University of Art and Design Linz

Institute of Media Studies

Interface Cultures

Productive Gaming

Author

Ulrich Brandstätter

Supervisors

Univ.Prof. Dr. Christa Sommerer

Univ.Prof. Mag.art. Dr.phil. Margarete Jahrmann

This dissertation is submitted for the degree of Doctor of Philosophy

2020 Linz, Austria

Acknowledgements

It is a pleasure to express my gratitude to all who supported me through the development and the completion of this thesis. First of all I have to thank my wife **Marlene Brandstätter**: not only did she co-create the project foreverloops over the course of several years, involving an enormous investment of time, energy, and creativity, she was also a competent and interested discussion partner concerning the cornerstones and edges of the concept of productive gaming. Also, I am deeply indebted to her for the proficient proof-reading, and the consequent topical discussions.
Due to the scope and ambition of this thesis, there are so many people and organizations that contributed in various ways I want to express my gratitude to.

Concerning the development of the project *foreverloops*, relevant persons and parties include the team-mates of predecessor projects, including **Oliver Buchtala**, **Marlene Brandstätter**, **Andreas Diensthuber**, and **Enikö Kovacs**, as well as **Martin Kaltenbrunner** and **Georg Russegger** who provided critical feedback and ideas, the creators of the award-winning foreverloops commercial video, i.e. *Las Gafas Films* **Christian Dietl** and **Luzi Katamay**, plus **Philipp Kroll** who created the promotional music, graphics design company *Livingroom digital solutions GmbH* with **Vesela Mihaylova** in particular, sound sample library designer **Reinhard Gupfinger**, video sample library designers **Michael Wirthig** and **Verena Henetmayr**, demo track composer **Gregor Woschitz**, the collaborators on subsequent developments *foreverloops VR* and *FAME*, especially **Jeremiah Diephuis**, **Daniel Kepplinger**, **Friedrich Bachinger**, **Erik Thiele** and the *PIE lab*, and *tech2b* and *aws* who enabled the realization of foreverloops on a commercial level by providing funds and expertise. Additionally, I am thankful to all the workshop participants, festival-goers, alpha and beta testers, and customers for their valuable feedback and constructive criticism.

Concerning the development of the thesis, I want to express sincere thanks to the people I had the pleasure of discussing and conceiving the thesis with, especially my supervisors **Christa Sommerer** and **Margarete Jahrmann**, but also **Peter Purgathofer**, **Jeremiah Diephuis**, **Karin Harrasser**, **Rainer Zendron**, **Volkmar Klien**, **Amir Bastan**, **Gregor Woschitz**, **Mathias Fuchs**, and **Leonhard Müllner**.
I am deeply indebted to the *Interface Cultures* department at the *University of Art and Design, Linz* for facilitating the opportunity to host the *Players as Producers* symposium to exchange views and expertise with specialists in the proximity of the topic, including the speakers **Christa Sommerer**, **Tiago Martins**, **Margarete Jahrmann**, **Jeremiah Diephuis**, **Samuel Moser**, **Peter Purgathofer**, **Hideaki Ogawa**, and the teams presenting relevant projects.
I am appreciative for providing me with the opportunity to acquire teaching expertise in the area of game studies (*Games Workshop* lecture), for encouraging the exchange of ideas and discussion culture via regular PhD colloquia, and the support of and opportunities for discussions with the

great Interface Cultures staff, students, as well as alumni.
I am also grateful to the University of Art and Design, Linz for providing a research environment that encourages and appreciates atypical approaches, and fostering a culture aimed at the exchange of views and the interchange of expertise; also, as their former student assistant, I am much obliged to **Rainer Zendron**, **Andre Zogholy**, and **Veronika Schwediauer** for providing me with the opportunity to contribute to this environment in small ways. Additionally, I will be forever thankful for the grant of a PhD scholarship, which made it possible to focus on this thesis and realize my ambitions.

Concerning the evaluation of central research questions, I am deeply indepted to **Kathrin Anzinger**, who helped me formulate and give final shape to the original questionnaire, to **Helene Hochrieser**, with whom the evaluation process was designed in consultation with; she also conducted the testing of the hypothesis, and the relevant statistical computing. Also I want to express my gratitude to all the persons who helped host workshops and conduct questionnaires, including **Volkmar Klien**, **Roland Richter**, **Simon Schmuckermayr**, and **Gregor Woschitz**.

Finally, I am deeply grateful to my friends and family, who gave me support during and motivation for the development and realization of this thesis. I am thankful to **Gerd Trautner**, my boss at the company *Brainsalt*, for providing an exemplary and remarkably flexible working environment that enabled me to finally finish this thesis in challenging times.

Table of Contents

1 Abstract

This thesis presents *productive gaming*, a process where playing activities of digital media yield qualify-able outcomes. Its development was preceded by several observations:
first, many players of digital games are creative, as they use their games and game systems in creative and constructive ways. Their creativity becomes apparent when looking at the vast number of player-created game modifications, the rise of video game streamers and platforms in the past few years, the explosion of player-created independent games, etc..

Second, there is a common understanding of play not being productive: games are played primarily for entertainment, voluntariness and freedom of consequences are requirements for play. On the other hand, the process of creating products normally is considered work, where voluntariness is limited, as is creative expression. In this respect, productive gaming is antithetical, as play and work usually are considered as internally inconsistent concepts.

Third, although the idea to combine creative gaming, i.e. digital play activities, with productivity, is not new, relevant concepts and projects for software effecting creative results by being played with are limited in number.

Following up on these key observations, the goal of this thesis is to characterize the contexts in which players are able to channel creative play activities in order to achieve products, i.e. results that persist beyond the game virtualities. These characterizations are derived from literature surveys, expert feedback on relevant scientific contributions, and user feedback on *foreverloops*: the development of this thesis was closely tied to the realization of the commercial project foreverloops, a digital sandbox that permits the creation of multi-medial compositions. The practice of accompanying research with the realization of a product yields several advantages: on the one hand, there are additional information channels and possibilities for user interactions, including comments in the public discussion forums, reviews, and user-generated results, data that enables the qualification of productive gaming. On the other hand, with the availability of foreverloops as a product it was possible to host several workshops and to participate in events that would enable the handing out of questionnaires to relevant target audiences. By doing so, central research questions could be addressed and handled, at the same time it was possible to refine and further develop the project.

This rather unusual approach turned out to be highly effective for substantiating productive gaming: true to the multi-disciplinary field of game studies, different research methods were used, as were the interactions of basic research, user feedback, product development, and constant evaluations.

2 Abstract (Deutsch)

Die vorliegende Arbeit erforscht die Transformation spielerischer Aktivitäten zu qualifizierbaren Erzeugnissen: *Productive Gaming*, i.e. *Produktives Digitales Spielen*. Im Vorfeld wurden mehrere Beobachtungen als günstige Voraussetzungen gewertet: Zum einen setzt sich eine Vielzahl von Spielern kreativ und konstruktiv mit Spielen auseinander, wie die hohe Diversität Spieler-generierter Modifikationen, die Popularität von Videospiel-Streamern, sowie die zahlreichen Veröffentlichungen von Independent-Spielen aus Spielerhand belegen.
Ferner wird Spielen üblicherweise nicht als produktive Tätigkeit erachtet, sondern dient primär der Unterhaltung. Es erfordert Freiwilligkeit, entzieht sich den Konsequenzen des Spielgeschehens, und grenzt sich vom Alltäglichen ab. Produktion hingegen wird der Arbeit zugeordnet, die im Regelfall mit eingeschränkter Kreativität und begrenzter Selbstbestimmung assoziiert wird. *Productive Gaming* ist in diesem antithetischen Spannungsfeld Arbeit versus Spiel verortet.

Schließlich gibt es zwar zahlreiche Ansätze, um kreatives Spielen mit Produktivität zu verbinden, aber nur eine geringe Anzahl konkreter Projekte, die es ermöglichen, durch spielerische Tätigkeiten produktiv zu sein.

Ziel dieser Arbeit ist es, die Kanalisierung von kreativen, spielerischen Aktivitäten zur Produktion von Erzeugnissen, die abseits der Spiel-Virtualitäten Bestand haben, zu charakterisieren. Genutzt wurden dazu i.a. Literaturstudien, Feedback zu relevanten Publikationen, sowie Benutzerrückmeldungen zu *foreverloops*, einem digitalen Baukasten für multi-mediale Kompositionen, dessen Realisierung eng an die Ausarbeitung der vorliegenden Abhandlung gekoppelt war. Die Verbindung wissenschaftlicher Forschung mit der Entwicklung eines kommerziellen Produkts eröffnete komplementäre Informationskanäle und Möglichkeiten zur Benutzer-Interaktion, beispielsweise Diskussionsforen, Produktrezensionen, und allen voran öffentlich verfügbare Benutzer-Ergebnisse. Durch die Abhaltung von Workshops und die aktive Teilnahme an Veranstaltungen wurde wiederum die Erfassung quantitativer Daten ermöglicht, und in Folge die Evaluierung zentraler Hypothesen. Erhaltenes Feedback konnte zudem für die Weiterentwicklung von foreverloops genutzt werden.

3 Introduction

In this thesis, productive gaming is proposed as a form of playing: digital play activities giving rise to artifacts placed at the disposal of their authors. The players are free to use their creations for arbitrary purposes, including boasting, monetization, creating building-blocks for other projects, idea-mediation, self-expression, crafting presents, etc..
This junction of two components, gaming and productivity, involves several constraints:

- gaming indicates digital play activities, therefore the examination will focus on software simulations, digital sandboxes, software toys and digital games.
- The productive prefix refers to a particular value proposition: player creations are to be used outside and beyond the playground, to ends chosen freely by the users.
- These products are envisioned and realized by the players, who set their creational objectives themselves.
- Although productivity is a subject matter of relevant software environments, it is not enforced by game goals.
- Productive gaming involves automatically enforced rules: at the same time, they restrict players, but also stimulate creativity.

On the other hand, productive gaming takes several liberties:

- it is not limited to specific products or genres: productive digital play is possible with AAA digital games primarily meant for entertainment, with programming environments, with game modifications, or even with mathematical simulations.
- Consequently, productive gaming is also possible within environments that dictate goals, such as digital games. Still, the creational objectives and game goals are required to be disassociated.
- Particular results are not limited to the digital domains, i.e. digital playing activities can also bring forth physical artifacts.
- Productive gaming is not required to encompass the entire generation process of the resulting product.

3.1 Goals of this thesis

The main objective of this thesis is the characterization of productive gaming, a particular manifestation of digital play activities bringing about products: game-play results in the form of digital artifacts that persist beyond the game virtualities.

The examination of this particular value proposition on the one hand requires an in-depth research concerning the state of the art, encompassing related projects, areas of research, art works, relevant games, and topical scientific contributions: of specific importance are the notions of game and play, the concepts and implications of software simulations, the relation to and differences from productivity software, and especially the ideas pertinent to value transferences from and to virtual environments.
On the other hand, as the development of this work was accompanied by the advancement of the project foreverloops, a multi-media software with the ambition to bring digital play and productivity closer together, a unique opportunity for the acquisition of quantitative data and qualitative feedback became available. The data, acquired by the conductings of several workshops and fair participations, enables the evaluation and verification of topical hypothesis.

3.1.1 Hypothesis

In addition to an overall characterization of digital play activities bringing about products, the junction of gaming and productivity is examined by the evaluation of several hypothesis. These hypothesis are primarily addressed using quantitative approaches, relevant data originates from workshop results, questionnaire analysis, and laboratory studies. However, as the realization of foreverloops as a product made additional information channels available and accessible, they were also used for the evaluation: impartial user feedback and comments, and especially the availability of user-created results on public platforms such as YouTube or Vimeo, turned out to be invaluable assets for verification, substantiation, and illustration. Consequently, the research questions are pursued by both quantitative and qualitative approaches.
The key hypothesis, rephrased as brief questions, are as follows:

- is using foreverloops (as a prototype for productive gaming) perceived as a playing activity?
- Is using foreverloops regarded as a productive activity?
- Do users enjoy learning foreverloops?
- Can foreverloops, as an example for a software simulation without victory or losing conditions, be considered as a game?

3.2 Structure

This thesis is organized as follows:

- first, a brief disambiguation focused on central notions, such as play or game, is presented.
- The subsequent main chapter is concerned with related concepts, key influences, relevant projects, and generally the value propositions of productive gaming.

- Afterwards, the main ideas of foreverloops, as an example for a project facilitating productive gaming, are discussed, as are the creational capabilities enabled by the underlying metaphor of interconnected virtual gears.
- Finally, the results of the accompanying quantitative analysis are discussed, followed by a study concerned with particular player creations. Complementary qualitative feedback will also be examined.

The thesis closes with a summary.

4 Terminology

In the preliminary introduction[1] of productive gaming, it was put forward as a category for video games that yield productive results by being played - a transformation of playing activities into creative processes. With this thesis, productive gaming is suggested as digital play activities resulting in quantifiable / qualify-able products. As argued by *Mary Flanagan* and *Helen Niessenbaum*,[2] digital play activities involve intrinsic value propositions, including recreation, fun, self-expression, and self-determination. Productive gaming explicitly induces additional value propositions: products, resulting from digital play activities. These products may have monetary worth, contribute to other works, be purely virtual or have physical forms, and generally result from creative processes.
The influences, properties, preconditions, and implications of productive gaming will be examined in more detail in later sections. Before that, it is necessary to establish and contextualize central notions. Therefore, this section presents a disambiguation concerning the central notions game and play, as well as an overview of relevant play environments.

4.1 Towards an understanding of the notion game

As discussed in a previous article, it is both easy and difficult to approach the notion *game*: "*it is already becoming tedious to keep track of current digital game definitions because there are so many of them; commonly used definitions (also including definitions for game and play) are based on the works of Huizinga, Caillois and Barash, Suits, Avedon Sutton-Smith, Sutton-Smith, Tavinor, Crawford, Kelley, Salen and Zimmerman, Juul, Malaby, Bjork, Hughes, Ermi, Mäyrä, Consalvo, Calleja, Sicart, Bergström, Esposito, and many more.*"[3]
A highlighting of the game definition dilemma can be found in the **Game Definition Generator** by *Molleindustria*. On every site reload, a new game definition is generated, for example

```
game /gām/ n. (pl. -games) a formalized object representing a subset
                           of the world
```

or

```
game /gām/ n. (pl. -games) a non-linear medium that involves a
                           competition soliciting a performative action.
```

or

```
game /gām/ n. (pl. -games) a non obligatory activity characterized
                           by an interaction.
```

[1] BS16.
[2] FN14.
[3] SBM17.

In the context of this thesis, the relevance of the term game is ambivalent. At the beginning, it was presumed that productive gaming implicitly concerns games and game systems. Also, the concomitant project foreverloops was thought of as a game, due to its formal characteristics: it is an interactive system, a software simulation, with specific rules that are automatically enforced, it requires players and playful attitudes. It does not however dictate goals, or resemble other games.

Over the course of this thesis, the attention shifted more and more towards gaming, i.e. digital play, but not necessarily of games. *Katie Salen* and *Eric Zimmerman* consider play a superset of the notion game: playing activities can occur within the more rigid frameworks games provide, but also in less structured contexts.[4]

Still, although productive gaming is looked at from the playing perspective, a contextualization of the notion game is as inevitable as it is important. The provision of yet another game definition is not advantageous: on the on hand, according to *Brian Sutton-Smith*, it "*is nearly impracticable to describe play and games in positive, non-paradoxical terms*".[5]
On the other hand, the agreement of many currently cited definitions on fundamental aspects of games can be used, including the following ones:

- players are regarded as a central component [6].
- Games are interactive [7].
- They are based on rules [8].
- The players struggle towards a goal.[9]

Also, central game characteristics can be illustrated, as exercised by *Raph Koster*: "

- *They present us with models of real things—often highly abstracted.*
- *They are generally quantified or even quantized models.*
- *They primarily teach us things that we can absorb into the unconscious, as opposed to things designed to be tackled by the conscious, logical mind.*

[4] SZ04.
[5] Wal03.
[6] "*Games are described as designed objects (designed by designers or players) that give players the ability to intentionally act towards reaching the goals of a game*" [BJ12].
[7] "*I perceive four common factors: representation [...], interaction, conflict, and safety [...]*" [Cra84]. "*An interactive structure of endogenous meaning that requires players to struggle toward a goal*" [Cos02].
[8] Games are rule-based [SZ04]. "*A game is a pastime with formal and predefined set of rules for the progression of a game session, with built-in and quantitative definitions of success and failure*" [Juu00]. "*[...] It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner [...]*" [Hui49]. "*To play a game is to engage in activity directed towards bringing about a specific state of affairs, using only means permitted by rules, where the rules prohibit more efficient in favor of less efficient means, and where such rules are accepted just because they make possible such activity*" [SN78].
[9] SN78.

- *They mostly teach us things that are fairly primitive behaviors (but they don't have to)*

"[10]

In a previous work, the usefulness of *Bernard Suits*'s approach towards the notion game was pointed out: "*A great convenience is the game definition of Bernard Suits, consisting of three integral game properties: a prelusory goal that is understandable outside of the game context, the constitutive rules, and a required lusory attitude. Briefly outlined, a game consists of the prelusory goal, which can be understood and achieved apart from the game (every game has such a goal), of the constitutive rules, where the most efficient means to the prelusory goal are forbidden, and the lusory attitude, a person's willingness to accept the constitutive rules. As pointed out by Thomas Hurka and John Tasioulas,*[11] *Bernard Suits brilliant analysis creates a solid foundation for discussing the value propositions of games. Also, it has additional good qualities for our purposes: first, the prelusory goals are not necessarily limited to goals dictated by the game and may include player-set goals; it can be described independently of the game. [...]*"[12]

For our purposes, the consideration of player-set goals is of central importance. Goals, or specific outcomes players strive for, are fundamental components of relevant game definitions; however, the distinction between game-dictated goals and player-set goals is usually omitted, e.g. "*games are an exercise of voluntary control systems, in which there is a contest between powers, confined by rules in order to produce a disequilibrial outcome*",[13] or "*[...] classic definitions in game studies state that gaming and games – in contrast to playing and toys – are characterized by explicit rule systems and the competition or strife of actors in those systems towards discrete goals or outcomes*".[14] Concerning productive gaming, player-set goals are widely used, as relevant systems incite them by providing means for less controlled and more Paidia-aligned[15] ways of playing. Game-dictated goals on the other hand can still occur in conjunction with productive gaming, and induce different interactions. The relation of productive gaming with player-set goals is examined in more detail in section 5.1.

4.2 Towards an understanding of the notion play

A widely-adopted definition of the notion play was established by *Johann Huizinga* in 1938: *"Summing up the formal characteristics of play we might call it a free activity standing quite consciously outside ordinary life as being not serious, but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy and to stress their difference from the common world by*

[10] Kos05.
[11] HT06.
[12] SBM17.
[13] AS71.
[14] Det+11.
[15] CB61.

disguise or other means."[16]
Michael Liebe signalizes the importance of play for Huizinga: "*In Huizinga's view, play is so important to mankind that he shifts the notion of Homo sapiens – the intelligent being, to Homo ludens – the playful being, as the creator of human culture.*"[17]

Roger Callois expands on Huizinga's definition: he considers play as "*[...] an activity which is essentially: free (voluntary), separate [in time and space], uncertain, unproductive, governed by rules, make-believe*".[18]
Both *Huizinga* and *Callois* refer to play as an activity, yet do not clearly differentiate between game and play. This is insofar problematic, as many currently used game definitions are built on top of their works, and as a consequence inherit the implicit ambiguity, a conceptual problem also pointed out by *Michael Liebe*[19] .

Both approaches preclude productivity: material interests, the prospect of profit, an affinity to what is considered work, bear the risk of tainting and corrupting play, as the core requirement of voluntariness is violated. Although productive gaming may appear controversial in that respect, it does not necessarily invite a contradiction: voluntariness and artistic freedom generally are basic conditions for productive gaming, but specific boundary conditions are construed less obstructed. On the one hand, oscillation effects concerning play phases must be acknowledged for: pure free-form experimentation may transform into more mechanical processing into learning phases, and vice versa. Even if an isolated examination of a specific point in time during one of the learning phases would challenge the perception of the current activity as play, the overall appreciation should not. On the other hand, player-set goals are aligned with productivity: players may create audio tracks for their newest release, picture shows for family events, or even 3D printed Christmas presents. In other words, they produce digital or non-digital artifacts with worth, and may use the results for arbitrary purposes, including monetization.

For *Katie Salen* and *Eric Zimmerman* there are two distinct, yet interconnected relationships concerning the notions of game and play[20] . On the one hand, they consider games as a subset of play. They follow through a typological argumentation - play takes on many forms, including rhyme singing, dogs chasing, or playing on a seesaw. At the same time, they see play as a component of games. This point of view can be seen as a phenomenological approach - *the experience of play is but one way of looking at and understanding games.*

Jesper Juul distinguishes between four historically important central conception of play: "

1. *Playing as submission, where the player is bound by the limits set forth by the game rules.*
2. *Playing as constrained freedom, where the game creates a space in which players acquire a certain amount of freedom and the opportunity to perform particular acts.*

[16] Hui49.
[17] Lie08.
[18] CB61.
[19] Lie08.
[20] SZ04.

3. *Playing as subversion, where the player works around both the designer's intentions and the game object's apparent limitations.*

4. *Playing as creation, where the game is ultimately irrelevant for (or at least secondary to) the actual playing.*

"[21]

In the context of this thesis, playing as constrained freedom and playing as creation are the two most important conceptions. Concerning the former, Juul argues that *conceiving game playing as a type of constrained freedom assumes that this freedom is enabled by the game design.* And, following Suits, *game rules also enable new meaningful actions that would not be possible without the game.* Juul also points out the proximity of playing as constrained freedom to forms of art, specifically to the theater and the performance arts. Concerning the latter, players become the center of attention, and overshadow the relevance of game rules: on the one hand, different games can be played with the same set of core rules, and these are primarily determined by the players. On the other hand, the act of playing is stressed and enables creation, the more rigid structure of the game becomes secondary.

The notion of play itself is considered ambiguous, it spans several phenomena. *Graham Jensen* summarizes as follows: "*Although play constitutes a significant part of all human activity, it is an exceptionally difficult phenomenon to define. To some, play is an exclusively human pursuit, a highly structured activity or set of activities designed to ward off boredom; to others, play is an outlet for expression, a spontaneous and complex manifestation of human emotions.*"[22]

Without claiming completeness, *Brian Sutton-Smith* outlines relevant phenomena in several categories[23] : "

- *Mind or subjective play: dreams, daydreams, fantasy, imagination, ruminations, reveries, Dungeons and Dragons, metaphors of play, and playing with metaphors.*

- *Solitary play: hobbies, collections, (model trains, model airplanes, model power boats, stamps), writing to pen pals, building models, listening to records and compact discs, constructions, art projects, gardening, flower arranging, using computers, watching videos, reading and writing, novels, toys, tracel, Civil War reenactments, music, pets, reading, woodworking, yoga, antiquing, flying, auto racing, collecting and rebuilding cars, sailing, diving, astrology, bicycling, handicrafts, photography, shopping, backpacking, fishing, needlework, quilting, bird watching, crosswords, and cooking.*

- *Playful behaviors: playing tricks, playing around, playing for time, playing up to someone, playing a part, playing down to someone, playing upon words, making a play for someone, playing upon others as in tricking them, playing hob, putting something into play, holding*

[21] Juu16.
[22] Jen13.
[23] Sut01.

it in play, playing fair, playing by the rules, being played out, playing both ends against the middle, playing one's cards well, playing second fiddle.

- *Informal social play: joking, parties, cruising, travel, leisure, dancing, roller-skating, losing weight, dinner play, getting laid, potlucks, malls, hostessing, babysitting, Saturday night fun, rough and tumble, creative anachronism, amusement parks, intimacy, speech play (riddles, tories, gossip, jokes, nonsense), singles clubs, bars and taverns, magic, ham radio, restaurants, and the Internet.*

- *Vicarious audience play: television, films, cartoons, concerts, fantasy-lands, spectator sports, theater, jazz, rock music, parades (Rose Bowl, mummers', Thanksgiving), beauty contests, stock-car racing, Renaissance festivals, national parks, comic books, folk festivals, museums, and virtual reality.*

- *Performance play: playing the piano, playing music, being a play actor, playing the game for the game's sake, playing New York, playing the fishes, playing the horses, playing lago, play voices, play gestures, playbills, playback, play by play, player piano, playgoing, playhouses, playlets.*

- *Celebrations and festivals: birthdays, Christmas, Easter, Mother's Day, Halloween, gifting, banquets, roasts, weddings, carnivals, initiations, balls, Mardi Gras, Fastnacht, Odunde.*

- *Contests (games and sports): athletics, gambling, casinos, horses, lotteries, pool, touch football, kite fighting, golf, parlor games, drinking, the Olympics, bullfights, cockfights, cricket, Buzkashi, poker, gamesmanship, strategy, physical skill, chance, animal contests, archery, arm wrestling, board games, card games, martial arts, gymnastics.*

- *Risky or deep play: caving, hang gliding, kayaking, rafting, snowmobiling, orienteering, snowballing, and extreme games such as bungee jumping, windsurfing, sport climbing, skateboarding, montain biking, kite skiing, street luge, ultrarunning, and sky jumping.*

"

With this list, *Sutton-Smith* points out the diversity of observable play phenomena, and he demonstrates that they can originate from states of mind, activities, or even events, and illustrates the fuzziness of their boundaries.

Miguel Sicart also acknowledges the impossibility of carving out an absolute and (self-) consistent definition of what play is, he approaches the subject by discussing and emphasizing central properties[24] . He characterizes play as *contextual*, *carnivalesque*, *appropriative*, *disruptive*, *autotelic*, *creative*, and *personal*.
According to him, the first requirement for play is a context, comprising the environment, used technology, and the involved players. Rules have the role of facilitating the play context; the discussion, interpretation and negotiation of rules are a central part of the play activities.

[24] Sic14.

His second requirement, play being carnivalesque, originates from play enabling both creation and destruction, and the balance between them. It stresses and points out the expressive capacities of play.
The third requirement, play being appropriative, and the fourth one, play being disruptive, are closely related: conceived in general terms, the context of play affects the real-world, it appropriates the space the playing activities are happening within, and therefore, in the words of *Sicart*, may disrupt the normal state of affairs. Gaming addictions and gambling are common negative manifestations of the disruptiveness of play.
Another property is play being autotelic: it has a purpose of its own, but a flexible one, as it is repeatedly re-negotiated.
The last two requirements are play being creative as well as personal: play activities require and induce expression that can be shared, but ultimately have a personal nature.

With this preliminary understanding of the notion play, a more specific context relevant to productive gaming will be examined subsequently: digital play.

4.2.1 Digital play

In the context of this thesis, digital play and gaming are treated as synonyms: the main concern involves digital play / gaming activities yielding products. These are not limited to more rigid game structures, but can also occur in the context of free-form experimentations with software simulations that do not necessarily dictate player goals. For the more rigid computer game media, *Michael Liebe* identifies several fundamental characteristics:[25] they are games, based on computational technology, rely on interaction, can process and store information, and allow the realization of virtual environments that do not have a corresponding model in the real world.
Gaming involves the characteristics of traditional play activities, as well as additional predicates: as examined in the following, they involve comparably young media, automatic rule enforcement, and potentially specific interfaces.

4.2.1.1 Fresh media

Digital technologies have only become available in the second half of the 20th century, they have a comparably short history. Concerned with computer games, *Jesper Juul* stated in the year 2000: "*First, I should like to describe were we are, so to speak. The computer game is somewhere between 39 and 42 years old. Movies, by comparison, are 100 years old. [...]*"[26]
Even with a young history, the occurrence of the first actual computer-game is still debated. Frequently mentioned are **Tennis for Two**[27] (1958) by *William Higinbotham*, **OXO**[28] (1952) by *Alexander Shafto Sandy Douglas*, the **NSS Chess Program**[29] (1958) developed by *Allen*

[25] Lie08.
[26] Juu00.
[27] Hig58.
[28] Dou52.
[29] NSS58.

Newell, *Herbert Simon* and *Cliff Shaw* at the Carnegie Mellon University, **Spacewar!**[30] (1962) by *Steve Russell*, *Martin Graetz*, *Wayne Wiitanen*, *Bob Saunders*, *Steve Piner* and others, but there are also more obscure early games, such as **Bertie the Brain**[31] (1950) by *Josef Kates*, a machine that enabled its users to play a game of tic-tac-toe against an early artificial intelligence. In the context of this thesis, a limitation to computer games for approaching productive digital play activities falls too short, it is necessary to examine additional directions as well. Still, digital games comprise several conceptions, e.g. video games or electronic games. *Grant Tavinor* points out that "*videogames are variously referred to as "computer games," "electronic games," and even "digital entertainments." These terms cannot be taken to be strictly synonymous.*"[32]

4.2.1.2 Automatic rule enforcement

Arguing the transference of the card game Hearts to the digital domain, *Jesper Juul* observes the following characteristics: "*[...] the computer can uphold and compute the rules that would normally be upheld by humans, and that the computer has the memory capacity to remember game state and the interface to respond to player input. [...]*"[33]

The first key property is the capability of digital games, and in a broader sense of interactive simulations, to enforce the (game) rules automatically. Automatic rule enforcement provides various advantages: they make complex rule-sets manageable, and allow users to play games even if they do not know all the rules. As pointed out by *Jussi Holopainen* , "*computer games can paradoxically be perceived as less rule-governed, because players do not need to explicitly be taught rules in computer games, they can try numerous actions and activities and learn by experience how the rules in the game work*".[34]

Michael Liebe argues that "*[...] rules of the game are part of the system, but the player does not have to learn beforehand which actions are allowed and which are not: He does not have to artificially limit his action possibilities according to the rules in order to play correctly. Illegal actions cannot be performed or they are automatically penalized. The rule system does not have to be magically upheld by aware players. The rules are upheld by the program code.*"[35]

Often, critical rules are explained while digital games are played, using in-game tutorials or cinematic cut-scenes. In open-world games, the so called white-boxing of the rules, i.e. their exploration by playing, can also serve as a source for player satisfaction and even competition. Generally, game rules are enforced impartially, therefore the principle of fairness is bolstered. Of central importance is the capability of digital play environments to automatically enforce relevant rules *fast*: as soon as the player presses a button, an effect is observable, usually even without perceivable delay.

