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The Internet Is Not Forever: Challenges and Sustainability in Video Game Archiving and Preservation

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Video games are an increasingly significant cultural touchstone in people's everyday lives. However, preserving and archiving video games faces unique challenges, including intellectual property law, technology degradation, and the broader question of what it means to preserve a video game. In an exploratory study investigating sustainable game preservation practices, we spoke to 15 amateur game preservationists and hobbyists about their informal work with code, gaming consoles, and servers for online play. We found a lack of access to particular games during childhood or young adulthood led participants to seek out these games in other formats—such as emulated games they could play on other mediums (e.g., playing Nintendo games on your personal computer). Their nostalgia and the communities they found searching for these experiences inspired them to undertake archival work. Participants leveraged distributed knowledge across their communities to keep video games accessible for anyone interested in playing them. Considering these findings in the context of modern archival practices, we discuss what it means to archive a game, especially when that game is dependent on interactive, communal experiences, and what is potentially lost in current archival practices in contrast to informal, accidental archival work.

Keywords: video games, digital archives, modding, romhacks

I think with some games, Nintendo is very much like, oh, yeah, Mario World, we got ya. [. . .] But there's some games where it's either untranslated, like there's this game called Wagian Paradise. [. . .] And it's definitely not popular enough to warrant being put on Switch Online. Because like, who'd pay for that? But like, you know, I mean, I'd paid for that. —P15

In 2023, Nintendo shuts down their eShop services for the 3DS and WiiU. This, along with Sony's announcement that they intended to shut down their online storefronts for the PlayStation 3 and PlayStation Vita, represents change for hobbyists who wish to play older games (Kuhnke, 2022). Although Sony eventually reversed their decision, the closure of digital marketplaces catering to older generations of consoles led to a loss of access for many gamers. In fact, as Oisin Kuhnke of *GameSpot* points out, with the closure of these virtual marketplaces, some games will be lost to players who wish to play the game legally and cannot afford to pay hundreds of dollars for a physical copy of the game cartridge (Kuhnke, 2022). Moreover, these physical cartridges will not last forever, and even the games preserved at official game archives, such as the Computer History Museum or the National Videogame Archive, run the risk of being lost due to the natural demagnetization of game storage on physical game cartridges and discs (Monnens, 2009). Archiving video games and consoles requires restoration work that is relatively new compared with preservation practices in mediums such as film or music (Kuhnke, 2022).

Video games exist in a complicated place in terms of archival work and cultural recognition—it is challenging to convince people who do not play games that they are an art form worth preserving (Kuhnke, 2022). Formal archival work is still determining what it can and cannot do in preserving video games as their code. The code itself is often proprietary and controlled by companies like Sony or Nintendo (Kraus & Donahue, 2012). Beyond formal archival work, many game hobbyists hack and modify game code (Newman, 2018) and pirate games (Newman, 2012) for personal collections, representing part of the effort toward culturally preserving games. Video game scholars have written extensively about the importance of hobbyist practices of modifying existing games—or "modding"—that copy and modify game code for hobbies like building fan games, making challenge runs, building new game content, and speed running (Consalvo, 2013; Murphy, 2013; Newman, 2012, 2018). Here, we note that video game companies are antagonistic toward game modding communities and modders themselves because of the *modding* of the game rather than any assumed commercialization of the modified game code. Modified games such as Pokemon Uranium (Frank, 2016b), Pokemon Prism (Machkovech, 2016), a fan remake of Metroid 2 (Frank, 2016a), and, more recently, a Grand Theft Auto mod all received Digital Millennium Copyright Act (DMCA) takedown notices. Nintendo has shut down people who share speedrunning videos on YouTube as well (Parlock, 2015).

As the field of game studies develops, we must investigate sustainable practices for preserving not just video games themselves but also the creative materials generated around and from video games as historical and cultural artifacts. In this article, we expand on prior work documenting the practices of hobbyists working with game code and digital emulators (Sköld, 2018). Digital emulators are programs that operate on a computer that can play game code that an archivist, hobbyist, or gaming company has made available online. Due to the limitations of what archivists can and cannot legally do to preserve games and their derivative works, talking to game hobbyists and documenting their practices presents an opportunity to better understand best practices in preserving and sustaining digital games and their surrounding play.

In an exploratory study into sustainable game preservation practices, we present findings from 15 semistructured interviews

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with hobbyists about their informal archival and restoration work with game code and physical gaming consoles. Our participants come from a range of backgrounds, including amateurs as well as people who work professionally and academically in game preservation spaces. In this article, we bring into focus informal, unstructured practices that people engage in outside of their official work. We discuss the interconnectedness of preservation work through the lens of the hobbyist as a player, as a modder, as a creative, and as an archivist. Our participants leveraged distributed knowledge across multiple online communities to make their work successful, keeping these games accessible not only to themselves but also available to anyone with a desire to play. Oftentimes it was nostalgia that drove participants to look for other ways to (re) experience these games and, subsequently, connect with a community of gaming hobbyists collectively engaging in preservation work. In the next section, we outline related literature and briefly describe our research methods before characterizing the interconnected work of preservation that our participants described as well as our findings. We discuss the roles that nostalgia and a fear of loss play in preservation work, then explore the question of what it means to truly archive a video game and whether or not it is sustainably possible to archive an entire gaming experience.

Background

This research sits at the intersection of game studies, archival and preservation research, and knowledge work within online communities. Over the years, video games have changed rapidly from a relatively undefined, obscure creative medium to a titan of industry that generates enough revenue to rival film and television, and video games themselves have broadened to be a nearly ubiquitous part of social play (Paul, 2018). Despite video games dominating popular culture, they still have headway to make in being recognized as an artistic medium (Gee, 2006) and as a distinct practice requiring new policy and regulations (Király et al., 2018). Like other digital art forms, these factors generate challenges for working with video games as cultural artifacts. They exist as both a social experience and an amalgamation of hardware and software.

