PART I

Chiptunes

Introduction

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And three 'bips' disrupted the silence – this is how a written history of game sound might start. These famous 'bips' in three different pitches occurred when players hit the white pixel representing the ball with the controllable white bar representing the bat, when the ball bumped from the upper or lower border or when the ball went off screen in the first widely commercially successful arcade game, *Pong* (1972). These sounds were not produced with a sound chip, but by the voltage peaks of the circuits in the gaming machine: in other words, their origin was analogue. Three years later, the arcade game *Gun Fight* (in Japan and Europe released under the name *Western Gun*), created by Tomohiro Nishikado, included a monophonic version of the famous opening bars of Chopin's funeral march from his Second Piano Sonata, and was the first game to include a melodic line. Again three years later, Taito's arcade title *Space Invaders* (1978), also created by Nishikado, used a changing soundtrack for the first time. It drew attention to the possibilities that a dynamic approach towards sound and music provided in terms of enhancing the player's experience during play. The arcade cabinet produced its sounds using the Texas Instruments SN76477 sound chip that had come to market the same year. Such programmable sound generators (PSGs) were used to produce the sound and music for arcade titles, home consoles and home computers. Some of these chips came to fame, either as they were used widely and in many gaming devices, or because of their distinct sound, or both. Famous examples are General Instrument's AY-3–8910 (1978), the MOS Technology 6581/8580 SID (Sound Interface Device, 1981) Atari's POKEY (Pot Keyboard Integrated Circuit, 1982) and the Amiga Paula (1985). While these chips are usually each referred to under one name as one item, it is worthwhile noting that many of them were produced in several iterations and versions. Another early approach towards game music beside the use of PSGs was wavetable synthesis, most famously adopted by Namco with their Namco WSG (Waveform Sound Generator) for their 8-bit arcade-game system boards such as the Namco Pac-Man board (1980) or the Namco Galaga board (1981). From the mid-1980s FM synthesis (Frequency Modulation synthesis) was popular, particularly after the release of Yamaha's DX7 synthesizer, and became the standard for game sound until the mid-1990s, with Yamaha being one of the main hardware producers. Unlike the PSGs, which used set sound-waves to give particular timbres, FM synthesis allowed waveforms to be blended and altered, giving rise to a far greater variety of timbres.

Early programmable sound generators usually provided three to five voices in the form of square, triangle or sawtooth waves plus a noise channel. The music had to be written in machine code, namely in programming languages such as BASIC or Assembler, which meant that either a composer needed programming skills, a programmer needed musical skills or the two professions had to work together. As Andrew Schartmann describes it for Koji Kondo's *Super Mario Bros*. soundtrack on the NES:

> The NES master's idea had to be translated into the language of computer code. And given that Kondo's music would be *perform*ed by a programmable sound generator, he couldn't rely on a human element to bring expression to his work. . . . For a video-game composer . . . a crescendo requires precise calculation: it is expressed in numbers ranging from 0 to 15, each of which represents a specific volume level. There is no continuum to work with, thus forcing composers to create the illusion thereof.[1]

That early game music composers only had a limited number of channels at hand oftentimes leads to the conclusion that early game music was limited in its expression by technology. And while this is certainly true for the sound aesthetics (as, for example, the use of real instrument samples wasn't possible until MIDI) and number of available channels, it is not for compositional quality. As early game composers such as Rob Hubbard, Junko Ozawa, Yuriko Keino, Martin Galway, Koji Kondo, Nobuo Uematsu, Yoko Shimomura, Jeroen Tel, Chris Hülsbeck and so many others have demonstrated, PSGs and WSGs can be used to create complex and exciting compositions, if the composer knows their instrument. Furthermore, by inventing their own programming routines and tricks,

1 Andrew Schartmann, *Koji Kondo's Super Mario Bros. Soundtrack* (New York: Bloomsbury, 2015), 36.

these composers created sounds and music that were continuously pushing the boundaries. In addition, the players themselves entered this new playground early on.

Chiptune Culture from Old School to New School

Thanks to the coming of affordable and programmable home computers from the late 1970s like the Apple II, Sinclair ZX Spectrum or the Commodore 64, computer hardware and games found their way into private households. While some players used the possibilities of these open and programmable systems to create their own homebrew games, others aimed at cracking the standard copy protection of commercially distributed titles and competing with each other as to who could do it first. These cracked games were circulated within the community of enthusiasts, and were marked with so-called intros (also sometimes known as cracktros). These small programs started before the actual game, and usually showed the (oftentimes animated) name of the cracker group as well as scrolling text containing messages like greetings to other groups, all underscored by computer music. Driven by the idea of creating increasingly sophisticated intros and going beyond the apparent limits of the respective technologies' capacities, the creation of such little programs became a distinct practice in its own right, resulting in the emergence of the demoscene and the chip music scene. While the demosceners were interested in creating audiovisual real-time animations (demos), the chip musicians were only interested in the sonic aspects.