T. L. Taylor points out the advantages of automatic rule enforcement as follows: "*[...] the*

[30] Rus+62.
[31] Kat50.
[32] Tav09.
[33] Juu03.
[34] Hol11.
[35] Lie08.

machine steps in and acts as the ultimate referee. We, as participants, are seen as not needing to read rule books, haggle over interpretations, construct house rules, or perform any other typical activities that support gameplay. The computer simply takes care of it all for us. [...]"[36]
Another aspect of digital rules is that they not only restrict, but also empower: "*Computer game programs accordingly define what one can do, and consequentially do not really restrict practical possibilities, but enable them to be performed. This explains why computer games can contain many more rules than traditional games without making them too complicated. The player can only act within the boundaries of the programmed possibilities and does not have to remember what is allowed or not allowed, as he simply has no other choice. At the same time, he could not do anything at all if the program code did not provide him with a framework of action possibilities.*"[37]
Summarizing, automatic rule enforcement yields possibilities that are not obtainable in non-digital contexts.

4.2.1.3 Specific interfaces

Digital games, being interactive pieces, afford specific interfaces for game interactions. These involve physical interfaces, such as mice and keyboards, game controllers, including specific game interaction sensors, such as the *Microsoft* **Kinect** device, cameras and microphone arrays, but also software interfaces, including buttons and menus, audible cues, score tables, etc..
In our previous work, an outline concerning the relevance of specific interfaces for the user experiences as well as the overall game perception is provided: they "*have several key advantages, as they are able to transform available games into more intimate and rewarding experiences, to improve game accessibility, to put players in a ludic state of mind, and to communicate both overall game goal and some of the relevant game rules even before the game commences*".[38]
Of particular interest concerning user interfaces is the intersection of play and productivity: as *Pippin Barr* points out, "*the majority of current video game HCI does acknowledge play as a distinct form of interaction*".[39] He also discusses the differences of video games and applications concerning HCI methods: "*First, the motivations for playing video games differ from productivity application use. Specifically, players play games for their own sake, while they generally use productivity applications to achieve some other task. Second, video game interfaces are not neutral, presenting carefully designed narratives and complex graphics to the player. Third, video games frequently dictate goals to players, while productivity applications generally facilitate user goals. Finally, video game designs purpose-fully involve conflict and constraints on the player, while productivity applications are designed to minimize them.*"

We agree with Barr's assessment, and acknowledge the necessity to manage the balancing act required when mixing playing activities with productivity. Although there are scenarios that

[36] Tay12.
[37] Lie08.
[38] SBM17.
[39] Bar07.

facilitate productive gaming without permitting player-set goals, the majority of relevant projects banks on and encourages them. At the same time, they are nurturing playful attitudes by promoting experimentation and letting users discover key mechanics at their own pace. In his observation, Barr mainly considers digital games; however, the claims for interface neutrality, dictating goals, as well as artificial constraints, also very much apply to software toys, i.e. digital playgrounds without concepts for winning or losing.

4.3 Digital play environments

In this thesis, apart from video games, several digital play environments are discussed. For the most part, they are introduced in detail in later sections; still, a brief taxonomy with condensed disambiguations is anticipated in the following, and illustrated with figure 4.1:

- digital games, video games, and electronic games are used as synonyms in the context of this thesis; usually they are designed for interactive entertainment and dictate player goals.
- Serious games are digital games with a purpose beyond pure entertainment; a well-established example can be found in so-called educational games, games that aim at conveying knowledge.
- Music games usually refer either to digital games focusing on an interactive music experience, or to games aimed at the improvement of musical instrument skills.
- Software toys and non-games refer to digital video games with a less goal-oriented design; the popular genre of walking simulators counts towards this category. The defining trait is the lack of game-dictated goals.
- Digital playgrounds and sandbox games are similar to software toys; however, they often feature larger scopes and 3D open-world designs.
- Simulations can be seen as a super-set to digital games; they feature abstraction, interactivity, and automatic rule enforcement.
- Games with a purpose are digital games, and are not necessarily distinguishable from usual digital games by the players; by being played, the players coincidentally contribute to the solution of large-scale computational problems.
- Gamification aims at the introduction / usage of game design elements in non-game contexts; in working environments, gamification is often brought into bad repute by being realized as over-simplified reward systems.
- Productive use of construction games refers to the usage of games as a form of building blocks; e.g. Lego bricks are deployed for laboratory constructions due to their availability, material properties and cost-benefit ratios.

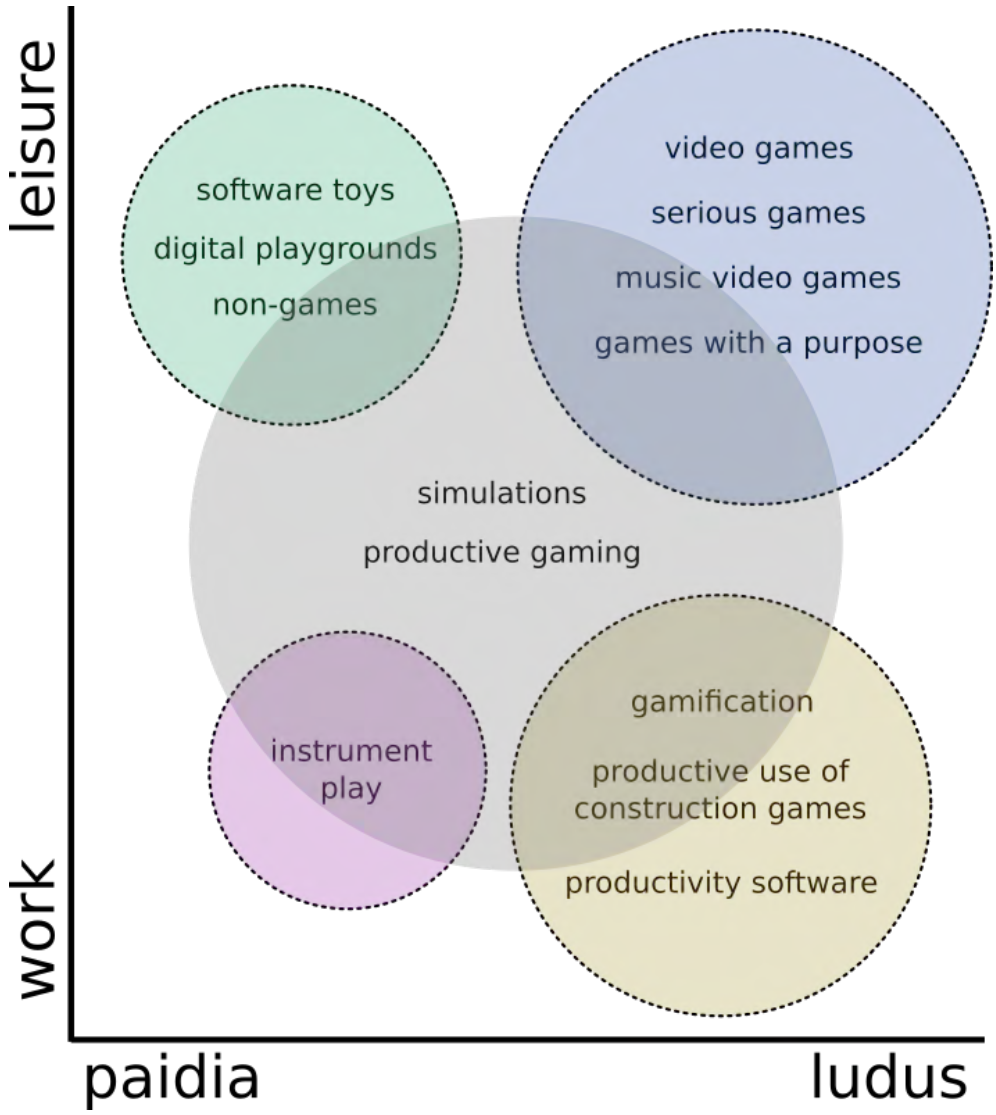


***Figure 4.1*: Central notions by work vs. leisure and paidia vs. ludus**

5 Towards productive gaming

Put simply, productive gaming can be considered as digital play activities bringing about products.
In 2016, a preliminary introduction[40] of productive gaming was presented: there, games facilitating productive gaming were considered as specific serious games, i.e. games with purposes beyond pure entertainment with additional characteristics:

- productivity is a subject matter of the game, not to be enforced as game goals, but enabled as goals of the meta game.
- Consistently, productivity is not reflected in victory conditions, creational objectives are set and determined before or during the play sessions by the players themselves, who retain unrestrained artistic freedom.
- Creation processes are aligned towards (and do not break) the game flow.
- Game-play results are perceivable without the game and, ideally, even without knowledge of the game.

Although these characteristics still very much apply to what we propose as productive gaming, we came to realize that the subject matter is a form of playing, whereas a conveyance of productive gaming as a specific game category falls too short. Of course, productive gaming can be exercised in conjunction with, but is not limited to, digital games. Concerning digital games, *Raph Koster* points out the implicit restrictions of the notion digital game, and the necessity for their relaxation: "*[...] games can take forms we don't recognize. They might not be limited to being "a game" or even a "software toy." The definition of "game" implies certain things, as do the words "toy", "sport", and "hobby". The layman's definition of "game" covers only some of the boxes in the grid. Arguably, all of the boxes in the grid are fun to someone. We need to start thinking of games a little more broadly. Otherwise, we will be missing out on large chunks of their potential as a medium.*"[41]

We have a junction of two components, gaming and productivity, inducing several implications, conditions and considerations.
Gaming refers to digital play activities: players use relevant software simulations, digital sandboxes or even games, to achieve user-defined goals. Relevant software impose frameworks of automatically enforced rules, simultaneously restricting players but also stimulating creativity and productivity.
The notion *simulation* is central to our approach, but due to its fuzziness makes another distinction necessary. *David Myers* provides the following disambiguation : "*The etymology of the term simulation is a curious one, simultaneously denoting difference and similarity. The simulation*

[40] BS16.
[41] Kos05.

references other than itself, yet the simulation is also necessarily something other than that reference: an act of pretense. The tension between pretense and imitation within the simulation is exacerbated by digital media - for example within the experientially uncertain "uncanny valley" - and requires increased interpretive effort and resolve."[42]

In his understanding, simulations and games are two ideas that cannot necessarily be used synonymously: "*[...] digital games have rules of different sorts and purposes than do digital simulations, whose rules are perhaps better understood as rule models. These rule models are than bound in some important way to that which they would simulate - a restriction not equally binding of game rules.*"

As aforementioned, productive gaming heavily involves playing activities, consequently a clear disambiguation of the notion game is of secondary importance; however, David Myers's assessment concerning the agency of rules still applies.

Another central aspect of digital simulations concerns their ability to induce and enable playful and productive processes, consisting of oscillating play and production phases.

Productive refers to a particular value proposition: digital play activities bring about products. Video games generally, and serious games specifically, involve broad diversities of value propositions, including entertainment, recreation, leisure, but also networking, learning, or self-expression. Here, the main interest can be found in the products facilitated by digital play, primarily, but not exclusively, digital artifacts that can be used outside and beyond the playground. These products are envisioned and realized by the players, who set relevant objectives themselves with unrestrained artistic freedom. Also, the player-producers dispose of their makings, there is no restriction: they can share them, remix them, display them, and even sell them (in case the EULA of a particular title allows it). In that sense, resulting products are both quantifiable and qualify-able.

Thomas Fröhlich describes the opportunities arising from the combination of digital play and productivity as follows: "*Playing would be the process of working itself, resulting in a work experience with creative freedom, chances for serendipitous creations, enjoyment, and a low learning curve.*"[43] His ambition is to create a playful work experience with creative freedom, whereas the idea of productive gaming mainly focuses on play experiences with productive outcomes.

Generally, the conjuncture of work and play, apart from professional players, gambling games, and typical career trajectories in e-sports (gamers become coaches become journalists), is considered an inconsistent field: on the one hand, the interconnections are clearly visible on the level of game mechanics, especially in newer digital games. On the other hand, as pointed out earlier, both notions are often regarded as paradoxical, and their combination as *corrupting*: "*There's been a fair amount of hand-wringing about the breech in boundary lines between work and play. Concerns over the grind nature of same game genres (MMOGs lead list of culprits), the overly repetitious nature of a game mechanic, the leaking gameplay into real-world economies, or the gamification of our everyday lives have all at least partially anchored their concern in a fairly dichotomous model of how play works. A heavily policed model of the magic circle has far too*

[42] Mye16.
[43] Frö17.

often led to the claim that when play is touched by the outside world, when it takes on meaning beyond the specialized game systems, when it matters to anything other than the play experience itself, it becomes corrupted, and corrupting."[44]

Robert Stebbins identifies two *bridges*, i.e. ways how people tend to combine work and play:

"*One bridge connecting work and leisure is the old practice of the busman's holiday, or the penchant of some people sufficiently enamored of their work to pursue one or more of its core activities in free time. The bus driver, when not on the job, was said to be so enthusiastic about the activity of driving that he—in those days it was exclusively a male occupation—took to the road during his off hours in his own car or truck for the sheer pleasure this brought. [...] A second bridge over which work comes to occupy some people's free time is that of reflection. This has been dubbed contemplation as serious leisure: complex reflective activity engaged in for its own sake [...] By way of example, consider the scientist who, while at the symphony, cannot put out of her mind certain implications of recent results from a study or the social worker who, intrigued by a client's intractable familial problems, continues to think about them while he is watching television after work. This sort of contemplation as serious leisure, much like similar contemplation stimulated by leisure interests, obtrudes on other, less absorbing, leisure. Of course the matters in question are also pondered at work, but they are too fascinating for the enthusiast to leave them there.*"[45]

In the following, the ideas concerned with productive gaming will be explored by discussing the following topics:

- the notion of simulation in the context of productive gaming
- play and productivity / dichotomy of work and play
- characteristics of productive gaming
- differentiation from productivity software
- play oscillation effects
- delimitation from related work
- influences

5.1 Simulation

The notion simulation was already used in the context of this thesis, in the rather practical way as proposed by *David Myers*. His approach bridges and at the same time differentiates the concepts of simulations and games by the inclusion of rules.

In his thesis[46] *Claus Pias* points out the historical interweavings of the notions video game and

[44] Tay12.
[45] Ste09.
[46] Pia04.

simulation. Of particular interest is his find of one of *Ralph Baer*'s earlier patents - US3728480A *television gaming and training apparatus*: "*The present invention pertains to an apparatus and method, in conjunction with standard monochrome and color television receivers, for the generation, display, manipulation, and use of symbols or geometric figures upon the screen of the television receivers for the purpose of training simulation, for playing games, and for engaging in other activities by one or more participants. [...]*"[47]

In the context of video game history, *Ralph Baer* can safely be considered a founding figure, as he headed the development of the first commercial video game console **Magnavox Odyssey**, the first light gun video game controller, and **Simon**, a well-known electronic toy that will be examined in more detail in a subsequent section. In his aforementioned patent application, he explicitly uses the term training simulation for his idea to provide an interactive shooting-range abstraction with a gun-like interface.

Paul Bratley, *Bennet L. Fox* and *Linus E. Schrage* follow through a more formal attempt, based on the term model: "*A model is a description of some system intended to predict what happens if certain actions are taken. Virtually any useful model simplifies and idealizes. [...] For a model to be useful, it is essential that, given a reasonably limited set of descriptors, all its relevant bevavior and properties can be determined in a practical way: analytically, numerically, or be driving the model with certain (typically random) inputs and observing the corresponding outputs. The latter process is called simulation.*"[48]

Briefly rephrased, they understand a simulation as the process of feeding inputs to a synthetic system (model) and observing the outputs. They require simulations to be easier to handle and more practical than their real-world counterparts, and urge for usefulness.

Roger D. Smith argues in a similar way: "*Simulation is the process of designing a model of a real or imagined system and conducting experiments with that model. The purpose of simulation experiments is to understand the behavior of the system or evaluate strategies for the operation of the system. Assumptions are made about this system and mathematical algorithms and relationships are derived to describe these assumptions - this constitutes a model that can reveal how the system works.*"[49]

Henry Ellington, *Eric Addinall* and *Fred Percival* provide a slightly different, and in a sense wider definition: "*A simulation can be defined as an operating representation of central features of reality. This definition again identifies two central features that must both exist before an exercise can reasonably be described as a simulation. First, it must represent an actual situation of some sort - either a situation drawn directly from real life, or an imaginary situation that conceivably could be drawn from real life (invasion by extraterrestrial beings, for example). Second, it must be operational, i.e., must constitute an on-going process - a criterion that effectively excludes from the class of simulations static analogues such as photographs, maps, graphs, and circuit diagrams, but includes working models of all types.*"[50]

[47] Bae69.
[48] BFS11.
[49] Smi98.
[50] EAP82.

Formally, a model (*actual situation of some sort*) and an ongoing process are still required; on the other hand, they cease to demand usefulness, practicality, and specific simulation purposes. *Katie Salen* and *Eric Zimmerman* propose the following formulation: "*A simulation is a procedural representation of aspects of reality.*"[51]
They derive their compact definition from four key observations: "

- *Simulations are abstractions. The real or imagined phenomenon [...] is most likely overflowing with layers of detail. But as with all forms of representational media, you will never be able to fully represent every facet of your subject. Thus your simulated representation [...] is an abstraction. [...]*
- *Simulations are systems. A simulation is a whole made up of smaller, interrelated parts. As with any complex system, meaning emerges from the interaction of the parts. [...]*
- *Simulations are numerical. Not only are simulations abstracted, systematic representations, but they are also reducible to formal, numerical structure. We know this already about games: at some level games are composed of rules, and at their most formal level, all rules are logical, mathematical, constituative rules. [...]*
- *Simulations are limited. Because simulations are numerical abstractions, they are intrinsically limited. [...]*

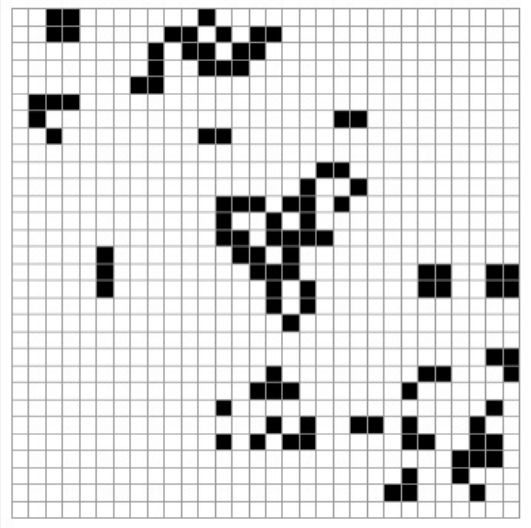
"[52]

In the context of this thesis, this generalization is very practical, as every examined example involves limited virtual systems based on numerical abstractions. Still, as relevant simulations are used for creative purposes, it is important to ascertain their capability to loosen the limitations of real-life systems. E.g., with the project foreverloops it becomes possible to program virtual gear meshes with digital media. On the one hand, it provides a simplified, and therefore limited, simulation concerned with gear mechanics. On the other hand, due to its virtuality, this simplified simulation becomes incredibly useful and powerful once the gears are understood as virtual sequencers. In this case, there is no equivalent real-world system, and therefore it enables and empowers its users to do things otherwise impossible.
Sherry Turkle argues that simulations are valuable tools for teaching and learning: " *Simulations, whether in a game like SimLife or in a physics laboratory or computer-aided-design application, do teach users how to think in an active way about complex phenomena as dynamic, evolving systems. And they also get people accustomed to manipulating a system whose core assumptions they may not understand and that may or may not be "true." Simulations enable us to abdicate authority to the simulation; they give us permission to accept the opacity of the model that plays itself out on our screens.* "[53]

[51] SZ04.
[52] SZ04.
[53] Tur01.

An influential and well-known example for a digital simulation can be found in the **Game of Life**[54] by *John Horton Conway*. First published 1970 in the *Mathematical Games* section of *Scientific American*, it generated much attention: its core rules are comparably simple, yet it is able to generate complex patterns with different behaviors, ranging from static structures to oscillators, from patterns with emergent properties that only become appearent after several generations to self-replicators.

Toy I: Game of life - Simulation game



Genre: Life-like turing complete cellular automaton

Developer: John Horton Conway

Publisher: Scientific American

Year: 1970

***Image 5.1*:** Game of life

Game of life usually is implemented as a discrete simulation, i.e. the simulation state is altered at specific, typically regular time intervals. Depending on the implementation, users usually generate the initial simulation state, for instance by drawing shapes or generating a random population, and than observe the simulation unfold, e.g. with one iteration per second. Insofar, Game of life is also a good example for a so-called zero player game,[55] although it is disputable if it can be considered a game. Despite its simplicity (rectangular arranged cells with binary states, cell state transitions are solely decided via states of direct neighbor cells), it is a Turing-complete simulation, i.e. it can potentially calculate anything that can be algorithmically computed.
A related, yet different life-like simulation can be found in the work **A-Volve**[56] by *Christa Sommerer* and *Laurent Mignonneau*.

[54] Con70.
[55] BJ12.
[56] SM94.

Artwork I: A-Volve

Artist: Christa Sommerer and Laurent Mignonneau

Year: 1994

Interactive real-time environment that lets users create and interact with virtual creatures in the space of a water filled glass pool

Image 5.2: A-Volve

Different from the Game of life, A-Volve is a real-time simulation that requires user interaction. Also, the rules are more involved, as every artificial creature has a user-generated shape and a set of properties derived from its three-dimensional form. These properties are directly linked to the simulated behavior of the virtual creatures: "*In the interactive real-time environment A-Volve visitors interact with virtual creatures in the space of a water filled glass pool. These virtual creatures are products of evolutionary rules and influenced by human creation and decision. Designing any kind of shape and profile with their finger on a touch screen, visitors will bear virtual three dimensional creatures, that are automatically alive and swim in the real water of the pool. Algorithms calculate the creatures form and their movement in space. The movement and behavior of the virtual creature is decided by its form, how the viewer was designing it on the touch screen. [...] Form and movement are closely connected, the creatures ability to move will device its fitness in the pool. [...]*"[57]

Besides creating a population of virtual creatures, there is no necessity for further user interaction - players can lean back and observe their creatures. In addition users of A-Volve can also intervene in the creatures' lives by for example protecting them against other predator creatures or by helping them to mate.

Both Game of life and A-Volve involve virtual simulations (discrete / real-time) and are limited abstractions of specific life dynamics, especially the life cycles. However, although there are sophisticated real-life equivalents, both enable users to seemingly create artificial life via comparably simple system interactions.

5.2 Play and productivity

The conjunction of work and play is often considered as an antithesis to established play conceptions: Cultural theorist *Johan Huizinga* describes play as a "*free activity standing quite*

[57] Syn+97.

consciously outside ordinary life as being not serious, [...] connected with no material interest, and no profit can be gained by it".[58]

Anthropologist and sociologist *Roger Caillois*, despite disputing Huizinga's emphasis on competition in play, builds upon this conception and describes six core characteristics: for him, play is "*[...] an activity which is essentially: free, separate, uncertain, unproductive, governed by rules, make-believe*".[59]

The dichotomy of work and play is addressed by *Celia Pearce*, who challenges the "*[...] axiomatic assumption that games are by definition unproductive. This position is shared by the majority of game taxonomies in recent years, although thankfully, we seem to be moving out of the phase of taxonomania and into a more mature cycle of investigation. [...]*"[60]

As argued before, there are comparatively few examples for projects consolidating play and productivity; besides foreverloops, there are relevant projects of *Toshio Iwai*, including **SimTunes**, the **PrintCraft** project, and few other examples; they will be discussed in detail in later sections. *Graham H. Jensen* points out the example of *Linden Lab*'s **Second Life**.[61]

Toy II: Second Life - Online virtual world

***Image 5.3*:** Second Life

Genre: 3D-based virtual world with player avatars, housing and a virtual currency

Developer: Linden Lab

Publisher: Linden Lab

Year: 2003

With Second Life, players can even use the software environment to generate revenue: "*In a highly paidic game or digital environment like Linden Lab's Second Life (2003), for example, "residents" are given no explicit goals and yet ludic situations can still emerge. The game's users are essentially free to "play" in the sense that Caillois intends, with one notable exception: Caillois (1961, p.10) states that "play" is unproductive, "creating neither goods, nor wealth, nor new elements of any kind; and, except for the exchange of property among the players, ending in a situation identical to that prevailing at the beginning of the game." In the case of Second Life, however, real wealth can be generated, and residents such as Anshe Chung have been able to convert virtual business success into real-world revenue ...*"[62]

[58] Hui49.
[59] CB61.
[60] Pea06.
[61] Lab03.
[62] Jen13.

Gert Eichler points out the semantic proximity of the notions work and play[63] : both refer to activities, they require a specific temporal framing, and involve repetition. Of particular interest is Eichler's assessment concerning educational levels, as they have a strong influence on correlation coefficients: with educational attainment, the conceptions of work and play become increasingly similar.
Also, Eichler specifically examines the notion of leisure. He argues that the negative definition of leisure as not-work time is not sufficient, as it occurs in both work- and spare-time in a positive interpretation of the term (coming close to the notion freedom).
Concerning productive play, and consequently productive gaming, a differentiation of work and not-work time is not required. According to Pearce, "*productive play also challenges traditional capitalistic notions of productivity versus leisure. We need only look at the history of hobby culture in the United States and elsewhere to see that for many, productive leisure is a welcome escape from the regimen of being productive at someone else's behest. Furthermore, as we have tended to relegate play to the realm of childhood, also a period of supposed unproductivity, the notion that play is not only productive but an adult-worthy activity represents a major shift in cultural perception.*"[64]
Another aspect is the productivity connected with (video) game fandom, which *T. L. Taylor* considers a field capable of improvement: "*Understanding the complexity of computer game and e-sport fandom remains an underdeveloped aspect of game studies. Yet it is one of the most powerful affective sites within the domain and is tied to play experience. As many media studies scholars have argued for several decades now, fans do not simply consume but are crucial participants in the production of cultural products. In the case of e-sports, though they may not be the professionals on the field, they infuse energy into events, giving meaning and social importance to activities, and often provide important contributions through their participation in various media (online and off). [...]*"[65]
Summarizing, although both linguistic usage and common conception may imply otherwise, productivity and play cannot be considered as inherently conflicting notions. In subsequent sections, several projects facilitating productive gaming will be examined in detail. These examples feature the concurrence of productivity and digital play, and show that it is not only possible to create while playing, but also advantageous.

5.3 Characteristics of productive gaming

Productive gaming involves several requirements. Most importantly, it needs a playground, typically a software simulation with automatically enforced rules: a video game, some sort of sandbox, a software toy, or some other interactive digital environment.
An important aspect of these playgrounds are artificial rules to both limit and induce player creativity. *Katie Salen* and *Eric Zimmerman* argue that rules are a fundamental condition for

[63] Eic79.
[64] Pea06.
[65] Tay12.

play to happen: "*[...] In all of its many guises, play opposes and play resists. But it does it so playfully, making use of existing structures to invent new forms of expression.*"[66]
A good, yet non-digital example can be found in **Lego**[67] : specifically crafted building bricks, made using plastic material, can be combined to create models of real-world objects (e.g. the Queen Mary II as shown in image 5.4), or even entirely new constructs.

***Image 5.4*:** Model of the "Queen Mary II" ship built from LEGO blocks, scale 1:50, **Andrey Belenko**, 2010

The properties of the bricks induce the rules: they have specific static properties, sizes, colors, ways of interfacing other bricks, and enable particular functions. New Lego sets are typically accompanied by manuals, featuring step-by-step instructions for the recreation of particular constructions. It is up to the players to determine if they want to use the manual, or use the pieces to build something different. Still, they are limited not only by the characteristics of the pieces, but also by their availability: the pieces are finite, therefore the players may run out of specific elements.
Another central aspect concerns the objectives: player goals are determined autonomously, and must not be reflected in potential victory conditions. Therefore, the creational goals of productive gaming environments have no bearing on the rules, the same applies vice-versa. However, productive gaming does not require the possibilities of winning or losing, or the inclusion of (artificial) goals. In the case of video games, victory conditions or mechanisms to lose the games usually are separated from user-defined creational goals. Still, creation processes generally are aligned towards the game flow.

[66] SZ04.
[67] CT49.

Involving play, productive gaming also requires a particular mindset from the players, a *lusory attitude*, a term prominently used by *Bernard Suits* in his definition of game play: "*To play a game is to attempt to achieve a specific state of affairs [prelusory goal], using only means permitted by rules [lusory means], where the rules prohibit use of more efficient in favour of less efficient means [constitutive rules], and where the rules are accepted just because they make possible such activity [lusory attitude]. I also offer the following simpler and, so to speak, more portable version of the above: playing a game is the voluntary attempt to overcome unnecessary obstacles.*"[68]

Put another way, the lusory attitude can be described as the player willingness to engage into playing activities, it often goes hand in hand with a playful state of mind and a disposition for experimentation; it always requires voluntariness.

A less sensitive requirement concerns the productive gaming results / products: ideally, they are usable / perceivable without the productive gaming environment they were created with, and perhaps even without knowledge about it. E.g., when a player uses *Minecraft*[69] in conjunction with *PrintCraft*[70] to create 3D printed figurines (an example is shown in image 5.6) as Christmas presents, the recepients can use them as they are, neither is it necessary to play Minecraft in order to use the makings, nor is the knowledge of their creation process of importance.