Archival Work on Digital Media and Games

Archives are a form of public cultural memory, which are often an expression of authoritative power (Bennett, 2013; Mbembe, 2002). The media represented in these archives are those that hold value in their expression of this power, and the mechanisms for creating, curating, and maintaining these archives are situated firmly in the hands of those with power (Bennett, 2013). In the case of video games, it is the companies holding the intellectual property rights over their products that maintain that power. With the advent of networked digital media production and transformation (e.g., creating a digital copy of a video game), however, those who have taken to digital archival work do not necessarily have the endorsement to do archival work from those with the power to articulate public cultural memory. Rather, they are "amateurs, fans, hackers, pirates, and volunteers" whose preservation efforts in online spaces democratize cultural memory as well as transform cultural artifacts into new forms of consumable media through their archival work (De Kosnik, 2016). Prior research has explored questions of ownership regarding third-party digital archives, such as the Vanderbilt Television News Archive, and the legal challenges the archive faced from major news broadcasters like Columbia Broadcasting System over its authority to compile an archive that was outside of Columbia Broadcasting System's control (Anderson, 2020). Professional archives and archivists are constrained by the legality of archiving cultural texts, whereas hobbyists and amateurs experience less of these constraints.

The tenuous legal nature of online archives has led to amateur archivists preserving everything from public domain literature to video games. In the context of digital libraries, Tenen and Foxman (2014) identified certain online book piracy efforts as a commons-based mode of peer production, with some illegal caches of digitized books amassing hundreds of thousands of publicly accessible entries. And although digital mediums bring with them a level of unprecedented global accessibility (Hauswedell et al., 2020), they also bring with them a dangerous ephemerality. Not only is the act of preserving the digital artifact in and of itself a fundamentally different task from preserving physical objects, recording the histories, documenting the tools, and preserving the cultural phenomenon around digital-first practices also brings forth a host of new challenges to preservation work (Wrather, 2019).

What does it mean to archive a video game? There are collections around the world that host various cartridges, CDs, cassette tapes, and digital files that compile a video game's virtual assets. Guttenbrunner et al. noted in (2010) that video games are being released in increasingly complex formats that demand more precise and ever-changing hardware. Nintendo's console the WiiU, for example, was released in 2012 and then supplanted in 2017 with the release of the Switch. Games made specifically for the WiiU (which had the option of employing a special touch-screen controller and stylus) could not necessarily be easily ported to other consoles or emulated in different environments. Similarly, Microsoft discontinued support for their motion detection device, the Kinect, in 2017, cutting off official support and production for the precise hardware that Kinect games and artistic applications relied on. Video game companies have the power to control how hardware and software associated with their game systems are used or discarded.

Video games are a relatively new form of creative expression, and the act of preserving their contents as well as cultural impact is still in the process of being defined, facing numerous technical barriers (Harkai, 2022). As noted by Guay-Bélanger (2021), video games as cultural artifacts are more than their individual software. They are an experience, and preserving that experience presents particular challenges that are not always present in other forms of digital media.

Some archivists have focused on preserving the content of games through summary and narration. Adrienne Shaw, for example, runs the LGBTQ Game Archive (Ruberg, 2017), a wiki-style website that contains entries on every instance of LGBTQ+ representation in video games. The entries provide text and visual descriptions of each moment of representation but, importantly, do not provide access to the source material itself.

Archives like the LGBTQ Game Archive allow preservation efforts to circumvent the legal challenges encountered by those preserving and archiving video games. To preserve video game contents themselves, archivists would need access to the source code of a game to modify and update that code and make copies of new files as old formats go obsolete. According to James Newman (2012), "The simple fact is that the same strictures that … technologically guard against both the individual and industrial-scale copying that is unilaterally and uncomplicatedly designated as 'software piracy' by the game industry similarly limit … the scope and actions of games archives and museum collections" (p. 46). In essence, to preserve video games in any manner of

permanence, archivists find themselves at a point where the only way to preserve games is through illegal means.

Beyond video games, archival work, in general, has entered a new phase of accessibility in the digital era, with online archives maintained by experts and amateurs alike permeating the public sphere (De Kosnik, 2016). Public-facing sites like Wikipedia source their content from volunteers around the world, with radically different barriers to participation in knowledge production and curation compared with historical sites of knowledge, such as libraries and museums (Phillips, 2013). Thanks to the internet, far more people have the power to curate and preserve cultural artifacts like games. However, exactly what can be preserved and how effectively we can preserve digital content represent a host of new challenges in the age of user-generated content.

Preservation and Nostalgia

Preserving a video game's software and hardware is different from preserving the social experiences that take place through video games. In this article, we center questions of preservation from the perspective of maintaining, collecting, and distributing both game hardware and software. But we also explore the question of what it means to preserve an experience facilitated through a digital medium. Games are played, and through that play, we generate parts of the game itself. We name our player characters, we form guilds, and we play cooperatively with friends and family. The experience of the game itself exists between generated save files and the memories a player makes. Hobbyists and their projects, then, represent an interesting intersection of the social and technical elements that comprise a video game.

