The Music of Microswitches.
Preserving Videogame Sound: A Proposal
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> 8-Bit Lisa Simpson: One day, your video game, too will be obsolete.
>
> Bart Simpson: No way! “The Simpsons Game” is awesome! Just because every video game up until now has been destroyed and forgotten, doesn’t mean ours will be.
>
> Lisa Simpson: Bart, she’s right. I mean, I’m right. We’re both right. No video game is safe from an industry that’s always chasing the hot new thing! Sure, “The Simpsons Game” is great, with its unique, upgradable character abilities, and its hilarious, self-referential cutscenes, but what about when the Xbox 720 comes out? Or the PlayStation 4? No one will want to play us then.
>
> (‘The Simpsons Game’, Electronic Arts, 2007)

Introduction

It is more than a decade since Lisa uttered those prescient words but in that time there has been a growing recognition of the vulnerability of digital data, the pervasiveness of obsolescence and media decay and the ease with which videogames can be lost forever. In response, preservation and archiving have risen up the game studies research agenda in recent years. Pioneering studies (e.g. Lowood 2009; Guttenbruner et al 2010; McDonough et al 2011) have drawn attention to the fragility of data stored on media such as floppy disks, hard drives, CDs and DVDs and cassettes as well as the rapid deterioration and inevitable malfunction of the computing hardware and peripherals required for access and play. Coupled with the deep-rooted industrial practices of planned obsolescence and supersession that leave old games and systems unsupported, undesirable and inaccessible, and a shift to digital distribution that confounds traditional ‘object-based’ approaches to collecting, archiving and preservation (see Kaltman 2016), our longterm ability to research and play videogames remains under threat and in need of urgent action (Newman and Simons 2018). As Pinchbeck (2014) notes, ‘games history and preservation are of great importance to contemporary developers ... [yet] almost three decades of cultural material has become endangered owing to lack of formal preservation structures.’

Alongside this interest in and concern for the history and future of videogames, the emergence of the discipline of ludomusicology has highlighted the visual-centrism at the heart of game studies. To some extent, we might argue that the preoccupation with game graphics at the expense of sound and music in scholarly studies of videogames is reflective of broader trends in game advertising, marketing and technology design that have privileged the *video* in videogames. In fact, counterbalancing the attention paid to animation, character design and other aspects of graphical representation with serious scrutiny of sound and music is not unique to academic enquiries of videogames and such an ‘auditory turn’ is similarly identifiable in studies of film and television (Rietveld and Carbone 2017). Nonetheless, despite a growing body of excellent scholarship mapping the field (Collins 2008; Cheng 2014; Donnelly et al 2014; Moseley 2016; Summers 2016), undertaking detailed technological accounts of platforms (e.g. Collins 2006a, 2006b, 2007; Marquez 2014; McAlpine 2017; Newman 2017), exploring practice (Phillips 2014; Sweet 2014) and even offering musicological analyses of specific videogame scores (Schartmann 2015), it is only marginally melodramatic to note that game studies as a whole remains deafeningly silent. More

prosaically, we can certainly say that without attention and action to issues of preservation, our ability to hear the sounds of games and gameplay in the future will be significantly undermined.

This essay is written from the intersection of the fields of ludomusicology and game preservation and seeks to contribute to both and to the wider discipline of game studies as the issues it raises cut to the very heart of the project of our collective academic enquiry. My aim is to present further insight into the importance and scope of sound and music in scholarly game studies and to offer methodological and conceptual criticism of extant approaches to game preservation, particularly as they relate to game sound. Ultimately, this paper seeks to challenge a number of taken for granted assumptions about the purpose and scope of game (sound) preservation from which current scholarship and practice proceeds. Key to the argument is a conceptualisation of the relationship between music, sound and play that diverges from the treatment of game sound and music as extractable and abstracted assets. By contrast, the methodology I propose recognises game sound and music as indissoluble constituents of a gameplay experience whose distinctive soundscape is generated by the performances and contours of play and players. This recognition of the configurative nature of play and the role of the player in co-creating the gameplay experience marks a shift away from preserving games as code or technological systems and develops the 'gameplay preservation' approach I have outlined elsewhere (e.g. Newman 2012, 2018).

