Co-Designers Not Troublemakers: Enabling Player-Created Narratives in Persistent Game Worlds

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Players in Massively Multiplayer Online Role-Playing Games (MMORPGs) generate long-standing histories with their characters, but cannot express or see traces of their adventures in the game worlds. We are interested in designing game systems where players shape and contribute their own narratives as game content. Study one designed and playtested three Virtual Tabletop Role-Playing Game (VTTRPG) prototypes where we found that structured, graphical representations of players' traces support co-design and narrative analysis. We also identified four categories of traces: environment, build, memory and object. We introduce Play Traces, a novel analysis method for representing and co-designing with players and their narratives. A structured observation including Play Traces studied 17 players over 16 four-hour sessions in the third VTTRPG prototype. We found that players successfully (and enjoyably) co-designed novel narratives. We identified three themes for how traces can affect and support players in shaping new interactive narratives. We present four design implications describing how player-created narratives in MMORPGs should first Reveal & Pull Attention from other players, Invite & Push further exploration, Guide & Assist toward endings, and optionally Show & Hide traces. Finally, we discuss how treating players as co-designers offers a promising approach for developing the next generation of MMORPGs.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**; • **Information systems** → *Massively multiplayer online games*.

Additional Key Words and Phrases: Co-design, Virtual Tabletop Role-Playing Games, Persistence, Interactive Digital Narratives

1 INTRODUCTION

Players are active and expressive agents who grow and shape the cultures in and around games [29, 30, 35]. 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 [39]. 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 [38].

In the worlds of Massively Multiplayer Online Role-Playing Games (MMORPGs), 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 [18].

Taylor [38] argues that the owners of MMORPGs should do more to integrate players directly into the design process. She urges game designers to consider a participatory design approach and view MMORPGs as *'vibrant lifeworlds in which productive player engagement is central'* [38]. While this raises fundamental challenges to the field, both methodologically and from a design perspective, we want to address Taylor's call-to-action and build upon recent work. Although

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players are not included as co-designers, Gustafsson et al. [18] demonstrate 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 content.

We are 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. Our goal is to provide a theoretical foundation and strategies for designing in-game tools that offer players greater influence by contributing their narratives as 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.

This paper explores strategies for increasing players' influence on MMORPGs by letting them design content based on their own persisted traces of activity, and investigates how this content affects the overall gaming experience. We first review related work, and then describe Study one, which included nine game sessions designed to identify effective strategies for encouraging players to leave traces as part of their game play. We describe a novel analysis method, *Play Traces*, inspired by Study one, and how it influenced the design of Study two. A structured observation with 17 players organized into four groups, participated in 16 four-hour play sessions and included players' traces between and across sessions. We conclude with a discussion of our findings as well as the challenges involved in integrating player-generated activity traces into game narratives, and suggest directions for future research.

2 RELATED WORK

We first cover how early research defines players' 'co-creative' practices in games and then move on to examine how game designers use tabletop role-playing games for prototyping and as an instrument for including players in the design process. We also review persistence and narrative in different types of game worlds and highlight three key aspects that we find lacking in the research literature: 1) *multiplayer* games that 2) capture and *represent* players' narratives and 3) invite them to *co-design* their narratives as *an integral* part of play.

Definitions. In this paper, we refer to Genette's [17] 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 use Eladhari's [12, 13] description of Interactive Narrative Systems (INS) in four layers: 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 retelling of play experiences, e.g. telling friends what happened or streaming gameplay online etc. which can indicate value or support critiquing games [13]. We define players' traces[1] as the outcome from their actions i.e. *potential* events in stories, which can become narratives through players' storytelling.

2.1 Co-Creative Game Design

Considering co-creation in game design requires fundamental understanding of the different aspects of play and player behavior in games. Back et al. [1] 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

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

dialog between game designers and players changes the structures of play, much like role-play and sandbox games; and *transgressive play* is when players challenge the game's structures.

