in the future.

We designed this study to explore different motivation strategies with multiple prototypes of tabletop role-playing games. We found that open sandbox environments inspired players more than pre-written scenarios, since traces arise organically through players' activity and allow them to stay immersed in the experience longer than if they had to simultaneously contemplate their traces. They prefer to reflect on their traces afterwards, which lets them control both the framing and content of their narratives. We identified four main categories of traces: *environment, build, memory* and *object*, which appear as different potential narrative elements. Given that the rate of play is much slower in tabletop games, when compared to MMOs, we would need an additional study to identify which specific types and quantities of traces will be most useful in the latter.

The study also highlighted the need for a method of visualizing and structuring players' traces, not only to facilitate our analysis, but also as a potential aid for game designers, and even for players to construct their narratives in retrospect. We developed *Play Traces* to graphically represent players' traces, and found that they supported co-design by helping players remember, reflect on and compose new game narratives. They offer a space where game designers and researchers can synthesize and identify potential relationships among different elements of the generated traces and thus co-author meaningful new narrative content.

We view *Play Traces* as a potential answer to the studies reviewed in Chapter 2.3, which argue that game designers should harness rather than restrict players' creative and transgressive behaviour. Their strategy focuses on letting players contribute to games by shaping their

individual experiences, e.g. with add-ons, and enhancing quest experiences based on player input. By contrast, *Play Traces* offer an explicit method for illustrating generated traces, in a clear format that helps players remember details, better reflect on their activities, and design new narratives for other players to follow and build on. The current version of *Play Traces* is only indirectly interactive, since players interacted with them via the administrator, but in the future, we would like to see fully interactive *Play Traces* that players can create, modify and reuse.

6.6 Chapter Summary

This chapter explored different approaches to study how we can turn players into co-designers of their own story content. I described an iterative design process resulting in three different Virtual Tabletop Role-Playing Games (VTTRPG) which led us to conclude that an 'Open Sandbox' is the best environment for studying how players interact with each other's persisted traces. I also show that players prefer that traces of their activity are generated implicitly from the environment rather than having to define them explicitly as they play. I suggest that player generate traces in categories of *environment* e.g. footsteps in the snow, *build* as player-constructed objects, *memory* as information with characters and *object* as items players interacted with.. Finally, I introduce *Play Traces* as a novel analysis method for representing players' stories and a story delivery method that encourages players to reflect on them.

7

Co-designing Player Narratives in Virtual Tabletop RPGs

This chapter describes a structured observation study with 17 players in a Virtual Tabletop Role Playing Game designed with methodology developed in chapter 6. The findings show three themes for how traces can affect and support players in shaping new interactive narratives. I present four design implications describing how player-created narratives in MMOs should first Reveal & Pull Attention from other players, Invite & Push further exploration, Guide & Assist toward endings, and optionally Show & Hide traces.[1]

[1] This chapter contains written material published in [(Gustafsson et al., 2021)] and was a collaborative effort conducted with Lilly Arstad Helmsersen and Wendy Mackay. I was the lead and corresponding author on the paper.

Gustafsson, V., Arstad Helmersen, L., and Mackay, W. E. (2021). Co-designers Not Troublemakers: Enabling Player-Created Narratives in Persistent Game Worlds. Proc. ACM Hum.-Comput. Interact.5, CHI PLAY, Article 273 (September 2021)

7.1 Method

I conducted a structured observation study (Bousseau et al., 2016; Garcia et al., 2014a; Koch et al., 2020) that incorporated the *Play Traces* and trace categories resulting from chapter 6. This let us explore how the structures of play unfold over time, with multiple levels of comparison and reflection across tasks, without jeopardizing ecological validity.

We created a Virtual Tabletop Role-Playing Game (VTTRPG) based on the 'Open Sandbox' approach and invited players to explore, interact and shape the environment based on their persisted activity traces. We focused on exploring how persisted traces of player activity affect and can support players in shaping new interactive narrative content.

Participants

We recruited 17 players (two women, fifteen men; aged 22-38) from our personal contacts and using a snowball technique (Handcock and Gile, 2011). To reduce the risk of poor group dynamics, we selected 4 groups of people who were already comfortable playing with each other. Their occupations included: software and process engineer, webmaster, senior account manager in IT, sound designer, writer, IT consultant, substitute teacher and farmer, student in robotics, as well as Ph.D. candidates in computer science, physics and earth sciences. All had previous experience with digital games and most (14/17) played TTRPGs before. Participants were not compensated for their participation.

Setup

All participants played remotely from their own computer. We created a dedicated *Discord* server to divide players into groups and separate communication channels. We used *Roll20* to roll dice and display game maps with different layers of content, including NPCs, monsters, mysterious encounters and traces of other players. Players start with an empty map, except for the starting town *'Tow'*.

Procedure

One researcher acts as Game Master (GM) and another as administrator who can also play as a stand-in if group members are missing. The administrator begins by sending each player a document with step-by-step instructions for how to setup the game environment *before* the first play session. Each group plays four sessions, divided into three parts: play (3h), reflection (30m) and participatory design (30-60m). Groups play four sessions each, in a circulating schedule with at least two different groups between to ensure that all groups encounter a significant number of new traces.

In session one, we introduce players to the study and deliver all the necessary information. Players receive a document with step-by-step instructions for how to setup the game environment. First they download, read, sign and send back an informed consent sheet. Players then join the dedicated *Discord* channel, virtual tabletop on *Roll20*, read the brief game world description, and finally, choose if they want to play a prepared character or create their own. If they choose the latter, the GM must validate the character to fit with the group and the scenario. Before playing, we review the instructions together to ensure that everyone has understood. As play begins, the GM orchestrates the game together with players while the administrator continuously draws *Play*

Traces of the group's progress.

In the first reflection session, the administrator presents the *Play Traces* to the players and lets them modify or add details to traces, but not design new narratives, since we want to familiarize them with the world and accumulate a bulk of traces. We also ask players what their favorite moment was, how they perceived other groups' presence through activity traces and what impact this had on their experience. In sessions two and three, we let players fully co-design new narratives by the help of *Play Traces* and design new interactive narratives as content which is presented to other players in following sessions. In session four, we concluded with an extensive discussion, explaining and revealing other groups' *Play Traces* instead of designing new narratives (since the game ended)

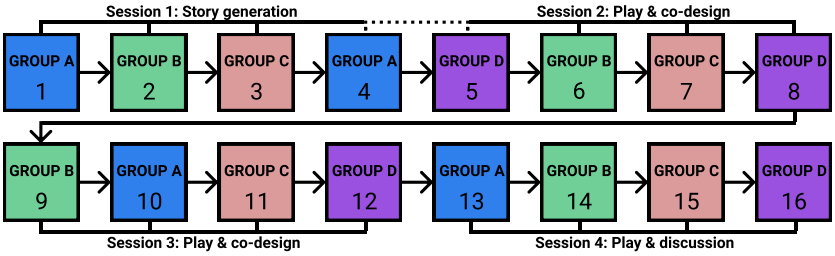

Figure 7.1. Structured Observation Procedure: Groups A-D play in four different four-hour sessions each, in a circulating schedule. This study design ensures that each group experiences new traces from at least two other groups every new session. Reflection activities also vary across sessions 1-4.

Data Collection

We recorded audio and one author's screen using *OBS Studio*[2]. We also collected the map and traces players draw on it, e.g., items, notes, bodies, flags, graves, characters. We saved all the *Play Traces* drawn in *Figma*[3] with corresponding notes, modifications and comments. After the study, we collected responses from players on their experience in a brief Likert-style questionnaire.

[2] https://obsproject.com

[3] https://www.figma.com

Data Analysis

The administrator fully analyzed the data using thematic analysis (Braun and Clarke, 2006), with a mixed bottom-up (inductive) and top-down (deductive) approach, and systematically discussed codes and checked on emerging themes with the GM. The deductive approach was emphasized, building upon the 'rules' component introduced in *Narrative Substrates* while specifically considering how players react to traces, and how traces support further exploration. The administrator also counted the number of traces in the environment, build, memory and object categories. The administrator transcribed, read and developed an initial coding of players' comments from the reflection part and

cross-referenced it with the *Play Traces* combined with notes on players' in-game activities. Then, codes were filtered by eliminating synonyms and grouping closely related concepts to generate an initial set of themes. This process was iterated several times while counting codes, themes and their prevalence in a spreadsheet. For example, initial codes related to players' first reactions when encountering traces in the game, which was then reconfirmed in the reflection part and finally merged into the larger theme *Trace & Context Synthesis* which encapsulates how the context of an encounter and traces' appearance affect players' willingness to begin interacting with it.

7.2 Results

The *Play Traces* show that players generated a total 208 traces, including: 18 environment, 15 build, 167 memory, and 8 object traces. The distribution of generated traces over groups and sessions is shown in Fig. 7.2.

We found that players not only enjoy and find it meaningful to engage in co-design practices, but also that they contribute with high quality content for other players to interact with, based on their own narratives. We identified three key themes for traces' effects on player experience and co-design, *Trace & Context Synthesis*, *Goal Guidance* and *Narrative Presence*, which indicated that: players respond differently to traces based on their context and how they guide further exploration; and that player-designed narratives need to support optional or flexible presence in the game so as not to disrupt players when they want to focus on other goals.

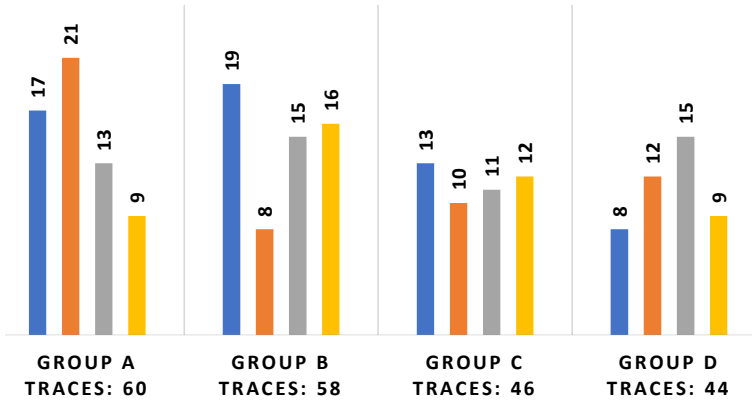

Figure 7.2. Distribution of traces across groups (bar-color indicates session order). Groups A & B preferred to progress in their own narratives and left more traces, whereas Groups C & D were more curious about other group's traces. Note that later groups left fewer traces, but had more traces available from earlier groups.

Players Can Act as Co-Designers

Players designed narratives by reviewing their *Play Traces* and discussing the relationships between traces and other actors. In dialogue with the administrator and the GM, they came up with different scenarios for how to shape coherent narratives. The administrator added their ideas on the *Play Traces* as the GM and the players discussed plausible ways for how to represent the narrative in the game. They created a total of nine unique narratives based on their own histories and named them: *The Longfoot Files, The Ghost and The Bottle, The Cabbage Cult, The Brick Brothers, Wedding Smoke Effects, Belladrini's Bookclub, Saba* and *The Stolen Compass*. Other players interacted with six of these.