Unlike the majority of current game sound and music preservation projects, the approach I propose is one not solely based on the acquisition of music and sound effects files from game data. It follows that it does not only focus on capturing the raw output of hardware systems and sound chips. Rather, the scope of the project extends to actuality recordings of games being played. This decision has two immediate consequences. In the first instance, it means that the recordings account for the totality of game audio emanating from systems and games at play. As such, rather than being artificially extracted and separated in the archival process, music and effects intermingle, sometimes complementing one another and sometimes competing for sonic space depending on the design of the audio engine. Second, the focus on actuality recordings suggests a further expansion of the scope of the game sound preservation project that moves beyond the electronic output of soundchips and playback devices to incorporate the characteristic sounds of interface elements such as joysticks and microswitches.

Preserving playability

The objective of much extant videogame preservation work is to maintain the playability of games in the longterm (or to make now unplayable games playable once more). That is, the outcome of game preservation is to allow players to continue to experience gameplay at first hand. Prima facie, this is not an unreasonable position from which to proceed. As Consalvo, et al (2013: 4) note in their Sports Videogames collection, '...although audiences of all types are "active" in the many ways delineated by Fiske (1987), players—or perhaps the play position—is unique in that the player must work to (co-)construct the object of interest—the videogame.' Indeed, we might argue that the field has defined itself through its placement of players and their experiences at its heart. More than a decade on, Aarseth's (2003) crucial discussion of the obligation to understand gameplay in order to do game studies remains most easily tackled by grasping a controller and seeking to attain at least some degree of expertise as a player.

Whether we recognise the 'configurative' aspects of play as Moulthrop (2004) describes or what Banks (2013) has called the co-created nature of videogame experience, if videogames are texts then their textuality is found in the interaction between design, code, and performance. Given the

apparent centrality of play and the oft-heard mantra that videogames must be played to be understood, centring our attentions on (re)creating conditions in which games may continue to be encountered in as close to their original state as possible appears to make perfect sense.

Typically, such preservation activity is conceived of as a software project and is achieved through emulation, where an application running on one system reproduces the environment required to run game code originally designed for a different system (see Rosenthal 2015). By way of example, software such as Open Emu effectively transforms a modern Macintosh computer into a plethora of different 1980s-era 8-bit systems such as the Nintendo NES, or even more recent platforms such as the Nintendo 64 and PlayStation. The power of modern computing platforms and sophistication of emulation software means that many early games can even be played in a web browser: the Internet Archive's Internet Arcade holds over 900 games that are playable online. Of course, not all emulators are created equal and as byuu (2011) the creator of a popular NES emulator has noted, creating truly accurate emulation of even apparently lowly-powered systems requires a huge amount of computing power.

Even more pressing than the availability of computing resources are the legal issues raised by emulation (see Zainzinger 2012). Space does not permit a full discussion of the finer details but it is important to note that, while the creation of emulators is generally considered permissible as an act of research and enquiry, the acquisition of copy protected code remains unequivocally illegal. In other words, creating an emulator to mimic the behaviour of an Atari VCS is considered unproblematic but ripping the code from a Space Invaders cartridge to play on it most certainly is not (see Good 2018 and Maiberg 2018, for instance, on Nintendo's action against a number of filesharing websites). As the European Federation of Games Archives and Museum Projects (EFGAMP) notes,

> Most European countries have legal restrictions on the creation of digital disk copies. Even heritage institutions are permitted to produce a copy only if there is no copy protection. Unfortunately, however, the majority of media with video games are endowed with copy protection methods, originally placed there to prevent software piracy. Hence a legal copy - even for memory institutions – is usually disallowed. (EFGAMP 2015).

Yet, for all these potential legal impediments (and perhaps in the hope that the lobbying of organisations such as EFGAMP will redress the situation), for many game preservation practitioners and critics, emulation remains the '...the only viable techniques of long-term preservation.' (Monnens 2009: 6; see also Guttenbrunner et al 2008).

