Christopher C. Haydock. Challenges in Preserving Video Games. A Master's Paper for the M.S. in L.S degree. April, 2018. 38 pages. Advisor: Christopher Lee

Video games are challenging objects to preserve for a variety of reasons, but their value is increasingly becoming apparent to cultural heritage institutions. This study describes interviews conducted with digital preservationists at Carnegie Mellon University, the Computer History Museum, the Library of Congress, Stanford University, and The Strong National Museum of Play to determine how they define meaningful preservation of video games and what they feel are the greatest challenges to achieving this level of preservation.

The obstacles the interviewees most frequently identified were laws that make it illegal to perform preservation activities without permission from copyright owners, difficulties obtaining this permission, and insufficient resources to preserve a vast amount of deteriorating media. The study concludes with interviewees' ideas for how to overcome these problems and calls for further research on how to make video game preservation successful and scalable.

Headings:

Acquisition of computer software

Digital media

Digital preservation

Interactive computer systems

Interactive multimedia

CHALLENGES IN PRESERVING VIDEO GAMES

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A Master's paper submitted to the faculty
of the School of Information and Library Science
of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Master of Science in
Library Science.

Chapel Hill, North Carolina

April 2018

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1. Introduction

Video games go by many names. Those played on a personal computer might be called *computer games*, while large, coin-operated machines might be called *arcade games*. I grew up using the term *video games* to refer only to console and handheld games. However, given the many similarities between all these types of games, and the rise of new types of games that do not fit neatly into any of these categories (such as online games and games for mobile devices), it is useful to have a single term to encompass them all. For purposes of simplicity and inclusivity, I have chosen to refer to all such games as "video games," which is increasingly being used as a blanket term for all electronic games (see, for example, Wikipedia's page on *Lemmings*, originally released for a personal computer but called a "video game" in the title).

Whatever one chooses to call them, video games have been a major part of American culture ever since the commercial success of *Pong* in 1972, almost half a century ago (Kocurek 2015, p. 1). However, despite their historical and cultural significance, video games are still somewhat of a novelty in the collections of libraries, archives and museums (LAMs), even when compared to other digital items. Several reasons for this have been identified in the literature, and I wanted to discover which ones are the most prevalent. Also visible in the literature is a difficulty determining exactly what a game includes – exactly how many aspects need to be preserved to constitute the authentic experience of the game. Since preserving context and meaning is just as

important to the archival profession as preserving records themselves, I have included these concepts in my definition of preservation.

The purpose of this paper, then, is to explore what digital preservationists in LAMs feel are the biggest barriers to meaningfully preserving video games. It is my hope that this will allow future researchers to generate ideas for overcoming those barriers.

2. Literature Review

Preserving video games in a usable and culturally meaningful form is challenging even by digital standards. Unlike some digital items such as text documents or photographs, video games are "complex digital objects" (Hedstrom 2003), meaning that they "contain core content, but they also have additional features such as formatting, visual aspects and graphics, monochrome and color images, and sound and video" (14). In other words, one must attend to many aspects in order to preserve the experience of playing a game.

Similarly, Lynch (2000) outlines a hierarchy of digital information objects, from least to most rendering-dependent. He places video games and other interactive works at the very top of the hierarchy because they are "rendered experientially." He then restricts his focus only to the simpler end of the hierarchy, saying that the higher end was "poorly understood and today is addressed only in a limited way; for example, through discussions about emulation as a preservation strategy." He also acknowledges the possibility of a migration-based approach, but says that it is "fraught with problems involving canonical representations of the user interface (which, in the most complex cases, involves interaction and not just presentation) and agreeing on what constitutes the authentic experience of the work" (36-7).

It is debatable exactly how many elements are necessary in order to constitute the "authentic experience" of a game. Taken to its extreme, the experience could include the

controllers for a console or even the type of monitor in vogue when a computer game came out. Hedstrom et al. (2006) report on an experiment in which users were asked to play the 1980s game *Chuckie Egg* in three forms – emulated, migrated, and on the original hardware – and compare them. They found that "subjects preferred playing the migrated and emulated versions rather than the original game on the BBC Micro. Although a few subjects lamented the loss of the original game 'feeling,' most valued the greater ease of manipulation and faster speed of the migrated and emulated versions" (171). So perfect authenticity may not be what all users want.

