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► **To cite this version:**

Viktor Gustafsson, Benjamin Holme, Wendy E. Mackay. Play Arcs: Structuring Player Stories for CoDesign & Content Generation in Persistent Game Worlds. DiGRA 2022 – DiGRA International Conference: Bringing Worlds Together, Digital Games Research Association, Jul 2022, Krakaw, Poland. hal-03991923

HAL Id: hal-03991923

<https://inria.hal.science/hal-03991923>

Submitted on 16 Feb 2023

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Play Arcs: Structuring Player Stories for Co-Design & Content Generation in Persistent Game Worlds

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ABSTRACT

Players of Massively Multiplayer Online games (MMOs) consume content much faster than game designers can produce it. However, they also generate stories through their interaction, which can contribute to adding novel types of content in the game world. We introduce and demonstrate Play Arcs, a design strategy for structuring emergent stories that players can co-design and contribute as unique game content. We develop an MMO with tools for co-design and ‘history game mechanics’ and test as a technology probe with 49 players. We show that Play Arcs successfully structure coherent stories and support players in shaping new, unique content based on their own histories. We found that these stories can inform and guide players’ decisions, and also that, while players often share simpler stories directly, they keep more notable stories to themselves for retelling later. We conclude by discussing design challenges and directions for future work with Play Arcs.

Keywords

Massively Multiplayer Online Games, History, Co-Design, Procedural Content Generation

INTRODUCTION

Game designers of Massively Multiplayer Online games (MMOs) struggle to develop sufficient game content that keep players engaged over long periods of time (Yannakakis and Togelius 2018). Part of the challenge is that MMOs aim to simulate persistent game worlds that always continue to exist (Bartle 2016b), but the reasons for staying and playing in these worlds decrease over time since players consume all available content faster than designers can build it (Debeauvais et al. 2014). One promising technique to mitigate this challenge is with Procedural Content Generation (PCG) tools, i.e. algorithmic computer software that create content by itself (Shaker et al. 2016). However, Short and Adams (2019) note that this does not necessarily save time since designing procedural systems can end up harder than expected and that PCG is sometimes unsuitable for competitive multiplayer and authored experiences i.e. designers want high control of game balance, equal conditions for

Proceedings of DiGRA 2022

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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 several opportunities for techniques that derive new content based on players' generated stories.

We explore an alternative approach to generating content where we view game worlds 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 systems are designed to address them (Gustafsson et al. 2020). For example, game proprietors can 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) 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 accelerates players' capacity to organize and specialize in overcoming the goals they have with the game (Gustafsson et al. 2020). 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).

We are 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 of each other, as well as let 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.

This paper explores how players generate and shape story content through *Play Arcs*, a concept which turns player stories into game content, implemented in our independently developed MMO *We Ride* (We Ride 2018). We first provide definitions and describe the underlying concepts of *Play Arcs*, including persistence, content generation and co-design. Then, we introduce the MMO with a scenario and details for our setup. Next, we describe the study which included 49 players generating and interacting with each others stories. We conclude with discussing the challenges of integrating player-generated activity traces into game worlds and suggest directions for future research.

DEFINITIONS AND BASIS OF PLAY ARCS

Play Arcs is the product of earlier concepts and work on designing persistent game worlds, interactive digital narratives (IDN) and procedural content generation (Gustafsson et al. 2020; Gustafsson et al. 2021; Kreminski and Wardrip-Fruin 2018). We outline the fundamental definitions of these topics and explain how they relate to this study.

Play Arcs

We define *Play Arcs* as a series of events generated by player interactions within a certain time frame. They are data structures which confine information as stories with beginnings, middles and ends. Game designers can parameterize and reuse different variables when designing game mechanics and systems that can generate new content based on player input.

We are inspired by and build upon *Narrative Substrates*, a theoretical framework for designing MMO game architectures that represent, manage, and persist player activity as unique, interactive content (Gustafsson et al. 2020). It consists of *Structure* for stories, management of *Relationships*, and *Rules* for handling the introduction and representation of content in the game world. This work shows that games can persist and manage data from the outcome of players' interactions, and demonstrates how designers and Game Masters (GM) can reuse and reify players' traces into new interactive narrative content. *Narrative Substrates* offers a practical approach and directly relates to MMOs as story generation machines. However, we want extend this framework and specifically explore how *players* shape and contribute their own stories as content.