Game I: Minecraft - 3D sandbox video game

***Screenshot 5.5*:** Minecraft

Genre: Procedurally generated survival game

Developer: Mojang

Publisher: Mojang / Microsoft Studios / Sony Computer Entertainment

Year: 2011

Spread: AAA

There are many aspects to Minecraft's appeal, including its particular visual style, the massive community that evolved around it, the availability of modifications and extensions, its potential for creative expression, the coverage of rock-star class video-game streamers, and its availability on several platforms. *Raph Koster* argues that allowing players to explore and to learn attributes critically to the attractiveness of a game. In his words, "*many games, of course, seem to become more fun as you learn more about them. This has a lot to do with the nature of the challenge presented in those games; they tend to present problems of a certain complexity level that reveals more subtleties the deeper in you go*".[71]

[68] SN78.
[69] Per+09.
[70] glo14.
[71] Kos05.

***Image 5.6*:** 3D printed temple, Printcraft, Maker Faire UK, **Cory Doctorow**, 2013

Silvia Lindtner and *Paul Dourish* summarize the value proposition of productive play as follows: **"** *The study of games has expanded beyond bounded game spaces and focused instead on a framing of game play as a site of economic and social production. Across different disciplines, researchers have investigated ways in which the production of value extends into play and vice versa, for example, when players utilize games to earn money, when player collectives continue to exist after the game itself disappears, or when gaming feels like work [...]. Findings from this work have shown that the kinds of outcomes produced through playing a game are not necessarily reducible to a game's rules or its supposedly inherent features. Anthropologist Thomas Malaby (2007) synthesized these observations by calling attention to games as legitimate arenas for contingency: Games and the kind of "real" stakes and consequences they produce are cultural accomplishments and grounded in human practice. Malaby suggests that we consider games and their outcomes not in terms of their intrinsic properties but as sites of production that extends into wider fields of social and cultural practice beyond just fun and leisure. Similarly, in our approach, we acknowledge that productive play does not end with economic or social value generated in the game [...] nor with the material production by players themselves, turning them from consumers into producers of content [...]. Rather, we suggest a new approach to productive play that considers production through game play and in relation to a range of experiences and processes, inside as much as outside the game, material as much as social and discursive. [...] By what we term the promise of play, we acknowledge the potential of digital gaming to produce new practices and meanings (within the game and beyond the immediate experience of game play) but also consider how the practice of game play is inexorably linked to other social and technological developments*

[...]."[72]

Summarizing, the concurrence of (digital) play and production facilitates outcomes that are potentially motivated and enabled by the rules and features of the playground, but at the same are not necessarily reducible to them; e.g. stop-motion Lego movies take advantage of the availability and aesthetic as well as material properties of the disposable Lego bricks. Content, scope and form of relevant movies on the other hand generally are unaffected by the particular functions of the pieces.

With productive gaming, creational goals are to be determined autonomously by the players: creative freedom and voluntariness concerning the setting of goals maintain the possibility for the players to attain a lusory attitude, a fundamental prerequisite for playing.

Concerning productive gaming results, relevant digital products should be usable without the playground they were created with, and possibly even without the knowledge about it. They may involve a monetary worth, exhibit particular aesthetic values, or convey a sense of achievement to its creators; they may constitute finished pieces on their own, or be part of other projects.

5.4 Differences from productivity software

Productive gaming playgrounds can potentially be established via productivity software, especially when concerned with more creative activities, like 3D animation, sound design, and to some degree even computer programming. As a general rule, it is more likely to occur with specific software involving abstraction and simulation. Put simply, you would play with it even without being productive or having a specific creational goal in mind. Pearce puts it this way[73] : "*[...] productive play, in which creative production for its own sake (as opposed to production for hire) is an active and integral part of play activities [...]*" She considers "*play as an act of production [...] a new hybrid entertainment form in which players [...] produce their own entertainment media*", and argues for the return of a preindustrial culture of play, "*a time when games were not products that were owned, published, and distributed by a corporatized "hegemony of play" but were made up, changed, and reconfigured by groups of ordinary people in site-specific, socially and culturally specific contexts*".

Productive gaming shares the same relationship to productivity software as video games: "*Video games are different from productivity software because productivity software, all things considered, is bound by whatever it is meant to achieve.*"[74]

There is also another critical aspect: the readiness of users to experiment and attain a more ludic attitude, i.e. playing with the software without having a specific goal, is not only dependent on the capabilities and functionalities of the environment, but also on its design. To put it less formally: if it looks like a game, users are more inclined to engage into play activities.

Referring to video games, *Pippin Barr* describes the main differences from productivity software as follows: "*First, the motivations for playing video games differ from productivity application*

[72] LD11.
[73] Pea06.
[74] JN09.

use. Specifically, players play games for their own sake, while they generally use productivity applications to achieve some other task. Second, video game interfaces are not neutral, presenting carefully designed narratives and complex graphics to the player. Third, video games frequently dictate goals to players, while productivity applications generally facilitate user goals. Finally, video game designs purpose-fully involve conflict and constraints on the player, while productivity applications are designed to minimize them."[75]

Juul and *Norton* consider game obstacles and challenges as the distinguishing features of games as opposed to usability for productivity software.[76] Likewise, *Greg Costikyan* seizes a distinction between games and productivity software based on uncertainty: "*In short, in designing most interactive products, the elimination of uncertainty is desirable. In designing games, a degree of uncertainty is essential. [...] interface clarity may still be desirable, but eliminating challenge and uncertainty is not. Games are supposed to be, in some sense, "hard to use," or at least, nontrivial to win.*"[77]

Productive gaming playgrounds are not limited to games, still, they often make use of gaming mechanisms in conjunction with creational objectives. This balancing act ideally leads to environments that allow users to achieve goals efficiently, and at the same time incite playfulness. Costikyan regards a particular source of uncertainty as a possible explanation: he categorizes *the difficulty of perceiving what's going on in the game space*, a difficulty that can be observed in various productive gaming playgrounds, as the uncertainty of perception. Often, this uncertainty originates from particular and uncommon simulation mechanics, necessitating changes of thinking by the players; e.g. *SimTunes* has powerful sequencing capabilities for making music, still, users cannot apply principles from other music software directly - they first have to playfully engage the simulation and rethink their usual approaches; they are effectively required to employ experimentation, observation and adaptation. Consequently, this constitutes a precondition for the goal-oriented use of productive gaming environments.

5.4.1 Software toys and non-games

In the context of productivity software, so called software toys and non-games require special consideration. *Raph Koster* describes a software toy as a "*common appellation for video games that are not goal-oriented*".[78] The notion software toy initially was coined by *Will Wright*, he used it to describe his project **SimCity**[79] as an environment that can be played with without the necessity of winning or losing.

[75] Bar07.
[76] JN09.
[77] Cos13.
[78] Kos05.
[79] Wri89.

Game II: SimCity - First software toy

***Screenshot 5.7*:** SimCity

Genre: simulation (city building)

Developer: Will Wright

Publisher: Maxis / EA

Year: 1989

Spread: AAA

SimCity can be summarized as a building simulation focused on cities, designed and developed by *Will Wright* and first released by *Maxis* in 1989, a very small company at that time. According to legend, the first version of SimCity with the working title *Micropolis* was already finished in 1985 for the Commodore 64 platform, however, no publisher was willing to sell a game without victory or losing conditions. Although formally, i.e. without the capability to win or lose, the original SimCity qualifies as a software toy, it is generally considered a digital game. Considering the game definition of *Katie Salen* and *Eric Zimmerman*, i.e. "*a game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome*",[80] SimCity eludes this classification: it lacks a quantifiable outcome, as there is no way to beat or to lose the game. Analogous, when examining SimCity through the lens of *David Kelley*'s approach, i.e. "*a game is a form of recreation constituted by a set of rules that specify an object to be attained and the permissible means of attaining it*",[81] there is no pre-determined object to be attained. The same is true for *Greg Costikyan*'s definition, "*a game is an interactive structure of endogenous meaning that requires players to struggle towards a goal*"[82] - again, there are no game-dictated goals in the original SimCity. On the other hand, players can, and to a certain degree are required to, set their own goals, like creating the biggest-possible city, or building utopias where virtual citizens no longer have to pay taxes.

Raph Koster considers the change of player expectations for play environments without dictated goals: "*[...] some provide not just the affordances but suggestions, prodding you towards methods of engagement. We play with a ball, we play with SimCity or Minecraft's sandbox mode, we play with our understanding of a book. We impose our own goals on these, but we were guided to them. In common usage, this is often called a toy but as you can see from the examples, not always.*"[83]

Commercially, SimCity was a huge financial success, and received significant recognition. Also,

[80] SZ04.
[81] Kel98.
[82] Cos02.
[83] Kos13.

it won lots of awards concerning both games and software categories. 2008, its source code was released under a GPL3 license, motivated by the inclusion to the **One Laptop Per Child** program.

Miguel Sicart highlights the simulation aspect of SimCity as one of the main reasons for its appeal: "*Sim City is a magnificent spectacle, a toy that can operate on its own while tempting us to tinker with its parameters to both see and understand what happens—and all the while, creating a feeling of otherness, a playful microcosm that we, as observers and tinkerers, want not to inhabit but to observe.*"[84]

Sicart refers to SimCity as a toy, a notion often accredited to children. *Jon-Paul C. Dyson* remarks[85] that "*toys have traditionally been associated with children*", and points out that there is an ongoing change in the usage and understanding of the notion: "*the strict historical association between toys and children has long been breaking down*". For him, targeted measures of the game and toy industries are decisive factors concerning this transformation. He argues that one central aspect is the extension of target groups of toy advertisements, especially the inclusion of families: "*Toy advertisements exemplified this notion. A.C. Gilbert, creator of the Erector set, promised parents to "solve the boy problem" and turn a boy into a man through play with these construction sets. Lionel similarly advertised its trains as a means to bring together father and son. Covers of Milton Bradley's Battleship (1967) pictured a father and a son happily playing the game [...]*".[86]

On the one hand, the inclusion of parents in advertisements makes a lot of sense, as more often than not it is them who will spend money on entertainment products. On the other hand, there are many example of toys specifically targeted at an adult audience, e.g. so called AFOL's (i.e. *Adult Fans Of Lego*), ALE's (i.e. *Adult Lego Enthusiast*), or AFOLB's (i.e. *Adult Fan of Lego Bricks*) refer to adults who did not abandon their favourite toy when growing up. E.g., according to the official Lego site [87], "*AFOLs spend between 1-10 hours per week on building with LEGO bricks*", more than "*20,000 product ideas have been submitted by AFOLs on the LEGO Ideas website*", and "*there are over 600 events for LEGO fans around the world each year*".

Concerning digital toys, this trend is even more apparent, since, as *Dyson* points out, players often persist in play when growing up: "*Since then the video game has been variously advertised as a device for children or for teenagers or for adults. As the market for video games has grown, as players have persisted in their play even as they have grown up, and as game makers have found more channels with which to reach customers, game makers have been able to segment and specialize. When Xbox debuted in 2001, for example, Microsoft clearly aimed it for an older audience, with images of young adults, not kids, playing the game [...]*".[88]

Current market analysis emphasize this assessment, e.g. the annual report of the Entertainment

[84] Sic14.
[85] Dys16.
[86] Dys16.
[87] https://www.lego.com/en-us/kids/articles/ll5funfactsaboutafolsaug19-57c77740ce1d42cd94cadb3b3d1d6f7b last accessed 2020-04
[88] Dys16.

Software Association for 2019[89] indicates that

- 65 percent of American adults play video games,
- their overall average age is 33 years (women: 34, men: 32),
- and they have been playing games for 14 years on average.
- Also, 57 percent of (American) parents play games with their children at least weekly.
- Coincidentally, the average age of the most frequent game purchases for PC is 38 years.

Interestingly, in their annual report the ESA classifies gamers by age: so called Millennial gamers are between 18 and 34 years old, Gen X gamers are between 35 and 54 years, and Boomer gamers are up to 64 years.

As the previous example SimCity revealed, it is difficult to cut a clear border between game and toy. From a more formal perspective, *Dyson* concludes that rules alone are not a sufficient criterion: "*This historical perspective on the relationship between toys and video games is perhaps unsatisfying to some who want to emphasize theoretical differences, but, as noted earlier, when we try to define toys, just as when we try to define play or games, we enter a rabbit warren of definitional complexity. Many ways of differentiating between toys and games seem arbitrary or not useful. For example, the distinction that games have rules, although true, does not obviate the fact that play of all kinds has rules, though often those rules are unarticulated and developed iteratively through the play. When children play with toys, they usually follow rules, though they generally make them up. [...]*"[90]

Better distinctive formal features can be found in victory or losing conditions and dictated objectives; e.g., the removal of a formal winner and game resolution leads to the notion of the non-game: it was coined by former Nintendo president *Satoru Iwata*, who describes it as "*a form of entertainment that really doesn't have a winner, or even a real conclusion*".[91] Non-games and software-toys are often used synonymously, as they both involve game objectives in the meta game and do not dictate victory conditions. In many cases, they are provided as open ended simulations without game-set goals with focus on free-form play; they allow users to explore and experiment with the game environment at their own pace.

These opportunities for experimentation, the ability to play in different, player-set ways, are central for non-games and software-toys. *Jon-Paul C. Dyson* arrives at the same conclusion: "*Two of Will Wright's games exemplify the problems arrived at by trying to reach a theoretical separation between games and toys. Wright has compared his two most successful games, SimCity (Maxis, 1989) and The Sims (EA Maxis, 2000), two playthings that are not games: SimCity to model railroad building and The Sims to dollhouse play. Most people would consider model railroads and dollhouses as toys, and yet SimCity and The Sims were widely considered games.*

[89] Ass20.
[90] Dys16.
[91] Iwa05.

[...] He noted that the best toys have a wide range of possibilities and encourage exploring and experimenting. Psychologists have long noted that good toys have many affordances that give children the opportunities to play in many different ways. So Wright set about creating a program that would have the affordances of toys but also partake of some of the qualities of a game or a model."[92] With this argumentation, software-toys and non-games are described in relation to playing / gaming activities rather than to game / simulation environments.

Miguel Sicart, rephrasing software toys as digital playgrounds, points out that they do not automatically enable creativity: "*Computers might have afforded a whole new way of understanding and creating playgrounds. The capacity of programmers to write their own physics and logic makes it possible to create worlds with different coherences from ours, that is, with different laws of physics, time, or even materiality. Digital playgrounds are still trying to formulate ways in which the important materiality of the props of material playgrounds can be substituted, to the same effect. Playgrounds explain how materiality and activity are joined together in the selected spaces of play. Playgrounds as metaphors also allow us to escape from game spaces, which are designed for the purpose of playing games but do not always allow the exploration of the creative and appropriative capacities of play.*"[93]

Although software toys and non-games are not always used *productively* (e.g. using SimCity, usually players do not create tangible results with usefulness beyond the simulation virtuality), there are many examples for more creative applications yielding outcomes that can be perceived apart from the simulation context. An early example of a software toy for creative applications can be found in *Jeff Minter*'s **Psychodelia**[94] :

Game III: Psychodelia - Early software light synth

***Screenshot 5.8*:** Psychodelia

Genre: Interactive visual pattern generator with joystick interaction

Developer: Jeff Minter

Publisher: Llamasoft

Year: 1984

Spread: A

Briefly summarized, Psychodelia players populate a virtual canvas with interactive color / shape

[92] Dys16.
[93] Sic14.
[94] Min84.

pulses using a joystick interface. The software does not use an audio signal to seed the light show, it completely relies on user input; still, it is primarily meant to create visualizations for music, and it does so by making the players responsible for audio / video synchronization.

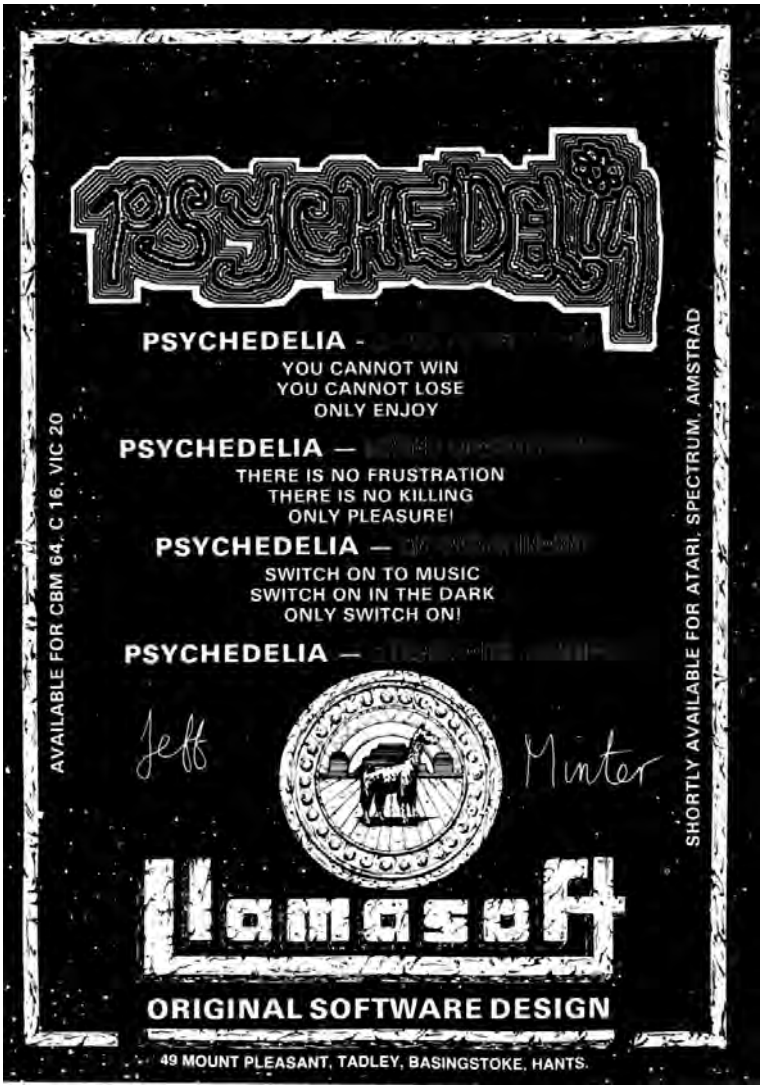


***Image 5.9*:** Psychodelia box art / player instructions, **FunkYellowMonkey**, 2020

As shown in image 5.9, the box art of Psychodelia prominently features the lack of victory or losing conditions, its focus on entertainment, and the uncommon yet pleasant expected player experience. In a way, it challenges potential costumers to engage into something new.
Psychodelia also provides more advanced features for experienced players, including presets, pulse customization, and recording capabilities. Potentially, users are able to record their visual performances via video recorder or capture, and by doing so are able to use the results of their play activities apart from Psychodelia: generated music videos can be used on their own, viewers are not required to own Psychodelia or to even be aware of the creation process.
One particular reason for the appeal of Psychodelia can perhaps be found in the multi-modal effect *Michel Chion* refers to as *Synchresis*: "*the spontaneous and irresistible weld produced*

between a particular auditory phenomenon and visual phenomenon when they occur at the same time. The join results independently of any rational logic."[95] *Karen Collins* summarizes is as follows: "*The concept of synchresis – that merging of image and sound – highlights the brain's ability to merge distinct sensory inputs. Indeed, our perception of one modality can be significantly affected by the information that we receive in another modality.*"[96]
Synchresis establishes an artificial relationship between the seen and the heard; using Psychodelia, players trigger visual cues in relation to the music they are listening to, and with some skill are able to trigger Synchresis effects.
Another prototypical toy is the predecessor of modern music video games: **Simon**.[97]

Toy III: Simon - Electronic music toy

Image 5.10: Simon

Genre: Music memory game

Developer: Ralph Baer

Publisher: Milton Bradley (now HASBRO)

Year: 1977

Using Simon, players memorize random sequences of colors with accompanying notes that become longer as the game progresses. The musical notes are arranged as a C-major chord (G, C, E, and another G an octave higher), and are assigned to specific colors (G / blue, C / yellow, E / red, and G+ / green). *William Knoblauch* compiled a comprehensive collection of information concerning the creation and impact of Simon.[98] According to him, it was initially titled *Feedback*, the name change to Simon was requested by Milton Bradley sales representatives, relegating to the children's game *Simon Says*. He also suggests the *Atari Touch Me* as the primary inspiration for the toy, exhibited at the Music Operators of America show 1976, which was attended by Ralph Baer. The *Touch Me* was a similar music memory game, with, according to Bear, bad execution - he deemed it visually boring, also he did not appreciate the sounds. *Knoblauch* also points out that Simon is the first electronic game for more than one person. The original version featured three game modes, it could be played with families across generations, and managed

[95] Chi94.
[96] Cos13.
[97] BM77.
[98] Kno16.

to sell 750000 times over the period of four decades. However, although Simon is sold as a toy, it is rather played as a game: players lose and have to start over upon making a mistake, the opportunities for experimentation and free-form play are limited. Still, it is possible to compose simple sequences of color and notes by exploiting the multi-player game mode. In this case, the limitation of just four different tones along the C-major chord is both an advantage as well as a drawback - on the one hand, it can be used as accompaniment for a fairly large number of popular songs, on the other hand more complex melodies simply cannot be realized with Simon.

A central figure to the topic of toys is Japanese multimedia artist *Toshio Iwai*. Starting 1992, he managed to create pioneering creative toys at an almost annual rate; relevant titles are **Music Insects**,[99] **Sound Fantasy**,[100] **Resonance of 4**,[101] **Piano - As Image Media**,[102] **SimTunes**,[103] **Composition on the Table**,[104] **Bikkuri Mouse**,[105] **Tenori-on** prototype (2001), **Phenakisti-scopes of Light**,[106] **Tenori-on**,[107] **Electroplankton**,[108] and **Morphovision**.[109] *Azby Brown* comments on his inventiveness: "*To say Iwai works across several media would be an understatement. To be sure, he has created several bodies of work, all intertwined and cross fertilizing each other. Some, particularly his earlier projects, rely more on mechanical motion. Others might be considered experimental video, such as his innovative TV shows created in Japan. Then there are commercial software programs such as SimTunes by Maxis. Though future art historians will probably consider his output part of one unified oeuvre, at present it defies easy categorization.*"[110]

Iwai's oeuvre contains many more pieces, *Brown* identifies three periods of his creative work: the mechanical period, the TV period, and the digital game period, which is highly relevant for productive gaming. Topically and conceptually, his works often expand upon and are influenced by his prior pieces. *Deanna Morse* identifies a key inspiration: "*The third pre-cinema inspirational toy for Iwai was a hand-cranked antique music box. This little toy uses paper cards, punched like the rolls on a player piano. It also came with a punch, so that the owner could create their own musical punchcards. Iwai found this device intriguing – an early depiction of visual music. In 1990, inspired by this technology, he created a computer game called Music Insects, as a tool for visual music performance. In the game, the player can make marks with a mouse, which are akin to the punches on the music roll. On the screen little insects react with sound, direction and color changes when they hit a mark. Later, he made a more complex version of this for Nintendo, called Sound Fantasy. Unfortunately, this game was never launched commercially, so*

[99] Iwa93.
[100] Iwa92.
[101] Iwa94.
[102] Iwa95.
[103] Iwa+96.
[104] Iwa98.
[105] ID00.
[106] Iwa03.
[107] IN05.
[108] Iwa+05.
[109] Iwa06.
[110] Bro97.

in 1996, he released a more developed version as the CD-ROM Sim Tunes in collaboration with Maxis, Inc. In these games, as with the hand-cranked music box, one can see the notation for the music visually on the screen, just as one does on the paper rolls that can be held in the hand. The punch one makes on a paper roll plays a note when it passes the music box. On the computer, one makes a mark, and when it passes an insect, it plays a note. But there were added elements that only could be achieved with the computer. For instance, the marks one makes not only create a sound, but also a visual animation to go with that sound. Plus, a Starfly insect would create music automatically. The program could also generate new music based on the player's composition."[111]

Game IV: SimTunes - Audio-visual software toy

***Screenshot 5.11*:** SimTunes

Genre: Pioneering interactive composition toy

Developer: Toshio Iwai

Publisher: Maxis

Year: 1996

Spread: AA

SimTunes is a perfect example of a productive gaming project:

- it is based on a simulation, with a unique set of rules and adequate complexity,
- it encourages players towards experimentation,
- it allows the creation of audio-visual compositions,
- that even can be perceived without the game or even without knowledge of the game,
- it does not dictate goals, or otherwise constrict creativity and player creation,
- and enables, with some player expertise, goal-driven compositions.

In our preliminary short paper on productive gaming, SimTunes was summarized as follows: "*A game example facilitating productive gaming can be found in Sim Tunes. It resembles a drawing game in which players populate a canvas with up to four virtual bugs of different color. These AI-controlled bugs traverse the displayed virtual space and trigger music playback. Specific pixel*

[111] Mor99.

colors represent different musical notes that are played by the instrument according to what is assigned to the bug. In terms of our proposed characteristics, Sim Tunes does not employ victory conditions, i.e., players set their own objectives and produce audio-visual creations by playing the game."[112]

Conceptually, it is very similar to our own project foreverloops. From a design perspective however, it is aimed at a younger audience: its colorful bugs, the available sounds, and also the demo material makes it appear as a game for children. Also, on first sight it comes into view as a rather simple drawing software, with limited capabilities, evidently to minimize fears of contacts. Over time, players discover the more complex, underlying bug-simulation that is capable of creating audible outputs as well. As SimTunes makes use of a non-linear sequencing paradigm - the traversing bugs can be controlled with several commands - it is a non-trivial task to re-create specific musical compositions, e.g. it might be next-to-impossible to bring forth a faithful re-creation of *Beethoven*'s **Fifth**. Nevertheless, players are able to create amazing results, as various online-videos attest to [113].

The *Game Innovation Database* lists **Otocky**,[114] an earlier Iwai project (1987), as follows:
"*Otocky is notable for being the first game to include creative/procedural generative music. Creative/Procedural is music generated by processes that are designed and/or initiated by the composer. The game merges the appeal of making music with a typical, side-scrolling space shooter in which the player can collect different musical instruments as the game scrolls by. The firing forms the crux of the musical aspect of Otocky, since for every different direction he can fire, a different note is pumped out of the current instrument. Otocky was released for the Famicom Disk System, an add-on for the NES available only in Japan. Developed by SEDIC and published by ASCII Corporation, the game was conceived and designed by Toshio Iwai.*"[115]

[112] BS16.

[113] E.g. **Ariwool** (`https://www.youtube.com/watch?v=HwtG9zD4rbs` last accessed 2020-04, *Lilith of the Maze*, 2012), **Hold Me Tightly (Jamie Paige)** (`https://www.youtube.com/watch?v=394S0TeQ2pw` last accessed 2020-04, *libertyernie*, 2017), or **DenDen Rappa** (`https://youtu.be/3e_PoMz5xOI?list=PLF7448B5336280E30` last accessed 2020-04, *Dogman15*, 2009)

[114] IS97.

[115] Cen04.

Game V: Otocky - Arcade game with procedural generative music

***Screenshot 5.12*:** Otocky

Genre: First game with procedural generative music that evolves along game play and player interaction

Developer: Toshio Iwai and SEDIC

Publisher: ASCII Corporation

Year: 1987

Spread: AA

The **Tenori-on** is perhaps the best known relevant Iwai-project:

- again, it encourages players towards experimentation,
- and allows the creation of audio-visual compositions.
- It is realized as a hand-held device.

Toy IV: Tenori-on - Electronic musical instrument

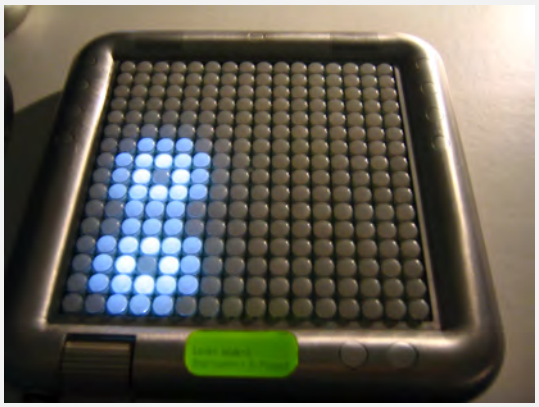


***Image 5.13*:** Tenori-on

Genre: Instrument for blending light and sound

Developer: Yu Nishibori and Toshio Iwai

Publisher: Yamaha

Year: 2007

Yu Nishibori and *Toshio Iwai* summarize their ambitions with the Tenori-On as follows: **"** *We developed this work with a new point of view to music. And we'd like to keep on thinking the musical structure and music with a new point of view. When we develop some work with the idea and the image gotten from this method and make the idea move, then you can catch a new image of music, which you've never seen before. And if you control the motion of the new image, the interface will be a brand new thing inevitably. Sometimes, you might have to develop some new basic technology at first to make it. In that case, you could develop a work that is exactly*

mixed art with science, and the possibility being a brand new work could be enhanced. We hope that people could get a new point of view to music and it could connect to the development and the expansion of the possibility of music by people using the interfaces like our work. Finally we hope this work would make it possible for many people (including people who don't usually play any musical instruments) to experience the pleasure of music more than before. And when our work that has a new point of view to musical structure helps to expand the possibility of music and to develop music, we would like to think that it would be our goal."[116]
From a technical point of view, the device contains a sixteen-by-sixteen grid of LED switches, used both to setup patterns and to visualize the sequences. Usually, a set event is indicated by the state of the corresponding LED switch. The Tenori-On supports several loop modes:

- the score mode, which corresponds to a step sequencer with a resolution of 16 events,
- the random loop mode, which allows users to program arbitrary shapes that define loop patterns,
- the real time record mode, which records the user interaction along a time-stamp, so that performances can be played back later,
- the bounce mode, which features dots that traverse the canvas up and down, and generate audible outputs when they hit the bottom line,
- the push mode, facilitating gradual changes of sound and light,
- and the solo mode, where the device assumes the interaction semantics of a keyboard instrument.