In this way a participatory music culture emerged, driven by an active and creative fan community, who did not just play the games, but also played *with* them and their material basis: the respective systems' technology. By hacking commercial products such as games, home computers and consoles, and inventing their own program routines and software tools, they continuously pushed the boundaries of the materials to create their own artefacts and performances. It was in 1986 that seventeen-year old Chris Hülsbeck published his 'Soundmonitor' in the German computer magazine *64er*. The 'Soundmonitor' was a program for the Commodore 64 based on his own MusicMaster-Routine, and allowed users to create music and exciting new sound effects with the Commodore's SID chip. It was easier to handle than commercial products such as the Commodore Music Maker, and is said to have been an inspiration for Karsten Obarski's 1987 'Ultimate Soundtracker', a music sequencer program for Amiga's Paula. The program was released as a commercial product, but, according to Johan Kotlinski, it was rather buggy and therefore did not achieve big sales. In 1988, the Dutch demo programmer Exterminator of the group Jungle Command hacked the program, improved it and rereleased it for free as Soundtracker 2 under his own name.

> The most important change was that he made the playback routine public, so that anyone could incorporate Soundtracker songs into their own productions. It was a very shameless and illegal thing to do, but the fact is that it was the starting point for the Soundtracker revolution. Slowly, Soundtracker became the de facto standard within game programming and the demo scene.[2]

The demo- and chip music scene not only became a first touchpoint for later professional game music composers such as Chris Hülsbeck or Jesper Kyd, but also allowed musicians from other fields to take their first musical steps. For example, the producer and DJ Brian Johnson, known under his alias Bizzy B., also reported in interviews that home PCs such as Commodore's Amiga made his entry into the music business possible in the first place by being an affordable experimental platform and allowing him to create music even though he could not afford a studio. With Amigacore, for example, a separate subgenre was established. Known representatives included the Australian techno formation Nasenbluten from Newcastle, who also pioneered hardcore techno, gabber and cheapcore in Australia. Such interrelationships between chip music and other musical genres are still to be investigated.

Studying Chip Music

The study of sound chip-based game music from the 1970s and 1980s has been the subject of interest in game music research since the very beginning. Pioneers in the field such as Karen Collins,[3] Nils Dittbrenner,[4] Kevin Driscoll and Joshua Diaz[5] and many others have written about the history of chip music in games and investigated the ways in which aesthetics and

[2] Johan Kotlinski, *Amiga Music Programs 1986–1995*, 20 August 2009, 8. Last accessed 2 May 2020, http://goto80.com/chipflip/dox/kotlinski_(2009)_amiga_music_programs_89-95.pdf.

[3] Karen Collins, 'From Bits to Hits: Video Games Music Changes Its Tune', *Film International* 12 (2005), 4–19; Collins, 'Flat Twos and the Musical Aesthetic of the Atari VCS', *Popular Musicology Online* 1 (2006); Collins, *Game Sound: An Introduction to the History, Theory, and Practice of Video Game Music and Sound Design* (Cambridge, MA: The MIT Press, 2008).

[4] Nils Dittbrenner, *Soundchip-Musik: Computer- und Videospielmusik von 1977–1994*, Magister thesis, University of Lüneburg, 2005.

[5] Kevin Driscoll and Joshua Diaz, 'Endless Loop: A Brief History of Chiptunes', *Transformative Works and Cultures* 2 (2009).

compositional approaches have evolved. Documentaries such as *Beep*, by Collins herself, or Nick Dwyer's *Diggin' in the Carts*, focusing on Japanese game music, offer an abundance of valuable material and first-hand insights from practitioners such as Junko Ozawa, Chris Hülsbeck, Rob Hubbard and many others. Additionally, practitioners are regularly invited to share their knowledge at conferences and conventions, and at time of writing, James Newman is working on establishing a Game Sound Archive he founded in 2017 in collaboration with the British Library. The chip music scene has also been investigated by researchers,[6] was the topic of documentaries such as *Blip Festival: Reformat the Planet* (2008) and practitioners such as Anders Carlsson,[7] Leonard J. Paul,[8] Haruhisa 'hally' Tanaka[9] and Blake Troise[10] have recently shared their knowledge in publications.