Persistent Game Worlds

Players' activities and stories affect MMOs differently, depending upon how game systems are designed to address them. By definition, MMOs are 'persistent game worlds', digital spaces in which players interact and can save their progress. They are defined as *persistent* if they evolve, at least to some degree, and continue to exist even if no players interact in them (Bartle 2003). Koster (2009) discusses players' ability to change game worlds in relation to how the outcome of their actions persist. He suggests that persistence is best understood as a spectrum, with a relationship between the degree of persistence and players' ability to change the world. For example, MMO is a broad term that includes two common subgenres. Most modern games, e.g. *World of Warcraft* (WoW) (Blizzard Entertainment 2004), are 'theme parks' and low on persistence. Bartle (2016) 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 (Koster 2009; Bartle 2016a). *Play Arcs* is most useful for sandbox games since they produce more dynamic stories, but although they are the primary environment for this study, we believe that theme parks also can adopt the technique, for example, to acknowledge and enhance player achievements.

Narratives and MMOs

Persistence not only relates to players' ability to change the world, but also the way narrative is represented in play. For example, in theme parks, game designers control the official narrative with pre-written content, typically in the form of *quests* that all players can interact with, while in sandboxes there is often little or no narrative linked to character progression. The focus is instead on letting players shape their own narratives with tools and a high degree of *agency*, i.e. "the satisfying power to take meaningful action and see the results of our decisions and choices" (Murray 1997). These *results* are what we consider the stories in our story generation machines or 'emergent narratives' as defined by Ryan (2018). Researchers

also study games’ “narrative potential: the accumulation of meaningful experience 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.

Terms such as ‘story’ and ‘narrative’ require clear definitions since they are often used interchangeably and can be confusing. For example, the famous ‘ludology vs narratology’ debate was a decade-long discussion about how to study and define video games among scholars coming from diverse background e.g. literature, games, theatre and media studies. However, it led to few constructive results since they failed to properly define or highlight what they meant by terms such as game, narrative and story (Koenitz 2018). More recently, a network of scholars working on Interactive Digital Narratives (IDN) tackle this issue head on, in an attempt to establish a common understanding of digital narratives by producing a shared encyclopedia for the discipline (Koenitz et al. 2020).

Inspired by this initiative, we borrow Genette’s (1983) 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. Additionally, we refer to Eladhari’s (2018) description of Interactive Digital Narratives (IDN) in four layers. 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). Koenitz propose the ‘SPP model’ for the analysis of IDN artifacts as three main stages with *System* as the digital artifact itself e.g. a game, *Process* as the ongoing interactive experience of the system and *Product* is the resulting experience i.e. recording or retelling as defined by Eladhari. The SPP model is the closest concept of how we think of MMOs as ‘story generation machines’ and valid representation of the process that constitutes *Play Arcs*.

Procedural Content Generation in Games

When it comes to content generation for MMOs, researchers and game designers typically refer to Procedural Content Generation (PCG), algorithmic computer software that creates content automatically (Shaker et al. 2016). In games, designers use different methods to generate content such as maps, levels, terrains, textures, and foliage (Liapis 2020; Hendriks et al. 2013; 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 we contemplate and design with both

cases: persisted 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. We 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) discusses 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)¹. They argue that the most fruitful approach to procedural storytelling is combining bits of pre-created, 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 inspired our design of *Play Arcs* for this study which further explores how storylets relate to persistence and support emergent narratives in MMOs.