We found that persisting and, especially, reviewing the *Play Traces* after a game session encouraged players to compose new narratives. 16 of 17 players said explicitly that reflecting on their activity helped them to design new narratives (See Fig. 7.3). The majority of players (15/17) reported that sharing traces within the world made them feel as though their actions had greater impact and meaning (See Fig. 7.3). Players also felt more involved in the game when they created stories based on their groups' traces (14/17) (See Fig. 7.3), but were less interested in seeing other player's traces (8/16, 1 blank answer) (See Fig. 7.3). One potential reason is that players are committed to their own personal goals. Another explanation is that we did not tell players which traces were player-generated until after the last session. Perhaps if they knew more about the context of the traces, they would have exhibited greater interest. Interest in traces also varied across groups. Group C, for example, preferred to gather as much information as they could about everything, whereas group B was far more focused on their own narrative and largely uninterested in traces left by other players.

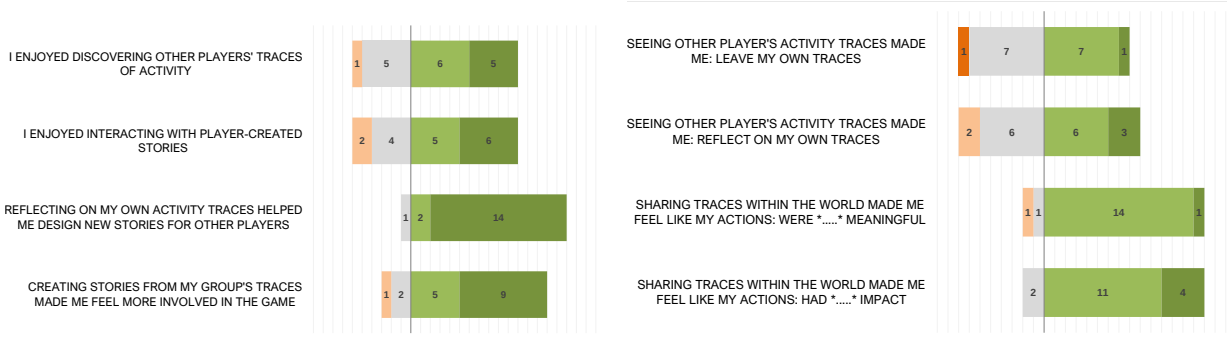

Figure 7.3. Survey (a) assesses players' level of enjoyment and involvement in the game. (Orange = strongly disagree or disagree, Gray = neutral, Green = agree or strongly agree.) Survey (b) assesses players' reactions to their own and other players' traces. (Orange = Much less or less, Gray = neutral, Green = more or much more.)

Trace & Context Synthesis

In the thematic analysis, we found that the majority of players' (15/17) willingness to explore traces depends upon how they are able to assess traces based on the context in which they are presented. Players explore the 'meaning' of traces, why they should interact with them, by analyzing their properties and characteristics within the presented context. Similarly, when players and the GM co-designed new narratives, they had to simulate suitable representations e.g. visually and audibly, and consider the scenario in which they were introduced to players.

Traces Need Explicitness & Calibration in Context. Players sometimes leave traces behind that lack any direct meaning or purpose for interaction. For example, one player decided to dig a hole in the ground at the main square where all players first arrived in the game. Although all groups encountered this trace, it never lead to any further interaction or usable knowledge since its discovery lacked consequences or notable relationships with its creator or other entities in the surrounding area. In VTTRPGs, this is confusing since whenever the GM describes something, it indicates that the players should pay attention to it and that it is a piece of content they should interact with. Group B said:

> *"It is like video game scenery versus literary scenery because in D&D its mostly like literary scenery so you focus on what is going to be relevant" (Participant 14, Group B, Session 1, P_{B14}, S_1)*

and

> *"In a picture you automatically describe everything that is there by the nature of looking at it, but in a book the reader sort of expects something to happen with everything that has been described" (P_{B13}, S_1).*

This is different from the *possibilities* in a digital persistent game world where content can be overlooked and saved for later. Although game designers typically want to encourage players to interact with content since they spent a lot of resources designing it, a persistent world where this type of content is generated as part of play and by players themselves, *directly* accessible content is less important. Traces can be part of the environment, available as optional content and enriched with actual histories from other players. Players want to explore traces that they understand is part of a meaningful context. Generating seemingly 'meaningless' traces can have different effects, given the type of game: What is annoying in a VTTRPG, not only adds to the scenery

of an MMO, but may also become important material for future narratives that players design themselves.

Players also want to understand the potential *benefits* of interacting with traces. One group of players viewed traces as 'consumed content' and therefore chose not to interact with them:

> *"We don't really need to pay attention to it. Because it is someone else's plothook or the result of someone else's actions and therefore... it's done. so I ignored it for the most part"* (P_{B16}, S_1).

Group D, the most experienced TTRPG players, assumed that most content would be pre-written. However, traces in persistent digital environments can also provide opportunities for acquiring context and knowledge that might be helpful for achieving the player's current goals or finding new ones. Even so, players' expectations, based on their previous experience with other types of games, may lead them to ignore traces. This suggests that traces should be able to signal their presence and hint at how players can interact with them.

In tabletop games, the GM decides how much information to reveal from traces' context and must find ways to represent them so they make sense for the players who encounter them. For example, if players investigate the aforementioned hole in the ground, the GM might start with small quantities of information to describe it, such as the tools used to dig it, and then move on to reveal more information, perhaps mentioning that a NPC saw who dug the hole, and describing that person. GMs have a wide variety of options when deciding how much information to reveal, since they know the complete history. However, they have to be careful not to reveal too much information, since it might become demotivating, or seem out of place if players are exploring something else. For example, new players are likely to want to situate themselves in the world before learning about other players' narratives.

This implies that traces should first attract players' attention and then indicate what players might gain from interacting with them, hooking them onto new goals. Considering the player's context might involve evaluating the player-character's level in the game: is it a new or experienced player? Certain traces might be accessible only for players within a specified range, e.g. level 20-30.

Goal Guidance

Players' interest in whether or not to continuously interact with traces, relates to how the GM *guides* players toward further exploration of their context and meaning (9/17 players). We also found that traces without specific relationships to a larger meaning can still play important roles in what goals players wish to pursue.

Traces are Clues to the Past. We observed that once players had learned the context of a trace, they considered it in relation to their surroundings and themselves. They found the information intriguing and evaluated their newly acquired knowledge to assess what they wanted to do next. Players noted how they perceived traces as warning signs:

> *"You hear whether the outcome of other groups survive... hearing the legend of the eversmoke... that no one who has gone down has ever returned..."* (P_{C3}, S_2)

and to increase suspense in their play:

> *"The exciting part was that we had seen this sign before about the farmer. So we knew something might be up with that. It was exciting that it could have led to something and we needed to be a bit more careful"* (P_{A7}, S_3).

After acquiring the context of such traces, players discussed and reevaluated their plans. While the traces or GM did not direct players toward any specific goals, they guided players to assess the environment and shape their goals accordingly.

Players Need Narrative, Not Just Context. Traces that are represented in player-created narratives gain contextual meaning, but also encourage players to further explore and pursue new goals. We saw this as players started to design and interact with co-designed narratives in session two, where one group's co-designed narrative became the main plot for another. Group A designed a narrative called *The Ghost and The Bottle* based on how they in one game session accidentally kicked the cork out of a muddy bottle while investigating some old ruins. Their story described how thick smokes suddenly started to build up in the ruins and that they began defending themselves against ghosts, only to realize there was no danger, just the bottle producing smoke. They took the bottle, but later experienced a rough encounter with a boar who got the unsealed bottle stuck on his tusk and then escaped the battle by running away, while smoking up the whole forest. Group B composed this story into a narrative where a ghost now haunts the ruins and is looking to retrieve its beloved bottle. This became a quest for group C as they encountered the ghost in their first session. How-

ever, group A had played their second session before and discovered that the forest was covered in thick mist as a result of the boar. They managed to retrieve the bottle from the boar, but then traded it for information in the next town with an NPC. Group C found their way to the same NPC by chance and then took the bottle. They kept the bottle for some time and then eventually returned it to the ghost.

We found that players successfully designed quests with their narratives, which generated new goals for other players to complete. They identified relationships between their traces and linked them together to form narratives that had a beginning, middle and an end. The GM played an essential role in completing each quest, continuously tracking each narrative and representing it to further assist players' progress. By the end of the study, players' co-designed narratives had become a major aspect of the GM's storytelling. Just as the GM can create narratives for any trace and assign it more meaning, players now did this themselves, based on their own experiences, and converted these traces into actual content. This fundamentally changed the GM's role: in the beginning of the game, she had to plan and come up with many plots herself, while now, she mostly just read the players' suggested narratives and found feasible ways of introducing them into the game.

Narrative Presence

We found that player-generated traces and co-designed narratives can solicit too much attention from other players' experiences (9/17 players). For example, players who strongly pursue their own personal goals like group B, are less interested in other players' narratives. Or, if players do not have limitations for what narratives they can implement, it can become difficult to balance and combine the resulting narratives together.

Players' Personal Goals Affect Their Willingness to Leave and Interact with Traces. We noted that the groups' commitments to their personal goals were surprisingly different from each other. For example, group B had a clear common goal to find their lost mother and anything that did not help them pursue this quest felt unimportant to them, although they did find a way for traces to help them:

> *"Our motivation here is to find our mother and one of the things we could have done is put up some sort of signage... like in the real world I'd put up a poster and say: please call phone number XX when you see the person that looks like on the picture"* (P_{B13}, S_1).

Other groups, like group A, who were more set on exploring their purpose and finding objectives enjoyed following and interacting with traces:

> *"I also like the last quarter now when we did a bit more things where we travelled and didn't really know what to expect and it was exciting now that we met the snake and more random encounters. Seemed like harder to survive. I think the battles seemed a bit more exciting" (P_{A7}, S_4).*

Strong and finite goals were possible in this environment, since players were aware of the length of the study, and the number of sessions they would participate in. However, MMOs do not include pre-determined endings and considering how many players expend hours per day for many years, they will transition between play styles (Back et al., 2017) and thus also their inherent goals. When content is new, exploratory and normal play dominate. Creative and transgressive behavior then increases as players gradually become experts and have finished more easily accessible content. This complexity suggests the need for supporting players regardless of their *current* goals, to control and manage how they want generated traces and narratives to appear in their environment. If players are currently pursuing an epic quest, they could specify that traces or narratives should attract less of their attention. By contrast, if players currently lack interesting goals, they could increase their exposure to other players' traces as a way to explore and find new objectives.

Players Need Limitations in Narrative Design. Players wanted to build upon their previous narratives as they played more sessions. However, in some cases, their suggestions needed tweaking so as to not change the world too much. For example, one group suggested a narrative with a wedding where many guest NPCs died in the end. This would have had a negative impact on new players who had just joined the game and old players who still had unfinished missions with them. This also highlights an issue concerning what to do with the accumulated histories of NPC's. The task of reshaping all that content into new narratives in a way that also shows logical progression could generate a great deal of work for the GM. We also noticed that when players struggled to find relationships among traces, they came up with new content or more radical suggestions as solution. This is probably a result of the open-ended nature of the design task as well as the tabletop game format, but indicates that a lack of limitations on co-designed narratives can adversely affect both the balance of the game and players' own design process.