Media archaeologist Stefan Höltgen points out the following issue with the research as conducted so far:

> Most research into computer sound hardware favors historiographical 're-narrations' . . . : the development of (sound) technology moves from the simple to the complex, from poor to better sound chips. Such evolution is often measured in terms of quantifiable attributes like year dates, sales figures, or technical elements (such as bandwidth, numbers of different wave forms, sound channels, filters etc.). Sometimes this perspective leads to the marginalization of (economically) unsuccessful systems[.][11]

Furthermore, as time goes by, the original hardware or entire systems become harder to find or unavailable, and researchers must depend on

[6] See, for example, Melanie Fritsch, *Performing Bytes: Musikperformances der Computerspielkultur* (Würzburg: Königshausen & Neumann, 2018), 252–67; Matthias Pasdzierny, 'Geeks on Stage? Investigations in the World of (Live) Chipmusic', in *Music and Game. Perspectives on a Popular Alliance*, ed. Peter Moormann (Wiesbaden: Springer, 2013), 171–90; Chris Tonelli, 'The Chiptuning of the World: Game Boys, Imagined Travel, and Musical Meaning', in *The Oxford Handbook of Mobile Music Studies*, Vol. 2, ed. Sumanth Gopinath and Jason Stanyek (New York: Oxford University Press, 2014), 402–26.

[7] Anders Carlsson, 'Chip Music: Low-Tech Data Music Sharing', in *From Pac-Man to Pop Music: Interactive Audio in Games and New Media*, ed. Karen Collins (Aldershot: Ashgate, 2008), 153–62.

[8] Leonard J. Paul, 'For the Love of Chiptune', in *The Oxford Handbook of Interactive Audio*, ed. Karen Collins, Bill Kapralos and Holly Tessler (New York: Oxford University Press, 2014), 507–30.

[9] Haruhisa 'hally' Tanaka, *All About Chiptune* (Tokyo: Seibundo-shinkosha, 2017).

[10] Blake Troise, 'The 1-Bit Instrument: The Fundamentals of 1-Bit Synthesis, Their Implementational Implications, and Instrumental Possibilities', *Journal of Sound and Music in Games* 1, no. 1 (2020): 44–74.

[11] Stefan Höltgen, 'Play that Pokey Music: Computer Archeological Gaming with Vintage Sound Chips', *The Computer Games Journal* 7 (2018): 213–30 at 214.

emulations for their investigations. Scholars have started to research these issues more broadly. Especially for older systems such as 1970s and 1980s arcade machines, home consoles, handhelds or home computers, a close investigation both of the respective sound chips and their features is necessary, as well as version histories and the features of the entire systems in which these chips were built. Looking at the technology, the 'instrument as such', firstly reveals the respective technological preconditions, and secondly furthers a more in-depth understanding of the compositional approaches and decisions both of contemporary game composers and chip music practitioners in the chip music scene.[12] Subsequently, another discussion is arousing more and more attention: the question of game and game sound preservation and accessibility.[13] In order to conduct such investigations, the hardware, software and the games must be available and functional. Emulations, recordings or watching gameplay videos can help when focusing on the mere compositions or describing how the music is played back during gameplay. But when it comes to understanding the original game feel, delivering the full original sonic experience including unintended sounds, some caused by the hardware used to create sounds and music – they fall short.

Furthermore, music making has not only made use of the dedicated means of production such as sound chips, but also the deliberate (mis-)use of other hardware components. As Höltgen puts it:

> [C]omputers have never calculated in silence. Computer technology of the pre-electronic era emitted sound itself, . . . because where there is friction, there will be sound. This did not even change when the calculating machines became inaudible. Their peripherals have always made sounds with their motors (tape and floppy drives, printers, scanners), rotors (fans), movable heads (hard disk and floppy drives), or relays (in built-in cassette recorders and power supply choppers).[14]

Furthermore, these sounds were not just audible during gameplay; they were also used in themselves to create sounds and music, be it for games or in the form of playful practices that used the given material basis to create music such as chip music, floppy music, circuit bending and the like.

Subsequently, Höltgen suggests an alternative approach from the perspective of 'computer archaeology with its methods of measuring, demonstrating,

[12] See, for example, Nikita Braguinski, *RANDOM: Die Archäologie der Elektronischen Spielzeugklänge* (Bochum: Projekt Verlag, 2018).

[13] See, for example, James Newman, 'The Music of Microswitches: Preserving Videogame Sound – A Proposal', *The Computer Games Journal* 7 (2018): 261–78.

[14] Höltgen, 'Play that Pokey Music', 216.

and re-enacting technical processes'[15] – in other words, the scientific study of musical instruments and questions of historical performance practice needs to be pursued in ludomusicological discourse and teaching.

Further Reading

Braguinski, Nikita. *RANDOM: Die Archäologie der Elektronischen Spielzeugklänge*. Bochum: Projekt Verlag, 2018.

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[15] Höltgen, 'Play that Pokey Music', 213.