The limits of emulation

However, even setting aside these not inconsiderable legal issues, we might justifiably identify other serious concerns about emulation as a preservation strategy. None of this should be taken as a criticism of emulation per se nor should it in any way detract from the extraordinary work of the teams of developers coding emulators. This work continues apace and makes almost unbelievable strides on a routine basis whether it is creating experimental Nintendo Switch emulators on the PC (see Evangelho 2018) or running older console and arcade games in a web browser. Surely the sight of Super Mario Kart running in HTML5 is the very definition of Arthur C. Clarke's (1962) third law that 'any sufficiently advanced technology is indistinguishable from magic.' Nonetheless, emulation presents a number of challenges that are impossible for preservation theorists or practitioners to ignore. Here I wish to identify some of the key

methodological, operational and conceptual issues associated with emulation and extent approaches to preservation in order to build a series of four principles from which an approach to game sound archiving can proceed.

1. Preserving emulators

The first question mark over emulation as a preservation strategy relates to the contexts in which emulators are developed and maintained. It is important to note that much of the most significant work undertaken in relation to videogame emulation is the product of amateur, not-for-profit, freeware project teams motivated by interest, passion and enthusiasm. As the PVW report notes, 'The community for emulation development, especially for video games, can be best characterized as a grass-roots movement led by a few dedicated programmers' (McDonough et al: 62). While in no way undermining the quality and quantity of this work, we should perhaps be mindful of the potential precarious nature of this situation where tools so central depend so greatly on the energy and goodwill of 'grass roots' projects and motivated individuals. As the findings of the PVW project's evaluation of emulators found, many potentially promising tools were eliminated at an early stage because they were in an indeterminate state of upkeep, thereby becoming outdated and obsolete in themselves.

However, while the motivation and dedication should impress us only slightly less than the feats of technical inventiveness that go into the creation of emulation applications, we must surely question whether a reliance on the products of amateur, fan culture is truly viable in the long-term.

> Dedicated emulators tend to receive few updates and are frequently discontinued when the authors become distracted from development. Therefore, hardly any emulators exists in a final version that perfectly emulates all games for a system. (Guttenbrunner et al 2010: 87)

Indeed, as McDonough et al note, many potential emulation solutions were discarded from their study at an early stage because they were in development stasis, had been abandoned altogether or their status was uncertain. '...this investigation has also revealed one of the critical weaknesses in the emulator community – as emulators age, they too can fall into neglect and disrepair.' (McDonough et al 2010: 69). As such, the emulator is as likely to become an object in need of preservation attention as it is a solution to the problem of preserving the games it initially sets out to make playable (Newman and Simons 2018).

Principle one: A game sound archive requires a repository committed to permanence for its collections and holdings.

2. Whither the Marty?

The second point concerns the scope of emulation, research and preservation activity. Of course, not all videogame systems are emulated. Systems such as the PlayStation which are based around proprietary hardware and software for which public documentation is lacking present a significant challenge for reverse engineers. The technical demands of emulating increasingly complex and powerful systems ensures that there remains a time lag between original platform and emulation with Guttenbrunner et al (2010) noting a clear correlation.

> Even popular systems of the first four generations are not perfectly emulated today. The more recent the system, the lower the degree of accuracy. Of two tested games on two

> emulators for the Atari Jaguar only one game was playable. The two games for the Sony PlayStation 2 proved entirely unplayable. (Guttenbrunner et al 2010: 86)

This lag is only further accentuated when ensuring compatibility with games developed later in the target platform's lifecycle where increased knowledge of and familiarity with the architecture or more sophisticated tools and middleware allow undocumented techniques, exploits and optimisations to be performed.

However, more than this, the availability of emulators is also a function of popularity and market recognition. As Conley et al 2004: 5) note, 'demand for a suitable emulator for a game system correlates directly with the popularity of a video game console when it was available in the retail marketplace.' The way in which activity coalesces around popular and already venerated consoles reminds us of Apperley and Parrika's (2015) methodological critique of scholarly 'platform studies' its 'epistemic threshold' and, in particular, its relationship to the archive of materials which it necessarily proceeds from and simultaneously reinforces and validates. While the NES might be well catered for, where then, are the FM Towns Marty emulators? Where are the emulators dedicated to non-commercial or self-published games that Vowell (2009) notes?

Quite apart from any conceptual argument we might make about the value of longterm playability, the sheer amount of labour, technical ingenuity and prowess required to reverse engineer and create a functioning emulator effectively ensures that a process of selective forgetting operates. As such, if playability through emulation remains our key objective, historical market conditions and commercial success will continue to exert considerable influence over the future canon of preserved games.

Principle two: A game sound archive should be extensible and wide-ranging in scope.