7.3 Discussion

This study explored how persisted traces of player activity both affect and can support players in shaping new interactive narrative content. We observed 17 players in four groups — each participated in four 4-hour sessions where they played, reflected and co-designed narratives based on their own traces. The results suggest that MMO designers should 1) build explicit support for helping players reflect on the traces of their play activities and 2) create tools that let them co-design well represented and interesting narratives. Players should also be able to choose the extent to which traces and co-designed narratives are available within their overall gaming experience.

We identify four key implications for the design of persistent game worlds in which players serve as co-designers of the game narrative. These require the game world to explicitly support persistence of players' narratives, for example, through *Narrative Substrates*. We summarize the themes below, and clarify how our findings relate to the design implications in Table. 7.4.

1) Reveal & Pull Attention: **To become successful co-designers, players need support for revealing their traces to other players, ideally by choosing among different suitable representations. Once traces are noticed, co-designers should be able to choose how to attract or 'pull' other players' attention and communicate the benefits of further interaction.** Since players' willingness to interact with other players' traces depends upon how they are introduced in the game world context, it is important that when players first encounter a trace, they can quickly understand its role and what they might gain by interacting with it. Previous work (see Chapter 2.2) identifies quests as the accepted method for conveying narrative in role playing games, with corresponding tools for analyzing and building engaging pre-written content, while highlighting the relative lack of research on how to co-design exciting and intriguing *player-generated* narratives. This suggests that players who are interested in co-design need specific support for designing compelling traces that reveal themselves, and for drawing other players' attention in ways that communicate the beginnings of meaningful new adventures.

2) Invite & Push Attention: **Players who are intrigued by traces should be invited to further interact with them and turn or 'push' their attention towards attaining new goals within the narrative. Co-designers should have access to an overview of possible traces, with**

suggested possible relationships that could link them together into a coherent thread. For example, co-designers can specify an event that the barkeep reminds players about in the tavern, or it might enable new player activities, such as an amulet that can now open a treasure box, or it may even actively draw attention to itself, such as a NPC approaching the player.

3) Guide & Assist: **Co-designers should have tools for designing narratives that continuously guide other players toward a final goal or narrative ending. This assistance should fit within both players' context and the history of the persisted traces from which the narrative is designed.** We found that players' commitment to interacting with traces correlates with how well the GM guides them through the narrative. In tabletop games, players depend upon the GM to describe the environment, including player-generated traces. However, in an online game, players must interpret traces by themselves. Although player-generated traces are clearly valuable in their own right, as interpretable elements of the game worlds' histories, their clear benefit obtains when traces are linked together into more complete narratives. Such multi-trace narratives offer greater narrative potential than that described in the literature (see Chapter 2.2). We also found that *Play Traces* significantly increased the value of traces: players combined them into coherent narratives, and instructed the GM how they should be represented. The most successful co-designed narratives clearly guided players through sequences of traces and immersed players in missions or quests that resulted in more engaging content and goals for players who interacted with them. This suggests that MMO game designers should include features that help players specify characteristics of traces that guide and assist other players through the newly generated narrative.

4) Show & Hide: **Players need control over how much they want traces and narratives to appear in their environment. Game designers should include functionality that lets players dynamically adjust**

Theme	Finding	Implication
Trace & Context Synthesis	Traces need explicitness & calibration in context	Reveal & Pull
		Invite & Push
Goal Guidance	Traces are cues in the environment	Guide & Assist
	Players need narrative, not just context	
Narrative Presence	Players' goals affects their interest in traces	Show & Hide
	Players need limitations in narrative design	

Figure 7.4. The key themes identified in Study two link directly to implications for design.

their amount of exposure to traces and narratives while playing. We found that players' goals are also linked to their willingness to leave and interact with traces: players prefer to choose how they are exposed to other types of content, especially traces that suggest new goals to pursue. This suggests that games driven by player narratives must allow players to control how much others' traces and narratives draw their attention or actively modify their interaction in the game world.

7.4 Future Scenario

The following future scenario illustrates how the above implications for design could be implemented practically in an 'open sandbox' MMO built on the *Narrative Substrates* architecture. It shows how to design in-game *prophecies* where players modify traces that shape *future* outcomes.

Alex is an experienced player who knows that traces of player's activities persist in the world. He plays a ranger character called Rufius. One day, after several hours of adventures in the game, Alex decides that Rufius should not only rest and resupply provisions, but also, importantly, visit *The Oracle* to practice the *Prophecy Crafting* skill.

Figure 7.5. (a) Dashboard with traces represented on the world map. (b) Players select traces to include in their narrative

Alex navigates Rufius into the Oracle's mysterious hut and is greeted by a raspy voice: *"Welcome. I can see that you have come to make a prophecy."* The system now presents a dashboard on Alex's screen (See Fig. 7.5a), with a panel showing samples of Rufius' previous traces, represented as a chronological thread on the world map. Another empty panel, titled *Prophecy Crafting* (See Fig. 7.5b), lets Alex drag and drop traces from the thread to create a collection that constitutes the plot points of the new prophecy. Rufius' prophecy crafting skill is low, so Alex can only craft prophecies that include at most three traces. Alex selects an environment trace (*Rufius snapped a sapling*), a built trace (*Rufius built an orc trap*) and a memory trace (*Rufius chatted with a tree Ent*), and constructs a new prophecy.

Reveal & Pull Attention. Alex wants to enhance how the sapling *reveals itself & pulls players' attention* and consults different audio-visual suggestions in the sidebar panel: *outline glow, jumpy, strange noise* (See Fig. 7.6a). The oracle is also available as a merchant, selling 'magical powders' to diversify these options and motivate players to flavour their narratives.

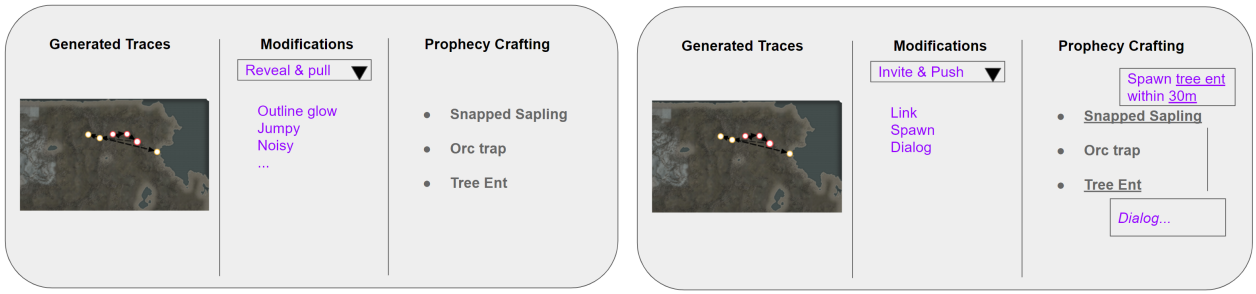

Figure 7.6. (a) Players modify traces to Reveal & Pull attention. (b) Players assign specific Invite & Push features to traces

Invite & Push Attention. To *invite & push* players' attention toward traces, Alex creates a direct link between the sapling and the tree Ent (memory trace) (See Fig. 7.6b). As other players get close to the sapling, Alex specifies that a tree Ent will spawn and approach them. Alex also writes a brief dialog for the tree Ent, which describes how a powerful ranger (Rufius) placed an orc trap in the forest and how players are likely to find treasure there.

Guide & Assist. Alex specifies that players can ask the tree Ent to *guide & assist* them if they want it to show them where the orc trap is located (See Fig. 7.7a). If players reach the trap, they will find an orc carrying a valuable medallion they can obtain, which Alex chose to sacrifice from Rufius' inventory.

The first player to successfully complete Alex's narrative gains a small amount of prophecy crafting skill and the medallion as a reward. Alex gains more skill and the potential to unlock more features to include in future narratives.

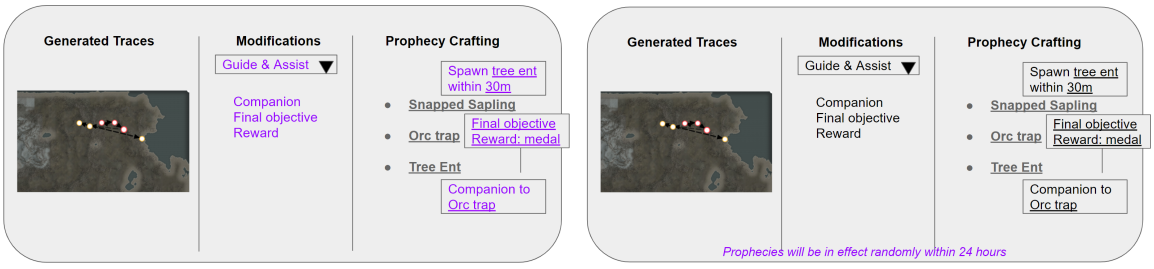

Figure 7.7. (a) Players select options to Guide & Assist others toward narrative endings. (b) Show & Hide mechanics are integrated in the game architecture

Show & Hide. Players will only see the sapling's augmented effect if they toggled their *Show & Hide* narratives option to be 'on' (See

Fig. 7.7b). To mitigate abuse of this system, we suggest that narratives come into effect in the world at random times and that prophecy crafters cannot finish their own narratives. If a narrative is implemented randomly, Alex would not know when his narrative is active and would therefore be unable to tip a friend to go there and finish the prophecy.

This scenario describes realistic features that MMOs, with the help of our principles, can offer players. We argue that this set of design implications demonstrates novel techniques for how game designers can build support for players to become essential co-designers who contribute unique, personal narratives that anyone can interact with.

7.5 Chapter Summary

This chapter explored how to design game systems in which players act as co-designers who shape and contribute their own narratives as persistent game content. We used *Play Traces* in a structured observation study, conducted with 17 players in 4 groups over 16 four-hour sessions, and demonstrated how they help players successfully co-design interactive narrative content, based on their personal play histories.

I show that enabling players to share traces made their actions more meaningful, with greater impact on the game world. Incorporating players' traces in the game fundamentally changed the GM's role, from fully driving the narrative, to supporting players' suggested narratives. I identify three key themes for how persisted traces of activity affect players' experiences and let them shape narratives into new content: *Trace & Context Synthesis* refers to how players respond to traces according to how they are represented in the game; *Goal Guidance* addresses how best to guide players toward new goals by exploring traces' context or eventual part of a narrative; and *Narrative Presence* argues that the presence of both traces and player-designed narratives must be optional to avoid disrupting players who want to focus on different goals.

I conclude the study with four implications for designing games that support player co-creation, illustrated with a scenario that shows how designers can build relevant functionality. Finally, I suggest that future work should demonstrate the potential of inviting *MMO players*

as co-designers where they can generate, design and implement new unique, narrative content in persistent digital game worlds.