2.1.1 More Than Troublemakers. With creative and transgressive play in mind, Taylor [38] explores the relationship between players and the producers of MMORPGs. She outlines how owners of MMORPGs 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. She argues 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 MMORPGs. We want to add to Taylor's vision by enabling co-design through players' self-generated narratives.

Prax [32] 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. He exemplifies 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 et al.'s [1] transformative model applies well to Dena's [11] work on co-design in Alternate Reality Games (ARGs), interactive transmedia narratives that strives to blur the lines between real and fictional worlds [8]. She 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. She 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 MMORPGs are confined and the tools are chosen by the developers, which presents a different set of problems and complexity to agency and co-design.

Volk [42] 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 [37]. 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. He proposes 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. We are inspired by these approaches to harnessing transgression in play and seek to offer such players support *within* the game, including fun features and mechanics that enable them to completely realize their characters' histories and contribute with meaningful content.

2.1.2 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 [14]. Players gather face-to-face to co-create narratives by playing or 'acting out' different character roles [7]. 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 [41]. 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 [41].

Eladhari and Ollila [14] study iterative design methods for experimental game prototype development in TTRPGs. They highlight game design as a 'wicked problem space' [33] 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 [43] 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. Although we seek to support co-design in MMORPGs, 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.

Delmas et al. [9, 10] examine how tabletop games manage narratives and derive implications for designing interactive storytelling in video games. They define a software architecture where players control the narrative (but not the game). Each narrative is built on agents that analyze and transmit data between game and controller; gather profiling data on players' behavior; and manage and direct possible narratives into the game. Their proposed story manager focuses on directing the narrative of the game rather than representing the traces generated by players and does not offer co-creative opportunities. This combination of representing players' generated traces and inviting them to co-design narratives is currently lacking in the literature.

Although this body of work contributes methodological insights, and investigates how play and narrative is structured in both virtual and physical tabletop games, it does not show how to increase players' influence, either by treating them as co-designers in MMORPGs or how to use virtual TTRPGs (VTTRPGs) as an 'exploration space'.

2.2 Persistence and Narrative in Multiplayer Game Worlds

In the physical world, persistence is an implicit property of the environment, where objects grow, change and continue over time. Game worlds are considered persistent if they evolve, at least to some degree, and continue to exist even if no players interact in them [3]. Koster [24] 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 degree of persistence and players' ability to change the world. For example, MMORPG is a broad term that includes two common subgenres. Most modern games, e.g. *World of Warcraft* (WoW), are 'theme parks' and low on persistence. Bartle [2] 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 [2, 24].

2.2.1 Theme Parks and Quests. By the above definitions, persistence does not only relate to *change*, but also to the role of narrative within games. 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. 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 [40] argues that quests often become repetitive or 'meaningless' and therefore, inspired by Juul's [21] exploration of *Emergence* and *Progression*, she proposes what she calls *hard* and *soft* rules for examining and analyzing quests. Hard rules make 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, and lets us evaluate how the causality between the two are balanced towards each other [40]. Although we find the separation between hard and soft rules useful for analyzing and evaluating quest narratives, the framework is not specifically focused at player-generated narratives. We first need to better understand how players co-design narratives and the forms they take, before applying the framework in analysis.

Sullivan [36] builds on Tosca's methods and suggests several tools for game designers to create more playable and meaningful quests. She proposes dividing narratives into four different categories: *world*, *game*, *quest* and *player*, which separates the focus related to different application areas when designing quests. Based on these categories, she introduces *The Grail Framework* to increase player agency and give meaningful choices to players. One goal is to direct narrative focus, structure and quests around the player's own history, with details such as different relationships, conversations and previous quests. Sullivan notes that, since many quests in MMORPGs are designed to be repeatable by subsequent players, 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. [31] 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 game designers define how they want to generate content within subjects, including 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 important 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, our goal is to create 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.

2.2.2 Sandboxes and Emergent Narratives. Narrative in sandbox games is treated differently from theme parks and quests. Here, the focus is on letting players shape their own narratives with many tools and a high degree of agency. Researchers study their 'narrative potential: the accumulation of meaningful experience as a result of agency [that] allows users to construct their own appropriate narratives' [15].