According to Bettivia (2016), the historical significance of a game expands far beyond any digital or physical artifact. For example, even though Carmen Sandiego and Oregon Trail are technically single-player games, children often collaborated when playing them. "This particular performance of play – crowded around the school computer – is itself a type of significant property not embodied in the code or the platform" (25). As with any other archival item, the context can be just as meaningful as the item itself. While LAMs cannot replicate every kind of contextual experience for their users, they can at least try to document the societal context of the games in their holdings. As it is, much important contextual information for video games has already been lost. For example, it seems that no one remembers for certain exactly when *Super Mario Bros.* was released (Dayton, 2010).

The LAM world has only recently thought about preserving video games on a large scale. In a 2008 study of Atari 2600 games in archives in the United Kingdom, Gooding and Terras found that "Ebay proved a better source of games than the combined collections of public archives [that they examined], a statistic which must cause us

concern since Ebay and its sellers are making no effort to preserve the games...” (30). They also found that the “illegal emulation community” was “currently the largest source of historical game information” (22).

Since then, there have been major advances in video game emulation. For example, in 2013, the Internet Archive launched the Historical Software Collection, which allows a user to play vintage games and other software in a web browser via built-in emulators (Internet Archive). Later that same year, they introduced the Internet Archive Console Living Room, a similar collection devoted entirely to console games. Dingman (2013) called it the first time early console games have been legally playable online, while Orland (2014) seemed to hint that there might still be some legal questionability to the endeavor.

Bachell and Barr (2014) point out that video game preservation suffers from several challenges beyond the ones common to all digital items: “[L]oss of context, copyright and legal issues, and the throwaway culture of the next game all hinder the ability of fans and academics to preserve video games and make them accessible in the future” (158). The “copyright and legal issues” are important, because video games differ from paper materials in two key ways. First, they need preservation attention fairly soon after they are created (unlike a book, which might stay in good condition until after its copyright has expired). Second, “preservation” for digital items almost invariably involves copying of some sort. In short, LAMs need the good will of the copyright holder to adequately preserve video games, as “crucial emulation and migration actions would otherwise be in breach of copyright (143).

Compounding the problem is “a worrying disinterest in preservation on the part of the industry” (141). Considering that preservation in the archival sense is not undertaken primarily for profit, it should not be surprising that the business sector would show little interest in it. However, as long as the copyright holder trusts the LAM institution to make copies only for preservation purposes, the company wouldn't stand to lose any profits. McDonough et al. (2010) suggest that the two groups of stakeholders could even go as far as to “work on legislative changes that will enable preservation of computer games to proceed in a manner that protects the rights of games’ creators while insuring that their creations are available to future generations” (8).

However, McDonough et al. go on to specify what they feel is the missing piece of the puzzle:

> The most fundamental issue for any cultural memory organization attempting to collect this material is trust. Many software companies would view sharing something like source code as equivalent to handing over the crown jewels. Assurances that material will be ‘dark’ archived and made available only at some later date or under certain conditions are not of any real significance to a software company unless they already have trust in the individuals and the institution making the promises” (24).

They further state that “there is a large gap of understanding and experience between people in the industry and those in cultural institutions, with scholars sitting somewhere in the middle – perhaps able to act as bridging agents” (121).

Hedstrom (2003) concurs that, in order to be willing to deposit digital content in archives, “Depositors must have a very high level of confidence that a digital repository will preserve content indefinitely, will not introduce errors, and will apply rights management, confidentiality, and other access rules consistently. Research in this area is closely tied to the concept of trust” (21).

This is not to say that it has been easy for archivists to develop expertise in digital preservation. Conway (2010) states, “Both digital preservation and digitization for preservation carry with them a level of technical complexity that the preservation community has not had to face since attempting to develop very large-scale deacidification plants in the 1980s.” However, Conway goes on to say that “Formal educational programs are emerging to begin filling the expertise gap” (73).

Game companies’ misgivings about archivists may be a reflection of a broader phenomenon among IT professionals. According to Oliver et al. (2011), a series of interviews with records managers in New Zealand's government agencies revealed that they did not entirely trust their own national archives to manage digital records. One respondent pointed out that unlike records managers and librarians, who have strong ties to archivists, IT professionals come from a different occupational culture and have less experience with archivists (312). However, the authors ultimately concluded that the biggest issue was not occupational culture but perceived competence: “Recordkeepers were perceived by respondents as being much more competent in the management and storage of paper records than in the management and storage of digital records,” and “there did not appear to be a high level of confidence in the ability of recordkeepers to either preserve digital information or to ensure that it could be accessed when required.” (321).