8

Designing Co-design & History Game Mechanics in We Ride

This chapter explores how players generate and shape story content in the MMO We Ride. I begin by presenting our design goal and the game, followed by a specific scenario related to the features we wanted players to interact with. Then, I introduce Play Arcs and describe the design of 'history game mechanics' alongside tools that let players co-design their own quests. I describe a two-phase technology probe which included 54 players generating and interacting with each others' story content.[1]

Game designers of MMOs struggle to develop sufficient game content that keep players engaged over long periods of time (Yannakakis and Togelius, 2018). MMOs simulate worlds without endings (Bartle, 2016b), but the purposes for staying and playing in these worlds decrease over time since players keep consuming content faster than designers can build it (Debeauvais et al., 2014). Throughout this thesis I have explored an alternative approach to producing content, where players' input is the center of generating new content based on their stories. I view MMOs as *story generation machines*. As input, players enter fictive worlds and possess characters to interact with game content, effectively producing their experiences from the resulting outcome. The output is then unique and personal stories, rich with experiential data that players keep to themselves or often share with others on the web, either publishing their narratives for entertainment or submitting them to knowledge databases. Players' generative activities and stories impact MMOs differently, depending upon how game

[1] This chapter contains written material currently in submission to *DiGRA'22 - Proceedings of the 2022 DiGRA International Conference: Bringing Worlds Together* and was a collaborative effort conducted with Benjamin Holme and Wendy Mackay. I was the lead and corresponding author on the paper.

systems are designed to address them.

Game proprietors benefit from players' enthusiastic storytelling and data gathering as free advertisement (Taylor, 2006) and game designers and scholars can analyze the stories to evaluate players' experiences (Eladhari, 2018). For example, Eladhari (2018) suggests that the mere occurrence of stories retold by players is an indicator of well-designed games since they took their time to tell them. However, as players also share their stories on the web, the growing availability of knowledge and tools accelerate players' capabilities to organize and specialize in overcoming the goals they have with the game. As a result, they consume game content — the expensive 'fuel' of story generators, faster, which game designers already struggle to provide players at sufficient rates (Debeauvais et al., 2014).

I am interested in techniques that let players not only generate, but also shape story content within game worlds. This can help MMOs transition from story generation machines into self-sustaining *story ecosystems* where game content and players' input feed and grow from each other, as well as letting players contribute with new, unique content for anyone to interact with. Game designers can prioritize features that enable more dynamic and generative content by harnessing players' active and expressive behavior and invite them to truly influence the game worlds in which they are playing.

8.1 Design Goal

The goal is to provide strategies for designing systems that let game designers harness the uniqueness and generative qualities from players' activity to continuously offer rich story content within persistent game worlds. This can reduce the demand for expensive pre-written content and instead let game designers focus on creating novel game mechanics and concepts, and at the same time give players new opportunities to express themselves through their emergent stories.

I want to support two types of narratives: 1) daily adventures that are quickly shared amongst people (e.g. news) and 2) long term history that grows over time. In the first, I specifically want players to enjoy creating quests for each other as well as find them meaningful to complete; that player-created quests actively signify living and changing game worlds, so that players want to log in and wonder what new has happened since the last time they were online. I want players to rem-

inisce and recognize their or other players activities as part of game world history. They should interact with history through mechanics of the game and discover artifacts or memorabilia with unique narratives that involve players.

8.2 Scenario

I built *We Ride* with a co-developer to provide a shared multiplayer game world where players' generated stories persist and are reintegrated into the game through systems and tools that enable players to interact with their stories. This scenario illustrates how players generate and shape story content supported by game mechanics in *We Ride*:

Figure 8.1. Story panel: the stories player generate appear listed in chronological order.

Generating Stories. Alex is an experienced player in *We Ride* and plays the character Ezra. Alex logs onto the game and finds Ezra standing by the blacksmith in the small town Tann. Alex needs more blacksmithing supplies and takes Ezra towards Midaen, a mining town up the mountain. When Alex rides Ezra through Dark Mountain Pass, a pack of trolls attack and forces Ezra to retreat back to Tann.

Customizing & Telling Stories. When returning to Tann, the system notifies Alex that Ezra can tell a story in the tavern. Alex presses the hotkey to bring up the 'story panel', a window that lists Ezra's

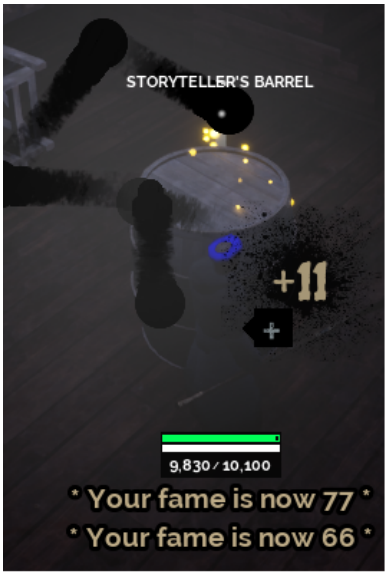

Figure 8.2: Story Barrel: Characters step up onto a story barrel to tell their stories in the tavern. At the same time, players navigate a mini-game deciding how 'well' the story is told.

stories with a corresponding map to each story that shows where it took place. Alex finds that the troll attack is now available to tell in the tavern. Alex takes Ezra to the tavern to interact with the 'storytellers barrel' and is now presented with the story panel again. Now Alex can select the troll story and sees a pre-written template for the story (See Fig. 8.1). However, Alex wants to tell it in a different way and edits the text to give more detail and background for why Ezra rode there and what the trolls looked like. Alex is happy with the story and presses the 'tell the story' button, triggering Ezra to climb up the barrel and start narrating the story in the tavern. Alex is now prompted to hit the barrel to begin playing a mini-game which will determine how well Ezra will tell the story and the amount of fame Ezra will get as a reward (See Fig. 8.2). While playing the mini-game, Ezra gains storyweaving skill and *fame*[2] for each step in the mini-game.

Creating Player-Quests. When the mini-game is finished, Alex sees a townsperson (NPC) approach Ezra and says they are willing to retell this story as a quest to other players (See Fig. 8.2). Alex can now control this NPC and either fire them (make them disappear), follow (place them anywhere), stop (stay at current position), or get info (if another player has taken on the mission). Alex asks the NPC to follow Ezra and stop outside the tavern where the NPC will remain until another player finishes the quest.

Unveiling Player-Legends. Alex abandons the idea of riding to Midaen and instead decides to finish a player-quest with the objective to slay undead at Tann's graveyard. Ezra slays a dangerous undead and finds an 'Ancient Document of Breen Graveyard' on one of their corpses (See. Fig. 8.4). Alex double-clicks the document and the system responds that Ezra need to find a library and buy a research journal to learn more.

[2] We introduced fame as a central variable in the game to motivate storytelling. Fame makes characters stronger and reduce prices with vendors. However, fame is a finite pool of points distributed among all players so if someone tells more or better stories they take points from you. You also lose 5-10% if you die.

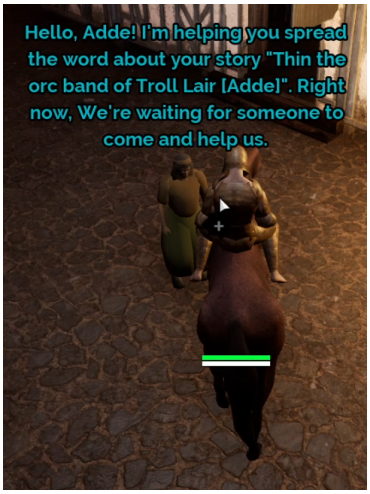

Figure 8.3: Players spawn and control their own quest NPCs.

Figure 8.4. Unveiling Player-Legends: Players can find ancient documents and bring them to the library to research old player generated legends.

Researching Player-History. At the library, Alex interacts with a bookshelf which brings up a history panel listing different events in chronological order in separate tabs for location, character and item in the game (See Fig. 8.5). There is also a research tab where Ezra's re-

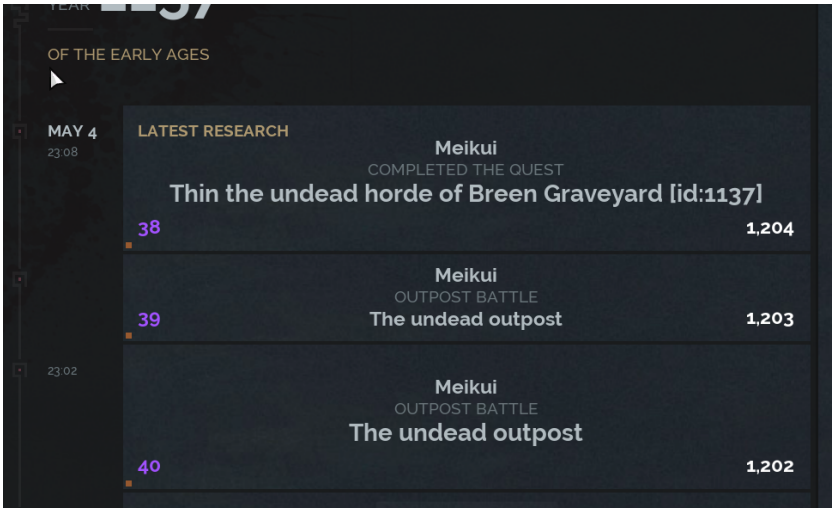

Figure 8.5. Researching Player-History: the history panel lists events in chronological order with information on location, character and item.

search, including a highlighted 'heirloom' event has appeared which when Alex clicks describes that this is the first of 11 steps to discover a mighty mace from ancient times (See Fig. 8.6). On this event Alex also

Figure 8.6. Researching Player-History: players can click events in the timeline to see how many steps of research they need to find the heirloom.

see other timelines that are related to the heirloom e.g. Kantry (player character) and Breen (town). Alex selects Kantry's timeline and scrolls down to find where in time Kantry was involved in the heirloom event, then selects the hidden events before and after in time to research. This brings Alex one step closer to finding the mace while learning about its history.

Gathering Location Clues. For one of the hidden events, the system responds that Alex have to find specific clues from another location, Old Brimmar. Alex takes Ezra to Old Brimmar and uses the story-weaving skill to interview the guard there and receives a clue which Alex now can bring to the closest library and continue the research (See Fig. 8.2).

Finding Artifacts. Alex continues the research quest, completing all the steps by interviewing or slaying monsters at relevant locations. When Alex discovers the final step, the system generates a treasure map describing where Ezra needs to go to unveil the treasure (See. Fig 8.2).

Alex uses the map upon which the system responds which location in the world that is closest to the treasure. Once Ezra is close to the treasure, the map only hints if it is getting closer or further away depending on Ezra's current location. Finally, Ezra finds the right location and retrieves the mace (See Fig. 8.8).

Figure 8.7: Interviewing NPCs for history research: Players can interview NPCs to gather clues in their objective to find heirlooms. If the interview is successful a message appears saying that "You successfully interviewed the person and keep the notes in your backpack".

Figure 8.8. An heirloom: the final reward after following the research quest.

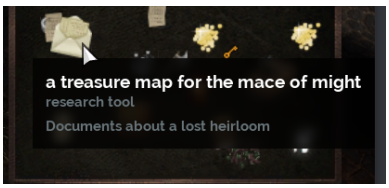

Figure 8.9: Treasure map is the final step leading directly to the location of an heirloom.

8.3 Game System Description

I continue to build upon existing technology and *Narrative Substrates* in *We Ride*. As described in Chapter 4, *Narrative Substrates* persists and reifies events of players' actions. In this work, I extend the theory to

support co-design and history research through game mechanics that also procedurally generates new content. I define the complementary data structure *Play Arcs* and describe how it is implemented in *We Ride* directly based on the design implications from chapter 7.