Ryan [34] defines the outcome of narrative potential as *emergent narratives*. He explores the differences between successful and unsuccessful storytelling games, and argues that it depends on how the design of the game world's content supports players in *curating* their own narratives. He suggests 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. Ryan's work focuses mainly on the emergent qualities of single-player games. We are interested in extending these effects by including players *within* the context by which the narratives emerge, where they can react, reflect and contribute their unique perspective, to build narrative potential for other players in a shared world.

Madden and Logan [26] describe a framework for persisting player activities 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 ontology. The goal is to motivate players and establish a sense of community 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, we are more interested in how players can actually narrate new content and reshape how their narratives are presented to other players. Our goal is also to enrich the game world, rather than encourage transmedia storytelling. To achieve this, we combine elements of knowledge from co-design, narrative theory and persistence to explore and understand how game designers and researchers can introduce new features in MMORPGs, such that player narratives are influential and contribute in the content creation process.

3 RESEARCH METHODOLOGY

We are interested in (1) how players interact with traces 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, generative play. Our approach uses a triangulation framework [25] (see Fig. 1), that combines theory, empirical studies, and design. This 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 MMORPGs is complicated due to the significant time and effort it takes to develop such large-scale and complex systems [12]. Although studying players in existing MMORPGs can provide specific insights about how players interact with traces, researchers 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.
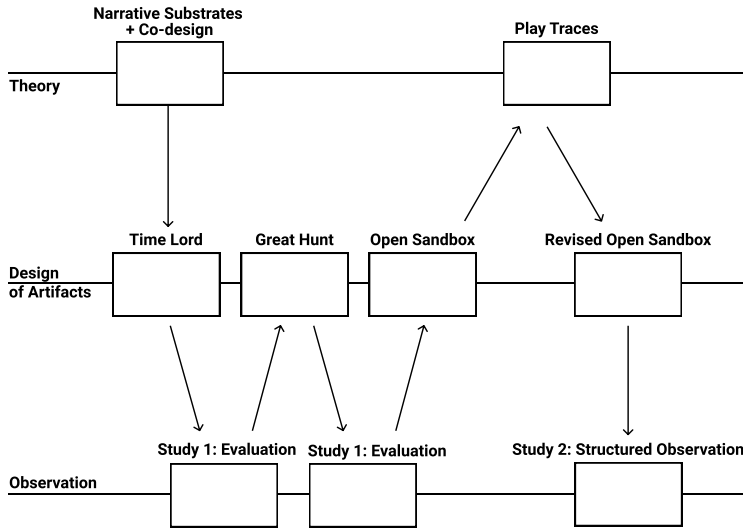
Fig. 1. Triangulation [25]: The theory of *Narrative Substrates* influenced the iterative design and testing of early prototypes, which led to the *Play Traces* method, that we tested in the final *Structured Observation* study.

Underlying Theory. Gustafsson et al. [18] introduce *Narrative Substrates*, a theoretical framework for designing game architectures that represent, manage, and persist player activity as unique, interactive content. They explore how to increase players' influence through persistence, and how to selectively choose and reuse narrative elements that emerge from players' actions. The framework consists of *Structure* for stories, management of *Relationships*, and *Rules* for handling the introduction and representation of content in the game world. They implement and test the theory in the MMORPG *We Ride*, an active and accessible test environment.

Their work shows that games can persist and manage data from the outcome of players' interactions, and demonstrates how designers and GMs can reuse and reify players' traces into new interactive narrative content. This paper builds upon *Narrative Substrates* with the specific goal enabling *players* to become co-designers and re-purpose meta-persisted narratives in a way that lets them capture and share their unique game play experiences.

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. Study one 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.

Study two is a 'structured observation' study [5, 16, 23], which is designed to let us observe real-world interaction and compare variables over time, while preserving ecological validity. Unlike a controlled experiment 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. We began with insights drawn from Study one, and created a procedure where each group could respond to their own and roughly the equivalent numbers of traces from other groups, with corresponding reflection points throughout the four-session game period.