A driving factor for our participants in preserving video games is nostalgia, which is considered to be a key element of the success of retro gaming (Wulf et al., 2018). Nostalgia, the warm affection we feel for a period or place, is a complex emotion (Johnson-Laird & Oatley, 1989). Although a person's own emotions, memories, and experiences often play a central role in the nostalgic experience (Sedikides et al., 2004), nostalgia also serves as an important social evaluation tool (Wildschut et al., 2006). In these social contexts, the remembered experiences involve interactions between an individual and close others, which, in turn, bolster social bonds (Wildschut et al., 2006). Nostalgia has led to an explosion in retro gaming wherein both memory of games played and the (re)creation of gaming experiences lead to enhanced experiences of player well-being (Wulf et al., 2018). As nostalgia-driven retro gaming flourishes, figuring out how to preserve both physical copies and the game code of older games has become a concern for hobbyists, archivists, and scholars alike.

Preserving video games presents unique challenges. First, video games are subject to the business and marketing practices of large corporations, meaning that game code, even for older games, is considered proprietary information (Newman, 2009). Moreover, Newman (2009) argued, the constant searching for the next and best game leads many older games to be rendered obsolete quickly and for companies to see comparatively little value in archiving game code. Guttenbrunner et al. (2010) identified further points of tension in the challenges of preserving game code, focusing first on the technical degradation of ROM cartridges and the challenges introduced in attempting to extract and reverse engineer game code from the microchips embedded in the ROM cartridges. They, further, note how the optical media (e.g., CDs and DVDs) used by video game companies oftentimes had some sort of built-in copyright protection that made extracting game code challenging (Guttenbrunner et al., 2010). Put simply, game code is hard to extract from physical media for a number of reasons, and video game companies do not have a vested interest in maintaining the availability of older games.

Yet, despite these challenges, preservation work for video game code exists in several varieties of particular note to this paper. First, there is the museum approach, which is undertaken by video game archives, such as the National Videogame Archive (Newman & Simons, 2009), where work is done to maintain the original software and hardware and preserve these physical artifacts as well as the digital game code upon which they operate (Guttenbrunner et al., 2010). A similar, but far more legally gray, secondary option emerges in the form of video game emulation. Emulation is the ability of one device or computer program to replicate the behavior of a different device or computer program (Guttenbrunner et al., 2010). For many players, emulation is an accessible option to experience or re-experience video games, as physical copies are either no longer available, inaccessible due to technology degradation, or are prohibitively expensive to acquire. Guttenbrunner et al. (2010) suggested that emulation is a successful strategy to preserve games from obsolete systems onto more modern mediums, meaning that creating emulators for games is a viable form of game preservation.

Emulation, however, is not legal. The distribution of emulated game ROMs and emulators for various gaming systems and platforms is largely contained within small niche communities of gaming enthusiasts and is under constant threat of Digital Millennium Copyright Act takedown notices from game companies like Nintendo. Despite this threat, emulation and emulating practice are thriving online, with archival and preservation work largely done by hobbyists who tend to learn how to do the work through the community itself. In the next section, we explore communities of practice and knowledge work.

Communities of Practice and Knowledge Work

Online communities often leverage situated learning to instruct community members in producing content (Lave & Wenger, 1991). These learning practices become part of membership in the community, turning the community's everyday interactions into a community of practice (Wenger, 1998). Online communities, like fanfiction writers that maintain Archive of Our Own, use situated learning and *legitimate peripheral participation* to train incoming community members in maintaining and improving the archive (Fiesler et al., 2017).

In the case of Archive of Our Own, the community is also an *affinity space* (Gee, 2005). That is, its members are brought together because of a shared affinity for some kind of media: a television show, a book series, a movie, or a video game. Because the common factor is a shared affinity, this community draws together people of varying talents and skills with wide ranges of expertise from novice to master. As a result, knowledge, expertise, and mentorship are distributed in a flat hierarchy as opposed to traditional top-down models of sharing knowledge (Campbell et al., 2016; Evans et al., 2017). Online communities like affinity spaces rely on many different kinds of expertise to operate, with that knowledge distributed across a series of sociotechnical structures (Hutchins, 1995).

The different kinds of expertise we explore in this research range from advanced programming techniques, such as reverse engineering software, to successfully administrating digital platforms to repairing and maintaining physical hardware. Preservation

work with video games faces challenges in the form of both hardware and software degradation, technologies becoming obsolete at a faster and faster rate, and strict legal barriers to playing with and altering the hardware and software that make video games possible. Keeping these challenges in mind, we turn to communities that practice informal work outside the bounds of traditional preservation. In doing so, we hope to elucidate different possibilities and challenges for preserving video games.

Methods

We set out to understand nontraditional practices around archiving and preserving video games. To do this, we circulated recruitment posts on Twitter that called for participants involved with the following: "working with video game ROMs, restoring hardware, and any work that plays with, alters, or adapts video game code!" We also encouraged people to reach out to us if they were "interested in talking about archiving or preserving video game content (both official and unofficial)." Our recruitment posts were shared by the Media Archeology Lab, an archive dedicated to preserving the functionality of aging hardware and software.

Our recruitment posts received extensive interaction, with 94 retweets and 88 likes. Relatively famous video game hobbyists, like foone[1] with over 146,700 Twitter followers (at the time we conducted the study), also shared the post, ensuring that it traveled well past our own social circles. Recruitment materials all linked to a Google Form that volunteers could fill out. This form asked participants to list their age (we did not have approval to speak to anyone under 18 years old), to indicate whether or not they were comfortable being interviewed, to briefly describe their experiences with games and archival work, and to leave contact information. We received 36 responses to the form, excluding one response from someone under 18 years old.