Figure 8.10: Narrative & Template Types

Narrative Type	Template
SimpleBattleAi	*BragBattleAi*
BattleAi	*ThinTheHerd*
BattleAi	*KillBoss*
KilledByAi	*Revenge*

Play Arcs

I define *Play Arcs* as a collection of story events within a certain period of time. The system continuously logs, filters and compiles *Play Arcs* when players are logged in with their characters. New potential *Play Arcs* begin as soon as players leave locations that are tagged *safe*, e.g. towns and villages, and ends when they return after spending some time in *unsafe* areas. Depending on what happens on this *trip*, the system assigns three different *narrative types* (see Fig. 8.10) with each corresponding pre-written, but customizable template stories (see Fig. 8.12). For all *Play Arcs* of the trip type, we use many different tags in the trip special string[3] (Fig. 8.11). For example, we capture how players made the trip e.g. walked, how long it lasted, if they stayed on roads, which locations they passed and what other story events they generated on the way.

[3] The special string (introduced in chapter 5) is an untyped data structure we use to quickly communicate between the database and Unreal Engine to handle them however we want using blueprints.

Outposts. When players tell stories of the *ThinTheHerd* narrative type, they generate an NPC who gives them as quests to other players. Upon accepting the quest, the system generates an enemy outpost at the location mentioned in the story, to which the player need to go and defeat the enemies at. This is different from the outposts introduced in chapter 5 which are procedurally generated, unannounced and not associated with any particular player story.

Trip Special String

```
#walk
#duration:11
#offroad
#locationids:,Welcome To We Ride,Newbie Dungeon[...]
#locations:@414156,-133259,-15503@414156,-133259[...]
#distance:4073
#narrativeType:simpleBattleAi
#maxDistanceFromStart:4353
#narrative:done#public
```

Figure 8.11. Trip Special String: the information structure of *Play Arcs*, logging duration, traveltype, location, distance and type.

History Game Mechanics

The design of the history game mechanics described in the scenario above required new specific algorithms to filter and select relevant heirlooms for players to research. The history game mechanics we de-

signed comprise of *story chains*, *story clues*, *story hooks* and *interviewing skills.*

Story hooks. Ancient documents are the *story hooks* to begin quests of finding heirlooms. They are the starting points and seeds for which type of heirloom that can be found based on its location e.g. Breen Graveyard in Fig. 8.4.

Story chains. When players first use an ancient document at the library, the system parses the database for story events that are related to each other, forming long *story chains* as supported by *Narrative Substrates*. It calculates how many steps i.e. relationships the chain holds, and represents how many story events players have to research. However, even if players do not currently have a story hook, they can always do research from a library to learn more about that library's town and therefore reduce their time spent researching heirlooms if they are associated with that location. Players' character effectively gain more 'knowledge' about the world as they unlock story chains and thus reward their wisdom.

Story clues & Interviews. Players always have to conduct their research in libraries, which only has information related to that location. If a story chain involves events from other locations, players have to go there and gather *story clues* by interviewing people (either friends or enemies) with the storyweaving skill, or slaying them to search their loot.

Type	Intro	Trip	Conflict	Consequence	Resolution
Revenge	Come here! I have some [c]juicy[/c] gossip for you.	I heard that [primaryPlayer] [travelType] out from [startLocation] towards [c]Tann[/c]	[primaryPlayer] stopped at [conflictLocation], and before he knew it, a [c]giant[/c] [antagonist], was [c]slashing away at[/c] him.	The [c]monster[/c] ripped his guts out and feasted upon [primaryPlayer]'s corpse.	Now there are posters hanging around, saying that [primaryPlayer] rewards [c]100 goldcoins[/c] to slay [antagonist].
ThinTheHerd	[c][primaryPlayer] was here recently and reported growing numbers of [antagonistRace][/c]	[c]He said that he scouted many of them while [travelType] around [conflictLocation][/c]	[c]Although he ruffed them up quite good, they seem to remain in the area looking for easy prey[/c]	[c]We need to keep our roads safe and having[/c] [antagonistRace] [c]around is a direct threat to our businesses.[/c]	[c]I'm willing to pay you a good sum of goldcoins if you bring back proof that you dealt with 8 [/c][antagonistRace] [c][/c]
KillBoss	[c]Hey! Isn't[/c] [primaryPlayer] [c]amazing?[/c]	[c]Last night at the tavern, [primaryPlayer] told us this epic story of how he fought hundreds of[/c] [antagonistRace]	[c]However, he said that one [antagonistRace][c], he couldn't slay. The[/c] [antagonistRace] [c]was huge and that it's eyes were glowing in red![/c]	[primaryPlayer][c] warned that unless we deal with this creature, it is going to raise rally troops and seek revenge[/c]	[c]Please, won't you help us? Bring back this beasts head and I'll make sure we collect many goldcoins in reward.[/c]
BragBattleAi	Listen up, folks!	I was [travelType]ing from [startLocation] towards [destination].	When I got to [conflictLocation], I noticed a bunch of [antagonistRace].	I gave them a good fight, slew at least [kills] of them, before they realized what had happened!	I managed to escape before they could regroup. Hahah!

Figure 8.12. Story templates: pre-written stories organized by type and structured in five different parts, where [c] and [/c] marks the beginning of text that players can edit.

8.4 Method

We deployed the system as a *technology probe* (Hutchinson et al., 2003) which let us iterate through a series of design ideas with continuous player feedback, while preserving ecological validity. We invited players to the game in two phases where we asked them to explore, interact and shape the environment in any way they could supported by the system. We focused on exploring how players co-design, generate and interact with player-shaped story content.

We specifically sought to gather initial feedback on if the system generates coherent, understandable stories for players, how the stories become content in the game world and what types of narratives players prefer to create.

Participants

In total, 54 players played the game. In phase two, we recruited 11 players who continuously provided us feedback. We made extra effort to recruit women by asking friends to post on women-only forums, resulting in 5 women and 6 men; ages 24-37; they were from Sweden, France, USA and professions as UX designer, web developer, warehouse ops, CFO, social worker, HCI student and one person unemployed. All had previous experience with MMOs and titles include *World of Warcraft*, *Runescape*, *Tibia*, *Ultima Online*, *Elder Scrolls Online*, and *EVE Online*.

Setup

All participants downloaded the game from *www.weridegame.com* and played remotely from their own computer. We created a dedicated *Discord* server to divide players into groups and separate communication channels.

Procedure

We announced the game's new testing phase in a post on the dedicated *Discord* channel and outlined all the changes we made since the last in-game season. We explained that we will begin with a two week long 'pre-season' where veteran players get to join early to generate stories, artifacts and identify crucial bugs and tweaks, which we then follow up with a longer test including more participants. This first phase ran from 25 April 2021 until 9 May and the second ran from 9 May until 9 June. To immerse players in the world and give them an optional long

term objective, we wrote a brief backstory of how a 'Dark Wyrm' had crawled up from the abyss and now haunts the castle of Blackthistle, which unless defeated will devastate the world. As players started to join the game, we switched between playing with them, observing them, and fixing bugs. Players' main tasks were to 1) create stories where they a) brag about a recent battle with enemies b) ask people for help to 'thin the herd' of certain enemies, 2) Complete at least two other players' quests, 3) Discover an heirloom by researching the history.

Data Collection

We collected players' posted feedback in *Discord* including images, voice recordings and video. We also collected data and the generated story events in the database.

Data Analysis

We noted players' comments in a spreadsheet and grouped them into themes related to how players tell their stories in the game, interact with each other's stories and the type of content the systems generate. By the end of the study, we ran queries to the database to find number of unique players, total hours they played, how many story events they generated, how many of them were trips, which *narrativeTypes* they were and how many story artifacts that were generated. We considered how this information was generated and how it related to players' overall experiences.

8.5 Results

We found that players can successfully create quests based on their own stories, for other players to pursue and finish. Although players could edit stories, they lacked direct incentives for sharing custom narratives. The quests filled the game world with narrative content which players could interact with to continuously shape and learn more about the world. *Play Arcs* is a valid model for how to segment generated events into stories which players can co-design and interact with to build narratives that over time contribute to persisted history.

Players Successfully Generate & Co-design Coherent Stories

The system supported players' storytelling by capturing and presenting traces from their play sessions, which they then retold in the tavern

as coherent narratives with beginnings, middles and endings. In total, 54 individual players played a combined 3611 hours and generated 3654 story events i.e. slightly more than one story event per hour. 2300 of the story events were *Play Arcs* in which the majority of them, 2018, were simple stories that players could tell in the tavern to gain fame and increase their storyweaving skill. The other roughly 300 trip stories were potential quests which players could customize and plant in the world for other players to pursue. Players created 116 of such quests and 108 of them were about thinning the herd of creatures and 8 about seeking revenge on someone. The consumption rate of quests were high with 110 out of 116 quests begun or completed by players.

Data generated:

- 54 unique players
- 3611 total hours logged
- 3654 total story events
- 2300 story events were trips
- 2018 simpleBattleAi
- 116 quests
- 374 story artifacts (chap:0)

Routine Bragging or Saving Stories for Later

The majority of stories players told were motivated by gaining fame and increase their skill in the game. However, it also gave them a sense of actually influencing the world through their actions. For example, P1 recalled:

> *"I did tell a couple of stories. So far, mostly because I imagine "fame" to be a stat which can be farmed, simply by telling many stories. Subsequently, my stories are quite dull. Kind of: "I killed two rats". It's really cool to know, still, that my story will be re-told across the world, but honestly I'm not really "proud" of any of them so far" (P1).*

This description was typical for players who had just started the game and had just finished the tutorial stages of the storytelling and combat systems. Although their initial stories felt simple, they enjoyed the mechanics and concept as part of the game:

> *"I told a story about how I won a fight against skeletons at Whispers Bay. I like the story telling, its nice to do a mini game everytime" (P4).*

and P5 said:

> *"We encountered a bunch of undead at a graveyard, and a bunch of pirates at the lighthouse. I told those 2 stories at the tavern, it was fun because I was looking forward to bragging about it!" (P5).*

Although players routinely told simple stories i.e. gossiping and bragging in the tavern when they came back to town, they wanted to save and contemplate stories for later if they felt like they had achieved something special or different:

> *"I told the story of killing pirates at the lighthouse. It wasn't my most interesting one, but I am more excited to tell the story of the Brimmar sewers once I*

play my next session" (P5).

and P10:

'Only told lame stories from failed battles lasting a minute. Saving the good once for later" (P10).

P1 enjoyed revenge stories and challenging moments that they felt proud to achieve:

"Once again, what stands out to me are the revenge quests, as I outlined before. Also, the fights that were won narrowly is something I was PROUD to tell. During our raid in the mines I got some more stories to tell which should be interesting to check out in the next session" (P1).

Players Effectively Learn About The World Through Their Stories

Players indirectly taught each other about the world through the stories they generate. They learned about threatening groups of predators, players killing other players, how big the world is and rumours about rare items they can strive to find.