4 STUDY ONE: HOW TO RESEARCH INTERACTION WITH TRACES

The goal was to develop a 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 MMORPGs. 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's [14] guide for experimental prototyping and playtesting, which resulted in the design and testing of three VTTRPG prototypes over nine sessions (see. Fig. 2).

4.1 Participants

We recruited 8 participants (one woman, 7 men; aged 21-37) by reaching out to people we know and using a snowball technique [19]. We specifically looked for groups of friends who already knew each other and played together regularly, resulting in five different groups.

We ensured that all groups included players who already knew each other. 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.

4.2 Setup

All participants played remotely from their own computer. We created a dedicated *Discord*[2] server to divide players into groups and separate communication channels. We used *Roll20*[3] to roll dice and display game maps.

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[2]https://www.discord.com
[3]https://www.roll20.net
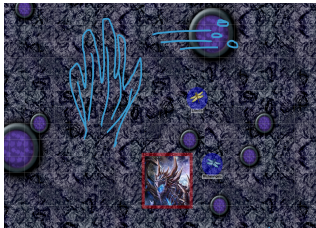
(a) *The Time Lord:* Players seek to slay the time lord dragon who disrupts time. Players save their progress in a linear narrative by designing traces *while* playing based on what they have recently done. The idea was to make leaving traces an integral part of the game, and easy for us to analyze.
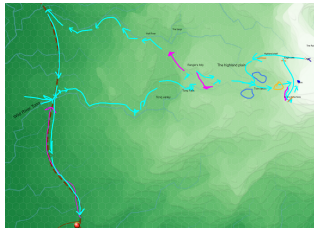
(b) *The Great Hunt:* Two separate groups (but playing as one team) try to retrieve treasure from a dragon in shortest time possible. Groups only communicate by leaving traces in the game within their individual play sessions. We focused on collaboration through traces between groups, across study sessions.

(c) *The Open Sandbox:* Players are 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 of their own.

Fig. 2. Three Virtual Table Top Role-Playing Game prototypes designed to encourage players to leave traces. The images represent the maps of the game worlds.

4.3 Procedure

Two researchers discussed and revised the game according to the players' activity and comments, yielding an iterative design process where each session built upon the previous one (see. Fig. 3). One researcher acted as Game Master (GM) and another as administrator who could also play as a stand-in if group members were missing. The administrator began 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 needed to download, read, sign and send us an informed consent form. Then they joined our dedicated *Discord* channel, game on *Roll20*, and finally read the brief game world description and chose if they wanted to play one of our prepared characters or create their own. If they chose the latter, the character had to be validated by the GM so that it fit with the group and the scenario. Before playing, we reviewed the instructions to ensure that everyone was ready. We discussed and evaluated each game session after playing and quickly iterated with new features and prototypes to adjust our approach.
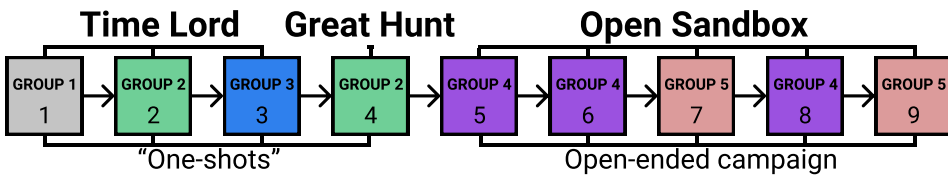

Fig. 3. Over nine iterations we developed two 'one-shot' and one open-ended VTTRPG prototype. Color indicates group: Groups 1-3 participated in separate one-shot games (1-4). Groups 4-5 participated in the remaining multi-session games (5-9).

4.4 Data Collection

We recorded audio from everyone and one author's screen using *OBS Studio*[4]. 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*[5] with corresponding notes, modifications and comments.

4.5 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. 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, authors compared their notes for how each prototype let players leave traces, how they fit in other players' narratives 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.