3. Some emulators are more equal than others

The third issue is perhaps the most serious and relates to the imprecision of emulation. Despite representing extraordinary technical achievements, many emulators do not reproduce gameplay experiences with the unerring authenticity they might proclaim. Certainly, the survey of emulation platforms presented in the Preserving Virtual Worlds report (McDonough et al 2010) notes significant variations in performance between emulators in comparison with reference systems. Depending on the specific use-case, small variations or inconsistencies in sound reproduction might be insignificant and an overall flavour of the audio output might be entirely sufficient. However, for scholars of ludomusicology, such variations might be of immeasurable consequence.

Interfaces, too, present opportunities for considerable variation in emulated experience. Many systems feature dedicated and distinctive joysticks whose feel is integral in shaping the gameplay experience. The particular feel of the two round-topped buttons on an NES pad is not only a characteristic feature contributing to the feel of playing Super Mario Bros., for instance, but allows - even encourages - a distinctive rolling motion of the thumb between the run and jump controls. Square-topped buttons with hard edges simply would not feel the same and would not allow the same smooth motion of the right thumb across, between and over what effectively become a single rocker switch.

More recently, Altice's (2015) magnificently detailed investigation of the NES/Famicom platform has pointed to the need for the inclusion of emulation information in the citation of games. This call

recognises that present videogame citation practice is not well-standardised, emulation is increasingly the means by which we come to gameplay from non-current platforms whether as scholars or consumers, and crucially for our purposes here, that emulator performance varies greatly.

> Since emulators vary widely in accuracy, the emulator listing provides the reader with information about how the author viewed the particular file. If NESticle is listed rather than Nintendulator, for instance, the reader will know that the file's raster effects, sound, or palettes may have been emulated improperly. (Altice, 2015: 341)

While Altice's point on the rendering of raster graphics is well-taken, it is in the realm of sound reproduction that the greatest variations between emulators are typically found. This is due, in part at least, to the simple fact that sound emulation is perhaps the weakest aspect of current videogame emulation practice and may be a further reflection of the comparative bias towards visual fidelity identifiable throughout game culture.

Looking again to the Preserving Virtual Worlds project, we find considerable variations in the handling of sound in emulations of id software's seminal first person shooter DOOM. Some emulators performed intermittently before becoming unstable while others offered absolutely no sound support whatsoever.

And lest we consider the imprecision in sound reproduction to be a consequence of amateur emulator coding or a lack of technical documentation, scrunitising Nintendo's own re-release of its 'Legend of Zelda: Ocarina of Time' title, we note an intriguing caveat in the instruction manual of the GameCube Collector's Edition.

> This NINTENDO GAMECUBE software is a collection of titles originally developed for other Nintendo Systems. Because of the process of transferring software from Game Paks to a Game Disc, you may experience slight sound irregularities or brief pauses during which the system loads data from the Game Disc. Such instances are normal and do not indicate defective software or hardware. (Nintendo 2003: 3)

Even more recently, Nintendo's own emulation of its 1980s NES and SNES hardware in the form of the Nintendo Classic Mini series drew widespread criticism for the quality of their sound (e.g. Richretro 2017; Ciolek 2016; List 2016; Nerdly Pleasures 2016 and see also Great Hierophant's (2016) discussions at the NESDEV forums). Linneman's (2017) criticism is indicative.

> Music playback sticks out for its tinny output, lacking the richness you'll hear when using a real NES console, or other accurate solutions like the Analogue Nt. In the case of Kirby's Adventure, the backing track takes on a shrill note at points, while sound effects relying on the noise channel also tend to suffer. All miss the mark; from the fire power-up used by Kirby, to the text boxes in Zelda 2, and even the clap of thunder in Super Contra. There's even a subtle delay in audio playback compared to original hardware, creating a slight offset from the video. Simply put, the audio experience just isn't where it should be.

We will return to discussions of 'original hardware' later in this essay, but for now we shall take on board Altice's observations and recognise that the variations in emulator performance whether

audio, visual or any aspect of game feel, are sufficiently significant to demand the inclusion in game citation.

Principle three: a game sound archive should include comprehensive metadata, adhere to and drive best practices in videogame citation.