Pryor (2007), looking at why faculty deposited so little of their work in their institutions' repositories, states that “an inherent culture of self-sufficiency in the generation and organisation of data militates against what might be viewed as prescriptive intervention by knowledge management professionals” (137). Salo (2008)

adds, “This self-reliance can turn pathological. I have heard...of immense photographic-image collections wasting away to uselessness undescribed and unarchived, because principal investigators hired graduate students in the discipline with a little programming expertise but no knowledge of information management to fix the problem. Some researchers, it seems, would rather turn anywhere than to a librarian!” It would be interesting to know if decision makers in video game companies have similar reasons for avoiding LAMs.

It is also worth noting that when Wolper (2014) interviewed several archivists and librarians about the presence of role-playing games (RPGs) in their special collections, she found that “many of the subjects interviewed cited ‘academic snobbery’ as one of the main reasons why RPGs—and popular culture items in general—remain underrepresented in university special collections in spite of the considerable value that such items have for curriculum and research needs” (19-20). Seeing as video games occupy a similar segment of popular culture to RPGs, these barriers should be added to the list of potential obstacles.

The literature points to a large number of potential obstacles to meaningful preservation of video games by LAMs: their complexity and interactivity, copyright issues, cultural attitudes, the relative newness of digital preservation to the archival field, and the resulting lack of trust some groups have in their abilities. The purpose of this study is to explore these issues in more depth and determine which ones present the greatest hindrance to video game preservation.

3. Methodology

The overall research question for this study was “What do preservationists feel are the biggest challenges to meaningfully preserving video games and making them accessible?”

I began by identifying persons who have worked in the preservation of video games. Because of the exploratory nature of the project, I considered snowball sampling to be adequate and convenient. I obtained a list of candidates from my advisor, and sent emails to the candidates explaining the nature of the study. To those who agreed to participate, I sent a consent form informing them of their rights and the risks involved in participation. For those who agreed, we set a date and time for a phone interview.

During each interview, I asked the participant a series of six main questions. The central question, which related directly to the research question, was “What do you feel are the biggest obstacle(s) to preserving games and making them accessible?” Leading up to this were a few other questions, designed to gather contextual information. These included determining what types of games the participant was working with, and what level of preservation they were trying to achieve. Lastly, I asked the participants if they had any ideas about how to overcome the obstacles they identified, mainly as a guide for future researchers. I recorded each interview for later analysis.

Out of the participants I interviewed, I selected seven for analysis because they met the criteria of people who worked on the preservation of video games in their current jobs. These people represent the following institutions:

- Computer History Museum (2 participants)
- Stanford University (2 participants)
- Carnegie Mellon University (1 participant)
- Library of Congress (1 participant)
- The Strong National Museum of Play (1 participant)

As the data analysis phase began, I identified four areas of interest for study based on the questions asked: (1) the scope of the video game collections the respondents worked with, (2) the respondents' definition of integrity and authenticity, (3) the obstacles to video game preservation they identified, and (4) their ideas for overcoming the obstacles. I then listened to the interview recordings and took notes, grouping them into the four categories. I split ideas about context between categories 1 and 2. I then scanned each category for themes that recurred across many interviewees, or that otherwise provided insight into the corresponding study question. I reported these themes in the Findings section.

Next, I interpreted the findings and discussed the themes that emerged from them (Discussion section) and looked at what they might mean for video game preservation going forward (Implications section). I highlighted some remaining unanswered questions related to the study topic (Directions for Future Study section), and finally summarized the study (Conclusion section).

4. Limitations

The biggest limitations of this study are the size of the sample and the sampling method. Because of the exploratory nature of this study, the sample of preservationists I interviewed was quite small. And because I used snowball sampling to identify participants, the sample is likely biased toward members of certain social networks. Because of these two characteristics, the sample is unlikely to represent a well-rounded cross-section of the population of video game preservationists.

It is worth noting that the sample is heavily biased toward males; only one of the seven interviewees included in the final analysis was female. It is unknown whether this gender distribution is representative of the overall population of video game preservationists. Lastly, because I limited my sample to preservationists in the United States, the study should not be assumed to represent a worldwide perspective on the subject.