We contacted every respondent and eventually arranged and conducted interviews with 15 volunteers (Seidman, 2006). Of the 15 participants, 11 described their racial identity as White, one described themselves as mixed race, and three did not disclose their racial identity. We spoke to six cisgender men, two transgender women, and six nonbinary people.[2] Most of our participants were from the United States, with others being from Canada, Germany, and the Czech Republic. Four participants did not state where they lived. Please see Appendix for details on the archival tasks our participants did, both officially and unofficially. Our interview protocol outlined general themes to ask participants about, guiding our conversations through specific topics. However, we did not ask a set list of questions. In the interviews, we typically asked participants to share their life history first, starting with when and how they first started playing video games (what they remembered as being a significant moment with video games) and transitioning to how they got involved with their current archival or preservation work. Interviews ranged from 30 min to 2 hr, though they averaged at about 60 min in length.

The lead author was present for all but one interview and led 13 of the 15 interviews. Two of the authors met and discussed interview outcomes on a weekly basis. After reaching 15 interviews, all authors met and discussed whether the current data were sufficient for exploring the topic at hand or whether more data were needed. After careful deliberation and reviewing the data, we decided to stop data collection as we had achieved saturation and move onto transcription and analysis work (Low, 2019).

The lead author iterated through deidentified transcripts in a thematic analysis with assistance from a research intern credited as third author (Braun & Clarke, 2006). After an initial pass, the authors met and discussed distinct themes emerging from the data and grouped those themes into initial findings. These findings were shared between the authorship team and iterated on further until all authors were in agreement that they were presenting the most salient findings tied to the project's initial inquiry. Terminology commonly used among participants but uncommon outside of the context of this community is defined in a glossary of terms (see section Glossary of Terms). Before sharing our findings, we first address concerns around participant information and community safety, given the legally gray nature of some of the work our participants engaged in.

In presenting our findings, we do not provide a table of the demographics for our 15 participants. This is to help preserve their privacy and the safety of their communities and their creative works. Instead, we provide a table of the kinds of labor that participants contributed to their communities (see section Archival Work). Although many of our participants were comfortable with their online handles being referenced in research, we chose to reference them as participant numbers so as to not draw unwanted attention or unintended consequences to the communities and projects that our participants might overlap with. This study was conducted with approval from our institution's ethics review board.

Findings

Beyond collecting video games in their original condition, many participants also worked with video games to modify and adapt old gaming software and hardware to fit new situations and creative projects. Preserving video games was often less about capturing a specific nostalgic moment and more about opening doorways for community members to play in new ways with one another. Preservation meant keeping the spirit of a community alive rather than capturing a moment in time. In our findings, we explore the interconnectedness of preservation work and how collecting games is tied to doing not just social activities with those games but also archival and preservation work. We then examine motivations for these kinds of informal archives and preservation tasks. Our participants relied on communally distributed knowledge and expertise to conduct their work and faced challenges from gaming companies disputing their transformative use of intellectual property as well as losing material hosted on sites not secure enough to preserve community works. Taken together, these findings illustrate challenges in sustainably preserving video games as well as opportunities to reimagine video game archiving and preservation beyond current practices.

The Interconnectedness of Preservation Work

Many of our participants came to their community roles through their interest in playing older games that they no longer (or never) had easy access to. Participants described playing emulated games on their computers, usually as older adults. Many participants commented on how the games they played were too expensive or obscure to find and play legally, and so they resorted to downloading a "ROM" to run on a local emulation program. The act of setting up and running older games led to participants getting involved with communities that did much more than collect and distribute software. In these spaces, our participants dove deeper into not only preserving game software but also altering, adapting, and updating it for new experiences. In this section, we characterize the work that our participants described across four broad

categories: playing games, modifying games, transformative work, and archival work. In each section, we discuss the various tasks or practices involved that led our participants to doing and participating in their community-based work. Table 1 represents a summary of that work.

Playing Games

Universally, our participants considered themselves *players* of games in various forms: both on original hardware and gaming code as well as on modified hardware and game code. For most of our participants, finding platform emulators and then gaming ROMs was a product of happenstance. Some, like P1 and P7, found out about emulation through googling, whereas others, like P9, discovered emulation through mIRC channels they participated in. Participants described how playing these emulated games opened their eyes to the possibilities of emulation, and several participants discussed playing randomizers for *Pokemon* (P1, P6, and P11), *The Legend of Zelda* (P7), and ZZT[3] (P3) as how they came to want to understand more about how games were coded and, eventually, how they might improve the gaming experience.

Table 1 The Four Categories of Preservation Work and the Tasks and/or Routine Behaviors Involved With Each One, With Notation of Participants Who Described Each Task

Preservation work	Tasks involved
Playing games (P1–P15)	Finding emulators (P1, P2, P4, P6–P11, P13–P15) Finding ROMs (P1, P2, P4, P6–P11, P13–P15)
Modifying games (P1–P15)	Finding and participating in a modding community (P1, P3, P5–P10, P12–P15) Extracting code (P3, P4, P6–P10, P15) Editing code (P3, P4, P6–P8, P13–P15) – Restoring lost game content/code (P2, P4, P6, P7, P9, P11, P13) – Improving game quality (P2, P4, P8–P10, P13–P15) – Improving game accessibility (P4, P6, P7, P9, P12, P15)
Transforming games	Making music (P4, P15) Altering the game to reflect their experiences/identities (P1, P3, P5) Creating fan-made games/game content (P4, P6, P9, P10) Creating fan/joke translations (P4, P10, P11, P15)
Archival work	Creating archiving communities (P2, P3, P6, P12) Community engagement (P1, P3, P4, P6–P9, P11, P12, P15) Hosting archives—online (P2, P5, P6, P8, P9, P12) Hosting archives—offline (P5, P11, P12) Content verification (P1, P2, P12) Extracting and preserving code (P2, P4–P9, P11) Restoring/preserving hardware (P6, P10, P11, P12) Addressing security concerns (P2, P4, P5, P7, P9)