The Game Sound Archive: A Proposal

In line with the three principles that emerge from the general critique of emulation and the more specific consideration of the limitations of emulation-based preservation strategies that seek to deliver longterm playability, I wish to propose a game sound archive that:

- is based on widely available and accessible tools and techniques and that does not rely on the creation of complex new hardware/software systems such as videogame emulators that necessarily limit the scope of the endeavour (principle one);

- is extensible in its coverage and hamstrung by documenting those systems already agreed to have significance or about which an archive of documentation already exists (principle two);

- is sensitive to the wide variations in performance of putatively identical game code that arise from the use of different hardware or software systems and devices.

In short, what I am proposing here is a sound archiving project for videogames that draws inspiration from and directly follows in the footsteps of the sound archives of the Library of Congress' Recorded Sound Research Center and the British Library's Sound Collections. That is, a project that is based around archival sound recordings of videogame music and effects rather than a project centred on attempts to technically (re)create the conditions of play for obsolete systems.

While thus far the discussion in this article has focused on emulation and maintaining playability, in light of the principles above, it would be wholly remiss not to draw attention to a number of projects that, prima facie, appear to tackle the issue of sound archiving in a very similar manner. Well-known projects such as the High Voltage SID Collection (HVSC) have undertaken incredibly thorough work excavating, cataloguing and documenting over 50,000 Commodore 64 music tracks, developing a structured credits schema and directory structure, and represent some of the most comprehensive sound archiving projects to date. However, the HVSC along with similar projects including VGMrips, collect packages of extracted music files intended for playback under emulation on dedicated players or plugins. As such, while these projects are remarkable achievements in archiving and speak to the appetite for game sound among the legion of enthusiasts who contribute to, share and download the ripped files, they serve a somewhat different purpose from the Game Sound Archive I propose in this essay. In fact, as I note below, the emulated output of the Commodore 64 tracks collected in the HVSC and reproduced under the SIDPlay application might well form the basis for archival recordings in the Game Sound Archive as demonstrations of the specific audio performance and capabilities of that version of the player running under that operating system.

Perhaps more directly comparable to the Game Sound Archive proposed here is 'Stone Oakvalley's Authentic SID Collection' (also known as 'SOASC='). SOASC= makes use of

automated recording techniques to mass-record music from the legendary Commodore 64 and its original SID sound chips. Whilst recognising the quality of the work undertaken by those developing and refining Commodore 64 sound emulation, Stone Oakvalley (2015a) notes that it remains imperfect.

> It's near perfect, the keyword is ‘emulate’. It means to simulate or reproduce something in another environment than its original environment. Please be aware that SID chips have incoming capacitor lines which are made out of natural elements and this means that the filters are impossible to simulate on a computer 100%.

We will briefly return to the nature of the Commodore 64 soundchip in the closing section of this essay, but for now, let us note that the motivation for SOASC= is found in precisely the limitations of emulation that we note above. Much like the variations in the rendering of graphics that Altice notes in the scrutiny of different NES/Famicom emulators, for some users and use cases of these materials in the future, these variations will be unnoticeable or insignificant yet, for others, they will make all the difference in the world. It is clear that, in the world of game sound and ludomusicology, the very existence of projects such as HVSC and SOASC= as well as the continued refinement of Commodore 64 sound emulation routines, all speak to the care, attention and meticulousness of these communities of practice and that these variations, however subtle, can be heard loudly.

Push the button

Although there might appear to be immediate similarities between the catalogued archives of mp3 sound recordings or playable music files collected at SOASC=, the HVSC and Gamerips, there is one further fundamental difference that differentiates these projects from the proposed Game Sound Archive. This difference moves beyond sound archiving alone and cuts to the heart of the game preservation endeavour. Whether they are based on ripped files for playback under emulation or the captured output of a hardware Commodore 64 encoded as an mp3 audio file, each of these collections treats sound as a distinct and discrete entity. The musical soundtrack to Rob Hubbard’s Thing on a Spring is just that. It is the musical soundtrack to Thing on a Spring played in its entirety from start to finish. It is also quite unlike any performance of the music that a player might expect to hear in the game. This is not a matter of nuanced audiophile interrogations into the specificities of the track’s playback on a 1985 Commodore 64 versus an 2018 emulator. Rather, it is a consequence of the fact that, during play, Thing on a Spring’s constantly playing musical accompaniment is constantly interrupted by the sound of jumping, of collecting objects… of play.