Also, I never explicitly defined the scope of the term “electronic game” (the term for “video game” I was using at the time of the interviews), nor did I ask the interviewees for their definition of the term. Accordingly, there may be some differences in how each subject interpreted it, and if so, these differences would affect the nature of their responses. For example, one of the interviewees briefly mentioned pinball machines, which may be seen as peripheral members of the category “electronic games” because

they contain a mixture of electronic and mechanical parts. However, the vast majority of the interviews centered, as far as I could tell, on purely electronic games.

5. Findings

What follow are my notable findings from the interviews. Each section consists mostly of answers to the corresponding question(s), but sometimes material came up in response to one question that I felt was more pertinent to another. In those cases, I have moved the material to the section I felt most appropriate.

5.1 Scope of Collections

The scopes of the repositories consulted vary widely. Probably the most comprehensive collection, in both size and breadth, belongs to The Strong National Museum of Play. The Strong has some 60,000 video games, which range in age and nature from 1960s mainframe games to modern games for consoles and mobile devices. They also have hundreds of thousands of archival materials relating to games.

Stanford University also has an impressive collection of games, owing in large part to the presence of the Cabrinety collection. Stephen Cabrinety was a collector who died in 1995 and bequeathed his collection of video games to Stanford (SearchWorks). The Cabrinety collection contains about 15,000 games from the years 1972 to 1993, and is very comprehensive for those years, spanning many genres and platforms. Stanford has tried to fill in their collection by collecting post-1993 games, but an interviewee said their collection is probably still not quite as comprehensive as for the Cabrinety years. In addition to the Cabrinety collection and other special collections, Stanford has a

circulating collection with thousands of games in it. They also collect ephemera related to software, including books, magazines and the platforms the games run on. An interviewee identified Stanford's weakest area as modern games, especially mobile and streamed games. In addition, they do not generally collect arcade games, which one of the participants called "a whole different ball game" due to their size and the fact that they are just as much artifacts as they are software.

The Library of Congress is the only government institution among those interviewed. Their acquisition of games happens mostly as a by-product of the copyright registration process, as games must be submitted as part of a copyright application. This requirement has only been in place since about 2007, so presumably their collection is most comprehensive in the years since then. They have also received some earlier games from collectors, such as Apple IIe floppies and cartridge-based games. However, the interviewee said the bulk of the Library's collection consists of PC and Mac CD-ROMs from the earlier years and console titles from more recent years.

The Computer History Museum (CHM) does not generally seek out games in their acquisition policy. This is because they are more focused on types of software that there is less interest in preserving – programs that might be lost if they do not preserve them. Nonetheless, they have acquired games as parts of larger collections and are concerned about preserving them. The games that they do have cover a broad spectrum in terms of era and genre. For example, they have everything from games from the 1950s and 60s on punch cards and paper tape, up through modern games. The genres are equally diverse, ranging from *World of Warcraft* to educational titles.

Lastly, Carnegie Mellon University is also an outlier among the institutions analyzed – in their case, because their game preservation activity is still in the planning stages. The university has a professional master's degree program in game development, and they are planning a repository for student creations. The Entertainment Technology Center (ETC), as it will be called, will preserve those works of the students that are free of intellectual property restrictions, and will make them available online on the university's public data repository. They are hoping to create a process for interviewing development teams and packaging this information, together with the actual games and their metadata, into a zip archive. The game design program also has a private game library, but it exists only for their own use.

5.2 Authenticity and Successful, Meaningful Preservation

At least three of the interviewees' definitions of successful preservation agree with the classic archival maxim "It depends." One interviewee from Stanford said that he viewed my question about authenticity as really a question about use cases. He pointed out that some researchers care mostly about the gameplay, while others look at games more as software or technology. Some will want to play the game themselves, others not. He said that each repository must make its own decision as to which user groups' needs they will prioritize. The other Stanford interviewee said that too few researchers had used the collection thus far for them to define authenticity – thus implying that it is ultimately the users, through their behavior, who determine what aspects of a game matter. One of the CHM interviewees likewise pointed out that the exact shades of colors one uses in rendering a game matter if and only if the researcher cares about them.

It is also evident that, for many of the respondents, meaningfulness extends beyond the game itself. Even though I included a question about documenting context in the list of questions, at least four of the respondents mentioned ancillary materials in their definitions of authenticity, without needing to be prompted. (This is one of the reasons I decided to combine these two topics in this report.) One of the CHM respondents used the term "ecosystem collecting" to refer to the practice of surrounding a game with materials contextualizing it. "For example," he said, "for the *Hitchhiker's Guide to the Galaxy* Infocom game, just having the bits isn't enough. In that case, you need the whole ecosystem of it, from the packaging, to the feelies that came with it, to the gameplay itself."