Adams (2019); the famous game designer of Dwarf Fortress, describes 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 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 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 agency, but the key point from Adams is that successful procedural storytelling design requires a careful balance of the types and proximity of relationships among different story elements. For this reason, Tabletop Role-Playing Games (TTRPG) are often used to explore novel story mechanics, since they offer both flexible prototyping and emergent storytelling with interplay between pre-set rule structures, a game master and the players (Eladhari and Ollila 2012). For example, Gustafsson et al. (2021) explored how to achieve co-design mechanics in MMOs by studying player-generated stories in Virtual Tabletop Role-Playing Games (VTTRPG). They propose four design implications for how game systems should support players in designing stories that first ‘Reveal & Pull’ attention from other players, then ‘Invite & Push’ further exploration and ‘Guide & Assist’ toward endings, and optionally ‘Show & Hide’ traces. Although they describe this in an MMO scenario, it was never implemented and tested in an actual

game. We combine the constructive theories, definitions and concepts from all this previous work to develop a concrete example MMO. We want to establish a research environment in which we can gather first-hand insights in real scenarios and maintain close dialogues with players.

DESIGN GOAL

Our 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 let game designers emphasize creating novel game mechanics and concepts, and at the same time give players new opportunities to express themselves through their emergent stories.

We want to support two types of narratives: 1) daily adventures that are quickly shared amongst people (e.g. news) and 2) a long term history that grows over time. In the first, we 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. We want players to reminisce and recognize their or other players' activities as part of game world history. In the second, they should interact with history through mechanics of the game and discover artifacts or memorabilia with unique narratives that involve players.

SCENARIO

We built the MMO *We Ride*, a live running early-stage 3D sandbox game where players share a seamless open world in medieval fantasy setting, where they train to become warriors, mages, rangers and crafters. Players are settlers of an unknown continent with mysterious powers to pursue fame and fortune, but are entirely free to form their own goals while exploring the world, improving skills, and make friends or enemies on the way. Relationships are important, since the world has no safe zones. Players can attack each other anywhere and if they die, everything they wear, plus inventory, stays on the ground for anyone to loot. The stories they generate persist and are reintegrated into the game through systems and tools that enable players to interact with their stories. The following scenario illustrates how players can generate and shape story content supported by game mechanics in *We Ride*.

Generating Stories. Alex is an experienced player of *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 force 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 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

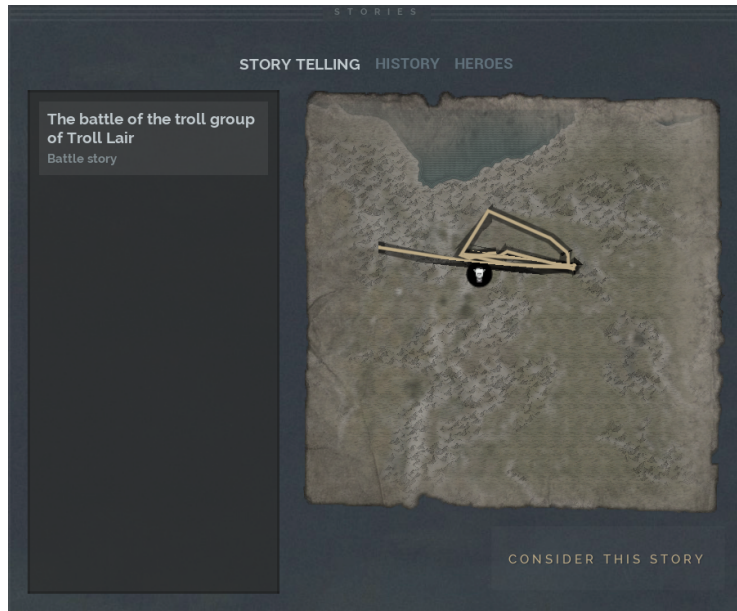


Figure 1. Story Panel: The stories players generate appear listed in chronological order.

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 use a pre-written template for the story (See Figure. 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 then prompted to hit the barrel to begin playing a mini-game that will determine how well Ezra will tell the story and the amount of fame Ezra will get as a reward (See Fig. 2a). While playing the mini-game, Ezra gains storyweaving skill and *fame*² for each step completed.