What is absent from collections such as the HVSC, Gamerips and SOASC= is the player and the act of play. Indeed, the interplay between the sound effects triggered by the player’s actions as they bound through the game world are not only overlaid atop the music but, in keeping with many other games of the time, actually interfere with the music. With just three channels or ‘voices’ at the disposal of the Commodore 64 composer, sound effects literally compete for the same sonic space. And they always win. The sound of Thing on a Spring’s bouncy melody and whimsical harmonies played back in their entirety reveals something of Hubbard’s musical intention but little of the player’s experience. And while the act of play might seem like an act of sonic barbarism that literally interrupts the musical performance, it is nonetheless, a soundscape that more accurately accounts for the game at play than any extracted file or mp3.

It would be foolish to suggest that one type of recording should replace the other and, clearly, the two are not mutually exclusive. However, at present, the approach to game sound archiving that is embodied in the work of those contributing to and building the HVSC and its ilk mean that we only have access to one

Just as being able to play Thing on a Spring under emulation at a point in the future when all the Commodore 64s in the world are nothing but piles of beige dust tells us nothing of the ways in which the game has been played or the techniques and tactics that players developed, so the extracted and abstracted sound file is similarly bereft of the play that is so fundamentally important, configurative and constitutive of the experience and textuality of the game. As a piece of music, it is fuller and more rounded, uninterrupted by the metallic 'sproings' of a series of mistimed jumps, yet it is simultaneously lacking and tinged with a sense of emptiness. While emulation makes possible the discovery of playability and writes the player into the future of the game, it does not reveal its past or present. In a similar way, the ripped sound file recreates that most sorrowful of all situations, the unplayed game.

Of course, if we wish to incorporate and give voice to the player and their actions as they play, we can go further still. Each jump has its own in-game sound that can be extracted and played back as a discrete sound file or enmeshed in the soundscape of frantic play. But each jump also has its own specific and unavoidable mechanical sound as the player's hand presses a key on the Commodore 64 keyboard or bashes the button on the Competition Pro joystick. As I write this section of this essay at my laptop, I notice an altogether different sonic accompaniment to my thoughts as my fingers bear down on the MacBook keyboard than when I pecked out the earlier sections on the touchscreen of my iPad. We have become well-used to appreciating the distinctive feel of interfaces, but perhaps we are less sensitive to their distinctive sounds. Yet, when we encounter games such as Grandstand's Astro Wars or Nintendo's Game & Watch series, we cannot fail to hear the technical sounds alongside the electronic. Every movement of the joystick as we attempt to steer our ship away from enemy fire or undertake the seemingly impossible docking mission, or roll of our thumb over the 4-way directional pad as we climb our way to the top of the building to grab yet another stay that holds Donkey Kong imperiously aloft on his perch, every movement, every action and interaction in the game is accompanied by a click, a clunk, or a snap as a switch is thrown or a contact is made.

Each interface has its own sound and each is utterly integral to the experience of play and indivisible from the sonic world of gameplay. It is this distinctive mechanical soundscape to which I refer in the title of this essay: the music of microswitches. Utterly a part of the gameplay experience and utterly absent from current approaches game (sound) archiving. The inspiration for these 'actuality' recordings comes in part from Matt Parker's work on The National Museum of Computing's 'Imitation Archive'. This collection of audio recordings of some of the most historically significant computer technologies in the Bletchley Park collection drills down to an almost visceral level as it documents the whirring, clicking and literal machinations of these behemoths as they start up, operate and shut down. Interestingly, as the mechanical sound is paramount to the Imitation Archive project, the presence of people could be construed as problematic. As Parker explains,

> As is often the case with recording in spaces with people in them, it doesn't occur to mind that perhaps any sound you make, any movement, heavy breath, *whispering*! will be

> picked up by the microphone! Achieving silence in the space for more than two minutes would be an almost impossible task! (Parker 2015)

However, for the proposed Game Sound Archive, the presence of players is highly desirable and their physical, bodily interactions with the interfaces as well as their interactions with one another are entirely within scope. The cheer of success, the helpful advice of a co-pilot guiding one along a tricky pathway, the jeering of an ungracious winner, all of these are the sounds of gameplay and all belong within the scope of a Game Sound Archive.