The Library of Congress is now trying to save game boxes, manuals, and anything else that comes with a game, even advertisements. The ETC at Carnegie Mellon is planning to include development documentation and interviews with development teams in its game repository. However, the most detailed game preservation plan I heard was that of The Strong. The respondent there explained their fivefold approach to preserving a game, which consists of (1) preserving the original game, (2) taking a video of gameplay, (3) performing preservation activities such as emulation or migration, (4) collecting magazines or other media related to the game, and (5) collecting records that document the game's creation and impact.

When I explicitly asked the respondents about the documenting of historical and social context of games, two of them said this was not their job. One of these then added that this task would be the responsibility of a curator. However, several others did show varying degrees of interest in context. Stanford collects the records of game developers

and designers (as does Carnegie Mellon), and is using the Internet Archive's Archive-It tool to crawl websites related to games. One of the CHM interviewees said that they pay some attention to social context, but they are more focused on technological context. These two categories are connected, but also quite distinct, he stressed. The Strong, by contrast, is very interested in social context, probably the most of any institution represented here. They frequently collect materials documenting the reception of games within the broader culture. The interviewee felt that their "Women in Games" initiative was a good example of this. "By focusing on the area," he said, "you sort of drill down, you get people's experiences." He gave the example of the experiences of people who worked at Atari, a game company that was a pioneer in employing women, but whose cultural attitude towards women has come under criticism in more recent years.

Lastly, one of the Stanford interviewees provided a unique but highly interesting definition of meaningful preservation. He included accessibility in his definition, even though they have had limited success in living up to this ideal thus far.

5.3 Challenges to Preservation

The most commonly identified obstacles to preservation were legal issues and the instability of physical media. Five of the seven interviewees mentioned copyright restrictions, intellectual property laws or other legal issues as hindering their ability to preserve games. Two mentioned that it is illegal for them to break through copy protection or digital rights management (DRM) schemes. Three mentioned challenges in obtaining permission from rights holders. The Library of Congress interviewee said he felt that the success of film archiving has been largely due to the cooperation of film

studios. Game companies, by comparison, are only starting to realize the value of their history.

A Stanford interviewee elaborated on the specific challenges of dealing with rights holders, at least in his own institution's experience. He said that when Stanford encounters a gray area in the law, they prefer to play it safe and ask the publisher or rights holder for permission. (He compared this policy to that of the Internet Archive, which takes more risks, and also receives more challenges.) Stanford has found that most rights holders readily grant permission for reading room access and the posting of scanned materials online, but very few are willing to allow delivery of a game over the Web. He also mentioned the particular challenges associated with orphaned works, such as games where the publisher has gone out of business. Stanford rarely has trouble finding out who the current rights holder is, but many times, such rights holders are reluctant to assert their rights. Typical responses, according to the interviewee, include things like "We can't find any contracts in our files," or "We don't have proof there aren't any third party rights involved."

The short lifespans of physical media were the second most commonly identified obstacle, featuring in four of the interviewees' responses. The Strong interviewee stated this to be probably the biggest challenge to preservation. One of the CHM interviewees used the phrase "a race against time," while the other said that "time is working against us to be able to image and then emulate successfully" and "the longer we wait, the worse our chances of recovering a game." Magnetic materials like floppy disks and tapes were the most frequently mentioned, but the Strong interviewee also brought up CDs, saying

that there is not very good knowledge of how long they last over the long term and that many factors are involved.

Another challenge the Strong interviewee mentioned – one, he says, that has mostly been surmounted – is that not everyone realizes why games are worth preserving. He compared this to the skepticism that other media received when they were first invented, such as novels in the 19th century and film and television in the 20th. While this is no longer as much of a problem as it used to be, he said they still try to remember when writing a grant application that the reader may not have grown up playing video games.

Two interviewees also mentioned the challenges of preserving online or networked games. The Carnegie Mellon interviewee talked about the difficulty of preserving games that run on online networks, because one must preserve all the servers and systems that the game interacts with in order for the game to be playable. He called this the "network contingency issue." The Strong interviewee, meanwhile, mentioned the unique issues surrounding massively multiplayer online (MMO) games, since the presence of a large number of other players is central to the experience. With these games, he said, a video of gameplay might be a better representation of the experience than the game itself.