As SimTunes, on first sight the Tenori-On appears like a comparatively simple toy, as the primary function grows apparent immediately. But like the other, it offers its players opportunities and rewards for free-form experimentation, here mainly via different play modes. As a toy, it does not dictate goals, and lets users play and discover at their own pace.

It is not a coincidence that the term non-game was coined by former Nintendo president *Satoru Iwata*, as key to his vision was expanding the gaming industry's customer base. *Sangbeom Kim*, *Ian Lamont*, *Hiroshi Ogasawara*, *Mansoo Park* and *Hiroaki Takaoka* provide plausible reasoning and valuable background information on the rational behind Iwata's decisions,[117] briefly summarized in the following: in the aftermath of a technological arms race, often referred to as console wars, market competitors, including Sega, Sony and Microsoft, focused on core-gamers by selling state-of-the art consoles, typically sold at a loss right after launch in order to grow the customer base. "*Sony lost an estimated 100-160 USD per PlayStation 2 when it was first launched, but reportedly made up for the loss with profits generated by selling game titles and accessories.*"
In 2003, Nintendo decided to avoid this sales strategy, as *Genyo Takeda*, the general manager

[116] NI06.
[117] Kim+11.

of the integrated research and development division at Nintendo, proposed the deviation from the technological road-map for upcoming consoles. For the Nintendo Wii console, they built on different core concepts: in excerpts, it should work for all members of a family, particularly appeal to mothers, be relatively inexpensive, and allow less-invested gaming.
These concepts attributed to the advent of less structured and more play-focused toys the company is now famous for. In the following, an extract of relevant titles for Nintendo platforms, sorted by units sold (the data on unit sales was retrieved from the Nintendo website (Nintendo Wii[118], Nintendo DS[119], Nintendo WiiU[120], Nintendo 3DS[121]):

- **Wii Sports**[122] by Nintendo, Nintendo Wii, 82.88 million pcs.
- **Wii Sports Resort**[123] by Nintendo, Nintendo Wii, 33.11 million pcs.
- **Wii Play**[124] by Nintendo, Nintendo Wii, 28.02 million pcs.
- **nintendogs**[125] by Nintendo, Nintendo DS, 23.96 million pcs.
- **Wii Fit**[126] by Nintendo, Nintendo Wii, 22.67 million pcs.
- **Brain Age: Train Your Brain in Minutes a Day**[127] by Nintendo, Nintendo DS, 19.01 million pcs.
- **Brain Age 2: More Training in Minutes a Day**[128] by Nintendo, Nintendo DS, 14.88 million pcs.
- **Animal Crossing: New Leaf**[129] by Nintendo, Nintendo 3DS, 12.45 million pcs.
- **Animal Crossing: Wild World**[130] by Nintendo, Nintendo DS, 11.75 million pcs.
- **Nintendo Land**[131] by Nintendo, Nintendo WiiU, 5.19 million pcs.
- **Super Mario Maker**[132] by Nintendo, Nintendo WiiU, 4.01 million pcs.

There are many more examples for non-game products on Nintendo hardware, also by 3rd party developers. In the following, two specific titles relevant to productive gaming, **Super Mario Maker** and **Mario Paint**,[133] will be examined in more detail.

[118] retrieved from https://www.nintendo.co.jp/ir/en/finance/software/wii.html, last accessed 2020-04
[119] retrieved from https://www.nintendo.co.jp/ir/en/finance/software/ds.html, last accessed 2020-04
[120] retrieved from https://www.nintendo.co.jp/ir/en/finance/software/wiiu.html, last accessed 2020-04
[121] retrieved from https://www.nintendo.co.jp/ir/en/finance/software/3ds.html, last accessed 2020-04
[122] EAD+06.
[123] Nin+09.
[124] Nin+06.
[125] Nin+05b.
[126] Nin+08.
[127] Nin+05d.
[128] Nin+05c.
[129] Nin+12a.
[130] Nin+05a.
[131] Nin+12b.
[132] Nin+15.
[133] Nin+92.

Game VI: Super Mario Maker - Game creation toy

***Screenshot 5.14*:** Super Mario Maker

Genre: Platformer level creator with community focus

Developer: Yosuke Oshino, Takashi Tezuka, Hiroyuki Kimura, and many more

Publisher: Nintendo

Year: 2015

Spread: AAA

With **Super Mario Maker**, players can create levels in the platformer style of Super Mario games. Initially created as an internal development tool for level designers, the toy enables its users to become game designers themselves. On the other hand, players can download and play millions of user-created levels, the platform provides search filters and heavily relies on its community to evaluate individual levels. In order to upload and share a level, the creator is required to complete it first herself. *Isabelle Lefebvre* examines the idea of utilizing the creativity of the players: "*particular emphasis is placed on the integration of players' creativity, thus blurring the borders between users and producers*".[134]

In concrete terms, she provides explanatory models concerning player incentives. Super Mario Maker, besides presenting an accessible game creation toolkit with a gratifying experience, incorporates more social, community based reward systems, and as a consequence a form of social capital users are striving for: "*in Super Mario Maker, the star reward system reflecting a player's appreciation of a given level constitutes the form of social capital that a player-creator receives. This form of appraisal also has the power to propel the level higher in the algorithm of levels' appearance, thus increasing the chances to attract other players to try it, meaning the level could receive additional stars, etc. A player-creator who succeeds in amassing a substantial number of stars also gains certain benefits, such as a greater upload limit for her creations, otherwise initially restricted to ten levels. [...] Therefore, regardless of what player-creators seek in their experience of creation within Super Mario Maker, it is obvious that the social platform's interface highlights their potential desire to attract success upon their levels (i.e. receiving more social appraisal from their peers).*"[135]

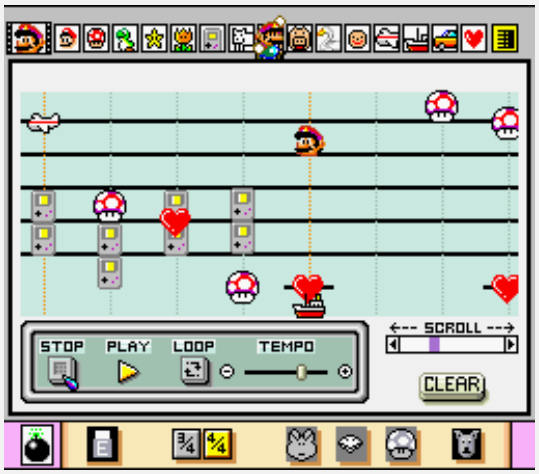
Isabelle Lefebvre argues that this concrete implementation of a social reward system has an effect on the players' creativity, as it influences creational objectives: "*[...] the creative expression of player-creators is not only limited and oriented by the restrictions of themes, items, characters, and actions contained within the creation tool's catalog, but also by a form of social pressure based on the estimation of what the player's community wishes to encounter in a level to accumulate*

[134] Lef17.
[135] Lef17.

more social capital [...]".

Mario Paint as the other example of a Nintendo non-game utilizing the same prominent video game legacy - the Super Mario franchise.

Game VII: Mario Paint - Prototypical Nintendo non-game



***Screenshot 5.15*:** Mario Paint

Genre: Drawing / music making tool

Developer: Hirofumi Matsuoka, Gunpei Yokoi, and many more

Publisher: Nintendo

Year: 1992

Spread: AAA

Mario Paint can be summarized as a collection of creativity toys, initially released for the Super Nintendo Entertainment System in 1992. It was sold in a bundle with a specific mouse peripheral for the console, the Super NES Mouse, providing similar functionality as a two-button computer mouse. In its history as a gaming company, Nintendo often sold specific hardware alongside particular software, e.g. the Nintendo GameBoy device was sold with a copy of the game Tetris, greatly attributing to its status of the most successful video game of all time. Another example can be found in the Nintendo Wii console - its customers receiced a free copy of the incredibly successful Wii Fit game.

On the one hand, Mario Paint provides several tools for drawing: besides comparably simple functions for creating static images, including brushes and text editing, it can also be used to create simple animations. Users with access to video recorders were able to capture their creative processes and results on tape.

On the other hand, it also contains the influential and popular music making tool Mario Music. *Dana M. Plank* provides an excellent overview of its capabilities and limitations: "*[...] After the players have selected an instrument icon, they can add up to three distinct pitches per beat to form triadic harmonies or adorn a simple melody with percussion ([...]). Players can switch between triple and quadruple meter, adjust the tempo from approximately 40-240 beats per minute, add a repeat sigh (though only at the end of the piece in place of the double bar), and play back the existing score. Despite these capabilities, the composing tool's limitations are soon keenly felt. The program is restricted to the diatonic tones of the C-major (or A natural minor) scales, and so the player attempting to recreate favorite songs by ear has to transpose from the original key*

and often either omit notes or encode incorrect pitches. The player cannot subdivide the rhythms in the measure in units smaller than quarter notes; recreating eighth and sixteenth notes requires a degree of planning - multiplying the the tempo by two or four and treating each quarter-note space as the new smallest note value. But with a maximum length of twenty-four measures of 4/4 or thirty-two measures of 3/4, these kinds of manipulations leave little wiggle room to compose. Mario Paint lacked an export function, and there was no save slots for individual compositions in the music-writing tool: Clear the existing song or load one of the presets and any previous work was lost forever. [...]"[136]

As a non-game, Mario Paint does not prescribe goals - there is no way to beat or to lose the *game*. It can be used as a creative tool for self-expression and digital experimentation: "*Though hardly a comprehensive tool for the aspiring artist, it served as a useful device engendering freeform play: an accessible, brightly colored, and friendly introduction to the basic techniques of computer art and musical notation and sequencing.*"[137]

5.4.2 On media

Media and games become more and more interwoven, for several reasons: first, as *Jesper Juul* points out, individual games can no longer be attributed to specific media: "*[...] many games actually move between media: Card games are played on computers, sports continue to be a popular computer game genre, and computer games occasionally become board games.*"[138]

A perfect illustration can be found in the game of chess: primarily, chess is considered a board game for two human players, who play in a café, in a chess club, or in parks with large-scale pieces. Specific openings and their variant forms, end game theory, as well as prominent matches can be studies in the form of books and chess magazines. Also, there are electronic chess computers, often used for training purposes of single players. Mail-chess is another variant, where two player play asynchronously and send their moves in turns to the other player via mail, causing a game to for months or even years. Computer chess enables sophisticated game analysis, and provides data-bases concerned with famous games, opening theory, etc.. Online-chess on the other hand allows anonymous players to be automatically matched based on their past performances; they usually involve faster rapid or blitz-chess formats. In addition, as with other games, the practice of game streaming becomes more and more relevant: grand-masters (players with the highest rating) offer their insights and knowledge in online-videos, as do chess-enthusiasts with the help of computer analysis. Summarizing, chess alone involves various media, both physical and virtual.

Consequently, Juul notes that games are trans-medial: "*There is no single game medium, but rather a number of game media, each with its own strengths. The computer is simply the latest game medium to emerge. While computer games are therefore part of the broader area of games,*

[136] Pla16.
[137] Pla16.
[138] Juu03.

they have in many cases evolved beyond the classic game model."[139]

Second, as discussed by *Raph Koster*, games and especially digital games are compound media: "*Of course, games are a compound medium, and can have stories, artwork, and music all working alongside the game system.*"[140]

Third, games become increasingly interlinked with social media, for several reasons: players form online-communities to discuss tactics and help each other out, they engage in a form of dialog with the developers, they use their in-game achievements as a form of badge, and give feedback on specific games, mechanics, players, or events.

Fourth, coming back to a central premise of this thesis, there are quite a few gamers with the ambition to extend or contribute to their games and game fictions. According to *Celia Pearce*, this is not as an isolated phenomenon within the game culture, but *zeitgeist*: "*Not only do player-producers simulate simulations, they propel them out into the real world so that reality becomes the playground of the virtual. And, as we've seen in the case of earlier fan culture forms, such as the Star Trek fan Trekkie phenomenon (Jenkins, 1992), they also expand the game narrative and eventually begin to take it over. The preponderance and increasing legitimacy of blogs, zines, and open-source content-production frameworks, such as Wikipedia (www.wikipedia.org), demonstrate that self-created content is not just an isolated phenomenon within game culture but a widespread, trans-medial, and international zeitgeist.*"[141]

Silvia Lindtner and *Paul Dourish* share this view: "*[...] games, like other media, are sites of cultural production, imagination and identity in contemporary transnational configurations.*"[142]

Fifth, the availability and accessibility of digital game technology enables their re-use for media production purposes. A highly relevant and particular interesting trend is the *Machinima* movement. *Jenna Ng* outlines Machinima as follows: "*[...] the machine remains the singular element for understanding machinima, which are commonly defined as films made by real-time three-dimensional (3D) computer graphics-rendering engines ([...]). The term machine, then, points to the complex amalgam of computer hardware, accessories, and software as well as the mechanical nature of the "engine" that facilitates machinima's creation. The key to making machinima is the targeted use of rendering software; in that sense, machinima is is unlike both animation, which builds its imagery with geometrical shapes, and live-action cinema, whose images are recorded primarily by a camera in front of a live event or actor. In comparison, machinima redeploys preexisting rendering engines to generate its imagery, sound software to record and synchronize its soundtrack, and editing software to piece it together into a desired narrative. It is born-digital media, produced entirely on a computer. To that extend, the sense of the "machine" runs through the entirety of its creative conception, development and ontology. It should be no surprise, for several reasons, that video games were the first engines used to make machinimas. First, the development of 3D game engines in the early 1990s, heralded first by Wolfenstein 3D (id Software, 1992) and then by DOOM (id Software, 1993), had achieved unprecedented sophis-*

[139] Juu03.
[140] Kos05.
[141] Pea06.
[142] LD11.

tication; with such advances, the ground was technologically laid for using game engines to create 3D imagery. Second, the practice of modification inherent in redeploying video game engines to make films lies within a tradition of subversion that runs deep in gameplay, which can be traced to themes of subversive play and entertainment in Dadaist and surrealist movements. [...]"[143]

Karen Collins identifies the practice of *vidding* as a likely origin for Machinimas: "*Machinima evolved in part from the history of vidding, in which television and movies are mashed up and set to music, with the result known as a vid or songvid. The history of vidding can be traced back to a 1975 Star Trek slideshow that was set to music and called "What Do You Do with a Drunken Vulcan?" (Coppa 2008). A second influence is likely that of MAD movies, which are anime parody videos that are made primarily in Japan and were popular in the 1980s (Ito 2011). These videos were shown at fan conventions and had limited distribution until the arrival of YouTube (Jenkins 2006b). Particularly relevant to this discussion and to machinima's development is the important role that has been played by music in the construction of vids and MAD movies: many were montages set to music, in which "vidders use music in order to comment on or analyze a set of pre-existing visuals, to stage a reading, or occasionally to use the footage to tell new stories." In vidding, the fans are fans of the visual source, and music is used as an interpretative lens to help the viewer to see the source text differently" (Coppa 2008). MAD videos, for instance, often swapped out the original song with a new song whose rhythm and lyrics coincidentally aligned with the original. Songvids, as music-based vids became known, are arguably the most popular form of vidding and influenced machinima.*"[144]

Specific video game mechanics encourage player-created content, e.g. the automatic capture of screen-shots at narrative peaks in role-playing-games (as observed in **Dragon Age**[145]), specific camera-game modes to allow players to create albums (as observed in **The Sims**[146]), or the serialization of game states to facilitate interactive replays (as observed in **Starcraft II**[147]).

Sixth, video game streaming, i.e. recording gaming sessions and commenting on them in real-time while at the same time making it available to a wide audience, becomes more popular, as it also is a coveted career path for ambitous gamers. A relevant game technology is the capability of game-play recording. *Jenna Ng* summarizes its origins and ramifications: "*[...] the recording of game-play was called "Quake movies" specifically because of the connection between Quake and the phenomenon of recorded gameplay within this game's community and playing teams. By the end of the decade, by far the most popular games on the scene were team-based games such as the Quake sequels ([...]) [...]. In this fusion of modification, recording technology, team-based play, and the desire to show off skilled game-play, players began to document game techniques as recorded imagery for exhibition and circulation, initially made on demos (recorded films playable only with the engine installed on the computer) and later generated or "recammed" as moving-image file.*"[148]

[143] Ng16.
[144] Col13.
[145] Bio+09.
[146] WM00.
[147] Bli+10.
[148] Ng16.

At the time of writing, there are quite a few competing game streaming platforms, including **Twitch**, **YouTube Gaming**, **Mixer**, **Facebook Gaming**, and **DLive**. The constant expansion of available and newly created content is remarkable, as shown in figure 5.16 (for Twitch).

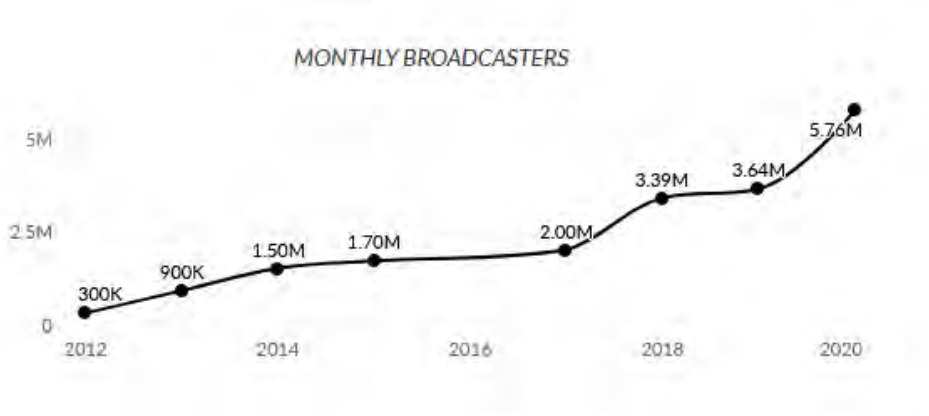


***Figure 5.16*: Number of active broadcasters on Twitch** (chart generated by https://twitchtracker.com/, 2020-07-01)

On the other hand, this content growth is matched by its demand (on Twitch), as shown in figure 5.17.

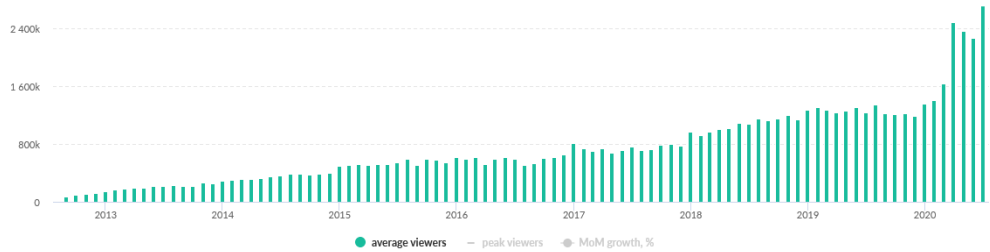


***Figure 5.17*: Number of average viewers on Twitch** (chart generated by https://twitchtracker.com/, 2020-07-01)

The reasons for the obvious appeal of watching other people play video games are manifold: to name a few, players can observe new tactics and by viewing are able to improve their own skills, they can root for their favorite teams, they can use the feeds as a decision aid whether to buy a game or not, they can get a feeling of community concerning particular games or even individual streamers and their followers, and generally engage in a less exhausting manner. *T. L. Taylor* refers to an activation moment connected with spectator-ship: "*Beyound the cognitive work the observer does, there are important affective and embodied aspects of spectatorship worth addressing. When I watch someone else play a computer game I am often activated internally as a player. I may feel excitement, tension, remembrances of my own similar play moments. Watching may inspire me to to get back to my own machine and play. While we regularly notice the ways player hold their body in relation to play – leaning into the screen, muscles tensed – spectators can also become activated in their bodies, sitting forward in anticipation during a tense moment, intently focused on the screen, feeling the visceral reverberations of the digital actions*

within their bodies, cheering with excitement or clapping when victory happens. [...]"[149]
Finally, there is also the aspect of subversion, observable with specific video games, on particular video game streams, with Machinimas, and with game modifications. Concerning video games and subversive players, *Joshua Tanenbaum* points out a certain tradition of game designers fearing the agencies of so-called subversive players: "*players [...] will actively (and perhaps maliciously) seek to undermine the intentions of the "author" within a simulated world. From this standpoint, players and designers exist in natural opposition to each other [...].*"[150]
However, he concludes that the players approach different games with different mindsets in different situations (he proposes the notion *stance*), and that acts of subversive game play should be considered as opportunities for designers to grow, instead of obstacles to blindly avoid: "*[...] most players are more interested in playing with the game than against it. Subversive play is seldom actually about subverting the will of the designer. Sometimes it is about a player pursuing multiple goals at once. Sometimes it is about a player trying to learn how to best make meaning in a game system. It is often not even to cheat or gain an unfair advantage. [...]*"
Concerning Machinima, *Jenna Ng* outlines its conjunction with subversion by example of the Machinima movie **Diary of a Camper**: "*Besides gameplay recording, machinima during this time was also marked by other developments. In 1996, a group of players called the Rangers hacked Quake to make a short film called Diary of a Camper. This film differs from the recordings that preceded it in two significant ways. First, it does not record gameplay. Rather, it consists of an independent narrative: two Ranger members from a team of five are sent ahead to scout a room but are ambushed by a waiting camper and killed. As revenge, the remaining three Rangers return fire and kill the camper. Although gaming elements are present in this machinima ([...]), the players were not playing the game while making this machinima. Second, the machinima was recorded from a third-person virtual perspective, clearly departing from the first-person shooter outlook of Quake. [...] Machinima as presented by Diary thus profoundly changed the nature of video games, from being a media object with a specific goal ([...]) to being used to make Diary. The video game essentially became and open-ended tool kit for creative use with purposes removed from its original goal of gameplay and unrealized by the game developers themselves. In view of this subversion, Lowood, paying homage to Marcel Duchamp's "found object", calls machinima "found technology" [...]*"[151]
The practice of modding, and its connection to subversion, will be explored in more detail in section 5.6.3.2.

Productive gaming is often concerned with, but not limited to, media production, common results are user-created images, pieces of music, videos, or even interactive playgrounds: pre-compiled media and assets are modified and rearranged to the likes of the users, relevant results can be re-used as assets, or comprise stand-alone pieces.

[149] Tay12.
[150] Tan14.
[151] Ng16.

5.5 Oscillation effects

In general, productive gaming is closer to free form (*paidia*) than to more structured (*ludus*) playing, relevant softwares are often considered simulations, toys, non-games, or digital playgrounds. Still, the principles of free-form and structured play cannot be considered either-or, as they do not denote game genres; rather, as *Graham H. Jensen* puts it, "*paidia and ludus are not separate genres but independent principles or forces that form two ends of a continuum on which all games are located*".[152]

We argue that this continuum interacts with game-play on several levels: on the level of player experience, of game or play modes, of play phases, and of game play experience.

Concerning player experience, it is easy to visualize different phases of learning in almost any game and toy. E.g. with the aforementioned Lego bricks, it is productive to first build sets under the guidance of instruction manuals: this way, players get familiar with relevant construction patterns they can later deploy for their own creations. When imagining a more competitive game such as Basketball, players require skills and expertise in several areas, most of which are trainable: ball handling, dribbling technique, pinpoint accuracy, but also running speed, endurance, positional awareness and well attuned strategies. Or when using SimTunes to produce music: in order to use it productively, players are required to first learn about its controls and interaction patterns, understand the basic ideas behind the simulation, and be aware about specific techniques to achieve secondary goals, like realizing a melodic progression. In all these examples, players are required to invest time and effort in order to effect achievements, as *Jesper Juul* points out in his essay *The Art of Failure*.[153] Similar to the practice of learning a musical instrument, the particular steps to improve upon specific aspects can occur in rather structured, goal-oriented, and *ludic* ways (e.g. running exercises, studying YouTube videos, consulting manuals, memorizing chess openings, or finger exercises), but also in more playful, paidian manners (e.g. playing Hide and Seek, experimenting with different sounds, free-form improvisation). It is important to ascertain that these learning steps are not either-or, but ideally complement each other, and condition the aforementioned oscillation on the paidia - ludus continuum.

Concerning game or play modes, toys can typically be played with in several ways, whereas games, both classical and video games, often provide different modes out of the box, not to mention player adaptations. Considering the example of chess, there are many ways and formats it can be played, including Blitz-chess, Fischer chess, and tandem-chess. Also, chess with handicap is not unheard of: the more experienced player starts with less pieces, levering out chess opening theory. This game mode is, among others, prominently featured by recorded games of American chess prodigy *Paul Morphy*. A totally different flavor comes in the form of chess puzzles: players are expected to find forcing move sequences that usually result in check mates in particular numbers of turns, or to reconstruct the course of events of particular games states.

Another interesting example can be found, once again, in Minecraft, as it features several modes that fundamentally alter game play mechanics: the survival mode is a more game-oriented mode,

[152] Jen13.
[153] Juu13.

where players are enabled to beat the game, usually involving hours of several play activities, ranging from fighting enemies, to exploration, base-building and tinkering specific pieces of equipment, while at the same time making use of the game-specific technology tree. The other game-oriented modes are adventure, which focuses more on exploring and less on building, and hardcore, which drastically increases the game difficulty while at the same time limiting the player lives to but one. There is also a toy-oriented sandbox mode, called the creative mode, where players become virtually immortal. With this mode, players manage to build unreal creations, ranging from real-time video decoders exploiting the capabilities of the underlying simulation, to large-scale re-creations of entire real-world cities. Finally, there is the spectator mode, where players can observe other players interacting with the game, but cannot create things or otherwise alter the virtual world. Of course the classification of Minecraft in either creative or spectator mode as a game is debatable, as there are no in-game objectives for the players to fulfill. Generally, game modes accommodate the preferences of different players, and enable the experience of game environments from different partitions on the paidia-ludus continuum.

Concerning play phases, especially newer video games try to blend several genres in order to provide a diversified game play experience. E.g. Minecraft, which also happens to be the best-selling video game to date with a total of more than 200 million copies sold at the time of writing, implements day-night cycles heavily influencing in-game occurrences: during the day, players are expected to harvest resources, to build and strengthen their home bases, and to improve their equipment. Typically, players traverse the terrain, use their archetypical pickax to hammer down rocks yielding resources that can later be used for different crafting recipes, and combine several ingredients at their furnaces for virtual food, better equipment, and improved tools. During the night on the other hand, enemies will try to attack the player base, so during that phase the play experience is more combat oriented.

But also classical, highly competitive games such as chess involve different phases: at higher levels, more experienced players are able to play the first moves by heart, due to extensive studies of chess opening theory. The same is true for many endgame situations - by memorizing particular patterns and endgame regularities, professionals are able to determine if a position is winning or not in mere seconds. It is usually the middle game where combinatoric, tactical and strategic skills come into play.

With software toys such as SimTunes players also experience different phases. For example, when SimTunes is used to re-create a specific piece of music, play generally is more goal-oriented. Still, as its mechanics are so different from typical sequencing paradigms, players often find themselves rethinking their approaches, and drifting towards phases of experimentation.

Summarizing, movements on the paidia-ludus continuum are also likely to be experienced over the course of a single play session, with either toys, newer genre-hybrid games, or even classical board games. A genre-specific analysis of particular play oscillation behaviors would shed more light on its particularities, but is beyond the scope of this thesis.

Concerning oscillation effects on the level of game play experience, it is necessary to point out its complexity. *Laura Ermi* and *Frans Mäyrä* wrap it up nicely: "*Human experiences in virtual environments and games are made of the same elements that all other experiernces consist of,*

and the gameplay experience can be defined as an ensemble made up of the player's sensations, thoughts, feelings, actions and meaning-making in a gameplay setting. Thus it is not a property or a direct cause of certain elements of a game but something that emerges in a unique interaction process between the game and the player."[154]

Consequently, game designers only have limited control over the actual play experiences of individual, heterogeneous players: they may be first-time players, with different levels of experience with similar games or environments, they may like or detest particular cultural encodings, they may enjoy the outcome of an in-game decision, etc.. What game designers can do is to strive for the creation of great play experiences through *meaningful play*, a concept described by *Katie Salen* and *Eric Zimmerman* in two separate, yet related ways: first, "*meaningful play in a game emerges from the relationship between player action and system outcome; it is the process by which a player takes action within the designed system of a game and the system responds to the action. The meaning of an action in a game resides in the relationship between action and outcome.*"[155]

Second, "*meaningful play occurs when the relationships between actions and outcomes in a game are both discernible and integrated into the larger context of the game. Creating meaningful play is the goal of successful game design.*"[156]

Another approach for game designers is to strive for maximized fun: "*People play games for the experience that can only be achieved by engaging in the gameplay. In other words, a game's value proposition is in how it might make its player think and feel and fun is the ultimate emotional state that they expect to experience as a consequence of playing.*"[157]

To that end, *Raph Koster* proposes that games should provide some complexity: "*Fun comes from "richly interpretable" situations. Games that rigidly define rules and situations are more susceptible to mathematical analysis, which is a limitation in itself. We don't think that we can drive just because we know the rules of the road and the controls of a car, but extremely formal games (such as most board games) have fairly few variables, and so you can often extrapolate out everything about how the game will go from the known rule set. This is an important insight for game designers: the more rigidly constructed your game is, the more limited it will be. To make games more long-lasting, they need to integrate either math problems we don't know the solutions to, or more variables (and less predictable ones) such as human psychology, physics, and so on. These are elements that arise from outside the game's rules and from outside the "magic circle.*""[158]

Summarizing, game play experience, affected by meaningful play and fun, is particularly interrelated with movements on the paidia-ludus continuum, with cause-effect relations on both ends.