5 STUDY ONE: RESULTS AND DISCUSSION

Over the course of two months (March 31st to June 1st, 2020) we designed and tested the three VTTRPG game prototypes (Fig. 2). We identified three key findings for developing a VTTRPG

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[4]https://obsproject.com
[5]https://www.figma.com

approach with transferable results to MMORPGs. 1) Players prefer to generate traces organically, as part of play, and then reflect on them in retrospect. 2) Players produce four main categories of traces: *environment* signifies the 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, graphical representations of players' traces support co-design and narrative analysis.

5.1 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' [4] – 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.

5.1.1 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 on, discussing their traces and design 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' narratives 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.

5.1.2 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.

5.1.3 Game Type Affects Quantity of Traces. Another finding involved a major difference between VTTRPGs and MMORPGs, 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.

5.2 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.

5.2.1 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 [40] 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 led players and designer to collaboratively design new narratives that fit into the world and proved intriguing to other players.
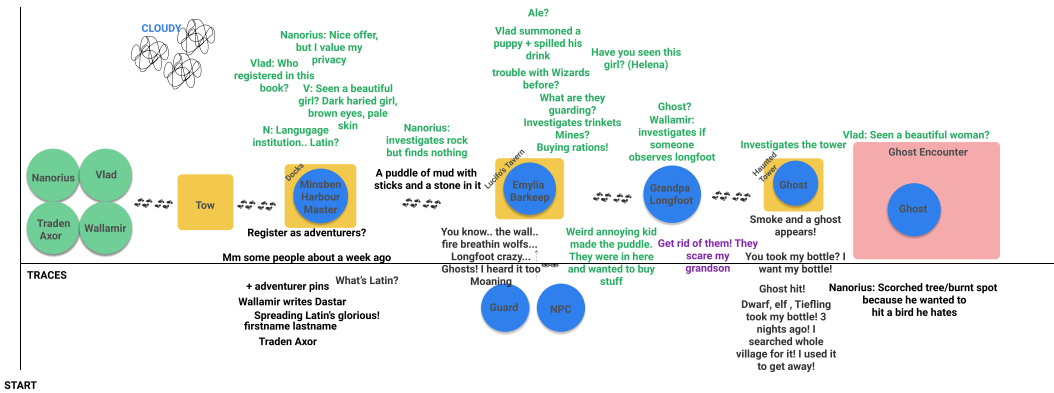

Fig. 4. Play Traces: a continuous representation of players' encounters, traces and dialog.

5.3 Play Traces

We designed *Play Traces* (see Fig. 4) to explicitly capture players' traces 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.

5.3.1 Context. Illustrated user stories have many names, e.g. 'journey maps', 'experience maps' and 'story maps'. Howard [20] 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 [22] developed *Narrative Maps* for representing and extracting underlying graph structures with information stories e.g. news stories. In an evaluation study, they revealed 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. [28] 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 Maudet's [27] *Story Portraits*, a method for studying designer practices that includes interviewing, synthesizing and visualizing designers' stories into a format

that supports later analysis and inspires new design ideas. Our findings 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 narratives by visualizing their traces on a map. They can synthesize and identify new potential relationships from the different components of their narratives.

5.3.2 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: 'environment', 'build', 'memory' and 'object' (Fig. 5). In the Open Sandbox VTTRPG, the administrator used *Figma* to draw the diagrams by combining icons from the toolbox, continuously observing and depicting events from left (start) to right (end) in each game session. Over multiple sessions, we placed a "session stop" icon (Fig. 5) where playing stops to segment the diagram and then simply continue drawing from there when the next session starts. The end result is a timeline of the complete game, 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.
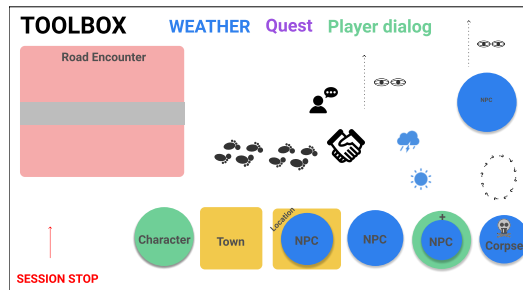

Fig. 5. Play Traces Toolbox: a collection of icons for recording characters, encounters, dialog, actions and circumstances, such as weather.