5.4 Ideas on Solving Challenges

Solving problems was not the direct goal of this study. However, I intended the study to act as a platform for future research and the eventual development of solutions. To provide a jumping-off point for this research, I asked the participants for their

thoughts on how to overcome the obstacles they identified. What follow are their responses.

As for dealing with legal issues, the Library of Congress interviewee stressed the importance of convincing game companies that their preservation activities are not born of any intent to compete with the companies for business. He said that he has already seen some improvement in the companies' attitudes on this issue in the last decade, but that there is still a long way to go.

The Stanford interviewee who discussed orphaned works and the recalcitrance of rights holders said that there are solutions to this problem, but no one has yet clearly laid them out. If the rights holder mentions a third party license, he said, one could contact that license holder and ask for their permission as well. Or one could just forget about getting permission and engage in the preservation work anyway, saying they did their due diligence. He expressed the desire for a best practice for dealing with these situations.

The Strong interviewee outlined his institution's plan for dealing with media instability. Because of the massive volume of their collection, they cannot possibly preserve every game or game-related archival item they would like to preserve. Therefore, they have adopted a process for determining which materials qualify for top preservation priority. He likened this procedure to triage in an emergency room, but the health of the item is only one of the criteria taken into account. The Museum calls its criteria the RAVE standard, for Rare, At-risk, Valuable and Engaging. Each of these qualities determine how high a priority an item is for preservation. The Strong also conducts an audit of its game collection twice a year. In each audit, the staff randomly

select 100 games from the collection, and play each one to determine if it is in playable condition.

One of the CHM interviewees expressed the desire for emulators and other tools that are sustainable. If the developer of an emulator abandons its work, she pointed out, people who have come to depend on it will be forced to start over. For this reason, she would like to see the development of some fully open-source emulators. The other CHM employee seemed to have quite a different view about emulation. Rather than worry about access to emulators, he seemed fully confident in the availability of emulators in the foreseeable future. “Right now,” he said, “...the game community is very, very conscious of the need to preserve the ability to run these [games], and we're seeing emulation at a level that is unheard of up to now.” He said that preserving the bit stream of a game is a bigger challenge than emulation. One way the CHM does this is by collecting the source code of a game and printing it on paper, which is far longer-lasting than any digital media.

As for convincing people that games as a medium are worthy of preservation, the Strong interviewee mentioned several strategies he uses when talking with naysayers. One is to make analogies to media such as novels, film and television – media which some people once looked upon with suspicion, but which are now widely accepted as worthy of scholarly study. He felt that video games are having the same sweeping impact that these media did. They have grown into a huge industry, and they are often children’s first introduction to digital technologies. Once he reminds people of these things, he says, they will usually begin to understand the importance of video games, and hence the value of preserving them.

6. Discussion

One thing this study makes clear is that not all collection of video games by repositories happens on purpose. Even though all five of the institutions surveyed are interested in preservation of the games they have, only two (Stanford and Strong) actively go looking for games. In the other three, acquisition occurs chiefly as a by-product of other processes: copyright registration for the Library of Congress, acquisition of software collections (which sometimes happen to include games) for the CHM, and the game design program at Carnegie Mellon.

Equally important to note is that a lack of intention in collecting video games does not appear to translate to a lack of interest in preserving them. The CHM is perhaps the most striking example of this phenomenon. When the CHM acquires some games that it was not really looking for, one might well expect them to re-gift the games or let them gather dust in their warehouse. But instead, they are actively interested not only in preserving them, but also in emulating them and documenting their technological context. This may be a reflection of their mission. Even though games are not their primary focus, they are a part of the broader technological history that they seek to document, and thus they can see the value in preserving them.

Many of the interviewees said that meaning (i.e. what properties make a game meaningful) is defined by the user. In other words, there does not appear to be any academic elitism among those interviewed. However, as one of the Stanford interviewees

pointed out, users' needs vary and each institution must decide which group(s) it is going to prioritize.

Also, it is important to note that preservationists' ideals do not always equal what their repositories are actually doing. The Library of Congress interviewee was very up-front about this. He said that he would like to preserve gameplay, but currently they are only preserving bitstreams. Likewise, the Carnegie Mellon person said that his ideal form of emulation "involves a ton of work that hasn't been figured out yet."