[154] EM05.
[155] SZ04.
[156] SZ04.
[157] EM05.
[158] Kos05.

5.6 Value transferences

Game play requires a specific *artificial* context which game designers and scholars often refer to as *magic circle*. The notion was initially coined by Dutch historian *Johan Huizinga* in his book *Homo Ludens* 1949: "*All play moves and has its being within a play-ground marked off beforehand either materially or ideally, deliberately or as a matter of course. Just as there is no formal difference between play and ritual, so the consecrated spot cannot be formally distinguished from the play-ground. The arena, the card-table, the magic circle, the temple, the stage, the screen, the tennis court, the court of justice, etc, are all in form and function play-grounds, i.e. forbidden spots, isolated, hedged round, hallowed, within which special rules obtain. All are temporary worlds within the ordinary world, dedicated to the performance of an act apart.*"[159]
In his description of this game context, "magic circle" is but an item in a list of several phenomena referring to this artificial game space. *Katie Salen* and *Eric Zimmerman* provide a useful adaptation of the notion in *Rules of Play*, briefly summarized as follows: "*The magic circle of a game is the space within which a game takes place. [...] Within the magic circle, the game's rules create a special set of meanings for the players of a game. These meanings guide the play of the game.*"[160]
However, according to *Eric Zimmerman*, the "magic circle" is primarily meant as a concept to refer to the artificial context involved in and required for game play. It was not meant to depict a boundary between where the play happens and the real life (though apparently, many game scholars are using it in this way): "*The magic circle is not a particularly prominent phrase in Homo Ludens, and although Huizinga certainly advocates the idea that games can be understood as separate from everyday life, he never takes the full-blown magic circle jerk point of view that games are ultimately separate from everything else in life or that rules are the sole fundamental unit of games. In fact, Huizinga's thesis is much more ambivalent on these issues and he actually closes his seminal book with a passionate argument against a strict separation between life and games.*"[161]
Eric Zimmerman maintains the contrary: "*The magic circle, as put forward in Rules of Play, is the relatively simple idea that when a game is being played, new meanings are generated. These meanings mix elements intrinsic to the game and elements outside the game.*"[162]
Stephen Sniderman argues that with play activities, the boundaries of real life and the play context blur: "*[...] no game or sport is played in a vacuum. All play activities exist in a real-world context, so to play the game is to immerse yourself in that context, whether you want to or not. In fact, it is impossible to determine where the game ends and real life begins.*"[163]
Also, *Ian Bogost*, considering the persuasiveness of games, points out their potentially lasting effects on reality: " *Among computer software, I want to suggest that videogames have a unique persuasive power. Recent movements in the videogame industry, most notably the so-called Seri-*

[159] Hui49.
[160] SZ04.
[161] Zim12.
[162] Zim12.
[163] Sni99.

ous Game movement [...] have sought to create videogames to support existing social and cultural positions. But videogames are capable of much more. In addition to becoming instrumental tools for institutional goals, videogames can also disrupt and change fundamental attitudes and beliefs, leading to potentially significant long-term social change. [...] "[164]
Consequently, interactions between life and games can be observed on several occasions; in the following sections, these interactions are categorized into three groups:

- effects of the magic circle on real life,
- how real life affects the magic circle,
- and concepts with bidirectional influences.

5.6.1 Effects of the magic circle on real life

This category summarizes concepts and mechanisms facilitating a value transfer from play contexts to real life. More general value transfers, e.g. the satisfaction from performing a spare-time activities, or *post-game experiences*[165], are neglected in the context of this thesis.
Arguably, productive gaming is situated here as well, as playing activities cause the creation of products with uses beyond the magic circle.

5.6.1.1 Video game controversies

The advent of video games caused extensive media coverage, including negative aspects and controversies. Relevant discussions happen outside the game contexts, with several contentious issues. Disclaimer: the majority of cited video game in this section have not been played by the author. Also, for the most part they originate from *Andreas Garbe*'s **Quartets of Video Game Scandals**.[166]
Probably most discussed is the topic of video game violence, and the follow-up question whether video game violence makes people more violent. Over the past decades, many studies have been published in the context of this exact questions, deploying a multitude of methods and yielding inconsistent results. *Ian Bogost*, in a more recent article in *The Atlantic*,[167] summarizes the state of research on the connection of video games and violence as follows: "*[...] the evidence is very clear that there's not a relationship between violent video games and violence in society. There's not evidence of a correlation, let alone a causation [...]*".
Furthermore, he shines a light on relevant political influences and agendas, especially in the USA

[164] Bog10.
[165] *Gordon Calleja* describes post-game experiences as follows: *"Postgame experiences can range, for example, from the sense of accomplishment derived from completing an elusive game goal (ludic involvement) to the satisfying feeling of recalling impressive feats of avatar control (kinesthetic involvement) or a sense of inner peace following travels in aesthetically moving surroundings (spatial and affective involvement)."* [Cal11]
[166] Gar.
[167] Bog19.

with the two major parties Republicans and Democrats: "*[...] Video games have become a patsy for both sides. For the pro-gun right, they offer a credible explanation for violence that turns attention away from gun regulation and domestic terrorism. For Democrats — already on the defensive — they provide a springboard to pivot back to more important, material issues. [...]*"
Heavily discussed more recent violent games include **Hatred** (2014), **Madworld** (2009), the **Call of Duty** series, **Manhunt** (2003), or **Postal 2** (2003). However, older prominent examples make the scope and history of the issue apparent, e.g. **Carmageddon** (1997), **Phantasmagoria** (1995), **Doom** (1993), **Night Trap** (1992), **Mortal Combat** (1992), **Barbarian / Death Sword** (1987), **Commando Libya** (1986), or **Death Race** (1976). The secret of the success of the bigger part of these examples can be identified with the controversy of visual and interactive violence: for instance the aforementioned video game **Carmageddon**, visually and game-play-wise less than stellar, had the unique selling proposition of enabling players to overrun pedestrians, awarding points for virtually killing them.
Politically discussed are video games bringing up, intentionally or not, topics concerned with terrorism, foreign affairs and the depiction of chief of states or otherwise important political figures. On the one hand, there are several violent video games associated with persons running amok, e.g. the perpetrator of the *Columbine massacre* 1999 evidently liked to play the video game **Doom** (1993), whereas the committer of the *Erfurt massacre* 2002 played **Counter Strike** (2000). A slightly different example can be found in **[08:46]** (2015), a virtual reality simulation that lets players experience the *Nine-Eleven* terrorist attack first hand. Here, the recurring discussions evolve around the questions if violent video games encourage violent behavior, if they should be attributed to media glorifying violence, and if the deployment of regulation is justified. The matter is even more sharpened by the availability of highly problematic and morally questionable titles like **Super Columbine Massacre RPG!** (2005) or **Dawson college massacre!** (2010), where players slip into the role of frenzied attackers. Other games aimed at political controversy are parody-games disparaging specific politicians, e.g. **Stay Mayor** (2013) making fun of the *Rob Ford* video controversy, or **KHG** (2015), a board game making fun of Austrian populist politicians.
Another source of controversy in video games is gender discrimination and sexism, with a broad range of examples, happenings, and movements with interwoven dependencies and effects, eventually culminating in the so called *Gamergate* controversy. Concerning Gamergate, *Torill Elvira Mortensen* gives a comprehensive overview of the events that pre-mediated this most complex topic.[168] To name a few relevant examples, there is the video game **Fire Emblem: Fates** (2016) featuring a magic elxir that can be used to cure homosexuality, **Dead or Alive Extreme Beach Volleyball** (2003), where player success is awarded with more lightly dressed player avatars, **Duke Nukem 3D** (1996) which enabled players to pay dancers to expose themselves, or **Gotcha** (1973), an early Atari game featuring controllers shaped like female breasts.
A socioculturally related controversy can be found in video games incorporating, reciting, or even generating racist stereotypes. E.g., the game **Call of Juarez: The Cartel** (2011) awards an

[168] Mor18.

achievement for killing a number of enemies in an area with only African-Americans, or **Freaky Flyers** (2003) featuring racist stereotypes in almost all available player characters. Examples for games escalating the controversies are **Custer's Revenge** (1982), where the players are expected to rape a Native American woman tied to a pole, or **KZ Manager** (1990), a simulation game indexed by the German Federal Department for Media Harmful to Young Persons, where players take on the role of a Nazi concentration camp commandant.

Yet another source of controversy in video games is the demeaning of religion, and again, there is a wide range of relevant examples, e.g. **Smite** (2012) enables players to control a Hindu-goddess, or **Hitman 2: Silent Assassin** (2002), a third-person stealth game featuring a level where the player would fight against turbaned Sikh characters inside a Sikh place of worship. **Operation: pedopriest** (2007) and **Vatican Quest** (2013) are parody games aimed at the issue of child molestation by the Catholic church. Overtly contentious are games like **Muslim Massacre** (2008), a shooting game where the player takes control of an American hero and has to kill all the Muslims that appear on the screen, or **Ethnic Cleansing** (2002), created by the American white supremacist organization National Alliance, where players have to shoot African-Americans, Mexicans, and Jews.

Another much discussed issue concerns video game addiction, a theme recognized by the WHO (World Health Organization), who 2018 included it as gaming disorder in the ICD-11 (11th revision of the International Statistical Classification of Diseases and Related Health Problems). It is frequently discussed by various media, often based on specific titles players spend an over-average amount of time with, such as the early **Space Invaders** (1978), **Everquest** (2001), or **World of Warcraft** (2004). With a more global point of view, the fact that people spend more time with and more money on video games[169] ties in very well with the business models of current video game companies, especially the free-to-play paradigm: often, video game producers make their games available for free with the idea to attract a large audience, and provide in-game purchases to generate revenue. A prominent example for this Freemium business mode can be found in the competitive video game **Fortnite** (2017), where players can spend real-world money on skins to alter the appearance of the player avatars. *Timo Schöber* and *Georg Stadtmann* provide an overview of the economic ideas[170] used in Fortnite, but also point out some of its dangers; in particular, premium skins establish a form of competition, as players compare their skins with the virtual outfits of their teammates / friends, and consequently are able to determine how much money they spent on the game in relation to the others. They point out that players find it embarrassing to participate with the default-skin (within the Fornite community, "default", referring to the default-skin of a player, is a swearword) and may lead to be treated with scorn.

There are many additional sources of video game controversy, including economic aspects (e.g. region-based game pricing policies), questionable game marketing campaigns (e.g. issuing brass knuckles as press-gifts for **The Godfather 2** 2009), censorship (e.g. the deletion of a negative game review on YouTube for **Day One: Garry's Incident** in 2013), working conditions in video game companies (expectations that gaming company employees put in extra efforts during crunch

[169] Ass20.
[170] SS20.

times), video game platform exclusivity (e.g. Epic store exclusives), data privacy issues (e.g. the Xbox One online requirement in 2013), cheating and match-fixing (**Starcraft**-related incidents 2010), player defamation by news reports (**RTL Explosiv** report on gamescom 2011), game review manipulation, doping, pre-mature releases, plagiarizing, attention attracting contentious acts of particular video game streamers, etc.. *Anna Anthropy* explains the term crunch time as follows: "*There exists within the video games industry a phenomenon called crunch mode: working sixteen-hour days, staying at work until the game you're being paid to make is finished. This isn't something you're asked to do – it's expected, a standard condition of the job. And it's likely the reason most people in the games industry, their physical and mental health fizzled, burn out and quit within a few years, forced to retrain and find a new career.*"[171]
However, these controversies do not directly affect or originate from playing activities, and therefore are only of secondary importance in the context of this thesis.
Video game controversies based on violence, politics, gender discrimination, sexism, racist stereotypes, demeaning of religion, and game addiction however can be experienced by the players firsthand, and have effects on the real life: as a topic of discussion or by making them question or even shift their values. The latter is the primary concern of *Anita Sarkeesian* in her video series **Tropes vs. Women in Video Games**: she considers the integration of questionable values in video games as dangerous, because they are shaping and affecting relevant cultures. The portrayal of stereotypes in video games but also in other media is highly problematic, as stereotypes, and particularly reinforced stereotypes, have the capability to become a source of misinformation. E.g., the author is particularly biased against Austrian giveaway newspapers that even profess to be able to influence the opinion of the people: not only can their contents often be attributed to particular political colors, a highly controversial matter due to their claim of political independence, but also do their articles and stories often feature bad practices of journalism, including prejudgments, one-dimensionality, biased replications of articles by news-reporting services, reenforcement of questionable and disputatious values, etc.. Additionally, they tend to try to gain attention by deploying questionable headlines with suggestive wording, more often than not emphasized by exclamation marks. In the opinion of the author, as recipients of national press subsidies, the particular newspapers should counteract the stultification of the people, not encourage it.

5.6.1.2 Video game technology

For several reasons, modern video games often provide mechanisms to export game play events as *external* media, examples range from video captures to screen-shots, from chat protocols to re-usable 3D models. The export capability is the key feature for productive gaming, as it enables players to preserve their makings beyond the game context, i.e. the magic circle. Technically speaking however, especially when using PCs, the export capability can also be achieved by external tools, including the screen-shot tool of the operating system, game video capture software, or audio recording software. As discussed previously, *Jenna Ng* points out the

[171] Ant12.

significance of capturing tools in the context of Machinima productions,[172] where they can be considered the enabling technology.
As pointed out by *Ramón Reichert*,[173] the first Machinima productions relied on the external tool **LMPC** (Little Movie Processing Centre) by *Uwe Girlich*, which enabled its users to create movie-like sequences with particular games. Deeply interesting with the LMPC, as well as with other early tools, is that they were not created or provided by the game developers. *Ramón Reichert* describes these people as Machinima fans, who *hack* available games, appropriate their technologies for their particular objectives, and coincidentally develop media competences. He refers to this re-appropriation of more rigid game systems as transformative play, as do *Katie Salen* and *Eric Zimmerman*. An interesting example for transformative play can be found in the family album feature of the video game **The Sims**.

Game VIII: The Sims 3 user story - Life simulation video game

***Screenshot 5.18*:** The Sims 3 user story

Genre: Single-player open-world life simulation god game

Developer: Darren Gyles, Morgan Godat, Sean Baity, and many more Maxis employees

Publisher: Electronic Arts

Year: 2009

Spread: AAA

Gonzalo Frasca describes it as follows: "*According to the designers of the game, the family album is a feature that has evolved in an unexpected way. Originally, it was simply intended for allowing players to take snapshots of particular moments in their Sim's lives, and then build a family album that could be easily published online. What the designers did not anticipate was that players would use this feature to craft stories starring their Sims. Suddenly, the family album became a comic book. [...] Creating these family album stories is not an easy task. Since Sims are quite autonomous, the author has to wait until she gets the right snapshot to add to the sequence, a job that can be very time-consuming. Unlike other action video-games, where players record their performances on video in order to analyze or show off their skills, the family album storytellers' do not focus on the game itself but use the feature as a narrative tool.*"[174]

Digital post processing also becomes a possibility, as demonstrated by *Duncan Harris*, who drives

[172] Ng16.
[173] Rei15.
[174] Fra01.

his career via video game capturing: as a screen and video capture artist for video-games, he creates promotional assets based on in-game footage, a job requiring both extensive technological knowledge and an artistic disposition. A sample of his work[175] is shown in image 5.19.

Image 5.19: Capture sample for the video game Betrayer, **Duncan Harris**, 2014

In-game photography is considered as a form of new media art, and has prominent practitioners, including *Eva and Franco Mattes*: a relevant piece, *Thirteen Most Beautiful Avatars*, was shown at the Postmasters Gallery in New York. An impression of the work, which was created using **2ndLife**, can be received with image 5.20.

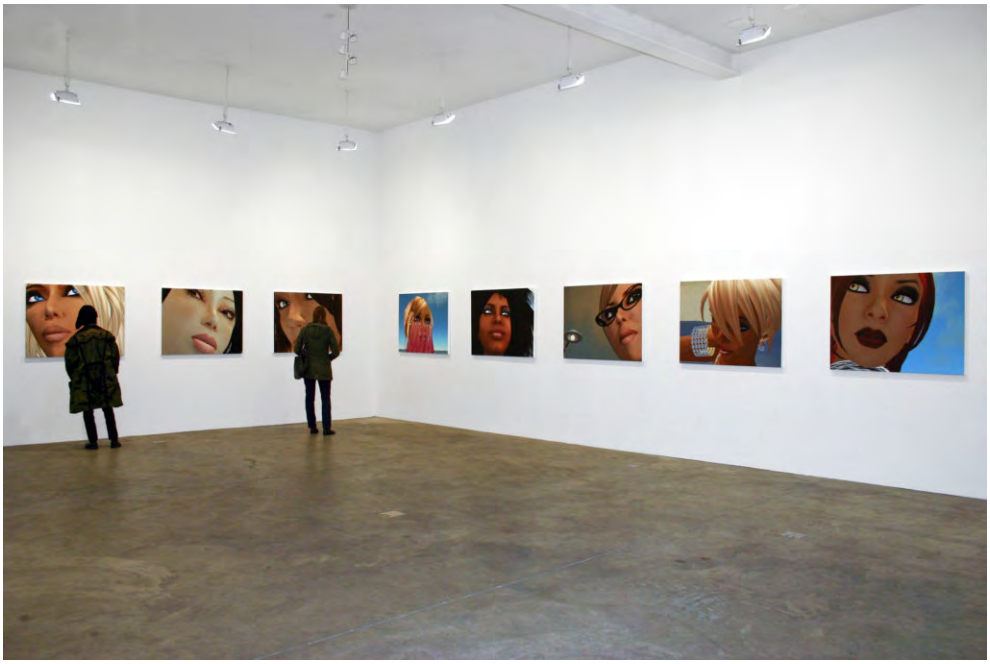


Image 5.20: Thirteen Most Beautiful Avatars at the Postmasters Gallery, **Eva and Franco Mattes**, 2007

[175]Duncan Harris's online gallery can be found here: http://deadendthrills.com/ (accessed 2020-07-07)

5.6.1.3 Video game achievements

A wildly popular mechanism for both players and game designers can be found in video game achievements, summarized by *Lucas Blair*, who developed a taxonomy concerned with game trophies to identify and assess their usefulness as a tool for player motivation: "*An achievement in a video game is a reward or recognition earned by players for an in-game accomplishment. Achievements are often used in video games to extend play time by adding additional goals or by serving as extrinsic motivators added to those incumbent in the game. The concept of achievements has been in video games since Space Invaders (Midway, 1978), which allowed players to earn a hi-score and post their initials for other players to see.*"[176]

A similar concept was deployed for early home entertainment system, as pointed out by *Mikael Jakobsson*: "*The Atari 2600 had a similar system in place almost 30 years ago. For some of the Activision games, the manual listed challenges, for instance to score ten thousand points. If the player managed to do this, took a picture of the TV screen, and sent the photo to Activision, they would in return send a decorative patch made of fabric [...] to the player.*"[177]

T. L. Taylor traces the early games featuring high-scores to **See Wolf**, respectively **Asteroids** and **Star Fire**: "*[...] Sea Wolf in 1976 offered the first high score notation that carried over from game to game ([...]) and, depending on who you source, either Asteroids or Star Fire in 1979 brought the personalized (typically via initials) high score lists to the platform. [...]*"[178]

Video game achievements are often categorized as a meta-game mechanism, as they are usually not directly related to the game objectives, designed with the purpose to promote customer loyalty and increase time spent with a game. E.g., as shown in image 5.21, modern video games feature whole lists of attainable achievements, promoted by video game portals that also provide accessible player statistics (concerned with the achievements).

[176] Bla11.
[177] Jak11.
[178] Tay12.

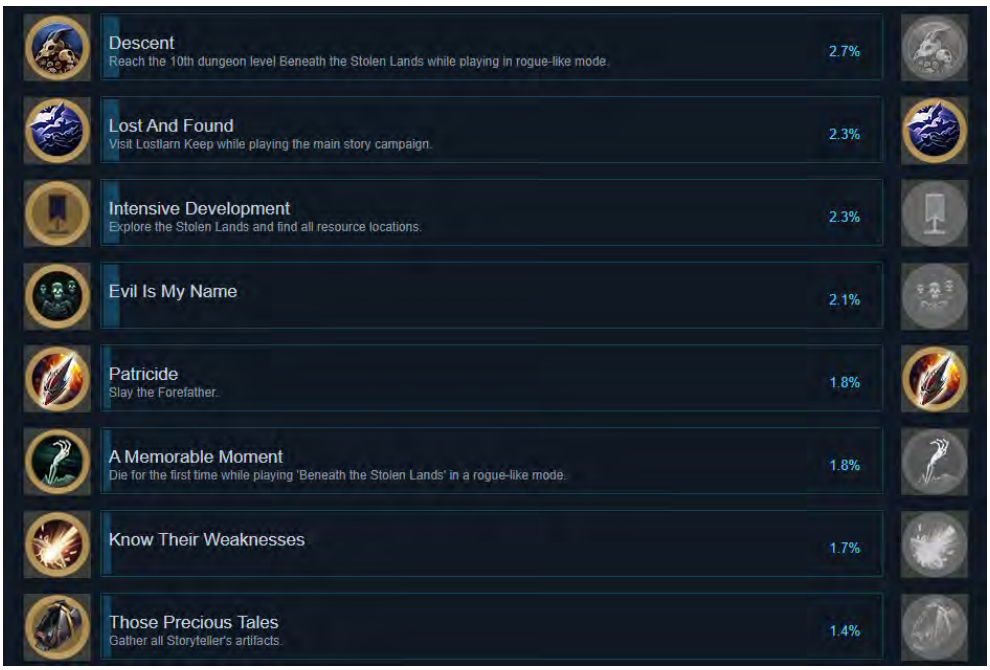


***Image 5.21*:** Global Steam achievements for the game Pathfinder - Kingmaker, **-**, 2020

For the most part, the requirements to obtain the achievements, i.e. the achievement conditions, are visible to the players, and may cause players to take actions to acquire them (goal-oriented achievements). However, their accomplishment may involve a high level of difficulty (e.g. *Descent*), or coded objectives (e.g. *Those Precious Tales*), or more repetitive and even boring tasks. There are also hidden (or unexpected) achievements (e.g. *Know Their Weaknesses*) players may or may not discover in their play-throughs, negative achievements (e.g. *A Memorable Moment*) requiring player failures, or incremental achievements (e.g. reach level 50, followed by reach level 60), to name a few flavors.

Concerning achievements, *Mikael Jakobsson* identifies three player archetypes: casuals, hunters and completists. He describes the casuals as follows: "*Many gamers, me included, only relate to achievements in what we could call a casual manner where the achievement system adds value by providing mental scaffolding utilized in the process of shaping the gaming experience. When I play games on the Xbox 360, I usually do not think of achievements until, by chance, one is unlocked. It is not until I have finished a game but want to continue playing it the achievements come into play in a significant way. [...]*"[179]

Achievement hunters are pictured in the following way: "*Achievement hunters typically care more about the accumulated gamerscore than getting all the achievements in any given game. Their approach is to deplete a game of all its time efficient achievements as quickly as possible and then move on. [...] While there are several pleasures associated with achievement hunting, like the social pleasure of being included in a select group of elite gamers, the main drive is to exhibit skill and dedication to others. [...]*"[180]

[179] Jak11.
[180] Jak11.

Finally, there is the third player category: " *Video game completists [...] are not collecting games, but rather items and rewards in games such as unlockable character models [...]. They consider games to be unfinished until they have everything, including all achievements, that can be collected in a game. They often self-identify as completists [..] and their approach to gaming leaves a distinctive trace in their achievement records. To these players, achievements make the type of work they always have put into their games more concrete and visible.*"[181]
For players, obtained achievements have value outside the game virtuality: as trophies, they can be viewed by or shown to friends, and consequently induce competitiveness (player competitiveness is apparent since the early high-score mechanism of space invaders).
On some platforms / with some games, achievements are interwoven with virtual currencies: for the completion of specific achievements, players are awarded in-game items that can be used for tradeable cosmetic modifications or even item upgrades. Evidently, game producers manage to make good use of player achievements: players are motivated to spend more time with specific games, bringing about network effects (also referred to as *demand-side economies of scale*, i.e. the value of a product increases with the number of users). Also, considering the aforementioned achievement hunters, the incorporation of achievement mechanisms in digital games can also effect the increase of sales.
A unique perspective on video game trophies can be found in the **Pain Station I**, an installation by *Volker Morawe* and *Tilman Reiff* from 2001.

Artwork II: Pain Station I

Artist: Volker Morawe and Tilman Reiff

Year: 2001

Pain-inflicting installation adapting the arcade game Pong

Image 5.22: Pain Station I

The authors describe it as follows: " *[...] PainStation comprises a box structure housing a horizontal screen over which the two players face each other. The software is based on Pong, an early computer game. Players use their right hands to control a bat on screen, and must keep their left hand on the console's "pain execution unit". Removing your hand means breaking the circuit – game over. During play, if your screen bat misses a ball, your left hand suffers the consequences through the application of heat, electric shocks or a quick whipping on the back of*

[181] Jak11.

your hand. "It's amazing how players get engrossed in the game to avoid being hurt", says Reiff, "and how audiences behave. The combination of the PainStation's sound effects, the behaviour of the players and onlookers makes the game an experience for the audience as much as the players." Many players have ended up with red, bruised hands – although not for long. "[182] Concerning PainStation trophies, the players tend to openly display their wounds, take pictures of their injuries, and upload them to social media sites and particular photo galleries; one such testament is featured in image 5.23.

***Image 5.23*:** PainStation play results, **Simone Angelis**, 2011

5.6.1.4 Serious and learning games

Another popular concept for the value transfer from play to real life can be found in educational and / or training games, i.e. serious games with the specific goal to teach specific skills and / or the acquisition of knowledge: by playing relevant games the players are capable of imparting knowledge, including general knowledge, knowledge required at school, specific skills for their work, and capabilities hard to come by in real-world situations, such as accident scenarios.
Generally, serious games are considered games with purposes beyond pure entertainment. *Fedwa Laamarti*, *Mohamad Eid* and *Abdulmotaleb El Saddik* approach serious games based on their literature survey in the following way: "*Probably, the most common definition of serious games is "games that do not have entertainment, enjoyment, or fun as their primary purpose" [...]. Following this definition, serious games can be distinguished from video games by their design objectives in that serious games have a primary design objective other than entertainment. However, basing the definition of a serious game on its design objective causes a problem [...]. This problem is that if one wants to decide whether a specific game is a serious game or not, one would necessarily need access to the objectives or intentions of the game designer while designing*

[182] MR01.

that given game, which is far from practical. [...] serious games are determined by some developers intention - a highly esoteric and impractical conceptualization. Developers' intentions are rarely accessible. [...] Hence, we define serious games as an application with three components: experience, entertainment, and multimedia [...]"[183]

In the context of this thesis, the most common definition, as they call it, is sufficient; accordingly, games facilitating productive gaming can be considered as serious games. However, concerning productive gaming, the design objectives are secondary - it is inconsequential whether a game was made for productive gaming or not, as long as it can be used for productive gaming. With regard to the aforementioned screen-shot / export capabilities of current video games, the AAA video game **Skyrim**[184] provides a sophisticated character appearance editor, used by players to contribute to the **Faces of Skyrim** virtual exhibition (an example is shown in image 5.24) curated by *Andrew Cull* - this particular game is not considered a serious game, and it was most likely not created with the intent to incite virtual galleries. Still, players use it for that exact purpose, and therefore *productively.*

***Image 5.24*:** Character created using the game Skyrim, **89 G.J**, 2013

A central characteristic of serious games can be found in their proximity to simulation; *Geoffrey M. Rockwell* and *Kevin Kee* eloquently summarize the stance of *Espen Aarseth* on this exact relationship: "*[...] Espen Aarseth has argued that [...] simulation is what drives most "serious games" [...]. In simulations, and I quote, "knowledge and experience is created by the player's actions and strategies". Aarseth calls for recognition of simulation as "a major new hermeneutic discourse mode, coinciding with the rise of computer technology, and with roots in games and playing.*"[185]

On the other hand, *Ian Bogost* points out a critical limitation of serious games, caused by authorial intention: " *Serious games are videogames created to support the existing and established interests of political, corporate, and social institutions. [...] Educational games translate existing pedagogical goals into videogame form; government games translate existing political goals into videogame form; health games provide doctors and medical institutions with videogame-based tools*

[183] LES14.
[184] Bet+11.
[185] RK11.

to accomplish their existing needs; military games help armies and soldiers address existing global conflicts with new, cheaper, and more scalable simulations; corporate games provide executives with videogame-based tools to accomplish their existing business goals; first responder games offer simulated views of already known methods of responds to natural disaster or terrorist incident; and science games provide appealing videogame-based tools to clarify known principles and practices. "[186] Consequently, serious games are generally limited to known principles and practices, and are aligned with fixed values and world-views.

In common usage, educational games are considered as serious games with the additional goal of imparting knowledge. However, *Anastasia Salter* argues for a clearer differentiation, as otherwise all games can be deemed educational: "*All games might be termed educational by a broad definition: they demand learning as part of mastery of the system. Depending on the genre of the game, success might be possible only through solving puzzles and problems, making observations and judgments of an environment or situation, employing reflexes and mastery of a control system, or working in cooperation with a team whose members employ different skill sets. However, educational games are often understood as something separate from video games in general, with a history that predates the introduction of the computer into educational spaces. Educational games marketed specifically for the socialization and skill development of children predate video games, with popular examples ranging from Milton Bradley's The Game of Life (1860) to the Indian board game Snakes and Ladders. The term educational games must likewise encompass games employed for the development of skills and knowledge among adults, including the genre of wargames, particularly as used for military training but also played more broadly for simulating strategy, tactics, history ([...]).*"[187]
Still, as *Reem Altamimi* and *Geoff Skinner* point out, video games in general often have positive impacts relevant for the education context:
"

- *Improving cognitive and reading skills.*
- *Motivating logical thinking process.*
- *Strengthening observational skills.*
- *Acquiring basic and factual knowledge.*
- *Enhancing the abilities of problem-solving and decision-making.*
- *Developing strategic planning.*
- *Supporting spatial awareness.*

"[188]

[186] Bog10.
[187] Sal16.
[188] AS12.