The towncrier proved effective in quickly conveying short stories about what is going on in the world. For example, P5 said:

"I saw the towncrier tell a story about another player fighting some stronger monsters which I probably wouldn't go near yet. That was pretty awesome, because it gave me something to work towards" (P5).

and P1 learned about predators from:

"a message that some wolves somewhere in the world are growing stronger (and probably needs to be taken down rather soon)" (P1).

Players not only learned to be vary of predators, but also each other:

"I also saw a story of a player (Dracs) killing another player, which made me wary of them. So if I encounter them in the future, I don't think I will trust them or be willing to work with them easily. I also heard of them finding rare weapons, which makes me want to do the same!" (P5).

As the game grows bigger and people get more and more invested with their characters and items, this kind of information can be crucial for surviving and staying strong. P9 commented that they:

"heard stories about other players which did expand on the world, making it feel

more alive. It was cool actually seeing the player you had heard a story about in the game world" (P9).

8.6 Discussion

This study aimed at designing and getting first-impression feedback on the systems and insights into how players co-design, generate and interact with player-shaped story content in an MMO. We discuss these results with respect to how they contribute to developing the concept of *Narrative Substrates* and understanding of players' experiences in regards to engaging play and persistent narrative co-design.

Play Arcs Reify Stories, Not Just Events

We demonstrate how *Play Arcs* acts as a successful format for structuring data generated from players' actions, compiling them into stories and offering players the choice to edit and create coherent narrative content as part of the game. We propose that *Play Arcs* is an extension to *Narrative Substrates* in the way that it builds upon the story events structure, extends the discoverability principles and adds support for co-design. *Play Arcs* support reification of full stories in addition to individual story events. They enable co-design of persistent story content which enriches context and depth of the world narrative. Players can, if they want, describe their experiences in their own words and contribute to the history without any extra effort from game designers, once the system is set up.

Although the *History Game Mechanics* were still in early development, we did manage to guide a few players through the process of finding an heirloom and found that the *story chains* properly reified relationships, where players through *story hooks* were introduced to narratives of old *story artifacts* and could partake in coherent research missions, gathering *story clues* and interviewing NPCs about real events that had previously happened in the world. Designing *story chains* was challenging due to the complexity of representing multiple dimensions of data in an interactive and user friendly way, especially since we were limited to only using Unreal Engine's tools for designing UI elements. Future work should further explore how to design game mechanics with interactive information visualization techniques that handle players' narratives and intersecting storylines over long periods of time.

Story Co-design is Generative Content Creation

Players generated hundreds of new quests by telling stories, effectively generating content with different difficulty levels and objectives spread all over the world. Considering the narrow range of story types available in this study, these are promising results since we can easily scale the system with more variety of tellable stories and offer other modes for players to customize their narratives. While players had agency to freely position and decide if they wanted their stories to become quests, few players customized the text content of their stories. The UI did not specifically communicate that the text was editable and the players who understood it lacked incentives to write something themselves since there were no feedback loops in the system or direct rewards for doing so. To quickly get some insight into what type of stories players would write, we created a temporary feedback loop on discord and announced a small competition where the best customized stories (decided by votes from the player community) would win. Four players shared their narratives inspired by their experiences and supported by the templates (see example in Fig. 8.13).

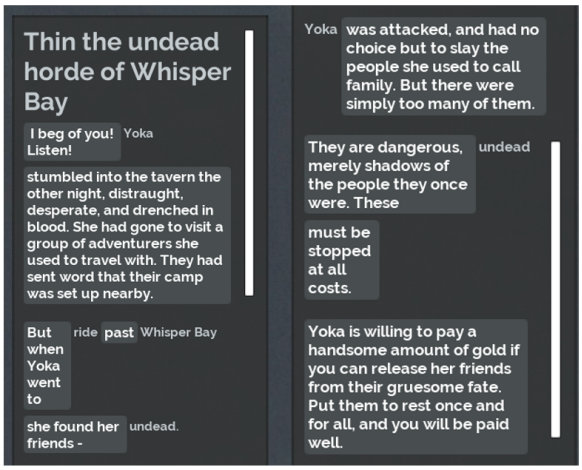

Figure 8.13. Player Narrative: players can customize the text of stories to say whatever they want.

We want to offer more ways for players to customize their narratives, but the early nature of this study had us focus on fundamental features that can scale from ten as well as hundreds of players. This taught us the importance of introducing the right ways for balancing the generative qualities of the systems. For example, early in the test we found that some quests spawned too many NPCs at the outposts and that outposts also could spawn too close to each other, crowding an area and significantly causing lag to the server. We then had to limit how many NPCs can spawn and specify the distance for how far away outposts need to be. Many similar, but smaller findings appeared in the test and highlights the importance of rapid, continuous

testing, especially for *generative* systems.

Persistent Stories or Memories?

Players found the game mechanics related to storytelling engaging, even if the range of different stories were limited to few 'narrativeTypes' i.e. simpleBattleAi, thin the herd and revenge. This was not an unexpected outcome of the study since our aim was to early test robust structures which we easily can expand on later. We added these simpler stories to get players to train storyweaving frequently and gain fame. It was more surprising that players often saved stories for later when they felt like they had more time contemplate them, and actually something we had to address during testing when stories started disappearing from players' panel because it was full. This finding led us to consider how we should persist *untold* stories and what role they should have further in the game. Should characters keep stories as memories like we people do in the real world or should we just limit them to a short time period? We propose that the former is interesting future work. In real life, we keep stories in memory and then pick and choose from all of them to compose narratives. How does this extend on *Play Arcs* and what does it mean in terms of co-design and narrative complexity?

8.7 Chapter Summary

This chapter described the design and testing of history game mechanics and features that let players contribute stories of their gameplay as content in the MMO *We Ride*. We build upon previous work with the goal to explore strategies for designing systems that let designers harness the unique and generative qualities players provide to game worlds through their stories.

We introduce *Play Arcs* as a conceptual component of *Narrative Substrates* that reify stories and *History Game Mechanics* that players explore the generated history of the game world. We deployed an early stage technology probe of the systems and found that they successfully support players in generating and co-designing content as coherent stories. We also found that players teach each other about the game world through their stories and they often saved more notable stories for later rather than when they generate simple stories and routinely tell them as soon as they can.

We conclude that *Play Arcs* is a suitable model for reifying stories and that future work should aim to broaden the systems and support a larger range of stories with greater variety. Designers should make use of interactive information visualization techniques to handle intersecting storylines over long periods of time and implement stronger incentives and feedback loops for customizing stories.

9

Discussion & Directions for Future Research

I discuss how the underlying theory and statements of this dissertation connects with its contributions. I also describe the challenges and limitations faced in the research process and suggest directions for future research.

Game designers need strategies to build enough content, yet oversee the potential of players' productive behavior and the stories they generate. I argue for leveraging persistence and envision digital game worlds which reify player stories and include them as part of the game, with potential to acknowledge players, location and items as true, history-enriched content. I state that:

> *"by understanding the role of persistence and how player narratives emerge in digital game worlds, we can design novel systems and tools that let people leave behind and shape the stories they generate by playing as well as continuously contribute new unique game content. This can help game designers build worlds that, not only keep players engaged over longer periods of time and mitigate the needs for successive updates of pre-written content, but also acknowledge players through the histories embedded in the environment."*

This thesis explores how to achieve this statement and in short, how to design persistent player narratives in digital game worlds. This required novel methodology to understand players' experiences in respect to persistence and narratives as well as additional theories for designing and testing game prototypes. I show how to gather player

stories by combining multiple methods from different sources, develop new tools for analysis and co-design and my own games to attain highest possible ecological validity through playtesting. I present how persistence affects players' gaming experiences and illustrate the potential of narrative co-design with players' own persisted traces as well as demonstrate their abilities to generate new content. Based on the principles of Instrumental Interaction and Co-adaptation, I introduce *Narrative Substrates* as a core concept for designing persistent player narratives with *Play Arcs* as an extra component to enable co-design and reification of stories. Finally, I demonstrate several implementations of technology in *We Ride* and tools for visualizing player narratives. In this chapter, I discuss the implications of this work, the challenges I encountered and which limitations the process presented.

9.1 Designing & Conducting Research in an MMO

The backbone and most unique contribution of this thesis is the research environment and MMO, *We Ride*. Unlimited access and control over the game let me deploy and test novel technology in a live, fully functional game world where researchers and designers directly observe and communicate with the players. The recent advances in game development technologies enabled me and my co-developer to single-handedly build a MMO — which in the past required dozens of people — and manage a community of players, listen to their feedback and swiftly patch new versions of the game within a few hours. This is, to the best of my knowledge, unprecedented in the peer-reviewed body of literature on game design, and thus contributes unique qualities which future research will benefit from. By including *We Ride* in our triangulation approach we could conduct research from multiple perspectives including players experiences, methodology, designs and technology. Earlier research of MMOs adopted more traditional approaches such as small-scale ethnographic studies or larger quantitative analysis of player behavior in existing, commercial games (de Castell et al., 2012; Nardi, 2010). While this can provide deep insights into how players interact with traces shaped by that specific system, it limits the outcomes to similar sets of already established game mechanics and lacks the possibility to compare new alternatives and iterate on designs. This dissertation studies persistence, a property already defined in the game architecture and *We Ride* provided a flexible research environment which let us quickly tweak parameters of the system based on direct player feedback.

The novelty of this approach also presented both practical and technical challenges. I borrowed techniques from experimental game design prototyping (Eladhari and Ollila, 2012) and the HCI literature to deploy technology probes (Hutchinson et al., 2003), but the scale and nature of MMOs still pose some problems for evaluating and studying players' game experiences. For example, people played the game from all around the world in different time zones, restricting us from directly observing or supporting them if they encounter any issues. This also caused some networking issues since the server was hosted on a regular consumer PC located in Sweden. For example, the speed for downloading the game files vary by region, so players in the U.S had slower connections. The server also caused issues in the second deployment (see chapter 5) when we ran the GM-authored event, sometimes causing severe lag in encounters with many different characters. Although we corrected this issue in later versions, it might have limited us in testing the *story monitoring interfaces* which we built both inside *We Ride* and as an web application, showing that Game Masters can search for persisted events to compose new narratives based on player stories. While the web application was never actually tested with *We Ride*, the process of designing it with external developers was insightful and demonstrated some challenges to visualizing item stories on the map. For example, how to filter out redundant information if the item was in the same location twice in a row or how to represent sufficient information in a chronological order without cluttering the map.

9.2 Studying Persistence & Player Narratives

In order to understand the role of persistence and player narratives, I continuously needed to develop novel methodology for gathering different types of stories and observing player behavior. Although analyzing re-told stories do not provide the same depth as ethnography or details as think-aloud techniques do, they can provide better ways to understand a broad range of players' experiences in respect to persistence. MMOs consist of large complex systems hosting many different types of players (Bartle, 1996) and activities, which also depend on thriving, active player communities, not only individual perspectives. After running four different studies and analyzing over 400 stories in chapter 3, I show how players' game experiences in themepark and sandbox MMOs are different due to persistence, and that although players highly value unique and first-time moments across both genres, the lack of persistence in themeparks lowers uniqueness

and promotes meta-persistence i.e. leverage persistence on the web for telling stories or collaborating, which in some cases also disrupts gameplay and reduce the rate at which game worlds remain relevant and interesting to players. I address these findings by proposing four design implications for how to design persistent game worlds that can persist elements of players' stories and turn them into reusable objects. However, as I developed *Narrative Substrates* and continued to build on these implications throughout the thesis, meta persistence remained as an observed phenomenon and promising concept on its own.