6 STUDY TWO: HOW TRACES AFFECT AND LET PLAYERS SHAPE NEW CONTENT

We conducted a structured observation study [5, 16, 23] which incorporated *Play Traces* and categories from Study one. 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 own traces. We focused on exploring how persisted traces of player activity affect and can support players in shaping new interactive narrative content.

6.1 Participants

We recruited 17 players (two women, fifteen men; aged 22-38) from our personal contacts and using a snowball technique [19]. 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 had (14/17) played TTRPGs before. Participants were not compensated for their participation.

6.2 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'*.

6.3 Procedure

One researcher acts as Game Master (GM) and another as administrator. 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 diagram 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 with the help of *Play Traces* and design new interactive narratives as content which is presented to other players in subsequent 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).
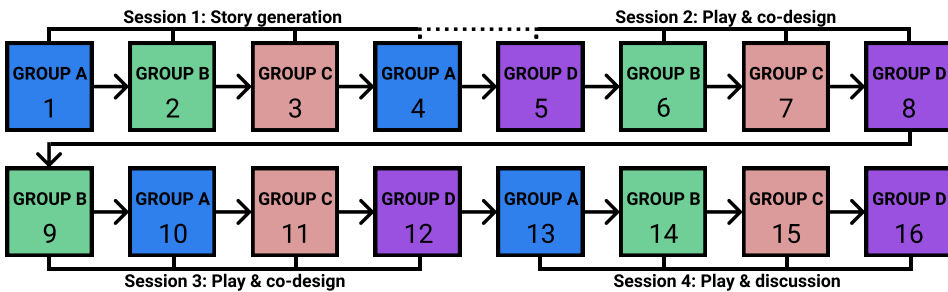

Fig. 6. **Structured Observation Procedure: Groups A-D play in four different four-hour sessions each, in a circulating schedule. This study design ensures that each group experiences traces from at least two other groups every new session. Reflection activities also vary across sessions 1-4.**

6.4   Data Collection

We recorded audio and one author's screen using *OBS Studio*[6]. We also collected the map and traces players drew on it, e.g. items, notes, bodies, flags, graves, characters. We saved all the *Play Traces* drawn in *Figma*[7] with corresponding notes, modifications and comments. After the study, we collected responses from players on their experience in a brief Likert-style questionnaire.

6.5   Data Analysis

The administrator fully analyzed the data using thematic analysis [6], 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   STUDY TWO: RESULTS AND DISCUSSION

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.

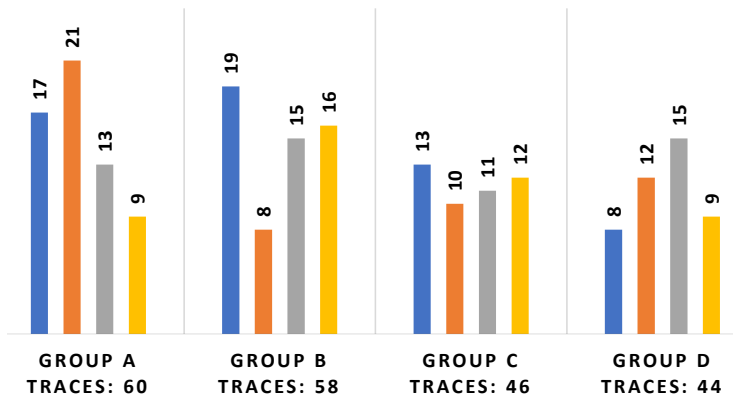[6]https://obsproject.com/
[7]https://www.figma.com/

Fig. 7. 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.

We found that players not only enjoy and find it meaningful to engage in co-design practices, but also that they contribute 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.

7.1 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. Most (16 of 17) players said explicitly that reflecting on their activity helped them to design new narratives (See Fig. 8).