Principle four: a Game Sound Archive should recognise and account for the presence, activity and co-creativity of the player by incorporating actuality recordings. It should account for games being played.

Ultimately, the version of game sound archiving that I outline in this essay develops what I have elsewhere termed 'gameplay preservation' (e.g. Newman 2012, 2018). Where 'game preservation' focuses on extracting and executing code in order to provide the context and conditions for future playability, gameplay preservation positions play as the object rather than the outcome of preservation activity. It is surely the case that game preservation seeks longterm playability in recognition of the importance of play in configuring and co-creating the experience. However, while it might appear initially counterintuitive, I argue that gameplay preservation and the recording, capturing and documentation of the practices of play is important not simply because play is important. Rather, gameplay preservation proceeds from the principle play is *too* important, too constitutive and configurative, to be only the outcome of preservation. If we are to understand how games were played, we must make it our business to document these practices. To only record game sound without recording the way in which players experienced it, as a cacophony of music and effects, button presses, talk and the competing sounds of nearby arcade machines, we do future scholars, researchers and players a disservice.

It is for these reasons that the UK's National Videogame Arcade has partnered with the British Library to found a Game Sound Archive in line with the four key principles outlined above. At the time of writing in late 2018, the project is currently underway and, in its first phase, draws on the collections of the NVA. The recordings will be lodged with the British Library and will be accessible via the audiovisual suites and web portal.

Coda: Game (sound) archiving and the myth of original hardware

As Swalwell (2017) has noted, there is a preoccupation among game preservation theorists and practitioners with recreating the 'original experience'. The problem is usually conceived in terms of the authenticity of a contemporary attempt to recreate a historic gaming experience. Altice refers to improper emulation in the discussion of citation while Lowood succinctly summarises the situation.

> There is a difference between preserving game technology and preserving game content, which includes gameplay. Is it necessary to play The Legend of Zelda on the original Nintendo Entertainment System, with the original Nintendo controller and a contemporary television set, in order to gain a historically valid experience of the game? The experience of viewing Birth of a Nation in a palatial theater with live music is different from viewing it on videotape, on our television, at home, and so is reading any rare book in a modern edition or format. Different, yes, but is that difference essential for scholarly research? (Lowood 2004: 5)

However, the problem actually cuts far deeper than this. What do we really mean when we speak of the original experience of a videogame? Whose experience? Where? When? All difficult questions to resolve, without doubt, And, perhaps more importantly, even if we can answer the when and where, can we truly be sure that there is a definitive experience that was reliably experienced? With Astro Wars or the Game & Watch series, we might stand a fighting chance of defining it as we encounter a relatively self-contained device replete with a visual display, sound chip, speakers and integrated controls. The sound of Astro Wars is the sound of that particular, definable and delimited combination of hardware and software in collision with the player. But what of Doom running on the PC or Space Invaders on the Atari VCS?

In the first case, in common with many PC-compatible titles of today, Doom sets out a minimum specification (386 processor, 4MB of RAM, VGA graphics card and a hard disk). However, beyond this basic specification, the game's compatibility with numerous sound and graphics cards each with different capabilities and specificities means that now, just as in 1993 when Doom was released, its performance, appearance and sound are essentially a moving target that exists somewhere within an envelope of possibilities defined by the minimum and maximum specification and compatibilities.

As for the VCS, Montfort and Bogost (2009) note in their foundational platform study that the console complies with a TV standard for audiovisual output but defines no specific audiovisual display. Unlike Astro Wars, it has no built in display. As McDonough et al (2010: 68) note, connect a VCS to a colour television with full-range speakers and you have an altogether different experience than when connected to a black and white set with a speaker with minimal bass response. It would be challenging enough to consider how the audiovisual reproduction of games is affected by the vagaries of 1980s technology with its afterimages, RF noise, colour bleeding, visible scanlines and the blurring and smearing. However, once we factor in the magnitude of the variations in the capabilities, performance and imperfections of different TV sets, the notion of 'original hardware, soon crumbles.