I suggest that meta persistence holds several promising directions for future work. In 2021, industry leading companies such as Facebook, Epic Games and Microsoft announced their active efforts towards building the so called *Metaverse* (Duffy, 2021), a digital universe extending the physical world we live in, with fully immersive 3D capability, supporting social interaction and vast cultures to emerge (Dionisio et al., 2013). Koster (2021) discusses the context of the metaverse 'hype' and suggests that much of the appeal of the metaverse have already happened in existing online worlds, that online world technologies is the backbone of the metaverse and how we still have to answer big questions around technology for standards, digital ownership etc. While the exact motivations for how or why *these* companies announce their strong interests in developing such technology remains speculative, it indicates strong future demand for better understanding persistence not only for game systems, but also for larger interconnected worlds with meaningful exchange between the physical and digital. I propose that future researchers build upon this previous work and establish an updated cohesive taxonomy surrounding concepts such as meta persistence (Gustafsson et al., 2020), metaverse (Dionisio et al., 2013; Koster, 2021), meta gaming (Carter et al., 2012) and magic circle (Huizinga, 1955). This will help founding robust structures for new future design strategies that can leverage meta persistence and directly support peoples' activities across different digital environments. For MMOs specifically, I encourage exploring not only how to design MMOs that are more resilient to the harming effects of meta persistence e.g. information hubs on the web allowing players to overcome challenges faster, but also the potential benefits it can provide to novel forms of gameplay e.g. hybrid worlds with elements of Alternate Reality games as Dena (2008) describe, but with 3D worlds and avatars on top?

9.3 Supporting Players as Co-Designers

By introducing and testing *Narrative Substrates* in *We Ride*, I showed that we can effectively design game architectures that capture and reuse components of the stories that emerge from players' actions, and letting game masters author new narratives with direct implementation inside the game. These results inspired me to explore how to include *players* as co-designers of their own narratives. To approach this topic, I first had to overcome a number of methodological challenges: What does it take to encourage players to leave traces of their own activity? When they do, how can we measure this activity with respect to players' enjoyment? Although the research literature lacked sufficient details for studying online multiplayer games that capture players' stories and also invite them to co-design as part of play, they did suggest ways of using Virtual Tabletop Role-Playing Games (VTTRPG) as constructive research environments (Eladhari and Ollila, 2012; Webb and Cesar, 2019).

I developed three VTTRPGs and found that an open sandbox environment was the better approach of the three, and introduced an experimental setup combining theory of *Narrative Substrates*, structured observation and *Play Traces*, as a method for organizing traces of players' activities through graphical representations so that they support analysis of stories as well as co-designing new content. I ran 16 four-hour sessions with 17 players and concluded with four design implications for supporting players in designing narratives that first *Reveal & Pull* attention from other players, *Invite & Push* further exploration, *Guide & Assist* toward endings, and optionally *Show & Hide* traces. However, although I have experience designing MMOs, I was limited by the reliance on my own interpretations as to how these observations would translate into real MMO environments over longer periods of time e.g. three years. Many significant differences exist between VTTRPGs and MMOs, especially in terms of players' reliance on the GM's descriptions and the passage of *time*, which I found for VTTRPGs to be much slower than in MMOs, but difficult to account for in the study, considering players' already generous commitments to several long play sessions. In the future, it would be useful to measure the effect of different strategies for encouraging players to leave traces that lead to narratives, and also identify what kinds of narratives they are more likely to interact with. Although structured observation provide rich, qualitative data with high ecological validity that allowed us to compare different game and design strategies, neither produced much quantitative data. A larger-scale quantitative study would allow us to

test specific hypotheses that arose in the study: Over time, do players interact more with each other's traces than their own? Which specific types of traces encourage greater interaction over longer periods of time?

Chapter 8 demonstrates these co-design techniques in a real MMO and show that players are productive contributors of narrative content through persisted traces of their activity. We observed that players supplement narrative potential of the game world, not through high granularity of detailed traces, but by telling stories in the tavern, producing quests and causing outposts to spawn in the world with references to past events. The *Play Arcs* and *History Game mechanics* are generative systems from which players instead of consuming, produce new content the more they play. Although this addresses some of the limitations mentioned in previous paragraphs e.g. validates the transition from VTTRPGs to MMOs, it also introduced novel challenges for future work to take up on. For example, the current approach for co-designing quests supported customizing text, however, I believe that we can support much richer narratives if players are given access to a full range of tools and will find stronger incentives to express themselves if the system supports complete feedback loops.

I believe that further interesting research opportunities will continue to unfold over time, as players continue to generate different kinds of traces from play, and begin to design narratives that are nested within each others player histories. I would like to know whether players' meta-persisted activities surge or reduce if they are reified with the games and how this will affect players' experiences. How can player-designed narratives be shared across different media such as Madden and Logan (2007) and Dena (2008) explore? I argue that this work offers a generative foundation for exploring ways of enabling players to actively influence and contribute to persistent digital game worlds.

9.4 Conducting Sex and Gender Balanced Games Research

I would also like to address the challenges of achieving sex and gender balance among players throughout these studies. In the preliminary interviews all participants identified as men, the story questionnaires one fourth responded 'female' and the stories from Reddit or early technology probes in chapter 5 did not disclose participants' sex and gender. Although I put in extra efforts to diversify participants by reaching out to personal networks and using a snow-

ball technique (Handcock and Gile, 2011), I only achieved to recruit one woman among eight participants in Chapter 6 and 2/15 in Chapter 7. However, since I was specifically looking for groups of friends who already knew each other and played together regularly, I asked for pre-established player groups, which led to a high percentage of male/men players. Although it would have been easier to achieve better sex and gender balance if I had sent out individual requests for participants and then organized them into groups, this would have meant that the players did not necessarily know and trust each other. In chapter 8, I managed better, with five out of 11 players identifying as women, much due to help from friends asking for participants in 'women-only' online forums.

I strongly urge researchers to continue striving for diversity in their work to stay relevant, inclusive and innovative. Despite the fact that women today make up close to half of the global player population (Yokoi, 2021), the video game companies still mainly consist of men. Styhre et al. (2018) report that after steady annual increase prior to 2018, the Swedish video game industry consisted of just roughly 16 percent of female employees. They also report results from an interview study with 35 people suggesting that: female video game developers are viewed as particularly knowledgeable about other female players' preferences rather than possessing general skills attractive to the video game companies; and *"that the masculine domination and the historical gendered divisions of labor are preventing the industry from creating more gender-equal workplaces and, as a consequence, fully exploiting market potentials"* (Styhre et al., 2018). Taylor (2003) explore how MMOs were initially attracting a 'surprising' amount of women compared to other genres (20-30% of the total playerbase) and concludes through ethnographic and interview data that considering how male-dominated the design of these games are, the numbers of women playing the major MMORPGs[1] are "actually quite remarkable given they are not the demographic being target". That "in many ways, women play *despite* the game". For this reason, I believe MMOs are far from having reached their full potential and that researchers and designers need to put conscious effort into building diverse knowledge and games.

[1] Taylor refers to *EverQuest*, *Ultima Online*, *Asheron's Call*

9.5 Designing for Persistent Player Narratives

The natural bottleneck for designing with persistence is that objects and states require specific instructions for how they should last and

change in the environment. The challenge is by part, a matter of granularity (Koster, 2009a), but also as I show in chapter 4, how to manage players' expectations and the outcome of persistent change across multiple dimensions such as world narratives, meta persistence and player progression. To handle these issues, I introduced *Narrative Substrates* as a theoretical framework for designing game architectures that represent, manage, and persist traces of player activity as unique, interactive content. This lets designers harness the power of stories generated by players themselves and build new features with elements of greater inclusiveness and agency.

One benefit of designing with emergent stories is that they do not *necessarily* have to impact or change the actual game worlds. Stories are by large ephemeral and spread, interpreted, morphed, and valued orally, without directly affecting the space or environment. Yet, their importance also relates to how they are shared and the number of people upon which they touch. For example, religious scriptures have greatly impacted people and then through us shaped the environment for building places of worship or practicing our beliefs. At the same time, peoples' diaries generally have low impact on others' lives even if they surely *can* have tremendous consequences in certain contexts (e.g. Anne Frank's Diary). Although I do not provide specific guidelines for how to anticipate or evaluate the effects of different forms of reified stories, there is vast potential for future work to explore how designers can adjust and balance the outreach of players' stories by assigning different forms of persistence e.g. tell stories in the tavern, inscribe information to artifacts, write books etc.

One example of important in-game books are found on *2b2t*, a *Minecraft* server that has been running the same map since December 2010 (miraheze.org, 2021b). Players there collect and trade 'Signed Books' which are valued according to 4 main factors: The player who wrote it, how old the book is, how common the book is and if the book is an Original, Copy of an Original, or a Copy of a Copy (miraheze.org, 2021a). While this is a fantastic illustration of the value persistence provides, the actual stories are not integrated or linked together the same way as if minecraft was built based on the *Narrative Substrates* model. In 2b2t, players collaborate to form their own historical timeline on a website[2] to segment different epochs and events. In chapter 8, I demonstrated what this could look like *inside* of *We Ride*, on top of *Narrative Substrates*, as a panel with multiple different timelines and views that players can browse and unlock as part of *History Game Mechanics*. Although our study primarily showed how to build and implement such technology, the theory behind an integrated, accessible world narrative

[2] https://time.graphics/line/28104

which players can refer to, reveals generative ground in which game designers and researchers can explore a range of novel mechanics and concepts from.

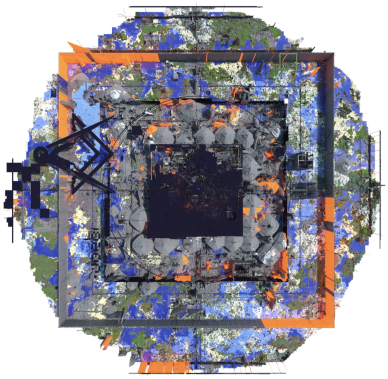

Figure 9.1: 2bt2 minecraft world: a top-down view of the entire map. Source: https://en.wikipedia.org/wiki/2b2t

Theorizing Reification & Co-Design of Player Narratives

The central theory behind my research is rooted in *Instrumental Interaction* (Beaudouin-Lafon, 2000) and *Co-adaptation* (Mackay, 2000). *Reification* is to turn user actions into first-class objects that act as tools. For example, (Riviere, 2020) reify segments of video to capture and save traces of dancers' movement which can then be manipulated, reused and shared as an object with unique properties. *Narrative Substrates* shows how to *Reify* elements of players' past activities as *Story Events* and *Reuse* them as story content. In chapter 5, I introduced four *types* of story events: *owner change, player kill, boss kill* and *custom* which persists such occurrences and can be used as actual plot points in narratives. While it would possible to expose the substrate directly to players and let them compose their narratives, we argued that the format of story events was too raw for building co-design mechanics that yield players meaningful interaction and fit within the game concept of *We Ride*. This is not to say that more complex systems where *Narrative Substrates* is fully accessible by players could lead to interesting results, but rather one of the limitations of this study and encouraged upon future work. We emphasized an approach for exploring the reification of full stories and came up with *Play Arcs*, a component of *Narrative Substrates* which reifies *stories* as a collection of traces to support co-design and full length narratives rather than just certain instances of events in time. In chapter 8, we introduced four *narrative types* to *Play Arcs* which players continuously generate through play, paired with corresponding templates that they can tell and edit as part of storytelling in the tavern. In terms of co-adaptation, I believe that future systems should accommodate both reification of events and stories, to let players shape the systems and their stories towards their needs, *beyond* what they already do on the web.