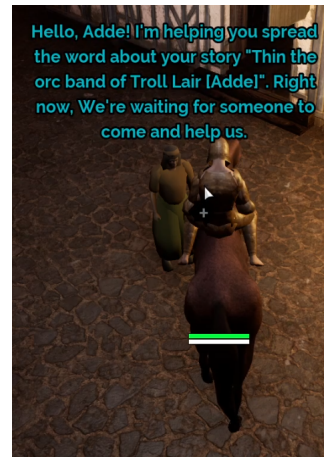
Creating Player-Quests. When the mini-game is finished, Alex sees a townspeople (NPC) approach Ezra who says they are willing to retell this story as a quest to other players (See Fig. 2b). Alex can now control this NPC and either fire them (make them disappear), instruct them to follow (place them anywhere), stop (stay at current position), or give information about the status of the quest (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 of slaying the undead at Tann’s graveyard. Ezra slays a zombie and finds an ‘Ancient Document of Breen Graveyard’ on one of their corpses (See Fig. 3). Alex double-clicks the document and the system responds that Ezra need to find a library and buy a research journal to learn more.

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,



(a) 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.



(b) Player-controlled NPCs: Players spawn and control their own quest NPCs.

Figure 2. Co-design tools for players to tell their stories

character and item in the game (See Fig. 4a). There is also a research tab where Ezra’s research, 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. 4b).

In this event, Alex also sees 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 must find specific clues from another location, Old Brimmar. Alex takes Ezra to Old Brimmar and uses the storyweaving 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. 5a).

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 5b). Alex uses the map upon which the system shows the location in the game 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. 6).

GAME SYSTEM DESCRIPTION

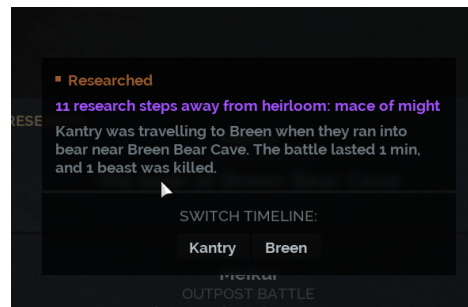
To develop *We Ride*, we built upon existing technology and *Narrative Substrates* which persist and reify events of players’ actions. We extend the theory to support co-design and



Figure 3. Unveiling Player-Legends: Players can find ancient documents and bring them to the library to research old player generated legends.



(a) The history panel lists events in chronological order with information on location, character and item.



(b) Players can click events in the timeline to see how many steps of research they need to find the heirloom.

Figure 4. Interface for Researching Player-History

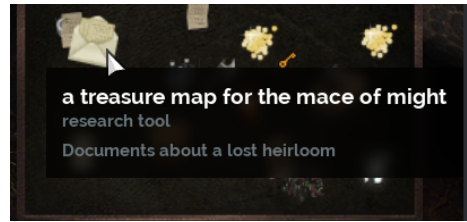
history research through game mechanics that also generates new content. We define the complementary data structure *Play Arcs* and describe how it is implemented in *We Ride*.

Play Arcs in *We Ride*

We 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*: *simpleBattleAi*, *BattleAi*, *KilledByAi*, with each corresponding pre-written, but customizable template stories, a variation of storylets (see Fig. 8). For all *Play Arcs* of the trip type, we use many different tags in the trip special string³ (Fig. 7). 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. When players tell stories of the *ThinTheHerd* 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, where the player must go and defeat the enemies.



(a) Interviewing NPCs for history research.



(b) Treasure map is the final step leading directly to the location of an heirloom.

Figure 5. Mechanics for history research



Figure 6. An heirloom with real player history

History Game Mechanics

The design of the history game mechanics required new specific algorithms to filter and select relevant heirlooms for players to research. The history game mechanics we designed consist of *story chains*, *story clues*, *story hooks* and *interviewing skills*.

Story hooks. Ancient documents are the *story hooks* to begin heirloom-finding quests, acting as the starting points and seeds for which type of heirloom can be found, based on its location e.g. Breen Graveyard in Fig. 3.