Modifying Games

Curiosity breeds creativity, and the majority of our participants described how playing modified and emulated game ROMs led them to *finding and participating in a modding community*. It was through these communities that some participants (P2, P3, P4, P6–P10, and P15) got interested in *extracting game code* to "reverse engineer" how things worked in the game, as P13 put it. Through this, some participants similarly described how they would start to *edit game code* to restore inaccessible, lost, or untranslated game content (P2, P4, P6, P7, P9, P11, and P13) and improve game quality though adjusting music (P4 and P15) and visual quality (P2, P6–P9, and P13–P15). Other participants discussed how they improved game accessibility by creating online multiplayer elements (P9), enhancing and remixing audio (P4 and P15), creating accessible editing tools for particular games (P6), or by making expensive, rare games available online (P12). These practices were initially driven by curiosity on behalf of our participants that turned into a hobby our participants were passionate about. This led to collaborative projects with others within their modding communities, oftentimes allowing participants to play to their strengths within the community, such as P4 or P15's expertise with coding music into games.

Transforming Games

Interestingly, most of our participants talked about the different elements of the modding community that they found interesting and how, in some cases, this led them to *create* with the materials they found in the games. P4 and P15 both spoke at length about how they started exploring how music was coded into the games they loved. As their expertise improved, both P4 and P15 described how they would compose their own music with the code they found in games as well as contribute music to game restoration efforts within their modding communities. Similarly, a few participants (P4, P10, P11, and P15) discussed how they would contribute to fan translations of previously untranslated games or improve existing translations. These participants described exploring game code to find translatable elements and, on occasion, running these elements through Google Translate to create a joke translation (P4) or to help come up with appropriately punny names for *Pokemon* in Czech (P11). Other participants (P4, P6, P9, and P10) also described creating fan games based off of original game content. Some of these participants were members of the Earthbound community and described multiple different projects based around that original source code. Meanwhile, P3 used the open-source code for the 1993 game *Doom* to remix and reimagine sound effects and music within the game. These transformative works required participants to build off of existing game code, thus creating records of the original and modified versions of the game code and gaming experiences.

For some participants (P1, P3, and P5), however, the act of transforming games was about seeing themselves represented in games. P5, for example, described modifying a *Pokemon* game to ensure that nonbinary identities were represented at the start of a

new game, when the player is asked to declare themselves a boy or a girl. They explained,

> [O]ne of the later games [. . .] put in a, you know, "first off, are you a boy or a girl" kind of question. Because they put in two sprites instead of making you play as, you know, Ash. So obviously, as a non binary person that annoyed me. So I went and found a project that was basically trying to be a starting point for modding Pokemon and figured out how to modify that. So that the Professor would now ask you, you know, 'are you a boy or a girl?' And you can answer boy, girl, or no. (P5)

Although P5 did not create a full mod of the game that included nonbinary player sprites and they/them pronouns, they were able to create a gaming experience and share it with others that included their refusal to place themself within a gender binary. Through creating this mod, P5 not only preserved the *Pokemon* game's code but also created and preserved a gaming experience for people like them who may have felt excluded from the game previously.

Archival Work

Finally, participants described how they became members of archival communities, either through creating their own archives of games online (P2, P3, P6, and P12), extracting or preserving original game code (P2, P4–P9, and P11), verifying game content (P1, P2, and P12), or hosting offline archives (P5, P11, and P12), such as P11's archive of Czech games in Prague. A large part of the work involved with these efforts is gathering together both online and offline community members to create archival spaces. P3, for example, works as a site administrator for a major archive of *Doom* modifications, fan games, and assets. Although P3 will never play or install many of the files hosted on the site, he volunteers time to maintain the community's space and ensure that inappropriate or harmful content that violates the community's standards is removed from the collection. Similarly, P6 volunteers for a centralized website that hosts not only game modifications but also the tools needed to build new mods as well as community forums where people discuss modding practices. Sites like the ones that P3 and P6 worked on have multiple volunteers maintaining the site and contributing to its longevity.

Participants emphasized that these public-facing sites were important to keep online, accessible to as many people as possible. The greatest tragedy would be for games and their transformative works to disappear into private collections, inaccessible to broader communities of players. The work that people like P3 and P6 carry out is viewed as informal and volunteer labor as part of their commitment to a community. As Tenen and Foxman (2014) framed book piracy as peer preservation, so too do many of our participants engage in collaborative work to preserve digital artifacts for public access as well as the community's culture surrounding those artifacts.

Access, Lack of Access, and Nostalgia: Motivation for Archival Work

When reflecting on how they first got involved with their communities, many participants identified a lack of access to the games they wanted to play as a motivating factor in seeking out game archives. Participant 1, for example, first found game archives while trying to play through games they never got to experience when they were first released.

> Once I figured out how to emulate stuff, I started playing old Game Cube games. I started playing Wii games that I couldn't afford at the time because I was a broke freshman in college. And I was like, oh, instead of paying for this I could just play them online. (P1)

Cost represented a substantial barrier to accessing video games, not just the games themselves but also the hardware to play games on, such as consoles and controllers. Another participant who focused on archiving content related to one specific gaming franchise expressed frustration over losing access to a mobile app publication of an entry in the series.

> On one hand, there's that understanding: if you upload something, it will never be gone. It will never vanish. But that is a lie. (P2)

As participants grew up, their perceptions of the permanence of digital content changed. Things that were always available before would disappear overnight, or an internal error would render content useless. Unlike books available in a public library, digital content is more challenging to preserve and curate, with copyright laws limiting professional archives from performing important preservation tasks (Newman, 2012). Instead of turning to public archives, participants found online communities that shared strong practices around preserving digital content and making it accessible to others.