Again, *Ian Bogost* points out a central limitation of educational games; according to him, they mirror customary classroom educational approaches, originating from two philosophies: behaviorist and constructivist: ” *Videogames may not be complete models of the material world, but they are certainly microcosms. These worlds, in the opinion of behaviorist-influenced educators, stand in for the material world in a one-to-one fashion. In so doing, videogames simulate the actual dynamics of the material world, and playing such games has the same effect as would real learning in the material world. That is to say, reinforcement through gameplay establishes repeat behavior, to which the player/learner adapts. [...] What about the constructivist-influenced approach to videogames? In Montessori, tactile interaction with abstract shapes and puzzles is not intended to produce abstract expressionist scupltors. Rather, the creative and menial work Montessori recommends for her students [...] was conducted ”[to make] them accomplish everything with enthusiasm that is almost excessive.” [...] From this perspective, videogames teach abstract principles that service general problem-solving skills and learning values. [...]* ”[189]

One of the earliest and also most successful learning games is the **Oregon trail**,[190] a text-based strategy game of 1971.

Game IX: The Oregon Trail - Early digital serious game

***Screenshot 5.25*:** The Oregon Trail

Genre: Text-based strategy video game

Developer: Don Rawitsch, Bill Heinemann, Paul Dillenberger

Publisher: MECC

Year: 1971

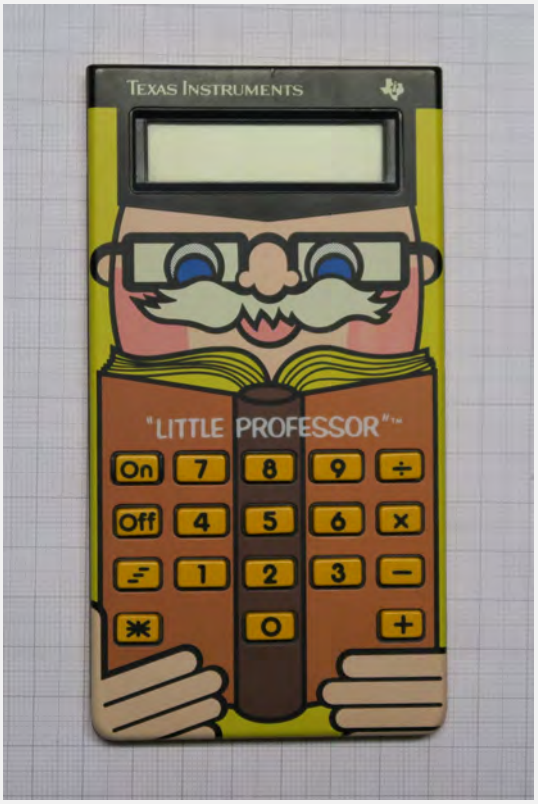
Spread: AA

Initially, it was developed for a junior high school to be used in the context of a history class; although the first version was without graphics and could only be interfaced via teleprinters, it was much affected by the school pupils. Players assume control of a wagon train journeying the Oregon Trail in 1847, and had to decide how to allocate resources and how to spend money, but the game features also interactive sequences for hunting and wagon defense. Besides teaching historical and geographical facts, the Oregon Trail conveys a broader understanding of the difficulties settlers had to face during the American western expansion in the 19th century as an interactive experience.

[189] Bog10.
[190] RHD71.

Another early example for a digital educational game can be found in **The Little Professor**[191] by *Texas Instruments*, an electronic calculator generating mathematical expressions to be solved by the player.

Game X: Little Professor - Electronic educational toy



Genre: Backwards-functioning calculator

Developer: Texas Instruments

Publisher: Texas Instruments

Year: 1976

Spread: AA

***Screenshot 5.26*:** Little Professor

A good summary on how it works can be found in the *Texas Instruments calculators for students* advertisement leaflet of 1976:

"*The Little professor is a unique product designed specifically to aid children 5 years and older in exploring basic mathematics. Although it is not truly a calculator, the Little Professor generates a sequence of problems – over 16.000 preprogrammed problems in all – and involves children in math practice through an enjoyable instant feedback and reinforcement situation. By using the four-position switch indicating degrees of difficulty, and the appropriate function key ([+], [-], [x], [/]), the teacher can select a range of random math problems needed for individual students. The student can then work independently as he progresses toward mastering math skills. Problems appear on the large LED display as an equation, and the child is given three opportunities to input the correct answer through the keyboard. An error indication is displayed for one second each time the child incorrectly answers the problem. If the correct answer is not given in three chances, the completed equation appears in the display, allowing the child to see the mistake. By*

[191] Ins76a.

pressing [GO], he can then proceed to the next problem. If the child inputs the correct answer, the complete equation is displayed for one second and a new problem appears. As an additional incentive, the Little Professor displays the score of correct first answers after each set of 10 problems."[192]

Although these two examples feature active play, more passive edu-play along trivialized game elements are considered problematic; also problematic is the fact that for the most part learning games target younger audiences. *Anastasia Salter* pointedly refers to relevant edutainement approaches as *chocolate-covered broccoli*: "*One subgenre of educational games that particularly embodies the philosophy of "chocolate-covered broccoli" or rote learning apparently made palatable by gameplay is "edutainement" ([...]). As Mitchel Resnick (2004) points out, the very notion of edutainement suggests the player is a "passive recipient", which undermines any activeness in play. Edutainment is not a category exclusive to games: television programs such as Sesame Street and Mr. Rogers also fall under the term and often include lessons and drills as part of their narratives. [...] [...] games excel at fostering learning mindsets that "are intrinsic to the game while the students are learning the content". Through game playing, students learn how to collaborate, solve problems, collect and analyze data, test hypotheses, and engage in debate" (Klopfer 2008, 19). This type of learning is not limited to children, but it is only rarely accepted explicitly marketed as a benefit for older audiences [...].*"[193]

Ian Bogost argues that games (especially digital games) are exceptionally suitable for teaching and learning purposes. He proposes the concept of *procedural rhetorics*, i.e. the practice of using processes persuasively, or authoring arguments through processes, as a key advantage of digital media: " *Procedural rhetorics afford a new and promising way to make claims about how things work. Consider a particularly sophisticated example of a procedural rhetoric at work in a game. The McDonald's Videogame is a critique of McDonald's business practices by Italian social critic collective Molleindustria. The game is an example of a genre I call the anti-advergame, a game created to disparage a company rather than support it. The player controls four separate aspects of the McDonald's production environment, each of which he has to manage simultaneously [...]. The McDonald's Videogame mounts a procedural rhetoric about the necessity of corruption in the global fast food business, and the overwhelming temptation of greed, which leads to more corruption. [...] The game makes a procedural argument about the inherent problems in the fast food industry, particularly the necessity of overstepping environmental and health-related boundaries.* "[194]

Of course, serious games are not limited to the domain of education, common other serious game scenarios include health, therapy, recruitment, and the creation of art.

Digital games with potentially beneficial effects on the players' healths are so called active video games, i.e. video games that make players use body movement for interaction. Successful active video game platforms are the *Microsoft* **Xbox** in conjunction with the **Kinect** device, the *Sony* **Playstation Move**, and the *Nintendo* **Wii**. *Reem Altamimi* and *Geoff Skinner* consider active

[192] Ins76b.
[193] Sal16.
[194] Bog10.

video games as a promising approach for an increase in overall health: "*Whilst active video games may not provide the same health benefits as real sports, they certainly have the potential to decrease the amount of time children spent undertaking sedentary behavior. Active video games are a valuable step forward in tackling the problem of childhood obesity.*"[195]

Concerning therapy games, in our previous mental care video games, such as **Reach Out Central** or **SPARX**, were addressed, their advantages were summarized as follows: "*In the last few years, a new research direction in mental health care has evolved: mental health care via virtual game worlds, an approach which has many advantages: it is interactive and situational, and enables the detection of certain mental health problems, as well as the display of correct behaviour in abnormal situations. It enables users autonomous access to mental health services in a non-threatening way that is appealing to the youth and an alternative for people reluctant to conventional therapy.*"[196]

Concerning games aimed at physical therapy, their conveniences were summarized in the following way: "*Interactive game systems can be very beneficial for physiotherapies sessions: they can track the patient's progress from session to session, collect, analyze and edit otherwise unavailable session data for the therapists, enable autonomous training sessions and motivate users by providing specific rewards, such as an increased game score. [...] the Nintendo Wii device [...] has been used for many purposes [...] including balance impairment reduction for elderly patients, therapy for patients with prosthetic limbs, and is considered generally more effective for individual physiotherapy exercises, because patients tend to exercise longer, more comfortable and are provided sporting challenges.*"[197]

Concerning recruitment, the most famous digital serious game is probably **America's Army**,[198] a multi-player first-person shooter developed and published by the U.S. Army.

Game XI: America's Army - Serious first-person shooter

***Screenshot 5.27*:** America's Army

Genre: Serious game aimed at advertising and recruitment

Developer: United States Army

Publisher: United States Army

Year: 2002

Spread: AAA

Zhan Li rates America's Army a cost-effective recruitment project: "*One of the strongest arguments made in support of the America's Army project is that the impact of the game is much*

[195] AS12.
[196] Bra13.
[197] Bra13.
[198] Arm02.

more cost-effective than other forms of media marketing the US Army uses. For instance, free distribution of the game through online downloads and partnership video game magazine CD-ROMS make distribution costs to minimal levels. The development costs of the game - although moderately high compared to the average high-end commercial PC game - are marginal when considered in relation to the US Army's 2.2 billion dollar annual recruiting budget. It is estimated that if the game motivates approximately an extra 400 recruits to join, then the project would have recouped its initial costs [...]"[199]

Due to its success, topic, mechanics and objectives, the game is surrounded by controversies, including its ESRB (Entertainment Software Rating Board) teen rating, its deployment at public schools, its accessibility, and its way opposing forces are represented in the game. Of particular interest is the game based performative intervention **dead-in-iraq** by *Joseph DeLappe*, a work using America's Army in ways not intended by the developers.

Artwork III: dead-in-iraq

Artist: Joseph DeLappe

Year: 2003

Game based performative intervention, using America's Army

***Image 5.28*:** dead-in-iraq

He summarizes dead-in-iraq as follows: "*This work commenced in March of 2006, to roughly coincide with the 3rd anniversary of the start of the Iraq conflict. I enter the online US Army recruiting game, America's Army, in order to manually type the name, age, service branch and date of death of each service person who has died to date in Iraq. The work is essentially a fleeting, online memorial to those military personnel who have been killed in this ongoing conflict. My actions are also intended as a cautionary gesture. I enter the game using as my login name, dead-in-iraq and proceed to type the names using the game's text messaging system. I stand in position and type until I am killed. After death, I hover over my dead avatar's body and continue to type. Upon being re-incarnated in the next round, I continue the cycle. As of 12/18/2011, the official withdrawal date of the last U.S. troops in Iraq, I completed the input of the last 200+ names into the game, for a total of 4484 names.*" [200]

[199] Li03.

[200] retrieved from Joseph DeLappe's project website http://www.delappe.net/project/dead-in-iraq/, 2020-07-16

Another category of serious games are so-called art games, i.e. games with an artistic intent. *Paolo Pedercini* identifies several common strategies involved in art games,[201] including

- *art modifications*, i.e. artists use or appropriate game technologies to create interactive pieces,
- *games made by artists*, i.e. games made with a distinguishable artistic intent,
- *games about art*, i.e. games referencing specific art works,
- *games redefining play*, i.e. games employing unusual game objectives,
- *game art*, i.e. artworks incorporating motifs or themes from game culture,
- *art with games*, i.e. more performative interventions with games, such as dead-in-iraq,
- *art games*, i.e. games with a strong emphasis on craft and on the procedural aspect of video-games,
- *games for grown-ups*, i.e. games aimed at more complex emotional responses,
- and *installation games*, i.e. games specifically designed for art spaces / audiences.

An interesting example for an art game, classified as a *game redefining play* by Pedercini, can be found in **Lose/Lose**[202] by *Zach Gage*, 2009.

[201] Ped13.
[202] Gag09.

Artwork IV: Lose/Lose

Artist: Zach Gage

Year: 2009

Video-game with real life consequences

Image 5.29: Lose/Lose

Lose/Lose can be considered as an anti-thesis to productive gaming, as it deletes files of the players' computers as the game progresses, and therefore disposes of potentially valuable files. The author summarizes it as follows: "*Lose/Lose is a video-game with real-life consequences. Each alien in the game is created based on a random file on the player's computer. If the player kills the alien, the file it is based on is deleted. If the players ship is destroyed, the application itself is deleted. [...]*" [203]

5.6.1.5 Player communication

Another aspect can be found in multi-player games and virtual games worlds facilitating communication hubs. *Katie Salen* and *Eric Zimmerman* consider the ability to provide networked communication a central feature of video games: "*A final trait that many (but not all) digital games possess is that they can facilitate communication between players. There are many forms of digitally mediated communication, from email and text chat to real-time video communica-*

[203] retrieved from Zach Gage's project website http://loselose.net/, 2020-07-16

tion. Two Game Boy consoles connected through a link cable can even be considered a miniature digital game network. It is clear that all multi-player games, digital or non-digital, are contexts for communication among players. However, digital games offer the ability to communicate over long distances and to share a range of social spaces with many other participants. For example, the persistent worlds of Ultima Online draw tens of thousands of players, all brought together in the same complex social space. [...]"[204]

Usually in video games, player communication, when made possible, is aligned towards the game mechanics. For instance, in the competitive team shooter **Counter Strike**, players communicate and adjust tactics with their team-members as game play progresses, giving them an competitive edge. The same applies for cooperative multi-player games such as **World of Warcraft**, where players discuss roles, positioning and strategy for more involving end-game raid scenarios. The latter game also awards players who team up with others with more experience, better in-game rewards, and the possibility to attend content otherwise not accessible.

Another central aspect to player communication is fandom - its capability of connecting people, how it shapes the relevant player cultures, and how it involves people with specific titles. Primarily concerned with e-sports, *T. L. Taylor* points out the relevance of fandom as follows: " *What is also striking is how much fandom extends throughout the scene. In my conversation with people involved in all aspects of e-sports the passion and love for it came through over and over. At events you could tell referees were often fans of the very people they were judging. Commentators were regularly supporters of particular games or players, through the worked hard to keep those comments to the back stage or more informal venues. Tournament organizers and journalists were often fans who had transformed their love of the games into a professional identity that allowed them to keep a foot in that world. [...]*"[205]

Modding, a practice tightly interwoven with fandom, is examined separately in a later section (5.6.3.2).

5.6.1.6 Game play affecting real life values

As an inspirational example for game play affecting real life values, an often debated issue is the question if the playing of violent video games increases the likelihood of resorting to violence in real life: do digital playing activities have the power to influence moral issues of the players? For the particular question concerning readiness to use violence, the answer is a cautious no (as discussed before, many studies have been published in the context of this exact questions, deploying a multitude of methods and yielding inconsistent results; according to the *American Psychological Association*, there is a link between violent video game exposure and aggressive behavior; however, there is no evidence of a correlation, let alone a causation between violent game exposure and violent behavior, which is a specific form of aggression). For the general question whether play can affect real life values, the answer is a yes, as highlighted by subsequent examples.

[204] SZ04.
[205] Tay12.

A circumspect and scientifically sound example can be found in the domain of active games, i.e. games that require and promote physical exercise. Concretely, as shown in a study by *Jorge Peña* and *Eunice Kim*, the appearance of an in-game avatar can have an effect on real-life physical activities: "*The findings revealed that the appearance of self and opponent avatars reliably affected physical activity in real life as participants played an exergame. While playing virtual tennis, female participants operating a normal weight self avatar showed increased physical activity relative to those operating an obese self avatar.*"[206]

An example for less desirable effects on real life can be found an a study conducted by *Ulrich W. Weger*, *Stephen Loughnan*, *Dinkar Sharma* and *Lazaros Gonidis* in 2015. The authors conclude that playing digital role-playing games may deteriorate the ability of making correct decisions by increasing computer-related social conformity: "*The results of the present study show that participants follow computers in making a wrong judgment—indicating that social conformity also emerges when opinions are voiced by nonhuman agents. More importantly, a brief period of immersive video gaming (here, 7 min) increased the extent to which individuals exhibited such social conformity. [...] The fact that participants calibrated their judgments with inaccurate computer votes — and did so increasingly after playing immersive videogames and in as socially sensitive a context as a job selection task — is noteworthy at a time when video gaming is so widespread [...]*"[207]

An entire video game category befitting the context of affecting real life values can be found in anti-advergames (advergames are commonly understood as games made with the purpose of advertising), a term proposed by *Ian Bogost* to describe digital games either advertising *against* a company, or working against the practice of advertising in video games. A prominent example can be found in **The McDonald's Video Game**.

Game XII: The McDonald's Video Game - Anti-advergames

Screenshot 5.30: The McDonald's Video Game

Genre: Business-simulation game criticizing the McDonalds corparation via game mechanics

Developer: Molleindustria

Publisher: Molleindustria

Year: 2006

Spread: Online game

In an interview with *Patrick Dugan*, *Paolo Pedercini* explains how playing The McDonald's Video Game conveys difficulties of and at the same time addresses criticisms to the fast food

[206] PK14.
[207] Weg+15.

industry: " *[...] Playing fair is not sufficient to satisfy the board of directors but on the other hand using dirty (but unfortunately very similar) tricks, you produce medium and long-term effects and consumer dissent that equally threaten your company. We wanted to explain why we think that fast-food economy is unsustainable and a fair meat industry can only be a marketing claim. [...]* "[208]

In the same interview, Pedercini also addresses the advantages of the game-format: " *Games can reach people who might not normally be receptive to political messages. Games and non-linear texts in general can easily describe very complex systems such as the economic and social ones. Ted Friedman once said that it's easier to imagine a video game based on Marx's Capital than a movie. Anyway games have many rhetorical potentials that are almost unexplored, we are still at the beginning.* "[209]

Ian Bogost summarizes The McDonald's Video Game as follows: " *The McDonald's Video Game is a critique of McDonald's business practices by Italian social critic collective Molleindustria. The game is an example of a genre I call the anti-advergame, a game created to censure or disparage a company rather than support it. The player controls four separate aspects of the McDonald's production environment, each of which he has to manage simultaneously [...]. More extreme tactics are also available: the player can bulldoze rainforest or dismantle indigenous settlements to clear space for grazing [...]. These tactics correspond with the questionable business practices the developers want to critique. [...] The game makes a procedural argument about the inherent problems in the fast food industry, particularly the necessity of overstepping environmental and health-related boundaries. [...]* "

5.6.1.7 Music video games

Audio in video games looks back upon a history of about 50 years, in large part driven by the advancement of relevant technology. Still, the notion is ambiguous, as it is used to refer to ideas: " *The term game audio and game sound (used interchangeably) refer to the combination of music, sound effects, and voice acting that make up a given game's soundscape.*"[210]

In his summary concerned with the historical development of game audio,[211] *William Gibbons* points out several key moments: the earliest commercially video games were, apart from the sounds made by the controllers on interaction, such as button clicks, free of music and sound effects, as they were more focused on the visual representations. The advent of coin-operated arcade machines caused the incorporation of sound effects, to both attract players and to add to their sense of excitement. During the 80s, many video games made, in the tradition of silent movies, use of pre-existing music, particularly of compositions by *Bach* and *Tchaikovsky*. In the second half of the 1980s, in order to better align game-play with music, games designers tried to make use of continuous music, i.e. shorter musical segments that are played back as loops. With

[208] Dug06.
[209] Dug06.
[210] Gib16.
[211] Gib16.

increasing difficulty, these loops would than be played back at a faster rate. *William Gibbons* argues that the advent of home-consoles encouraged continuous music, as home environments are generally much quieter than pubs and arcades, therefore the game music was more noticeable. The gradual improvement of game hardware made it possible to experiment with more sophisticated approaches to dynamic music, where player progression effects the musical contents for increased immersion and emotional affect. At first, developers relied on layering and branching techniques, i.e. playing back multiple voices, selected via in-game events, at the same time, and jumping to different parts in a pre-made arrangement respectively. Since 2000, video game composers deploy aleatoric elements, i.e. chance-based playback triggered by in-game criteria, facilitating sound-scapes unique to each play-trough. Another more recent method employed by video game composers is the integration of generative soundtracks, i.e. music scores algorithmically composed in real-time, again cued by in-game events and limited by pre-programmed probabilities.

Apart from this brief historical overview, in the context of this thesis only video games with more direct player / music interactions are examined. These interactions are not limited to the magic circle, as players repeatedly have exploited ways to alter game audio and reuse it in different contexts. Highly relevant for productive gaming, *Karen Collins* emphasizes the aspect of co-creativity concerning game audio: " *With video games, interaction with sound is a broad concept that goes beyond the playing of the game into altering the sound for players' own creations. Game sound becomes a form of play in the practices described here – including recontextualizations of game sound in other forms of music, covering, sampling, and using game sounds in nongame contexts for the purposes of personal expression. Players like to play with game sound, and interacting with that sound takes a great many forms. Sonic interactivity can mean taking elements out of a game and reusing them (in new songs or in machinima, for instance) or putting new sonic elements into the game (through voice and music, for example). Interactive media by its nature encourages a desire to engage in these types of cocreative practice and to find ways in which the game – and the experience of game sound – can be made our own. By calling into question notions of authorship through theses types of cocreativity, the line between professional artist/creator and consumer/player is disintegrating. These forms of cocreative interactivity extend the life of games, although they present copyright problems. [...]* "[212]

Arguably, this co-creation already occurs with commercial performative music games, as the music depends on, and to varying degrees corresponds to, player interaction: by simply playing relevant games, individual scores are generated, caused by a shared authorship due to pre-programmed audio elements and player input. Also, the music can be perceived by non-players, e.g. a crowd audience at a game faire, house-mates, neighbors, or even Twitch viewers. According to the Game Innovation Database, the first example of a digital game with player / music interaction is **PaRappa the Rapper**,[213] summarized as follows: "*PaRappa the Rapper is the first game where players can actually interact with music within a game, and where that is the actual focus of the game. In PaRappa the Rapper, players control a title character of the same*

[212] Col13.
[213] Nan+96.

name, and must hit a combination of buttons in the correct sequence and with the correct timing. If executed correctly, PaRappa will rap a song properly, and players can advance to the next rap challenge. PaRappa is also aided by a unique visual look, where all the characters appeared to be cut out of two-dimensional paper, but their surroundings are three-dimensional environments."[214]

Game XIII: PaRappa the Rapper - Early music game

***Screenshot 5.31*:** PaRappa the Rapper

Genre: First game where music interact is required and focused

Developer: NanaOn-Sha

Publisher: Sony Computer Entertainment

Year: 1996

Spread: AAA

Consequent continuations of PaRappa the Rapper can be found in games like **Guitar Hero**, **Rock Band**, or **SingStar**, as their main game mechanic is aligned towards performing music, with the help of specific instrument-like game interfaces. E.g. in Guitar Hero, players perform a popular song with a guitar-shaped interface, with the goal to hit the colored buttons at specified times, represented as an animated score, making accurate timing and lots of training necessary. The player takes on the role of a rock star on stage, and the audio-visual presentation of the game strengthens this illusion. On the other hand, the player is not creating a new song, quite the contrary: a perfect score corresponds to an accurate playback of the original song.
Karen Collins identifies different mechanisms facilitating more original music creation inside games: " *There are a variety of mechanisms through which players may perform music inside a game or virtual world [...]. [...] Some games have allowed player-characters to play a musical instrument in the game, although they may have little control over the music being played back. [...] In some cases, players can compose music by pressing music-mapped keys or inputting an ABC Notation file to create and perform their own music in virtual worlds [...].* "[215]

Thomas Studley and *Richard Vella* and *Nathan Scott* and *Keith Nesbitt* propose a specific category for music games enabling the creation of original songs: *creative-based music games.* In order for a game to qualify as a creative-based music game, it has to meet several conditions: "*For 'music', 1) the core gameplay activity must be predicated on musical decision-making and 2) the player must be able to influence the production of music through the direct use of game mechanics. For 'creative-based', 3) the player must plausibly be able to mentally frame their use of the mechanics as having created new music in all instances of play. For 'game', 4) an 'unnecessary obstacle' must be enforced by an automated game mechanic, and 5) the player must 'exert*

[214] Cen04.
[215] Col13.

effort' to achieve a self-imposed 'aesthetic goal', the value of which is mediated by their personal music bias, and for which the emotional 'consequences' are both self-negotiated and 'optional'. Finally, 6) the 'game' must be apprehended as an activity rather than an object."[216]

Besides their own project **EvoMusic**, they classify **Soundrop** as a prototypical example. As shown in section 6, our project foreverloops, as well as the previously discusses SimTunes, can also be considered creative-based music games, as all six criteria are met by either of them.
Another example for a creative-based music game can be found in the installation **Overbug** by *Hiroshi Matoba* from 2008.

Artwork V: Overbug

***Image 5.32*:** Overbug

Artist: Hiroshi Matoba

Year: 2008

Circular performance tool for minimal and dance music: Circles, with specific event-points, are used to describe interconnect-able tracks for virtual bugs, which move along them and trigger sound events in a rather stochastic way.

In a previous introduction to productive gaming, Overbug was summarized as follows: "*Overbug is a circular performance tool, but not a linear sequencer as it does not allow exact note-on events to be set up at specific times. Circles with specific event-points are used to describe compoundable tracks for virtual bugs that randomly traverse the setup, triggering relevant sound events. In terms of composition, Overbug is designed for the creation of minimalist and dance music, providing a novel interface for the creation of polyrhythmic music.*"[217]

Summarizing, there are many different examples for music video games with varying degrees of authorial control over the musical creations; some of the examples enable the creation of new music, and consequently the co-creation of music, and can therefore be considered as games encouraging productive gaming. Common ground of all music video games is their ability to make their players experience music interactively, they give variety to the traditional linear way of music consumption. Also, with the exception of serious games aimed at teaching skills for particular musical instruments (where music originates from the musical instruments), game audio is generally considered as *schizophonic*: *schizophonic*, a term coined by composer *Raymond Murray Schafer*, denotes sounds separated from their source, including synthetic sounds and recordings.

[216] Stu+18.
[217] BBS16.

5.6.1.8 Productive use of construction games

2016, we provided a preliminary introduction to the industrial use of construction games: "*A related concept can be found in the industrial use of construction games, e.g. the utilization of Lego for architectural prototypes, or using Minecraft*[218] *(in creative mode) as a 3D modeling environment. In both cases, productivity is a subject matter. The main distinction originates from the objectives. The industrial use of construction games typically involves predefined ambitions given by constituents, whereas in productive gaming the players themselves determine creational objectives before or during play.*"[219]
Of particular interest is the deployment of Lego bricks for science; examples range from the construction of a Brewster angle microscope[220] to applications in opto-mechanics[221] to laboratory automation[222] tasks. While Lego is generally considered a non-digital toy, most of these examples involve programmable components as well, and therefore the digital domain.

An example of a work using Lego bricks bridging the analog and digital domain can be found in **NPC** by *Marlene Brandstätter*.

Artwork VI: NPC

***Image 5.33*:** NPC

Artist: Marlene Brandstätter

Year: 2008

2ndLife modification aimed at the animation of a bothersome non-player-character

She summarizes her work as follows: " *[...] NPC is also the title of the author's artistic intervention in 2008: all interactions of Enelia Laval, the author's avatar in the virtual world of Second*

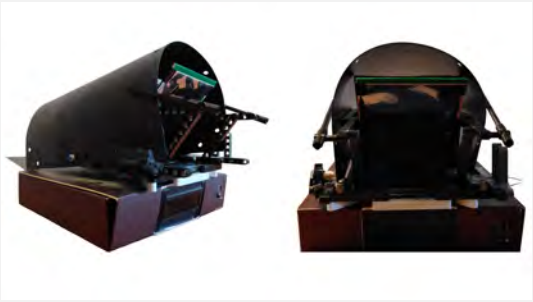
[218] Per+09.
[219] BS16.
[220] Construction of a home-brew Brewster angle microscope, as shown https://errantscience.com/blog/2012/10/01/bam-on-the-cheap/ (last accessed 05022020) or https://hackaday.com/2012/10/01/tens-of-thousands-saved-by-building-a-bam-microscope-out-of-lego/ (last accessed 05022020)
[221] Construction of a home-brew laser beam splitter, as shown https://hackaday.io/project/6586-lego-optics-lab-beam-splitter (last accessed 05022020)
[222] Lego-based laboratory automation, as shown https://hackaday.com/2012/04/19/lego-mindstorms-used-to-automate-tedious-laboratory-tasks/ (last accessed 05022020) or https://spectrum.ieee.org/the-human-os/biomedical/devices/diy-lego-robot-brings-lab-automation-to-students (last accessed 05022020)

Life[SecondLife], are completely processed by a computer script and a robotic construction. Enelia Laval is walking around independently from human interaction, which is not intended or explicitly supported in Second Life, harassing other players verbally. Responses by other players are parsed and commented with offending statements. Since each avatars are exclusively controlled by human users in Second Life, other participants did not expect an artificially automatized avatar and took the player behind Enelia Laval for a human, at least for a certain time, which is important to many aspects of this intervention. "[223]

Here, Lego bricks are used to implement a hardware interface with a computer keyboard: from a technical point of view, the frame of the Lego construction is attached and adjusted to a common PC keyboard, enabling it to operate specific keys in reaction to the visual cues emitted by a 2ndLife software modification.