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. 8). Players also felt more involved in the game when they created narratives based on their groups' traces (14/17) (See Fig. 8), but were less interested in seeing other player's traces (8/16, 1 blank answer) (See Fig. 8). 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.
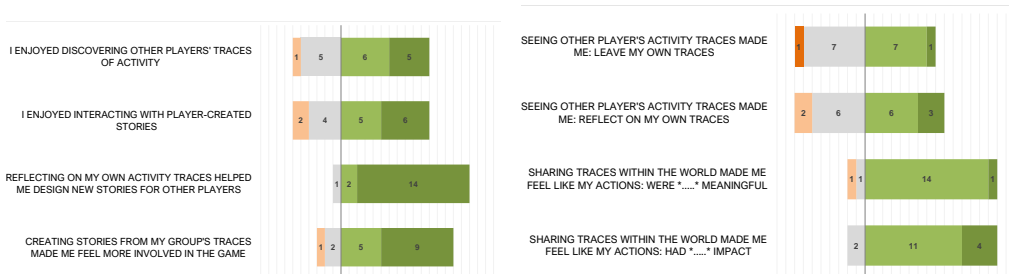

Fig. 8. Survey (a) assesses players' level of enjoyment and involvement in the game. (Orange = strongly disagree or disagree, Gray = neutral, Green = agree or strongly agree.) Survey (b) assesses players' reactions to their own and other players' traces. (Orange = Much less or less, Gray = neutral, Green = more or much more.)

7.2 Trace & Context Synthesis

The thematic analysis, showed that the majority of players' (15/17) willingness to explore traces depends upon how they are able to assess them in the context in which they are presented. Players explore the 'meaning' of traces and 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 visually and audibly, and consider the scenario in which they were introduced to players.

7.2.1 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 that they spent many resources designing, in 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 yield different effects, given the type of game: What is annoying in a VTTRPG not only adds to the scenery of an MMORPG, 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.

7.3 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.

7.3.1 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.

7.3.2 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 traces 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 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. However, 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, whereas by mid-game, she mostly just read the players' suggested narratives and found feasible ways of introducing them into the game.

7.4 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.

7.4.1 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, MMORPGs do not include pre-determined endings and considering how many players expend hours per day for many years, they will transition between play styles [1] 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.

7.4.2 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.

8 DISCUSSION

Our goal is 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.

8.1 Study One: Contributions

We designed Study one 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 MMORPGs, we would need an additional study to identify which specific types and quantities of traces will be most useful in the latter.

Study one 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 section 2.1.1, 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, as described in the future scenario in section 9.

The second key challenge is to understand how players actually co-author relevant narratives based on their earlier game play, which requires field testing the above motivation strategies. We designed Study two using a Structured Observation methodology in the form of a four-week field test with four groups of players. This lets us systematically observe and compare specific aspects of the game, with both quantitative and qualitative data, including reflections by the participants grounded in their immediate, real-world experience of the game.

8.2 Study Two: Contributions

Study two explores 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 MMORPG 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* [18]. We summarize the themes below, and clarify how our findings relate to the design implications in Table. 1.

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. Section 2.2.1 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 section 2.2.2). 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 MMORPG game designers should include features that help players specify characteristics of traces that guide and assist other players through the newly generated narrative.

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	

Table 1. The key themes identified in Study two link directly to implications for design.

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 their amount of exposure to traces and narratives while playing.** We found that players' personal goals are also closely 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 other players' traces and narratives draw their attention or actively modify their interaction in the game world.

9 FUTURE SCENARIO

The following future scenario illustrates how the above implications for design could be implemented practically in an 'open sandbox' MMORPG built on the *Narrative Substrates* architecture [18]. 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.