> Real men don't do backups, they just upload it and let the world mirror it. Because if you can just put it out there for everyone to download, enough people are going to download it so that copies will always exist. Even if your main archive goes down, there will be copies on people's hard drives to get re-uploaded elsewhere. (P5)

This method of preservation relies on a network of individuals copying and storing anything uploaded to a community. Referred to as "data hoarders" by P3, these people were never instructed or encouraged to privately back up community files. But if anything ever disappeared from a main archive, they were often able to find and share the missing pieces from their personal archives. Overall, participants were more concerned with preserving the transformative works built up around the video games they were fans of mods, fan games, ROM hacks, custom music and assets, and playful riffs on classic games. In the world of fanfiction, the Organization for Transformative Works advocates for and preserves fanworks, such as fanfiction or fan videos (Fiesler et al., 2016). However, the realm of fan games does not have a similarly unifying organization. In the absence of an official preservation team, community members developed their own means of ensuring the preservation of their work.

Distributed Knowledge Within Communities

Participants often sought to distribute their work publicly. If there was not an existing source to share their resources, then participants would create their own. P12, for example, maintains a standalone website that hosts information for repairing and modifying old video game consoles. He decided to consolidate the information after running into challenges hunting down specific information needed for various projects.

> I put everything I found [about modifying a specific console onto a subreddit] and organized it neatly so that someone

> following in my footsteps wouldn't spend hours going through old forums and, you know, hitting their head on the wall for not being able to find some little bit of information—especially since a lot of those sites died off or were dying off around that time. That information needed to be preserved somewhere. So I did that for [three different consoles]. And then I . . . ended up porting it all over to a standalone site [in 2021]. (P12)

The site still has significant gaps in its knowledge base, but P12 is hoping to convince other console modders to fill out the sections he does not have the knowledge to complete other entries. Not every participant was an expert in all things, but connected to a community that shared enough knowledge to bridge any critical gaps.

> Information used to be spread out all across the web. A lot of people would have their own homepage and post information about just one game, and the idea was to centralize this information. So a group of my friends online started the wiki. I pretty quickly got to have an administrator role there because I was trustworthy and did some maintenance work. I love the wiki. We cooperate with [another group of amateur game preservationists], which is a group of people who release video game prototypes. And they do amazing work with that. It's great to have these groups interconnected. (P11)

As P11 emphasized, each person is their own wealth of knowledge in perhaps one specific game or project. In developing centralized platforms like wikis or archives, communities are able to more efficiently share knowledge and resources for not only preserving games but also playing with and reinventing those games.

Participants described ways that knowledge was *distributed* across a series of interconnected communities, as P11 described. The sociotechnical system of experts, their practices, and their efforts to share and reproduce their knowledge formed a dense yet fragile network of distributed knowledge (Hutchins, 1995), largely dependent on resources controlled by outside entities (server owners and system administrators) and regulated by copyright law across multiple different countries. The intellectual property owners (gaming companies) could sometimes be a generous resource to participants, specifically in the case of *Doom*, whose studio released the game's source code for the community to play with (P3). In other cases, game studios represented a frustrating opposition of gatekeepers that fought to stop participants from carrying out their preservation work.

Gaming Companies as Opposition/Gatekeepers

Historically, online communities do not always have a strong understanding of what copyright law actually permits and how people using copyrighted material in a transformative work might push back against frivolous cease-and-desist notices (Fiesler et al., 2016). One thing that participants consistently feared while maintaining their projects was what might happen if a game company told them they could no longer continue their work. These fears ranged from legitimate concerns, such as being unable to field money for a legal battle, to comical rumors around how certain companies police their intellectual property.

> I've had fears about unintentionally DDoS'ing the [game franchise] website to download from it because I'm sending too many requests to the server—because I had a script to download everything in sight. And I was like, oh my god, I'm gonna get banned from the [game franchise] website that they haven't touched since 2012. I'm terrified. (P2)

Whether or not a company was in a position to stop a participant from archiving or working with game assets, there were persistent rumors of "what might happen" to keep participants guarded about their work. Participants were not in a position to push back against larger companies serving cease-and-desist orders or claiming copyright infringement for transformative works like ROM hacks and other modifications.

> The worst thing that can happen to someone is getting too popular before your project is done, getting a cease and desist, and then it disappears. If it gets featured on Kotaku or Polygon, it's dead. It's dead in the water. Obscurity is your best friend until you're ready to release. Because it's okay if you get a cease and desist once it's done, because it's already out there. (P10)

Many participants talked about ways that they protected themselves from legal consequences over their creative work, citing practices like forbidding archives from hosting a full and playable game and only maintaining "patches" to the original code. Communities like Super Mario World Central, for example, operate very publicly but also do not host any of Nintendo's original code on their archive. The site administrators leave it up to the community to find versions of the game elsewhere.

> They do not host ROMs. They have patches, which is like an instruction. It's totally legal. It's basically like a Game Genie code. And you get a ROM of the game somewhere. I don't know where. I suggest that people use their Google ROM dumping device. (P6)

These practices ensure that the community stays safe from takedown notices that would otherwise cause content to disappear. The game software itself is not necessarily as important as the community-based activities that those games facilitate.

Fear of Loss

Once participants were connected with a broader community, they became more aware of how fragile or temporary digital content could be. Connecting with others and sharing game modifications online required access to digital archives and the resources to sustain those archives. If the archive vanished, so did the content along with an important means of connecting with other people in the community.