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 conduct 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' characters effectively gain more 'knowledge' about the world as they unlock story chains and thus reward their wisdom.

```

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

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. 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.

Story clues & Interviews. Players must always 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.

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 and 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, 49 players played the game. In phase one, 38 veteran players who had played earlier versions of the game and was already active in the community joined the game. In phase two, we recruited an additional 11 players (P1-11) who were new to the game and agreed to provide us continuous, focused 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 with 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 the *We Ride* website and played remotely from their own computer. In addition to the games' official *Discord* server, we also created an additional *Discord* server to divide our new players into groups and separate communication channels.

Procedure

We announced the game's new testing phase in a post on the official *Discord* channel and outlined all the changes we made since the last in-game season. We explained that we would begin with a two week long 'pre-season' where veteran players got to join early to generate stories, artifacts and identify crucial bugs and tweaks, which we then followed 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 provided a brief backstory of how a 'Dark Wyrn' had crawled up from the abyss and haunted the castle of Blackthistle, which unless defeated would 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.

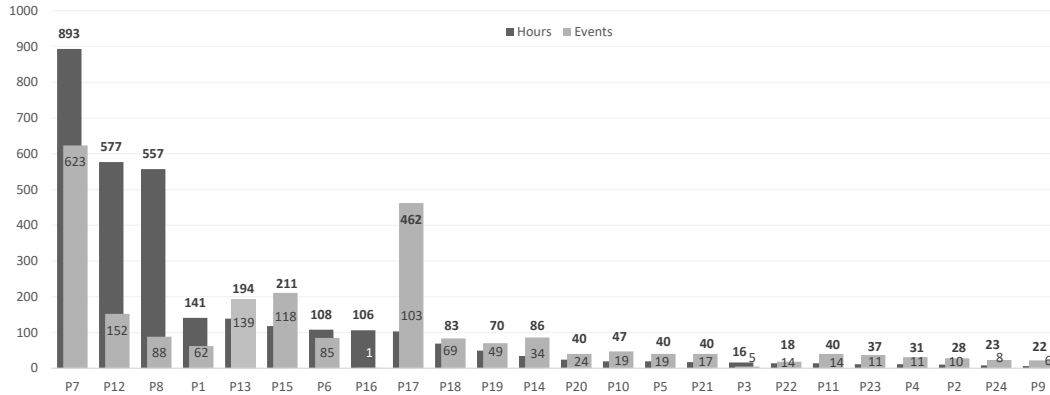


Figure 9. Distribution of story events and time spent among 25 top players

RESULTS

We found that players can successfully create quests based on their own stories, for other players to pursue and finish. Although players edited stories, they lacked direct incentives for sharing custom narratives. The quests filled the game world with narrative content which players interacted with to continuously shape and learn more about the world. *Play Arcs* acted as a powerful module for segmenting generated events into stories that 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, 49 individual players played a combined 3085 hours and generated 2578 story events i.e. a bit less than one story event per hour. The time spent among players was fairly evenly distributed except for some notable outliers e.g. P7, P12 and P8 (Fig. 9). P12 and P8 stand out since their time spent is quite high in comparison to how many story events they generated. The most reasonable explanation for this could be staying in the game without playing, but they could also have been staying in town, chatting or crafting. Another outlier is P17 who generated an impressive number of story events compared to time spent. The overall trend suggests that players generate proportionally more events when being new to the game, and then reverse after spending more time. This is a positive result and by design, indicating that the system effectively filters out events with low story points compared to players' fame level and judges them as less relevant. 1728 of the story events were *Play Arcs* of which the majority of them, 1537, were simple stories that players could tell in the tavern to gain fame and increase their storyweaving skill. The other 191 trip stories were potential quests which players could customize and place in the world for other players to pursue. Players created 135 of such quests and 127 of them were about thinning the herd of creatures and 8 about seeking revenge on someone. The consumption rate of quests were high with 131 out of 135 quests begun or completed by players. The following qualitative results are gathered from players P1-P11.

Routine Bragging or Saving Stories for Later

The majority of stories players told were motivated by gaining fame and increasing their skill in the game. However, they also gained a sense of actually influencing the world through

Players	Total Hours	Total Events	Trips	simpleBattleAi	Quests	Story Artifacts
49	3085	2578	1728	1537	191	192

Figure 10. Data generated in the study

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 recently started the game and had just finished the tutorial stages of the storytelling and combat systems. Although players perceived their initial stories as 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 ones 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 told. 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 wary 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).