10

Summary & Conclusion

This dissertation explores the role of persistence and player narratives in MMOs to understand how we can design novel systems and tools that let people influence digital worlds through the stories they generate by playing. I argue that this can help game designers build MMOs where players are acknowledged for their achievements through real history embedded in the game world, encouraging them to stay engaged over longer periods of time and mitigate the needs for continuous development of pre-written content.

I began my research by conducting preliminary interviews to learn the best methods for gathering stories related to persistence in players' experiences. The results suggest gathering many *short* specific stories, rather than few, long, detailed ones. Thereafter, I adjusted my approach and developed a variation *story questionnaires* which asked participants to respond with the first stories that comes to their minds after reading pre-written example stories related to persistence. I also gathered stories from Reddit, first by asking for examples of games that offer world-integrated player histories and then by analyzing a large set of stories from an independently created Reddit post. I found that lack of world persistence lowers player's sense of uniqueness and that players resort to the web to persist stories and collaborate, which sometimes disrupts how the games are intended to play. I also found that players are significantly influenced by uniqueness and first-time experiences, and that persistence affects the rate at which game worlds remain relevant and interesting to players. These findings suggested four design implications from which I introduced *Narrative Substrates*,

a theoretical framework for designing game architectures that represent, manage, and persist traces of player activity as unique, interactive content. I designed the Massively Multiplayer Online game (MMO) *We Ride* to illustrate and test this theory by running a two-phase technology probe over one year. I show that *Narrative Substrates* let Game Masters directly reify stories and create events *inside* as well as outside of games with novel tools to study player histories. I conclude that future work should explore how players can co-design their stories and support more detailed stories.

In the second part, I explored techniques for including players as co-designers who implement part of their narratives as content, inspired by persisted traces of their own play activity. First I developed methodology by designing and playtesting three Virtual Tabletop Role-Playing Game (VTTRPG) prototypes and introduced *Play Traces*, a novel analysis method that structure graphical representations of players' activity traces to support game designers and research in co-design and story analysis. In a second structured observation study, I included the new methods and found that players successfully co-design novel narratives and three main themes for how traces affect and support players in shaping new persistent narratives. I present four design implications describing how player-created narratives in MMOs should first *Reveal & Pull* Attention from other players, *Invite & Push* further exploration, *Guide & Assist* toward endings, and optionally *Show & Hide* traces. I built on these findings and introduced *Play Arcs*, an extension to *Narrative Substrates* that support the reification of *stories* in digital game worlds, in addition to individual traces. I demonstrated the concept in *We Ride*, together with novel *history game mechanics* and playtested a two-phase technology probe over five weeks. I found that players successfully contribute new content through co-design of self-generated stories and that *Play Arcs* offers several opportunities for future work to study players as co-designers and storytellers in persistent game worlds.

10.1 Conclusion

This thesis demonstrates how to design persistent player narratives in digital game worlds by embedding traces of player activity in *Narrative Substrates*, a concept grounded in the combination of my empirical findings and the theories of instrumental interaction and information substrates. *Narrative Substrates* persist and structure traces of in-game interaction over time, empowering game designers to detect

and manage emerging player stories and effectively turn them into novel and personal game content. This offers a generative foundation for developing new concepts and game mechanics that can increase player engagement as well as more efficient content production. *We Ride* shows that players can get officially recognized for their achievements and see their legacies persist as part of the world lore. Game environments can continuously change and stay engaging even if players visited there several times before. Items can become truly unique, representing their own histories and outlast many generations of players. *Narrative Substrates* also serves as design space for game masters and designers to browse events suitable for new narratives inspired by past events. Overall, *Narrative Substrates* direct focus on players' activities over designer content, encouraging *co-adaptation* and help MMO designers think beyond their own creative contributions and consider how players can add to and shape the worlds toward their own likings. After the first deployments in *We Ride*, this inspired me to think of players as co-designers, of how to let them share *their* personal narratives with true detail.

I sought to extend *Narrative Substrates* further by inviting players to co-design and implement narratives of their own into digital game worlds. The *Play Traces* instrument developed out of the need for researchers to easily capture and communicate traces and stories to players in Virtual Tabletop Role Playing Games (VTTRPG). It offers players as a space to reflect on their stories and modify them as they want e.g. add or remove details and even heavily fictionalize if they want. The VTTRPG studies revealed several implications for how to build game systems that support players in co-designing stories based on their own traces and *Play Arcs* is the resulting conceptual component which adds to *Narrative Substrates* and illustrated in *We Ride*. *Play Arcs* reifies full stories in addition to traces which creates a format where the game system automatically can support players in constructing full, engaging narratives without adding specific new features that require designer effort. It gives players the chance to shape their characters' stories, to co-adapt with the world and become part of persistent history. In the final version of *We Ride*, we demonstrated how *Narrative Substrates* generates a range of new game mechanics and future activities within the persistent narrative that collectively emerge from players' activities e.g. researching, treasure hunting etc.

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A

Synthèse

La persistance est une propriété implicite régissant la manière dont les mondes et les objets perdurent d'un moment à l'autre. Contrairement au monde physique, les mondes de jeux numériques, tels que les jeux en ligne massivement multijoueurs (MMO), ont une persistance limitée. En effet, ils exigent des concepteurs de jeux qu'ils décident spécifiquement de la manière dont chaque objet et état doit persister, ainsi que calculer soigneusement la manière dont les effets durables influencent les expériences des joueurs. Néanmoins, les joueurs génèrent des histoires riches et uniques à chaque fois qu'ils jouent, mais en raison de leur faible persistance, ils laissent peu de traces derrière eux et ne peuvent pas partager leurs récits dans le cadre du jeu. Je soutiens que la compréhension du rôle de la persistance et de l'émergence des récits des joueurs dans les univers de jeux numériques peut conduire à des systèmes et des outils novateurs pour accroître l'engagement des joueurs et aider les concepteurs de jeux à produire du contenu.

Je mène des entretiens, puis je présente une variante des questionnaires sur les histoires où les joueurs répondent avec leurs propres histoires inspirées par des exemples pré-écrits liés à la persistance. Je montre également comment utiliser Reddit pour recueillir des ensembles de récits écrits par les joueurs sur leurs expériences dans le jeu. Pour faciliter la co-conception et l'analyse des histoires, je développe des jeux de rôle virtuels sur table (VTTRPG) et présente "Play Traces", une méthode permettant de structurer les traces de l'activité des joueurs dans des représentations graphiques afin de concevoir de nouveaux contenus narratifs avec les joueurs. J'ai ainsi développé

mon propre MMO “We Ride” et l’utilise comme environnement de recherche, démontrant comment mener des tests itératifs rapides ainsi que des études longitudinales de différentes technologies de jeu avec un retour d’information constant des joueurs.

Je montre que les joueurs recherchent des expériences de jeu uniques et que leurs récits sont fortement influencés par les moments de première fois et les succès. Cependant, le manque de persistance dans les MMO affecte fondamentalement les joueurs, diminue leur sentiment d’expériences uniques et favorise plutôt les activités méta-persistantes, c’est-à-dire l’exploitation des caractéristiques persistantes du web pour raconter des histoires ou collaborer, ce qui peut perturber le gameplay et réduire le rythme auquel les mondes de jeu restent pertinents et intéressants pour les joueurs. Dans We Ride, je montre comment les “Narrative Substrates” aident les concepteurs de jeux à relever ces défis et comment les joueurs peuvent générer du nouveau contenu à la fois sous forme d’artefacts narratifs qui font perdurer des événements passés et par la co-conception de leurs propres histoires avec des arcs de jeu, tout en ajoutant à l’histoire intégrée du monde du jeu.

J’ai construit We Ride en tant qu’environnement de recherche pour le développement de systèmes de jeu qui peuvent persister et réifier les activités des joueurs dans le jeu, avec des mécanismes de jeu pertinents, y compris des objets qui montrent comment les joueurs ont interagi avec eux et évoluent en conséquence. J’ai également conçu une fonctionnalité qui permet aux joueurs de co-concevoir le contenu de l’histoire, de rechercher l’histoire créée par les joueurs dans le monde et de redécouvrir des objets hérités. En explorant comment soutenir les joueurs en tant que co-concepteurs, j’ai produit plusieurs prototypes de VTTRPG et des interfaces de suivi d’histoire, à la fois à l’intérieur de We Ride, et en tant qu’application web qui permet aux maîtres de jeu de rechercher des événements persistants pour composer de nouvelles narrations basées sur les histoires des joueurs.

ÉCOLE DOCTORALE
Sciences et technologies de l'information et de la communication (STIC)

Titre : La conception de récits persistants de joueurs dans les mondes numériques des jeux vidéo

Mots clés : Mondes numériques des jeux vidéo, interaction humain-machine, interaction instrumentale, persistance, narratif

Résumé : Les joueurs de jeux en ligne massivement multijoueurs (MMO), génèrent des histoires avec leurs personnages, mais ne peuvent pas exprimer ou voir les traces de leurs aventures dans l'environnement. Je soutiens que comprendre le rôle de la persistance et de l'émergence des récits de joueurs dans les mondes de jeux numériques, peut conduire à de nouveaux systèmes et outils permettant d' accroître leurs engagements De plus, cela peut aider les concepteurs de jeux à produire du contenu.

Je combine plusieurs méthodes pour comprendre des récits de joueurs et je présente We Ride, un MMO proposant le cadre du "Narrative Substrates" pour construire des architectures et des mécanismes de jeu qui tirent parti des récits persistants de joueurs. De multiples études montrent comment le "Narrative Substrates" encourage avec succès les joueurs à co-créer du nouveau contenu à partir de leurs propres récits, en leur permettant de façonner le monde et de contribuer à un contenu nouveau.

Title : Designing Persistent Player Narratives in Digital Game Worlds

Keywords : Digital game worlds, Human-computer interaction, Instrumental interaction, Persistence, Narratives

Abstract : Players in digital game worlds, such as Massively Multiplayer Online Games (MMO), generate long-standing histories with their characters, but cannot express or see persisted traces of their adventures within the environment. I argue that understanding the role of persistence and the emergence of player narratives in digital game worlds can lead to novel systems and tools for increasing players' engagement and help game designers produce content. I combine multiple methods for understanding player narratives, and present We Ride, an MMO that embodies and tests the Narrative Substrates framework for building game architectures and mechanics that leverage persistent player narratives. Multiple studies show how Narrative Substrates successfully encourages players to co-design new content from their own persisted narratives, letting them shape the world and contribute novel content. Finally, I discuss the challenges of this work and suggest several promising directions for future work.