Participant 3, for example, is an administrator for a web forum that hosts modifications for the popular video game *Doom*, specifically the 1993 release. Although the holders of *Doom*'s intellectual property title are mostly welcoming toward the mod community, some modifications make use of copyrighted material from other less tolerant media property owners. Furthermore, the modding community frequently makes use of storage and data transfer services that they have no direct control over. When those services come to an abrupt end, the community loses content.

> We started using third party file hosts like Rapid Share, Media Fire, and all of those, but they always either closed down or got brought down by force. A lot of people would upload to Mega Upload, and then Mega Upload was shut down by the authorities. That was a bad day, because we lost a lot of files to that. (P3)

Within a modding community like the one P3 hosts, game files might represent the only connection people have left with a community member that has perhaps since moved on or dropped out of that community space. Their contributions remain, however, and represent part of the archive as well as their connection to other people in that space. Losing parts of a fan game archive represents losing not only a piece of that community's history but also a significant piece of the community itself. Another amateur archivist, Participant 6, described the hard work not necessarily involving the preservation of the fan games themselves but of actually moderating the community.

> From a data storage perspective, the files are impossibly small. So it's not a problem to have a huge archive [of ROM hacks] . . . . Community moderation is always a [more challenging] job to go through. We have people that manually review everything that gets submitted—the code files, the game files, everything I play, it's my job to [test if it's playable]. Not just anybody can dump their files on [the archive] . . . . And some of [the uploads] might be kind of crude and funny, but some are toxic. So, I have to check all that out to see if it's a solid hack that represents the work of the community. (P6)

As staff for an online archive of ROM hacks, P6 plays the role of curator and monitors each contribution made to the archive. Losing content is less of a concern compared with the risk of losing a certain threshold of quality. The "toxic" content P6 alludes to also represents a challenge to the archive. Moderating the archive extends to moderating forum posts as well as game submissions. Maintaining the communities took substantial labor from our participants, whether through moderating site interactions, vetting submissions, or hosting repositories for knowledge.

Discussion

Participants engaged in a range of practices necessary for archiving and preserving not only video games but also the creative artifacts generated around those video games. From their nostalgia for something lost, participants found means of altering and adapting game code into a new playful experience. In our discussion, we revisit those themes of nostalgia and loss to discuss how the memory of an experience, or the lack of an experience, motivates preservation work. We then discuss what it might mean to fully archive a video game and the social experiences coupled with it, and we close with a call for further support and advocacy for the creative communities doing such important preservation work.

Nostalgia and Loss

The fear of losing games—either losing access to the ability to play them or losing the ability to maintain and preserve a copy of the game—was a major motivating factor for our participant's preservation work. Video games, much like all digital content, are ephemeral; their hardware degrades or becomes obsolete (Guttenbrunner et al., 2010), their stories and game code are replaced by newer and better game code (Newman, 2009), and the online archives for emulators and ROM hacks are not able to maintain or protect all their contents. It is challenging to save and preserve games for more social reasons too. Moreover, the cultural significance of games is still in a state of flux (Shaw, 2010), and the capitalistic motivations of game and gaming system developers introduce little incentive for these companies to put effort into ensuring the continuing availability of nonsuccessful or historic games—as our participants noted. All of these factors contribute to the feelings of loss and fear of loss that underpin the accidental archival work we observe in our findings.

This loss is, to some extent, threefold. Cavalcanti et al. (2017) introduced a framework of three different experiences of loss in ephemeral spaces when they discussed communication on Snapchat: media loss, meaning loss, and context loss. *Media loss* refers to the actual loss of an artifact—a game, a ROM hack, or an emulator of an obsolete system. *Meaning loss* discusses the loss of social or emotional significance of the shared experience or content. For games, it is the loss of the ability to collectively share in the joy of these games both as they were remembered and how they can be experienced and transformed through preservation work (e.g., fan translations and randomizers). Finally, *context loss* focuses on "a lack of understanding of a conversation's flow" (Cavalcanti et al., 2017, p. 1). Although games certainly are not Snapchat or other ephemeral conversational social media, the sense of context loss, as described by Cavalcanti et al., can be seen in how games become lost to time once their platforms become obsolete or are no longer available in eShops and digital game marketplaces. Without the availability of these games, their context is lost, rendering player experiences with these games completely removed from the broader context within which they were created.

Collectively, the findings show that these experiences of loss are additionally influenced by nostalgia that individuals have toward specific games, consoles, or gaming contexts. Much of the nostalgia our participants described as initial motivators for getting into game emulators and ROM hacking was situated in childhood. The nostalgia that participants described, however, went beyond games that they had memories of playing and extended to games that they had never had a chance to experience. The pain at the loss of opportunities coupled with the warmth and positive experiences toward childhood gaming introduces a sense of collectiveness to the nostalgic gaming experience. Physical artifacts of gaming function as material reminders that the "past is shared, lying in wait, to be actualized by memories, to be re-enacted and thus restored to their former glory by a community of our peers" (Makai, 2018, p. 1). These games are actualized through the community's commitment to preventing loss in future gaming generations, all the while operating within the precarity that games archives currently contend.

These feelings of nostalgia and loss come together for our participants, demonstrating how their informal and semiformal archival practices function as an effort to contend with these three categories of loss. Through community-based practice, participants took steps to mitigate and preserve their nostalgic experiences of these games as well as preserve context and collective meaning and memory.

Archiving an Experience

Ultimately, our participants sought to preserve more than just scraps of code and hardware. They were preserving collaborative, community-oriented experiences that relied on multiple different people and expertises. In the case of P2 describing the loss of a server-hosted online game, participants were also trying to preserve the act of playing something together with others.