Generally, the usage of toy bricks does not necessitate play activities: here, the objectives are superficial, the building blocks become cheap and feasible means for their achievement, and play is likely to be overshadowed by construction work.
In other examples, Lego is used to realize more playful projects, e.g. for music composition[224]. Still, even if these results enable play activities, their creation not necessarily involves play, even though toy bricks are used.
A final Lego example can be found in Pepper's Ghost, a game-project by the author also using Lego; here, the ambition was to create a 3D display with retro technology, using LCD displays in conjunction with one-way mirrors.

Game XIV: Pepper's Ghost - Electronic retro game



***Screenshot 5.34*:** Pepper's Ghost

Genre: 2.5D arcade game realized with technology available since the 1950s

Developer: Ulrich Brandstätter

Publisher: unpublished

Year: 2011

Spread: n.a.

For the construction framing, involving the mirrors, LCD sockets and some electronics, Lego was used. In this case, the production involved lots of experimentation, especially for determining proper mirror / display distances; notwithstanding the author would not consider it a gaming / playing activity, but laboratory work.

[223] Bra14.

[224] Lego-based looper, as shown https://hackaday.com/2016/09/20/lego-looper-makes-modular-music/ (last accessed 05022020), or Lego-based sequencing, as shown https://hackaday.com/2018/12/30/turning-lego-blocks-into-music-with-opencv/ (last accessed 05022020)

The majority of these examples could also have been realized using Minecraft in conjunction with PrintCraft; at a practical level Lego is more accessible: most people are used to it from childhood on, it can be bought cheaply at stores, it does not require specific software environments, also it is comparably cheap. From a technical view point Lego also has amazing material characteristics: the molds used to make Lego elements are accurate to within 0.004 millimeters, and one Lego brick can withstand up to 953 pounds of force before breaking[225]. Customer-grade 3D printers, as normally used in with PrintCraft, yield way inferior results concerning material quality. However, Minecraft has a great vogue in specific research communities, *Steve Nebel*, *Sascha Schneider* and *Günter Daniel Rey* provide a good explanation: "*As long as researchers are technically experienced and have enough competence to construct their own video-games, it will be possible to investigate additional theories on learning and moderating variables within this area. However, this is not always the case. Most researchers experience that a simple modification within existing video-games is barely feasible as they cannot access the code of the game or not capable of modifying it. Therefore, it is very important to focus on modifiable games in research that allow even less computationally skilled researchers to expand their research focuses on educational video-games. This competency gap could be filled with Minecraft. Due to its numerous modifications, easy structure, huge player community, and countless forums, blogs, and YouTube videos on how to implement different features and rewrite source code, this game can be used even by game development novices.*"[226]

5.6.1.9 Human-based computation games, or games with a purpose

2016, we summarized games with a purpose (short: GWAPs) as follows: "*Another approach can be found in human-based computation games, or games with a purpose, where "people playing computer games could, without consciously doing so, simultaneously solve large-scale problems" [Ahn06]. Here, human game interaction is used to acquire labeling data for specific meta game goals, such as the analysis of gene sequences [...]. By being played, results with validity beyond the game virtuality are achieved. However, the creational goals usually are fixed by the developers and cannot be influenced by the players.*"[227]

The concept was first introduced by *Luis Von Ahn* in 2006; in cooperation with with *Laura Dabbish*, they came up with the following definition: "*"games with a purpose," or GWAPs, in which people, as a side effect of playing, perform tasks computers are unable to perform.*"[228]

Kathleen Tuite describes them this way: "*Games with a purpose are a form of crowdsourcing and human computation. They share the goal of organizing human effort on tasks that cannot be fully automated.*"[229]

Still, she also identifies several points of criticism to the overall concept: "*This notion likely*

[225] as described in **100 Fun Facts You Probably Didn't Know About Lego**, https://bricksfans.com/lego-facts/ (last accessed 05022020)
[226] NSR16.
[227] BS16.
[228] Ahn06.
[229] Tui14.

stems from von Ahn's 2008 article in which he stated, "People play not because they are personally interested in solving an instance of a computational problem but because they wish to be entertained." This could be interpreted literally as an observation that ESP Game players are probably more interested in the tag-matching mechanic and guessing the same answer as another player than they are in providing labels for images. Or it could be interpreted, as mentioned above, that if you make a task entertaining, people will do it; that the sole purpose of GWAPs is to find the "fun" in otherwise tedious and uninteresting tasks. Games that aim to provide only entertainment in exchange for work risk seeming exploitative, even if that was not the designer's intentions. Even just the perception of GWAPs as potentially exploitative and shallow is damaging to the field, as it can drive players away and limit possibilities for people to build new games or to do research into designing better games."[230]

Summarizing, GWAPs can be considered as a particular manifestation of serious games, as they pursue an objective besides pure entertainment, even if the players themselves are primarily interested in the latter. It is even possible for the players to enjoy a game for the sole reason of entertainment and be completely unaware that it is a GWAP.

Formally, playing games with a purpose can be considered productive gaming, as they involve digital play activities, and they contribute to productive research. Still, to our knowledge there is no examples of a GWAP that enables players to set individual goals - existing GWAPs are aligned towards specific research objectives, where users can contribute by playing. As it is generally not possible to achieve user-defined goals using GWAPS, this concept will not be examined in depth in the context of this thesis; instead, environments enabling user-defined creational goals are focused on.

5.6.2 How real life affects the magic circle

To this point, several concepts of how game contexts are able to influence real life have been examined with regards to their relationship with productive gaming. Conversely, their are lots of concepts and mechanisms facilitating a value transfer from real life to the play contexts, including *boosting*, *meta game objectives*, *professional gaming*, but also *character customization*, the use of player and gaming data, and the question of intellectual property. These are examined in more detail in the following.

5.6.2.1 Boosting

A semi-legal practice related to virtual economies is boosting, i.e. players pay others to level up their virtual characters, or, put another way, to play for them. A compelling reasoning for boosting can be found in the advertisement of a service provider:

"*Why should I buy WoW boosting services? The answer is simple. You will be able to save tons your time and make the game more enjoyable. Let's face it. Farming is a time-consuming and tedious activity. Since the early vanilla days, players have dreaded spending countless hours*

[230] Tui14.

doing the same things over and over again to get pets, achievements, and mounts. Have you ever wondered how many hours you have wasted on farming over the years? Probably too much." [231]
Boosting providers can usually be found in the proximity of MMORPGs (i.e. Massively Multiplayer Online Role Playing Games), as they often require players to perform repetitive tasks in order for them to advance. In relevant communities, these repetitive, and often boring, tasks are referred to as grinding, as farming, or as tread-milling, and result in experience points, required to improve the character level. In some cases, so called free-to-play or freemium games, i.e. games that can be played for free, but provide various opportunities for their players to spend money, including cosmetic items or access to specific areas, offer players alleviation in exchange for money, e.g. in the form of so called experience boosts. As the most interesting game sections often involve high level requirements, the appeal of achieving sufficient character levels fast is enhanced, consequently promoting the underlying business model.
Grinding is often being compared to real-life work, by players as well as by game designers, and discussed controversially: as with being on duty, some players enjoy repetitive tasks to varying degrees, while others cannot stand it and even try to automate them (with scripts, preprogrammed mouse patterns, modding, or hacking the game itself). On the other hand, this comparison is flawed insofar as with video game grinding it is hard to fail, whereas with real jobs, mistakes can have undesirable consequences.
Concerning video game achievements, as pointed out by *Mikael Jakobsson*, many digital games contain objectives that can only be attained via grinding, especially concerning the aforementioned video game completists.
Inversely, as players invest money in order to advance their virtual characters, boosting service providers, and consequently the gamers offering their expertise, gain money, and even earn their bread and butter. Especially the practice of *gold farming*, i.e. the questing for and later selling of in-game items, is known to generate lots of places of employment. *Richard Heeks* identifies China as the employment epicenter, and summarizes gold farming as follows: " *From the start of the 21st century, a new form of employment has emerged in developing countries. It employs hundreds of thousands of people and earns hundreds of millions of dollars annually. Yet it has been almost invisible to both the academic and development communities. It is the phenomenon of "gold farming": the production of virtual goods and services for players of online games. China is the employment epicentre but the sub-sector has spread to other Asian nations and will spread further as online games-playing grows. It is the first example of a likely future development trend in online employment. It is also one of a few emerging examples in developing countries of "liminal ICT work"; jobs associated with digital technologies that are around or just below the threshold of what is deemed socially-acceptable and/or formally-legal.* "[232]
Still, boosting and gold farming, although they can be thought of an industry of their own, do generally not generate products that can be used apart from the game virtualities.

[231] Advertisement statement of *WoWVendor* (`https://wowvendor.com/`, accessed 2020-07-07)
[232] Hee08.

5.6.2.2 Meta game objectives

Another possibility for real life to affect the magic circle is via custom game objectives: on the one hand, there are games without victory conditions, including the aforementioned original SimCity, where players play on until they decide to quit or start over. With SimCity, but also with other *construction games*, where the game mechanics are used as an architectural toolbox, players have to decide on their game objectives themselves, e.g. building a city as large as possible, achieve a tax- and pollution free utopia, or earn the maximum amount of in-game currency.
Also, MMORPGs such as World of Warcraft usually cannot be beat by the players; it is possible to solve specific dungeons, achieve the maximum level, or acquire a specific item, however, these challenges, although arguably conferring a sense of achievement, do not enable the players to win. At the same time, it is also impossible to lose in World of Warcraft; even if a player is defeated by enemies, she will be revived in a nearby area and can continue to play without further delay. Although the latter can also be played competitively, the player is not forced or required to do so at all. MMORPGs provide incentives for players, including increased experience points, specific titles, fame, or in-game items and currency, in the end however it is up to the players to decide what to do within the virtual environments: they choose their own game goals.
An early example for a video game that does not dictate goals can be found in **DoodleCity**, a free-form oriented game mode of the arcade game **I, Robot**[233] by *David Theurer*.

Game XV: I, Robot - Arcade game with drawing mode

***Screenshot 5.35*:** I, Robot

Genre: Arcade game including a simple drawing tool, referred to as ungame in-game

Developer: David Theurer

Publisher: Atari, Inc.

Year: 1984

Spread: AA

I, Robot is a shooter game developed 1984, well-known for being the first commercial video game featuring flat-shaded 3D polygon graphics. The aforementioned DoodleCity is a specific game mode that allows players to engage in drawing activities. As an arcade game, players would have to pay for playing sessions, every minute spent within the DoodleCity game mode would cost the player a life; therefore, she could draw for three minutes per credit. Despite this time limit, players would only be limited by the game mechanics, and could otherwise decide for themselves

[233] The84.

on what to draw. *Andrew Williams* summarizes DoodleCity as follows: " *The 3D capabilities of the hardware saw other applications beyond games. The player could engage in what I, Robot identified as an "ungame" called Doodle City rather than play the game itself. In it, the player "painted" the screen for 3 minutes, using the game's visual assets. The works created were surreal as each object left a paint trail and could be rotated from a number of angles.* "[234]

Besides these more free-form game types, meta game objectives also play a role with more typical video game types, usually for personal challenge of increased difficulty. In some cases, they are mediated by the game developers in the form of achievements, e.g. beat the game in the highest difficulty without dying once. Other examples are motivated by specific communities, such as the so called *speedrun* communities for specific games: their main objective is to beat particular games in minimal time, with or without additional constraints (e.g. the exploitation of known game glitches, sticking to original hardware instead of emulators, beating the game with the lowest-possible score, etc.). Here, the players compete for the world record for specific games, which is usually not recorded in-game. A related approach can be found in the *stupid control method*, which we summarized as follows in our previous work: " *A current player approach to controller misuse is referred to as stupid control method [Gwi14a]. It designates instances in which players use inappropriate video game controllers in conjunction with very challenging or competitive video games. For example, Benjamin Gwin managed to complete Dark Souls, a popular action role-playing game well-known for its high level of difficulty, with a Rock Band guitar controller. From a technological point of view, he used the hardware without altering it, but he did provide a custom input-mapping. That resulted in severely limited game control capabilities, as only a small number of the keys can be bound to the few available buttons on the guitar interface. In a similar fashion, he also beat the game by using a specific drum controller [Gwi14b]. Benjamin Gwin summarizes this as self-challenge. Another approach of the GameMuscleVideos group is to participate in highly competitive first-person-shooter matches with inappropriate controller hardware; concretely, they produced a gameplay video of the highly disputed game Counter Strike: Global Offense (CS:GO) with the use of a wheel controller. Besides the additional challenge, the humiliation of the opponents who have been defeated is a base motivation which is employed in this wild-goose chase [Gam14].* "[235]

Productive gaming in general heavily relies on meta game objectives: relevant creations require player deliberation and motivation, they necessitate player creativity and authorial control. Meta game objectives are very natural for specific, more free-form oriented game genres, such as simulation and construction games, but also role-playing games. Still, players can introduce their own particular goals, respecting or disregarding existing in-game goals, for reasons ranging from an increased challenge to role-playing issues, from creative requirements to community orientation.

[234] Wil17.
[235] SBM17.

5.6.2.3 Professional gaming

According to *T. L. Taylor*, nowadays the career path of a professional gamer, i.e. a player who earns his living by playing video-games, usually by sponsorship, as well as the participation and winning of championships, is rather difficult and subject to a several interwoven factors besides player skill: ”*Ultimately, though, their ability to shift their gaming from casual activity to professional occupation is complex. It is never just an issue of individual skills but the ways an entire system of practices, institutions, values, and forms of identity work on, and through, that player. A career trajectory from amateur to professional involves the transformation of what was once simply a leisure activity into a new serious endeavor. Structural factors, networks of opportunity and training, formulations of personal identity, and cultural legitimacy all form core components upon which the ability to become a pro gamer is built. [...]*”[236]
Arguably, players providing aforementioned boosting services, train other individual or teams of players, or share their playing experiences via streaming services to wider audiences, also earn their keep by playing activities. In common parlance however the notion pro gamer usually is used to refer to the most elite players competing in tournaments. In this regard, pro gamers can be considered as top athletes[237].
Concerning e-sports funding mechanism, the sponsorship model is of central importance: ”*While there has been some investment funding supporting e-sports, sponsorships remain at the heart of the economic model. For most organizations they provide the core source of funding and are crucial in making all of this high-end play a viable business endeavor. Sponsorship can range in forms, from manufacturers providing a team peripherals (headphones, mice) to financial support for salaries or travel costs. There are also instances of a game company itself giving funding to a tournament with the proviso that their own game be slated as one of the supported, and featured, titles. Lucrative sponsorships are the real prize, often making or breaking a team or player's chance to stay active and compete. Sponsorships also typically support tournaments, including not just prizes but also various operational costs. Given how important securing sponsorship is, team owners, leagues, and tournament organizers can spend significant amounts of their time cultivating these affiliations. [...]*”[238]

5.6.2.4 Character customization

The ability of modern video games to enable character customization aims at increasing the player motivation, and at the same time facilitates particular real-world influences into the game

[236] Tay12.
[237] The relationship of sports and e-sports is a complex, hotly debated topic, with many structural similarities (e.g. athleticism, human action, agonal principles, etc.) and shared cultural heritages, but also tremendous differences from country to country: *“Games that may be the norm and perfectly acceptable in one country may be heavily regulated (or banned outright) in another. [...] And norms around play (including who plays) and appropriate behavior may vary slightly. While computer gaming exists as a decidedly global product, it simultaneously inhabits local contexts that situate it accordingly.”* [Tay12].
A thorough examination of the connections of sports and e-sports is well beyond the scope of this thesis.
[238] Tay12.

virtualities, including personal aesthetic views, wishful identification, role-play, and character depiction. *Selen Turkay* and *Charles K. Kinzer* identify several central customization strategies: " *Players use different strategies to create and customize avatars depending on their goals, game developers' goals and affordances of virtual worlds. For example, players may customize their avatars' appearance (cosmetic customization) to reflect their aesthetic views or dress-up (Fron, Fullerton, Ford Morie, Pearce, 2007; Kafai et al., 2010). Players may also customize their characters with a functional goal in mind. In Kafai et al.'s (2010) study, one type of functional customization for Whyville (1999) users was to disguise within the community (e.g. Gender swapping to hide one's actual gender). In MMOs, players may also choose a certain character class to fit a desired role within the game such as being able to heal other players. It is likely that functional and cosmetic customization may result in differing levels of identification with characters. For instance, when players customize their character appearance similar to their real life physical appearance, their perceived similarity with their characters may increase, whereas if they customize their characters to be strong and invincible their wishful identification may increase more than other identification aspects. [...]* "[239]

Selen Turkay and *Sonam Adinolf* point out two specific aspects concerning avatar customization; on the one hand, the capability to personalize player characters can increase overall player satisfaction: "*[...] avatar customization can amplify the psychological effects of video games through increased identification with one's character, and, in turn, may increase game enjoyment and time spent within a virtual world*"[240]

On the other hand, players enjoy avatar customization activities, and, although they generally do not attribute to the game progress and are not reflected during later game play, players are eager to invest time: "*[...] Players spend considerable amounts of time customizing appearance and abilities of their game characters [...]*"[241]

Character customization game mechanics have been around for almost 30 years by now; according to the Game Innovation Database, the first title to feature an editor for the character visual appearance is **4D Sports Boxing**,[242] a virtual boxing game from 1991.

[239] TK14.
[240] TA15.
[241] TA15.
[242] Sof91.

Game XVI: 4D Sports Boxing - Boxing game with first character editor

***Screenshot 5.36*:** 4D Sports Boxing

Genre: Polygonal boxing title with character customization and individual fightings styles

Developer: Distinctive Software

Publisher: Mindscape

Year: 1991

Spread: AA

They provide the following description: " *This boxing title features polygonal fighters duking it out in a stylized ring. All characters have different fighting styles; some prefer to attack, while others prefer to wait and counter-attack. The characters also have their individual strengths, such as speed or power. During the game, the player chooses which attributes to improve in his/her boxer: speed, power, or stamina. During the fight, it is possible to use different tactics and strategies, like all-out attacks, counter-attacks, dodging and so on. Sometimes fights end in a unanimous decision, even 15 round fights.*"[243]

Concerning digital role-playing games, game developers usually approach the issue of character customization with two distinct mindsets: Eastern role-playing games commonly evolve around specific, pre-determined characters and rather linear plots, therefore they seldom feature character editors. Western role-playing games concentrate rather on settings that can be played with more individualized, player-created characters. *Anna Anthropy* attributes the availability of character customization editors in digital role-playing games to cultural traditions: " *Why has character creation remained such a fixture of American interpretations of digital role-playing games while Japanese role-playing games have phased it out? It could possibly reflect that America is a young country, and a nation that has been capitalist almost since inception. American culture sells the idea of individuality and ego. In Japan, a much older country in which social roles are valued (and connected to uniforms), role-playing might more easily mean playing the role which you've been assigned. [...] There's an ongoing dialogue between Eastern and Western design these days, so none of these trends are exclusive [...], but there are clear pattern in games that we can trace to the values of the people who created them.*"[244]

Besides role-playing reasons, wishful identification, or increased player satisfaction, character customization also makes specific games and game engines attractive for reuse; e.g., the game **Neverwinter Nights**[245] by *Bioware* from 2002 was often used in Machinima productions with a focus on narration: it features an (at the time) powerful character editor, but also provides a

[243] Cen04.
[244] Ant12.
[245] Bio+02.

toolset to create player-maps that can be populated by multiple gamers at the same time. One example for an ambitious Machinima using Neverwinter Nights is **BloodSpell**[246].

Artwork VII: BloodSpell

***Image 5.37*:** BloodSpell

Artist: Strange Company

Year: 2006

Creative Commons licensed Machinima production using the Neverwinter Nights game engine

To this point, the discussed game examples feature character customization as a mechanism beyond the core play activities: World of Warcraft, Neverwinter Nights and also 4D Sports Boxing can be played with pre-generated characters as well, the players can, but are not required to, craft a personalized playable characters. However, there are also games were character editing is more tightly interwoven with the game play. Of particular interest is the video game **Spore**, as it is also a great example for a game facilitating productive gaming.

Game XVII: Spore - Life simulation God-game

***Screenshot 5.38*:** Spore

Genre: Real-time strategy game featuring the evolution of a virtual species from microscopic organism to spacefaring culture

Developer: Maxis and Will Wright and Brian Eno et al.

Publisher: Electronic Arts

Year: 2008

Spread: AAA

Spore enables its players to develop a custom and unique virtual species over four specific evolu-

[246]BloodSpell is one of the largest Machinima productions available, and can be retrieved here: https://www.bloodspell.com/ under the Creative Commons license.

tionary stages: the cell stage, the tribal stage, the civilization stage, and the space stage. During every stage, gamers have to adapt their species, starting with additional sensory organs, limbs, as well as with defensive and offensive mechanisms, and later with specific equipment such as armor, weapons, tools. Also, relevant vehicles, such as tanks and boats, must be created and regularly updated by the players. With Spore, player success is highly dependent on the regular use of the in-game editor. Unlike many other simulation games, Spore features a victory condition that can only be met in the final evolutionary stage; still, in case players beat the game, they can continue to play with their virtual species forever.

Spore is categorized as a massively single-player online game: player creations, including species and vehicles, are automatically uploaded to a centralized database, and used to populate the virtual worlds and universes of other players as non-player characters. Using an in-game interface, players can query information about their species, concerning distribution and the overall attitudes of other gamers towards their creations.

Concerning productive gaming, Spore provides a mechanism to export user-created models, including creatures, vehicles, boats, airplanes and spaceships, as 3D models, which can be reused in external software. Within the in-game editor, a user is only required to enter a simple command in the game console, and the model gets appropriately exported as a *Collada* file, including the basic mesh, material, but also its rig and skin weights, making its reuse as an animated model very easy [247]. On the other hand, Electronic Arts heavily restricts the reuse of player creations on a legal basis: during the export process, players have to agree to a particular limiting EULA, reducing the usage scenarios of player-created assets to the private area. In the following, the part of the EULA[248] concerned with player creations is displayed:

> B. Your Contributions. In exchange for use of the Software, and to the extent that your contributions through use of the Software give rise to any copyright interest, you hereby grant EA an exclusive, perpetual, irrevocable, fully transferable and sub-licensable worldwide right and license to use your contributions in any way and for any purpose in connection with the Software and related goods and services, including the rights to reproduce, copy, adapt, modify, perform, display, publish, broadcast, transmit, or otherwise communicate to the public by any means whether now known or unknown and distribute your contributions without any further notice or compensation to you of any kind for the whole duration of protection granted to intellectual property rights by applicable laws and international conventions. You hereby waive any moral rights of paternity, publication, reputation, or attribution with respect to EA's and other players' use and enjoyment of such assets in

[247] A detailed tutorial of the Spore export process is featured on the Spore websites: http://www.spore.com/comm/tutorials/export_creatures

[248] The entire Spore EULA was retrieved from https://media.contentapi.ea.com/content/dam/eacom/en-us/eula/spore-end-user-license-agreement-pc.pdf, last accessed 2020-08-04

> `connection with the Software and related goods and services under applicable law. This license grant to EA, and the above waiver of any applicable moral rights, survives any termination of this License. For example, and without limiting the provisions above, if you create a Spore creature and upload it (pursuant to EA's agreement) to an EA partner's site to create articles (such as a T-shirt or a replica), you acknowledge and agree that any other person can make the same or different article using the Spore creature or other assets that you created with the Software without any compensation, attribution, or notice to you.`

5.6.2.5 Intellectual property rights

Jas Purewal points out that until now, there has been no authoritative legal decision concerning intellectual property and video game assets and footage: " *[...] if a video is made of sequences in a video game, who owns the footage legally? This was largely an academic legal question for some years, but the rise of digital video platforms such as YouTube and Twitch have brought it to the fore and added considerable commercial stakes to the balance. As yet there has been no authoritative legal decision on the matter. However, it is likely that when that moment comes, there will initially be rulings in favor of the game creator, which will over time give way to a more nuanced analysis attempting to balance the rights of the game creator, who wishes control his or her or its work creatively and financially; of the video creator, who invested skill and labor in the video; of consumers, who want access to the video and may not care particularly about the legalities; and, finally, wider society's interest in rewarding creators but also protecting freedom of expression.* "[249]

Considering a more productive use of video games and interactive digital entertainment products, the current situation is particularly unsatisfying. A relevant controversy evolved with the *Nintendo Creators Program*, a video streaming platform to facilitate a revenue split between the video creator and Nintendo, but also to implement a form of censorship. Streamers could select from a pool of white-listed games and share relevant game-play footage on the Nintendo platform; otherwise content creators were forbidden from monetizing Nintendo game videos. Also, negative reviews or other content potentially harmful to video game sale numbers were subjected to censorship. Due to the decline of content creators and streamers featuring Nintendo games caused by these restrictions, the Nintendo Creators Program was eventually discontinued in 2018 (after ten years), and replaced by a more liberal set of rules. As of 2020, these set of rules[250] are as follows:

> `- You may monetize your videos and channels using the monetization methods separately specified by Nintendo. Other forms of`

[249] Pur16.

[250] The *Nintendo Game Content Guidelines for Online Video and Image Sharing Platforms*, as published on the Nintendo website `https://www.nintendo.co.jp/networkservice_guideline/en/index.html?n`, retrieved 2020-08-04

```
  monetization of our intellectual property for commercial purposes
  are not permitted.
- We encourage you to create videos that include your creative input
  and commentary. Videos and images that contain mere copies of
  Nintendo Game Content without creative input or commentary are
  not permitted. You may, however, post gameplay videos and
  screenshots using Nintendo system features, such as the Capture
  Button on Nintendo Switch, without additional input or commentary.
[...]
```

The allowed monetization methods are currently limited to the following platforms: Facebook, Niconico, OPENREC.tv, Twitch, Twitter, YouTube, and TwitCasting.
Both the lack of authoritative legal decision and the appropriation of player-created content, as discussed previously with the example of the game Spore, are adverse conditions for productive gaming: generally, if games provide opportunities for productive gaming, it is very unlikely that players are allowed to use their making in arbitrary contexts, especially for commercial purposes. E.g., if a player creates a new song using SimTunes, she is likely forbidden from selling it; she is definitely not allowed to create a commercial animated movie using the virtual creatures she created while playing Spore.
To encourage productive gaming, the relevant EULA for our project foreverloops explicitly allows commercial use. The relevant part of the foreverloops EULA is displayed in the following:

```
2.1 foreverloops grants the end user the non-exclusive, non-sublicensable,
    non-transferable right to use the application on one (1) license seat
    for personal use as well as for commercial purposes, under the
    conditions specified in this Agreement.
2.2 The contents may be used for both personal and commercial purposes.
    However, a transfer to third parties for commercial purposes is not
    permitted.
[...]
```

Still, even with an EULA explicitly stating that users are allowed to use their creations also for commercial purposes, several inquiries were made by customers in the past two years: players repeatedly asked whether they were allowed to use foreverloops for the creation of commercial songs.

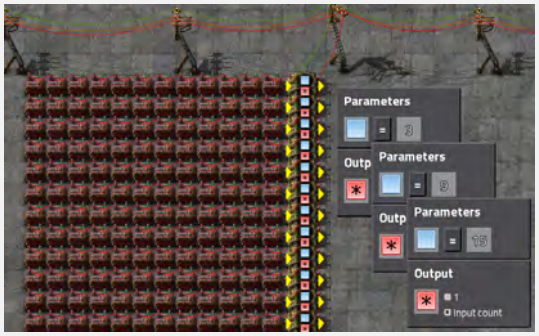
5.6.2.6 Player input

Another concept to influence play contexts is the making use of player information, feedback, and data. This approach is often applied along several game development levels, from early conception to monetization, from community-driven continuous development to player developers.

Concerning early conception, many game development companies, as well as independent developers, are making use of the early-access model: it enables players the consumption of games that are not yet finished. Early-access provides several advantages for developers, producers, and consumers. For one, it is primarily considered as a funding model, with the goal to alleviate the financial risks of game productions. *Richard Hill-Whittall* summarizes the early-access model as follows: " *Early Access / Alpha Funding is an increasingly popular way to help fund indie game development. It isn't right for every game though, and certain genres are much better suited to this type of funding. Sandbox games are a good fit for Alpha funding as players anticipate a fairly open specification in the early stages, and expect their feedback will help shape the game during the course of development. The primary risk for Early access funding is failure to impress the community, which could kill interest in the game before you even release. [...] The community playing your Early Access build is helping you and as such they need to be respected [...].* "[251]
However, early-access becomes increasingly popular for non-independent games as well; e.g. several popular shooter games released in the last decade were able to deploy this model with great effect, examples include **PlayerUnknown's Battlegrounds**[252] by *PUBG Corporation* and **Fortnite**[253] by *Epic Games*. For our project foreverloops, we initially considered adopting early-access also; in the end, we decided for a more traditional release approach, as we published the first available version as a completed product. However, contrary to this, we tuned and refined the software with several patches motivated by the feature requests and feedback of our community for a long perioud after the initial launch; in retrospect the utilization of early-access would have been more consistent and advantageous.
Generally, early-access enables game developers to receive bug reports and player feedback during the earlier development stages, including the pre-alpha, alpha, and beta stages. Not only are relevant player suggestions valuable for the further development and product refinement, it may also facilitate a dialog between developers and gamers, fostering a community central to the (financial) success of a title. E.g. the previously discussed game Minecraft is considered the best-selling video game of all time, although its visual style and core game-play mechanics stem from the free-to-play game **Infiniminer**[254] by *Zach Barth*. The main reason for its success can arguably found in the strong game community, fostered by exceptionally frequent updates based on player feedback. The community in turn provides preliminary funding, feedback and improvement suggestions, as well as player-to-player marketing via word-of-mouth, but also by uploading and sharing of game-play videos on YouTube.
A recent example for a successful early-access game can be found in **Factorio**[255] by *Wube Software*.

[251] Hil15.
[252] Cor+17.
[253] Gam17.
[254] Bar09.
[255] Sof+16.