We should also remember that while audiovisual displays might vary greatly, the gaming console or PC is, itself, by no means as singular or stable as the 'platform studies' nomenclature' might suggest. Our discussion of the Commodore 64 Sound Chip, known colloquially as the SID (Sound Interface Device) masks the fact that there are actually two fundamentally different designs with markedly different sonic characteristics. The later 8580 version fixes a bug in the earlier 6581 filter circuit which means that music that sounds crisp and dynamic on one Commodore becomes dull and muddy on another (see Judd 1996; Varga 1996; Oakvalley 2015b). Digging deeper into the SID Chip, we note further revisions of the chip and even perceptible variations between chips harvested from different production batches. That the sound of Thing on a Spring is dependent on the week in which the SID Chip was manufactured rather undermines the notion of the Commodore 64 as a stable 'platform' and certainly puts the lie to any discussion of original hardware (see Newman 2017b for more on variations in the SID chip).

Countless examples of differences in the performance and capability of putatively (and outwardly) identical systems abound. The variations in the output circuits of different revisions of the Sega Mega Drive/Genesis are so severe that one model is referred to by fans as 'the stinker' so bad is its performance (Ace 2009). Similar investigations of Nintendo's GameBoy have revealed similar variations in sound reproduction with the earlier 'DMG' often favoured by gamers and electronic

musicians redeploying the hardware. The GameBoy case is intriguing as, despite the apparently self contained nature of the handheld, variations in the specification of the digital to audio converter introduce distortions to specific versions of the hardware (see gbdev wiki (2008) for a detailed analysis).

Repeat to fade

So, when we talk of a gaming 'platform' or a desire to record, archive or play with the 'original hardware', what do we really mean? If the stability of gaming platforms as lived technologies is largely illusory and the VCS, Mega Drive, Commodore 64 et al are so profoundly altered and affected by the specificities of audiovisual displays, it is surely hard to sustain any meaningful discussion of an 'original experience'. What are our reference points and what should - and can - we preserve? Perhaps most pertinently, does this instability of platforms and the variety of devices all competing for the status of 'original hardware' undermine the project of preservation and make impossible a Game Sound Archive?

In one sense, the issues highlighted here are no more problematic for the preservation practitioner as they are for any scholar, researcher or player of videogames. It follows that the new approaches and methodologies that arise from preservation and archival focused work will benefit game studies in its entirety. What the recognition of the multiple instabilities highlighted in the conceptual development and operationalisation of the Game Sound Archive highlight is the need to accurately understand the nature of the experience under scrutiny, the hardware and software that is being used for play, study or preservation. One possible solution to the apparently paralysing absence of stable platforms, originals and definitive reference points is precisely to free ourselves from the fetishisation and search for stable platforms, originals and definitive reference points. Instead, as we note in relation to the Game Sound Archive, we might better focus our attentions on the development and adoption of rigorous documentation and citation practices that Altice suggests. One means of navigating the multiple entry points into a given game and the mutable, overlapping nature of the 'platforms' we have previously sought to solidify, is to compile detailed and high quality metadata. As with the Game Sound Archive, this imperative is not necessarily motivated by a desire to identify deviations from putative originals but rather to allow the interrogation of what is being played, in what context, with which combination of hardware and software so as to appreciate the impact and influence of these variables.

By coming to terms with the admittedly radical notion that 'original' and 'emulated' might have little if any real meaning (or, at best, a series of fluid and unfixed meanings), we can move beyond considering emulation to be either the solution to the preservation conundrum or as a masquerading alternative pitted against a putative and potentially illusory 'original'. Instead, we can treat the emulated version of Donkey Kong as just another means of encountering the game; another part of the constellation of 'Donkey Kongness' that, like all others, inflects its own distinctive character and flavour on the feel, look and above all, sound of the game.

Throughout this essay, I hope to have outlined some of the principles and precepts upon which to build an approach to game sound archiving. Among its objectives, my aim is to tackle two of the key challenges at the heart of gaming and game studies so as to account for the centrality and contingency of play and to squarely tackle the complexity and instability of videogame platforms. I hope to achieve these goals by promoting accessible sound recording techniques rather than sophisticated emulation software development; by spreading the net beyond the already established and self-perpetuating canon of systems and games to incorporate; and by shifting

focus from originals and copies to a more nuanced approach that recognises the continuity and afterlives of games as they move into new contexts such as emulation, re-release or remake: and by adding actuality recordings of games in and at play in order to move beyond the extracted and abstracted sound files of extant game sound archives so that we continue to hear the music of microswitches.

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