DISCUSSION & FUTURE WORK

This study designs and gathers first-impression feedback on the proposed systems with 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 novel, more self-sustaining game worlds through generative story content as well as better 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* act 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. *Play Arcs* serve as an extension to *Narrative Substrates* in the way that they build upon the story events structure, extend the discoverability principles and add 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. Inspired by storylets and the implications proposed by Gustafsson et al. (2021), we built systems in which players can express meaningful experiences with their own words and continuously contribute to history and content, without any extra effort from game designers, once the system is set up. This opens up new ways of thinking, beyond procedural techniques, moving towards primarily generative content derived from emergent player stories.

Although the *History Game Mechanics* were still in early development, we did guide a number of players through the process of discovering an heirloom and found that *story chains* properly reifies relationships, where players are introduced to narratives of old *story artifacts* through *story hooks* and can partake in coherent research missions, gather *story clues* and interview NPCs about real events that have 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 using only 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 varying 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 greater 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. 11).

We want to offer more ways for players to customize their narratives, but the early nature of this study led us to focus on fundamental features that can scale from ten up to hundreds of players. This taught us the importance of introducing feasible ways for balancing the generative qualities of the systems. For example, early in the testing, 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

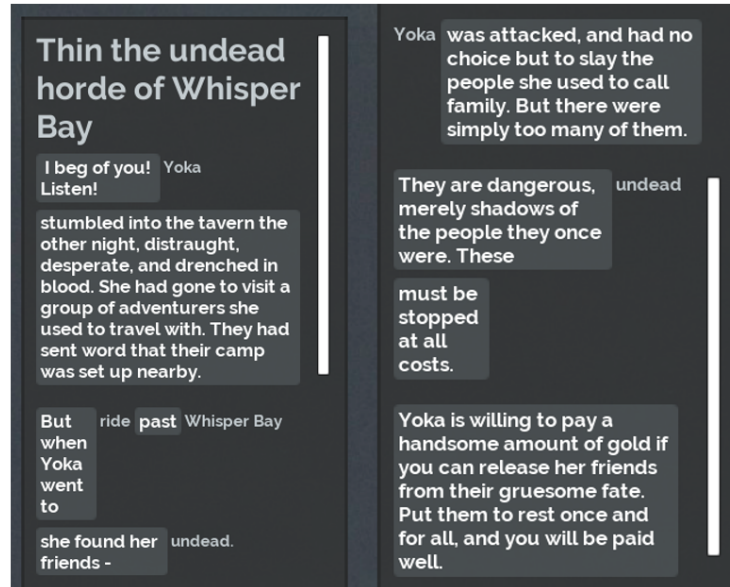


Figure 11. Player Narratives: Players customize the text of stories to say whatever they want.

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, ThintheHerd 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 as 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 from which we can pick and choose to compose narratives. How does this extend on *Play Arcs* and what does it mean in terms of co-design and narrative complexity?

CONCLUSION

This paper describes the design and testing of history game mechanics and co-design features that let players contribute stories of their gameplay as content in the MMO *We Ride*. We build upon previous work with the goal of exploring 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 concept that reifies stories and *History Game Mechanics* that

let 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 observe that players teach each other about the game world through their stories and that they often saved more notable stories for later, rather than when they generate simple stories and routinely tell them as soon as possible.

We conclude that *Play Arcs* can serve as a powerful model for generating stories that can be transformed into content. Future work should broaden the systems to support a wider 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.

This paper demonstrates the possibilities for designing a new generation of game mechanics that preserve players' activity data in a reusable story format which also supports co-design of content. This can alleviate pressure from MMO designers struggling with content upkeep and increase player engagement by letting them contribute and shape the game world. Ultimately, this can lead towards game worlds where players and their stories become part of and evolve story generation machines into self-sustaining content generating ecosystems.

Notes

1. In MMOs, theme parks are top-down and sandboxes bottom-up.
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.
3. The special string is an untyped data structure we use to quickly communicate between the database and Unreal Engine to handle them however we want using blueprints.

ACKNOWLEDGMENTS

This work was partially supported by the ERC (European Research Council) grant number 321135 “CREATIV: Creating Co-Adaptive Human-Computer Partnerships”

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