Fig. 9. (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. 9a), 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. 9b), 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. 10a). The oracle is also available as a merchant, selling 'magical powders' to diversify these options and motivate players to flavour their narratives.
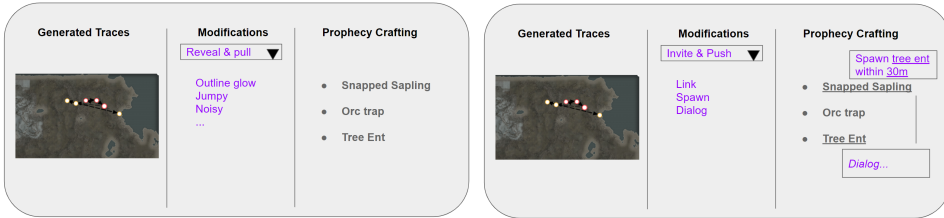

Fig. 10. (a) Players modify traces to Reveal & Pull attention. (b) Players assign specific Invite & Push features to traces

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. 10b). 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. 11a). 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.
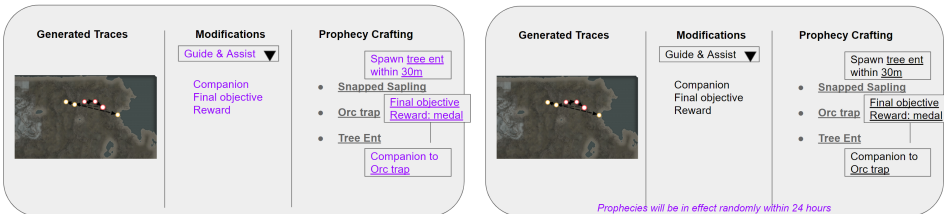

Fig. 11. (a) Players select options to Guide & Assist others toward narrative endings. (b) Show & Hide mechanics are integrated in the game architecture

Show & Hide. Players will only see the sapling's augmented effect if they toggled their *Show & Hide* narratives option to be 'on' (See Fig. 11b). 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 MMORPGs, 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.

10   LIMITATIONS AND FUTURE WORK

This paper describes how traces can affect and let players shape new narrative content in VTTRPGs and turns these results into implications for designing MMORPGs. The novelty of this approach first posed 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? 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 are they more likely to interact with. Although *Play Traces* and 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 from Study two: 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?

Study one suggested that an open sandbox environment was the best approach, and we designed the experimental setup in Study two based on *Narrative Substrates* and *We Ride*. However, although we have some experience designing MMORPGs, we were limited by the reliance on our own interpretations as to how these observations would translate into real MMORPG environments. Many significant differences exist between VTTRPGs and MMORPGs, especially in terms of players' reliance on the GM's descriptions and the passage of *time*. Study one found that the phasing of play in VTTRPGs is slower than MMORPGs, which was difficult to account for in Study two, considering players' already generous commitments to several long play sessions.

We also need to address the gender balance among players in both our studies with one woman among eight participants for Study one and 2/15 in Study two. We actively tried to find additional female players and reached out to our personal networks using a snowball technique. However, since we were specifically looking for groups of friends who already knew each other and played together regularly, we asked for pre-established player groups, which led to a high percentage of male players. Although it would have been easier to achieve a better gender balance if we 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.

Future work is needed that focuses on testing and validating the concept of traces in a real MMORPG environment, with quantifiable measures that let us evaluate their effects over long periods of time. We 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 intricately nested within player histories. We would like to know whether players' meta-persisted activities surge or come to an halt 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 [26] and Dena [11] explore? We argue that this study offers a generative foundation for exploring ways of allowing players to actively influence and contribute to persistent digital game worlds.

11 CONCLUSION

This paper explores how to design game systems in which players act as co-designers who shape and contribute their own narratives as persistent game content. Study one illustrates an iterative design process with three 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. We also found that players prefer that traces of their activity are generated implicitly from the environment rather than defined explicitly as they play. Study one also led us to develop *Play Traces* as a novel analysis method for representing players' traces and a story delivery method that encourages players to reflect on their narratives.

We used *Play Traces* in a second 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. We found that allowing players to share traces made their actions more meaningful, with greater impact on the game world. We also showed how incorporating players' traces in the game fundamentally changed the GM's role, from fully driving the narrative, to supporting players' suggested narratives. We identified 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. We 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.

We argue that combining three powerful concepts — persistence, narrative theory and co-design — allows game designers to create novel game worlds with new and more meaningful modes of play. In the future, we hope to demonstrate the potential of inviting MMORPG players as co-designers where they can generate, design and implement new unique, narrative content in persistent digital game worlds.

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