The identification of legal issues as one of the biggest barriers to preservation is consistent with the literature. However, it is worth noting that out of the five people who cited legal issues as a major difficulty, three also cited challenges dealing with rights holders. Furthermore, when discussing potential solutions, just as many discussed tactics for dealing with rights holders as expressed a desire for changes in the law. It is therefore difficult to point a finger at one issue or the other as *the* source of the problem, as it is only the combination of the two that causes particular trouble. If game companies were more cooperative with archivists about the preservation of their works – like film companies have been, according to the Library of Congress interviewee – the copyright restrictions requiring their permission before undertaking preservation actions would not be nearly as much of a problem as they currently are. Conversely, the opposite could also be true – a change in the law could reduce the necessity of negotiating with rights holders.

Stanford's position about always asking rights holders for permission if there was any question about its necessity is certainly an understandable one. (The interviewee's mention of a "gray area" may explain the contradicting statements about the legality of

the Internet Archive in the literature review, and why it has had to take down some items when challenged while still flourishing overall). However, Stanford's cautious position is the kind of position that can lead to so-called "copyright creep" – the gradual expansion of the power of copyright – by emboldening copyright holders.

However, this same interviewee complained that some of the rights holders he deals with are *too* cautious, showing that the definition of a gray area is clearly subjective. In my project proposal, which I wrote before undertaking this project, I mentioned that "it does not take much work to give someone permission to copy something." This was more of an assumption than an observation, and the interviewee's discussion about orphaned works has called it into serious question. He mentioned that oftentimes, it is perfectly obvious to him who currently owns the rights to an orphaned work, but it is not obvious to the rights holder. This seems to suggest a dissonance between the perspectives of archivists and game rights holders. To a very risk-averse company, it is *not* a small matter to act upon a privilege they are not completely certain they have. It is important to note that if the preservation of a game is successful, the benefits would accrue mostly to the archival repository (presuming the rights holder does not care much about historical value, which they well might not, especially if they did not make the game). On the other hand, if the preservation results in a legal challenge, the party who gave the permission would probably be in more trouble than the party carrying out the preservation work. So the difference in tolerance of risk between the archivist and certain rights holders may reflect a difference in how much each party has to gain or lose from the preservation venture.

The other major obstacle identified was the deterioration of physical media. As with the need to get permission from copyright holders, this would presumably not be a problem were it not coupled with another constraint. The CHM interviewees both emphasized the fear that they may not be able to save their games in time before they become unrecoverable. Though they did not mention it, limited funding is probably also an issue, since if they could hire more staff to work on the imaging, they most likely would. If obtaining permission to make images presents as many headaches as it does for Stanford, this would presumably slow down the process as well.

In short, it appears that, even though we can point to two major groups of challenges affecting the preservation of video games, we cannot narrow them down to just one or two specific obstacles. Rather, there appear to be two knots, each made up of interrelated issues that only present major problems in combination with each other. The question then becomes one of determining where the best place is to untangle the knots.

7. Implications

The fact that so many of the obstacles are intertwined is not necessarily a bad thing for preservation. As we have seen, overcoming any given obstacle may well make other obstacles less of a problem. As previously mentioned, changes in the law and improving relations with rights holders are not both necessary, as achieving one should make the other less of a problem. Changing copyright laws to make it easier to make preservation copies would certainly make preserving video games a lot easier. However, there appear to be a greater number of ways to work within the law than to change it. Some of these include convincing rights holders that their games are valuable and worth preserving, or convincing them that LAMs have no intention to use the games to compete with the rights holders. However, as with working to change the law, these may be easier said than done. Society is decentralized, and there may be no obvious place to start in changing the culture among or within game companies. A more realistically attainable measure would be to develop a best practice for dealing with cases of orphaned works where the party believed to hold the rights is not willing to assert them. An author could develop a set of criteria for determining if a preservationist had done due diligence in finding out who owns the rights to a game. If the digital preservation community can agree on such a standard, it might embolden them to take some chances and step into some legal gray areas for the good of digital history.

The other major challenge identified was bit rot and the ravages of time on media – and more specifically, the lack of adequate time to image the media before it fails. While it is conceivable that improving relations with rights holders might speed up the preservation process, the interview data do not suggest a strong correlation between the two major issues. Bit rot might be the harder of the two problems to solve, judging by the fact that fewer potential solutions to it were identified. The ideal solution would be to acquire the money to hire more staff, but none of the interviewees brought this up. This suggests that they may not find the idea feasible. While fund-raising or changes in budget allocations certainly might be possible at some institutions, they are outside the purview of digital preservation. The most realistic solutions are probably those that repositories can implement with the resources they already have. An example of such a solution is Strong's RAVE standard, which is essentially built upon the admission that Strong will not be able to preserve every game it has as well as it would like to. In light of this, they direct their preservation resources to where they feel they will produce the most value. This type of initiative – assessing resources, assessing needs, and then allocating resources to needs in a way that fits the institution's mission – is a step that any repository should be able to take.