How does one archive an entire experience? Video games have marched far beyond the solipsistic experience of one person holding a controller. Multiplayer games hosted on remote servers unfold in real time, sometimes leaving such drama in their wake that it spills over into narrative spaces elsewhere, such as the

exploits of EVE Online's communities (Carter et al., 2015). Would it be enough to play back footage of someone playing through a game? Would successful archive and preservation work allow someone to play a game with the original controls? What about with friends on an authentic server? As social experiences, games become a much more complex thing to preserve, and we, perhaps, need to rely more on the piecemeal tactics that our participants described, stringing together their experiences painstakingly with one reverse-engineering project at a time.

With the advent and expansion of the nearly infinite digital archive, questions start to emerge about what should be preserved and why. The human brain is not capable of holding and remembering everything it encounters, and digital archives now have the capacity to provide people with near-perfect recall of everything from beloved childhood experiences to traumatic events or losses (Mayer-Schönberger, 2011). Digital archives serve as places to preserve not only the artifacts of memories, events, and experiences but also the metadata that describe these artifacts (Guttenbrunner et al., 2010).

Most importantly, our participants sought to do more than preserve things as they were. Overwhelmingly, our participants sought to create new experiences with the objects they archived, whether through reinventing the games into something new (e.g., like with ROM hacks and mods) or through constructing new opportunities to play nostalgic games together.

In this sense, we see an opportunity for sustainable archiving practices moving forward. As advocates, we can support modifying and remaking video games to suit a community's specific interests and playfulness. Developers, too, can support this playfulness by providing tools that help this transformative work in ways that do not discredit these "rogue archivists" (De Kosnik, 2016) but, rather, foster a more collaborative approach between official and unofficial archives. Embracing amateur archival work also legitimates it as work, which allows the creator of the digital record and the original creator in the game developer to come together as one to preserve game tech for future generations. Video games are at a crossroads where we are seeing a rapid decline of access to older games as the technology ages. We must ask ourselves more broadly: Who owns the servers, and how will we preserve the cultural uniqueness of these playful moments? The opportunity is in the preservation work, in the role of sustaining community practices of play. In our work moving forward, we hope to advocate for means of establishing sustainable ownership over the resources required to operate community archives.

Conclusions

In this exploratory research, we touch on the challenges and opportunities that informal video game archivists and hobbyists are encountering in their day-to-day work. Their communities leverage a wide range of expertise to not only make games playable in their original format but also reinvent those games in new, creative, contexts. The lack of resources and of a centralized archive meant that our participants had to work hard to consolidate knowledge into accessible places. Furthermore, participants lacked the means to advocate for themselves when faced with legal challenges over their transformative works, so much so that some participants advised that silence and secrecy were often better forms of preservation than anything else. If we wish to sustain the creative practices that drive so many people to archive and preserve aging technologies, then there is a considerable opportunity to support those practices through advocacy and resources.

Glossary of Terms

Archive of Our Own—a volunteer-run archive that archives and preserves fanfiction.

Fanfiction—a type of transformative work that remixes characters and settings from an original media property to tell a new story through fictional prose.

Fan Game—a video game that presents a new story or experience to a player using the characters, setting, and assets from an original video game.

Fan Translation—a video game that has been translated by amateurs rather than professionals affiliated with a major gaming company.

Mod/Modder/Modding—a mod is a remix or alteration of game code that is applied to the original game as a patch. The act of applying that patch is referred to as "modding," and the people who make these patches often refer to themselves as "modders." Mods are typically applied to computer games.

ROM Hack—a type of transformative work that remixes data from a video game and modifies it into a new gaming experience. ROM hacks are like "mods" but specifically refer to games stored on cartridges.

Transformative Work—a creative work that remixes or *transforms* traditional media into something new. Common types of transformative works include fanfiction, game mods, and fan videos.

Notes

1. https://twitter.com/Foone

2. Of these nonbinary people, one used any pronouns, one used she/her pronouns, three used they/them pronouns, and one used they/he pronouns. In quoting these participants, we use the pronouns indicated.

3. A modifiable text edit game released as freeware: https://en.wikipedia.org/wiki/ZZT

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Appendix

P#	Day job(s)	Works in archiving as a profession?
P1	Works for an academic archive about games, generating entries on historical marginalized representation within video games.	Yes
P2	Hobbyist collector of game artifacts, news mentions, and online data related to a specific video game series.	No
P3	Administrator for a major website that shares uploaded modifications to the 1993 version of Doom.	No
P4	Works on ROM hacks for a major game franchise. Works to make sure ROM hacks stay available through distributing "patches" of the game software.	No
P5	Collaborates with large, national archives of technologies and videogames. Restores old hardware to read older software in consultation work with official archives.	Yes
P6	Professional livestreamer and moderator on an archive site for Super Mario ROM hacks.	No
P7	Works on a decompiling process for a major video game franchise, with a team of people working to preserve and reconstruct games in a playable format, especially games that are in danger of no longer being playable or becoming "abandonware."	No
P8	Moderator for Super Mario ROM hack archive.	No
P9	Major game franchise ROM hacker and fan game developer.	No
P10	ROM hack developer and academic scholar on ROM hacks.	Yes
P11	Contributes to a small European country's game archive; one of the lead organizers and managers.	Yes
P12	Manages and administrates website that hosts how-to guides for restoring retro gaming hardware.	No
P13	Builds and distributes tools for editing, modifying, and working with retro games.	No
P14	Works on forums for major game franchise and in the game's ROM hack communities, randomizer community, language translations, and other online ROM hack projects.	No
P15	Works on building tools to modify audio in ROMs and break into and manipulate audio production in older ROMs.	No