Similarly, it is important for institutions to define who their main users are and what their needs are. This will affect not only which games are a top preservation priority, but also what qualities and contextual materials they need to preserve.

8. Directions for Future Study

Some calls for further inquiry came from the interviewees themselves. The Stanford interviewee who discussed orphaned works mentioned that whether or not a non-original rights holder chooses to assert their rights sometimes appears to be random. He explained that sometimes he would send a company a request for preservation permission for a long list of games, and the company would assert their rights for about half of the games and deny the other half. It would be interesting, and perhaps fruitful, to explore the factors a company takes into account when making such decisions.

Likewise, the Carnegie Mellon interviewee pointed out that playing a game at the time it came out is an ambient experience, and emulation preserves only a part of that experience. For example, he said, no emulator could ever recreate the experience of playing a game on a cathode ray tube (CRT) monitor with custom peripheral devices. While this may not be a priority for the game preservation community, a project to preserve or simulate a game's original hardware in an enduring way would break new ground and be a learning opportunity for the community.

It would also be interesting to investigate why the two CHM interviewees expressed such different perspectives about the state of emulation. Are fan-made emulators open source? If so, was the person calling for open-source emulators unaware of them? Furthermore, it would be interesting to see if the motivation showed by fan communities for emulation could be tapped for other purposes. Since it appears many

institutions lack the staff to image all their deteriorating media, perhaps volunteers could be trained to help with some of the process.

9. Conclusion

Many types of institutions are now interested in preserving video games, including (but not necessarily limited to) museums, universities and the Library of Congress. Some of them intentionally collect games because they are central to their mission; others acquire games as a by-product of other processes but are still interested in preserving them. None of the collections surveyed seem to be highly concentrated in a particular genre or time period, although some are stronger in some of these areas than others. The institutions varied greatly in terms of how broadly they cast their contextual nets around a game, from preserving only a game's bitstream to carefully documenting its creation process and social impact. However, almost all of them like to acquire boxes, manuals and similar materials when possible, and many feel that only a user can define what properties make a game meaningful.

A number of issues keep the institutions studied from preserving video games as well as they would like. The ones the interviewees most commonly mentioned were copyright laws and other legal restrictions (compounded by challenges getting permission from rights holders) and bit rot or media failure (compounded by a lack of adequate resources to make images of the media in time). Other challenges they mentioned included a dearth of sustainable emulators and difficulties preserving games that are dependent on servers or social experiences.

The interviewees mentioned several ways they have worked within these constraints. In the legal sphere, such tactics include trying to convince rights holders that their games are valuable and that the institution will be responsible with them. Ways of dealing with media failure include printing the source code on paper and giving preservation priority to the materials that are in the most danger or that the institution deems the most valuable.

However, much more research is still needed on how video game preservation can be made easy, effective and scalable. Particular research areas the participants identified include the development of a best practice for dealing with rights holders of orphaned works, and the creation of open-source emulators. The author is also curious to know if non-professional game enthusiasts, who have made great strides in emulation, could be harnessed as volunteers to help with bit-level preservation.

This much is certain: The historical and cultural value of video games is increasingly becoming apparent to many people both inside the preservation community and out.

> I like to say that...just as novels were the dominant medium of the 19th century, and movies and television dominated the 20th…I feel like video games are on their way to being the predominant media of the 21st century."
>
> – The Strong interviewee

Preservationists have made significant progress in learning how best to preserve video games, but there is still a long way to go before preservation of video games becomes easy, widespread and effective. Because of the ephemerality of many digital media, time is of the essence in developing and implementing solutions to the challenges that face the game preservation community. The actions we take today will determine

whether countless future generations have access to these works of art and entertainment from the dawn of the digital age.

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Appendix: Interview Questions

1. Do you have any electronic games in your repository?

2. If so, what types of games? (era, platform, operating system, genre)

3. How would you define “successful” preservation of a game? What aspects or properties need to be preserved?

4. Have you tried to document a game's historical and social context?

5. What do you feel are the biggest obstacle(s) to preserving games and making them accessible?

6. What do you feel are some potential solutions to these challenges?