Game XVIII: Factorio - Real-time strategy / construction game



***Screenshot 5.39*:** Factorio

Genre: Resource management and industry network real-time simulation game

Developer: Michal Kovařík and Wube Software

Publisher: Wube Software

Year: 2017

Spread: AAA

Its development started around mid 2012, and entered early access in 2016. Currently, its release is scheduled for August 2020, but according to its website[256], more than two million copies are already sold before the release of the final version. As with Minecraft, the developers were able to form and profit from a large player community that provided bug reports, feature suggestions, and player marketing, again by sharing their creations with a wider audience via video streams. Particularly interesting are player-created machineries for specific problems, e.g. player-created real-time capable in-game video decoders[257].

Another strategy deployed by game developers to make use of player input is to raise the status of players to the level of a content creator or curator. Historically, this idea was often realized in text-based multi-user dungeon games (MUDs): players distinguishing themselves by investing more time and accustoming themselves with the respective game lores would be awarded with the wizard title / role, which enabled them to influence and modify the game virtualities in ways otherwise only available to the developers. With additional user rights, they could alter the game narrations, stage encounters with non-player characters, create additional digital content such as new rooms and entire dungeons, but also penalize and punish players disregarding game netiquette. One of the bigger German MUDs making use of this wizards mechanic is **Silberland**[258] by *Andres Cvitkovich*.

Game development companies can also make use of player data that is not actively provided by the gamers: the bigger part of recent AAA video games requires online connectivity during game play. On the one hand, this requirement implements a form of copy protection. On the other hand, it allows developers to gather and analyze player data, for various reasons: to appraise the development of the number of active players, to estimate if players enjoy a recently added feature, but also to roughly identify the physical player location for marketing purposes, to detect better ways for monetization, etc.. The latter is usually focused on by Freemium games: in

[256] https://factorio.com/blog/post/fff-327, last accessed 2020-08-06

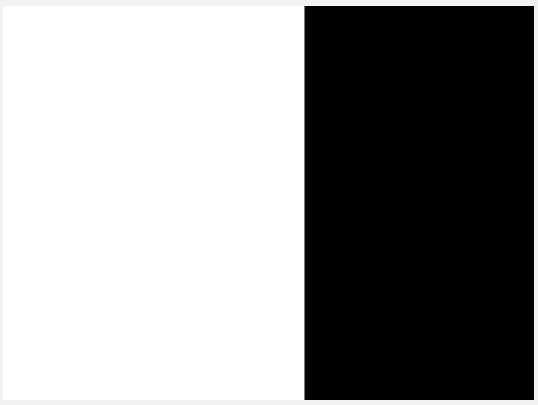
[257] 2016, player *DaveMcW* shared his in-game video decoder on the game forum https://forums.factorio.com/viewtopic.php?t=37490, last accessed 2020-08-06

[258] Cvi96.

order to maximize revenue, game companies try to identify the players willing to spend money, and to deploy mechanisms and offers to persuade them to invest more. The relevant gamers are often referred to as *whales*, as in many free-to-play games a low player percentage is attributed to a large share of expenditures. *Brendan Sinclair* argues that the notion whale is detrimental to both players and developers: " *For the gamers, it frames them as being pathological [...] And for the developers, it frames us as being psychologically exploitative. And it's bad in a third way in that it constrains how we design games because we assume gamers to have a certain mindset.* "[259]

A rather minimalistic art game, created at the Nordic Game Jam 2009 in less than a day, can be found in **4 Minutes and 33 Seconds of Uniqueness**.

Game XIX: 4 Minutes and 33 Seconds of Uniqueness - Minimalistic art game



***Screenshot 5.40*:** 4 Minutes and 33 Seconds of Uniqueness

Genre: Interaction-less online game that can only be won when played alone for 4 minutes and 33 seconds

Developer: Petri Purho and Heather Kelley and Jonatan Söderström

Publisher: Kloonigames

Year: 2009

Spread: A

This game uses player input in a unique way, its author *Petri Purho* describes it as follows: " *You'll win the game if you're the only one playing the game at the moment in the world. The game checks over the Internet if there are other people playing it at the moment and it'll kill the game if someone else is playing it. You have to play the game for 4 minutes and 33 seconds. It's an exploration to what actually defines a game. You can win or fail in the game, but there is no user input or interactivity of any kind. [...]* "[260]

It is a *gami-made* bow to the piece **4 Minutes and 33 Seconds**, created 1952 by *John Cage*, transforming the in-game state of its players into the central game mechanic. The possibility space of the players' input is limited to whether to start the game or not; but even with this severe limitation, due to its availability as a free game and its renown, to beat the game poses a challenge: the chances of winning diminish with more players inclined to start it within a time interval. Also, a spoilsport could automatically have the game restart every minute, and therefore make it impossible for anyone else to win.

[259] Sin14.
[260] Pur09.

5.6.3 Concepts with bidirectional influences

Until now, concepts of how game contexts are able to influence real life and mechanisms facilitating a value transfer from real life to the play contexts have been discussed. The examination so far followed through a sharp distinction: either the magic circle influences the real world, or the other way round. Admittedly, this perspective involves a simplification, as the relevant concepts often cannot be considered strictly uni-directional. As *Stephen Sniderman* puts it, "*[...] it is impossible to determine where the game ends and real life begins.*"[261]
Gordon Calleja refers to a specific ongoing interaction of game-play and real life as *macro-involvement*: "*When I turn off the PC and go to bed, I inevitably start thinking of different army configurations and other ways to use certain units. Like many gamers, I run through what happened in my recent battles and why certain tactics failed and others succeeded. [...] Plans for furthering one's conquest and dealing with deteriorating relations with neighbouring powers are formulated not just during gameplay but also during off-line thinking about the game, such as when one is riding the train or in other situations which do not require one's full attention. I refer to this form of ongoing motivation to interact with the game and the off-line thinking that fuels it as macro-involvement.*"[262]
As another example, in this thesis, virtual game economies have been mainly considered from the point of view of a consumer: e.g. a player can hire boosting services in order to pay others for in-game advancement - she invests real-world money for in-game prestige, which may as well in turn affect her real-life (good mood, sense of achievement, increased social status within her guild, etc.). On the other side, there is the player employed by the boosting provider who earns her living by playing - she receives real-world money for playing activities.
In the following, concepts involving more bidirectional influences, such as power gaming and modding, are examined, as is the overall role of digital games as cultural assets.

5.6.3.1 Power gaming

Power gaming is a video game play practice concerned with efficiency: players, well aware of relevant game mechanics, try to optimize their play to achieve specific goals at a rapid pace. Usually, power gaming occurs in conjunction with role-playing games, relevant goals include creating the strongest possible player character for specific encounters, or to achieve the highest level in the shortest time. The players deploying power gaming are referred to as power gamers, and they are often subjected to prejudice, suspicion and degradation. *T. L. Taylor* summarizes them as follows: "*[...] I had come in contact with a type of player dubbed a power gamer ([...]). Power gaming is a unique style of play grounded in intense focus and instrumental orientation. Very often power gamers are thought of as taking the game too seriously. They can appear to outsiders (and indeed sometimes even to themselves) like people who have converted their leisure into work. Their mindset is often deemed odd by fellow players, and some theorists have pronounced it cor-*

[261] Sni99.
[262] Cal11.

rosive to play. As the sociologist Roger Caillois wrote about the contamination of play by reality, obligation, and professionalism, "What used to be a pleasure becomes an obsession. What was an escape becomes an obligation, and what was a pastime now is a passion, compulsion, and course of anxiety. The principle of play has become corrupted. It is now necessary to take precautions against cheats and professional players, a unique product of the contagion of reality" [...] Yet I knew from spending time and talking to power gamers that things weren't so simple; that the line between work and play, pleasure and painful progression, was often blurred. Their experiences couldn't be so easily categorized or dismissed, bundled into the same category as cheaters and set outside the realm of real play. [...]"[263]

For the specific game **Everquest**,[264] Taylor identifies several qualities in power gamers: "*a focus on efficiency and instrumental orientation, dynamic goal setting, commitment to understanding the underlying game systems/structures, and technical skill proficiency*".[265] With focus on efficiency and instrumental orientation, she refers to the unparalleled obstinacy, learning willingness, and systematics of the power players she interviewed. Dynamic goal setting stands for their ability to identify and follow through constantly revising and developing player objectives, like gaining levels, obtaining specific equipment, but also gaining admission to particular guilds or acquiring special skills. She identifies the knowledge concerning the game structure, and the willingness to obtain it, as a precondition for effective play, and as a source of pleasure for relevant players.

5.6.3.2 Modding

A video game modification usually refers to a player-made alteration of a video game to change specific aspects, ranging from small tweaks to entirely new areas, from bug-fixes to alternate endings, from new player classes to improved user interfaces, or from enhanced game assets to total conversions. *Hector Postigo* gives a detailed summary of video game modifications: "*Modification, in the context of productive participatory game culture, is commonly referred to as "modding" by its practitioners. It is a concerted and well-thought-out intervention into almost every element of a commercial game's design. Modders, practitioners of modding, may seek to change every element of a video game: its code, sound, textures, physics, architecture, communication tools, and rules of play. They will also, either by design or as a consequence of their productivity, add dimensions to the structure of the industry. The term modding itself, as it may apply to video games, has an indeterminate origin and can at best be traced back to the first modifications (mods) to video games in 1980 (Postigo 2003). When the practice took first hold, modifications may have included substantive changes to the game engine source code, an admittedly far more technically difficult practice than modifying video game assets such as textures and sound elements. One can distinguish those modifications by thinking of them as hacks to the engine source, which may not have necessarily resulted in a discernible impact on*

[263] Tay12.
[264] Stu+99.
[265] Tay03.

the player experience."[266]

In our previous work, its utility for media productions was briefly described: " *A different, yet very popular concept is the utilization of game engines and modifications for media productions, e.g. Machinima communities using suitable computer games for video productions. Here, results typically are perceivable without the game and yield audio-visual makings. Nevertheless, productivity is achieved by using games rather than playing games.*"[267]

A relevant example can be found in **q3apd**, a modification by *Steven Pickles* and *Julian Oliver*.

Artwork VIII: q3apd

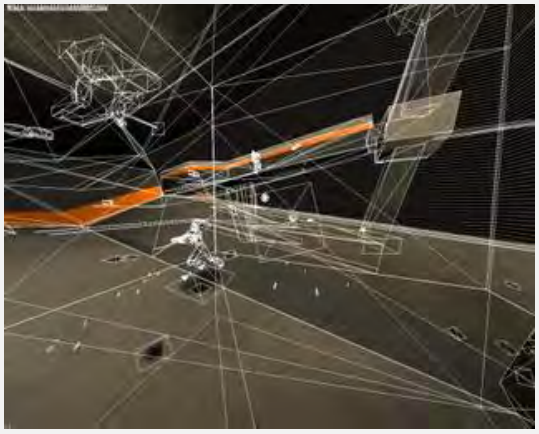


***Image 5.41*:** q3apd

Artist: Steven Pickles and Julian Oliver

Year: 2003

Quake3 Arena modification to export in-game information to external tools that create an auralisation of play activity

The authors describe q3apd as follows: " *q3apd was a project developed in 2002 and 2003 by Steven Pickles and Julian Oliver to expose the events in a game of Quake3 Arena, whether multiplayer or otherwise, to external programs used by artists to the ends of making music, graphical art or controlling mechanical events. It is the belief of the artists that the richness of activity in a 3D computer games is ripe for aesthetic and scientific investigation, merely needing some means of getting that information out of the game and into another tool. [...] In this installation the movement, position, health, viewangle and item status of 4 software agents in combat was sent to the synthesis environment Pure Data and used to make an auralisation of activity in the arena: a musical re-presentation of the flows and gestures of artifical life in combat. [...]* "[268]

Historically, the predecessor of today's video game modifications can be found in the removal of copy-protection mechanisms for home-computer games in the early eighties. Particularly interesting is its relation to musical production, as pointed out by *Karen Collins*: " *[...] the software and hardware of games have also become content and context for musical production. A series of related musical practices have developed from the early practice of circumventing copyright on games. In northern Europe and Scandinavia, this community is known as the demoscene. The demoscene obtains its name from the demonstrations that illustrated the skills of game "crack-*

[266] Pos16.
[267] BS16.
[268] PO03.

ers" who in the 1980s and 1990s "cracked" video-games by evading copyright controls or digital rights management (DRM) and thus enabled sharing of the game. Programmers sometimes spent many hours breaking the DRM and posted their nicknames on an opening screen to the cracked software to demonstrate their skill to others. Competing crackers gradually expanded simple text messages into real-time animated movies and music (Carlsson 2008), and these demo sequences themselves became the object of sharing, usually in the form of short noninteractive movie clips but sometimes as games. [...] "[269]

Anna Anthropy compares the activity of modding to the practice of sampling in contemporary music creation, i.e. the reuse of recorded sounds for new music productions: "*The repurposing of commercial game assets can be compared to sampling of music: using part of an existing song as an instrument in your own piece of music. Hip-hop artists often rap their own material over music sampled from another source, using the found music as a background for their own words.*"[270]

The creation of video game modifications involves activities originating in game development, including coding, asset creation, story-boarding, character animation, etc.. These activities are usually very challenging, time-consuming, and require lots of expertise, they are normally conducted and considered as work activities; however, due to their transformative nature, their smaller scope and their situatedness as spare-time activities, they are often considered as playing activities, e.g. by *Raph Koster*: "*In other words, modding is just playing the game in another way, sort of like a budding writer might rework plots of characters from other writers into derivative journeyman fiction or into fan fiction. The fact that some forms of interaction are constructive (modding a game), experiential (playing a game), or deconstructive (hacking a game) is immaterial; the same activities are possible with a given play, book, or song. Arguably, the act of literary analysis is much the same as the act of hacking a game—the act of disassembling the components of a given piece of work in a medium to see how it works, or even to get it to do things, carry messages, or otherwise represent itself as something other than what the author of the piece intended.*"[271]

The practice of modding is informed with the video game mainstream by now, although in more accessible ways. E.g., the aforementioned **Super Mario Maker** outsources its level design to the players, a trend challenged by *Paolo Pedercini*: "*Of course we have a lot of games like Minecraft or Little Big Planet that enable players to be creative, which is an euphemism for generating content for free.*"[272]

Also, in comparison to the early game modification examples, many video game developers provide level editors and modding tools to their players, usually bundled with the relevant games, or as free downloads. The provision of modding tools usually is very advantageous to the commercial success of digital games, prominent examples include the aforementioned **Minecraft**, **Neverwinter Nights**, and **Skyrim**. The release of authorial control to the players however can also have controversial effects: questionable and highly debated player alterations include

[269] Col13.
[270] Ant12.
[271] Kos05.
[272] Ped13.

modifications for graphical pornography, levering out the immortality flag of children non player characters, or increasing visual violence.
Segueing into the subsequent section, an example concerned with modding as a form of a productive and participatory activity can be found in the **Nybble-Engine** by *Margarete Jahrmann*, *Max Moswitzer*, *F.E. Rakuschan*, *Andreas Kunzmann* and *Heiko Idensen*.

Artwork IX: Nybble-Engine

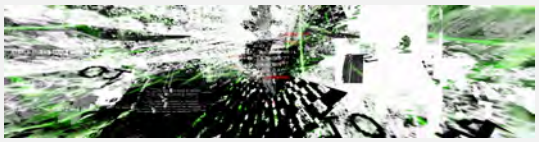


Image 5.42: Nybble-Engine

Artist: Margarete Jahrmann, Max Moswitzer, F.E. Rakuschan, Andreas Kunzmann and Heiko Idensen

Year: 2003

Unreal Tournament game engine modification as an artistic intervention

Of particular relevance is the idea of un-closing and democratizing proprietary software via modification practices: ”*The nybble-engine-toolZ are also a work about the interdependency between proprietary and non proprietary standards. By not just making a patch but modifiying the c++kernel of the unreal-engine and providing this modifications, the engines are opened and the discourse on its reuse is triggered.*”[273]
A good summary of the work is provided by its co-creators, the *v2_lab Rotterdam*: ” *The core of the installation is the Nybble-Engine itself a network application based on existing software of an interactive game. Participants may log onto the game-Engine from a variety of locations, including the sofa, and are then assigned a place in the network. They navigate the game's environment, bump into other players or the action bots (representations of server processes) and communicate with them via text messages. This generates network traffic, the server log files of which are routed to the game-Engine, where they serve as the raw material for the three-dimensional audiovisual displays of the installation. The Nybble-Engine tool converts the data from the network traffic into graphic clips that are projected on the screen. In this way, the server processes become visible outside of the game-Engine and the visitors influence the software of the Engine, eventually causing it to change its appearance. As a whole, the installation illustrates the potential of communication technology to interact with digitally organized data and manipulate its outcome.* ”[274]

5.6.3.3 Interactive art

Several examples examined to this point can be attributed to the domain of interactive art, including **q3apd** by *Steven Pickles* and *Julian Oliver*, **Overbug** by *Hiroshi Matoba*, and **dead-in-iraq**

[273] JM03.
[274] v2l03.

by *Joseph DeLappe*. In our previous work,[275] a few central relations concerning interactive art and digital games were highlighted: we briefly discussed the idea of the German poet *Friedrich von Schiller* of the urge to play (Spieltrieb) being a mediator between the instinctive feeling for eternal unchanging moral and other truths (Formtrieb) and the constantly changing feelings, perceptions and urges (Sinntrieb) giving rise to artistic beauty and freedom; we argued the role of *Marcel Duchamp* as one of the first artists to "*elevate the mechanics of play (in his case a chess game) into an art form in its own right. Doing so, he challenged the traditional notion of art making.*"; we pointed out that "*art and play have several common properties: they both are not bound to a specific utilitarian use, and they both have a certain frame-set within which they operate*"; we hinted at the connection of digital games and interactive art via *Umberto Eco*'s notion of the "Open Artwork"; we highlighted one particular flaw of this comparison: they involve different media, and their creation comprises heterogeneous processes.
In the introductory chapters of this thesis a successive approximation towards the notion of a game was already provided; from a structural point of view, several fundamental aspects of games were accentuated: players are a central component and are required to struggle towards goals, and games are interactive and based on rules. Still, these fundamental aspects fall too short, as there are several outliers, including the aforementioned simulations, with the popular example of SimCity, or zero-player games that do not rely on players or player-input. Summarizing, it is not possible to ascertain beyond doubt that a specific game really is a game for every example. On the other hand, the same is true for interactive art: formal criteria alone (e.g. the "*tautological definition of art that reads: "art is what artists do".*" as pointed out by *Paolo Pedercini*,[276] or the question of artistic intention, or the issue of context) also fall too short. However, a more involved elaborateness on the criteria of interactive art is beyond the scope of these thesis.
In some cases, relevant projects can clearly be attributed to both interactive art and digital game domain, e.g. the aforementioned **Lose/Lose** by *Zach Gage*. This chapter examines a super-set: projects attributed to interactive art involving digital play activities, ideally with effects protruding from the magic circle. In the following, relevant concepts in the form of particular termed strategies by *Ryszard W. Kluszczynski*, are examined in more detail.

a) Free-form / instrument approach

One of the relevant concepts is the *strategy of instrument*: "*The Strategy of Instrument, due to its specific abstract character (that does not obviously exclude the possibility of its ideological coloring on the construction level), allows the receivers of interactive art works realized with its use in the process of providing an abstract structure some specific, individual shape, to considerably apply independence. Precisely because of this such works bring the receivers stronger than in case of other strategies sense of creative character of their participation in the events that are its core.*"[277]

[275] SBM17.
[276] Ped13.
[277] Klu10.

An excellent example for this strategy can be found in *David Rokeby*'s **Very Nervous System**.

Artwork X: Very Nervous System

***Image 5.43*:** Very Nervous System

Artist: David Rokeby

Year: 1986

Interactive installation to create music / sounds without a physical interface

He describes his installation as follows: " *Very Nervous System is the third generation of interactive sound installations which I have created. In these systems, I use video cameras, image processors, computers, synthesizers and a sound system to create a space in which the movements of one's body create sound and/or music. [...] The active ingredient of the work is its interface. The interface is unusual because it is invisible and very diffuse, occupying a large volume of space, whereas most interfaces are focused and definite. Though diffuse, the interface is vital and strongly textured through time and space. The interface becomes a zone of experience, of multi-dimensional encounter. The language of encounter is initially unclear, but evolves as one explores and experiences. [...] The installation could be described as a sort of instrument that you play with your body [...]. [...]* "[278]

Another example, aimed at music production, can be found in **Scrapple** by *Golan Levin*.

Artwork XI: Scrapple

***Image 5.44*:** Scrapple

Artist: Golan Levin

Year: 2005

Synthesizes the visual appearance of tokens placed on an interactive table using spectrographic synthesis. Participants re-arrange ready-made tokens or even draw on the table interface to create new musical and rhythmic patterns.

Golan Levin summarizes his work as "*a real-time, camera-based spectrographic performance instrument with a tangible interface. Unlike previous camera-based systems, I use an 'augmented*

[278] Rok93.

reality' (AR) overlay to provide the user with in-situvisual feedback regarding the state of the system. This feedback helps the user to more accurately predict the effects of their actions (such as placing marks into the score), thus affording the compositional precision of stylus-based systems, while preserving the possibility for coarse body-based improvisation. [...]".[279]

Another piece often discussed in the context of interactive art is the **reacTable** (2005) by *Sergio Jord*, *Guenter Geiger*, *Martin Kaltenbrunner*, and *Marcos Alons*.

Artwork XII: reacTable

Artist: Sergio Jordà, Martin Kaltenbrunner, Günter Geiger, Ross Bencina, Hugo Solis, Marcos Alonso, and Alvaro Barbosa

Year: 2005

Collaborative electronic musical instrument with tabletop tangible user interface

***Image 5.45*:** reacTable

The authors describe the reacTable as follows: " *The reacTable* is a state-of-the-art music instrument, which seeks to be collaborative (local and remote), intuitive (zero manual, zero instructions), sonically challenging and interesting, learnable and masterable[...], and suitable for complete novices (in installations) and for advanced electronic musicians (in concerts). The reacTable* uses no mouse, no keyboard, no cables, no wearables. The technology it involves is, in other words, transparent to the user; it also allows a flexible number of performers that can enter or leave the instrument-installation without previous announcements.* "[280]

A common feature of these projects can be found in their innovative interface design: the Very Nervous System provides an intuitive and indiscernible interface for body movements; Rokeby summarizes his main ideas concerning the interface design as follows: " *The computer as a medium is strongly biased. And so my impulse while using the computer was to work solidly against these biases. Because the computer is purely logical, the language of interaction should strive to be intuitive. Because the computer removes you from your body, the body should be strongly engaged. Because the computer's activity takes place on the tiny playing fields of integrated circuits, the encounter with the computer should take place in human-scaled physical space.* "[281]

Levin also indicates the interface as the main innovation of Scrapple: " *The core innovation of the Scrapple instrument is the use of an "augmented reality" (AR) technique to provide essential*

[279] Lev06.
[280] Jor+05.
[281] Rok93.

visual feedback to the user about their actions and the state of the system. The AR takes the form of a layer of real-time computer graphics projected onto the table from above"[282]
The same applies to the reacTable*, its authors describe their interface conception as follows: " *The reacTable* is based on a translucent round table. A video camera situated beneath, continuously analyzes the table surface, tracking the nature, position and orientation of the objects that are distributed on it. The objects are passive and of different shapes, without any sensors or actuators. Users interact by moving them, changing their position, their orientation or their faces (in the case of volumetric objects), controlling with these actions the topological structure and the parameters of a sound synthesizer. Also from beneath the table, a projector draws dynamic animations on its surface, providing a visual feedback of the state of the synthesizer.* "[283]
Similar to SimTunes, these projects, as a realization of the strategy of instrument, are able to create music via playing activities: their interfaces bring about a playful state of mind, spark curiosity and *are capable of seducing the audience into a lusory attitude.*[284] At the same time, as installations they sufficiently communicate the prelusory goals: players have to venture onto the dance floor / magic circle, figure out the rules by experimenting or observing, and create awe-inspiring pieces of music.

b) Game topic

Another relevant concept can be found in Ryszard W. Kluszczynski's *strategy of game*: " *Strategy of Game organizes events each time becoming a work of art evolving around interaction itself. Obviously, interaction as a crucial and defining characteristic of interactive art per se, it is to be found in its every aspect, regardless of the strategy updated at each given moment. However, this interaction usually is entangled in other elements or aspects of an art work that subdue it. Or it may be conditioned by the relationship between the interface and a spectacle generated by it, or subdued to the data organization in which a navigational experience is taking place. It may also aim toward the shaped net of links or present inner logic of system technology. [...]* "[285]
Relevant pieces often are evolving around the specific topics of player interaction, game objectives, and the rules of play. Still, according to Ryszard W. Kluszczynski, they differ from mundane video games in several aspects:

- normal games usually do not claim a place in the world of art;
- relevant pieces of interactive art "*are of metadiscursive character, they draw the attention of the users not only toward the tasks that are outlined, but also toward the interaction's course, its architecture, relations between the game's structure and its properties, and also the other discourses included in the event. They place in the discursive opposition not only the player and the game, but also the process of playing, in this way gaining the*

[282] Lev06.
[283] Jor+05.
[284] SBM17.
[285] Klu10.

possibility to make all these aspects of the game and the game world as understood generally debatable."[286]

- Also, relevant pieces of interactive art discuss issues not directly connected to the game.

The Strategy of Game ties in very well with the common strategies involved in art games[287] identified by *Paolo Pedercini*, intersections can be found in several categories, including *games about art*, *installation games*, *art with games*, and especially *art modifications* as well as *games redefining play.* Examples given in both deliberations include **SOD**[288] by *JODI* (*Joan Heemskerk* and *Dirk Paesmans*), **Adam Killer**[289] by *Brody Condon*, and **The Intruder**[290] by *Natalie Bookchin.*

Artwork XIII: SOD

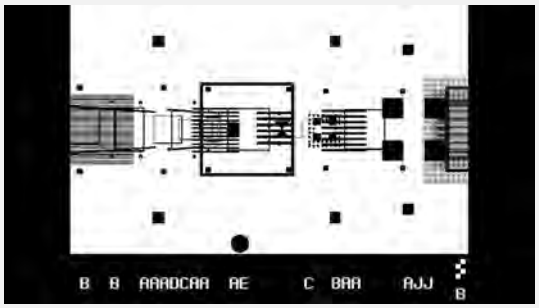


***Image 5.46*:** SOD

Artist: Joan Heemskerk and Dirk Paesmans

Year: 1999

Hack-based transformation of the controversial ego-shooter game Wolfenstein 3D by Id Software into an interactive constructivist painting

Martin Pichlmair describes SOD as follows: " *Technically, SOD is a modification of the once popular shooter game Wolfenstein 3D by id Software 1992. Conceptually, it is a deconstruction of the game space. For creating SOD, jodi (Joan Heemskerk and Dirk Paesmans) removed most of the game assets, replacing them with generic bare-bone placeholders. Textured walls were changed to flat black surfaces, and enemies converted to black triangles. The levels were renamed "Unitled 1", "Untitled 2", and so forth. The load and save dialogues are barely recognisable. SOD is a fundamental deconstruction of the original video game. Taking a game apart and subsequently reassembling it in an unexpected way introduced postmodernism to game art. SOD was a striking disturbance to New Media Art. Just like Wolfenstein 3D kick-started the first person shooter genre, SOD established the genre of game mods that reflect on games. SOD appropriates the game Wolfenstein 3D in order to reflect on this particular genre of digital games and games in general.* "[291]

[286] Klu10.
[287] Ped13.
[288] PH99.
[289] Con99.
[290] Boo99.
[291] Pic06.

Artwork XIV: Adam Killer

Artist: Brody Condon

Year: 1999

Hack-based transformation of the controversial ego-shooter game Wolfenstein 3D by Id Software into an interactive constructivist painting

Image 5.47: Adam Killer

Cindy Poremba provides an excellent summary of the video game modification Adam Killer: **"** *Adam Killer is in fact a series of eight mods created between 1999-2001 by artist Brody Condon using the 1998 computer game Half Life. As an iconic and somewhat controversial work of early game modification art, it can serve as a touchpoint for this larger discussion on frameworks for contextualizing art mods. In the mod itself, the player encounters a game level filled with multiple copies of the same character, Adam, standing unarmed, unaware and generally idle ([...]) in a nondescript white space. Adam is in fact modeled after a specific person: sculptor Adam Frelin, an acquaintance of Condon's who was ostensibly selected because he was commonly seen wearing a white shirt, which Condon felt would create an attractive contrast with the blood spatter (Condon 2002). The only course of action a player has available, aside from navigating through the space of Adams, is to dispatch with Adam using the variety of weapons in the Half Life arsenal (different types of guns, grenades, a crow-bar etc.). As Adam is annihilated, a software bug in the core game is exploited to create a dramatic kaleidoscopic trailing effect. This turns the environment into a visually intense, chaotic mess of fractured textures, marked by the characteristic bright red colour of virtual blood and guts.*"[292]

[292] Por10.

Artwork XV: The Intruder

Artist: Natalie Bookchin

Year: 1999

Series of arcade games to tell an interactive tragic short story

Image 5.48: The Intruder

Natalie Bookchin describes her piece The Intruder as follows: " *The Intruder is an Internet-based art project that uses a series of ten arcade-like game interfaces to tell a short love story by Jorge Luis Borges. In combining these familiar scenarios with Borges' short and brutal tale of a tragic love triangle, The Intruder seeks to make the metaphors in these interfaces—shooting, wounding, surveying (a woman's body)—grossly apparent. Players move forward through a linear narrative only by shooting, fighting, catching, or colliding. Instead of winning a point, a player is rewarded with a piece of the narrative, told in a voice-over. Playing transforms readers into participants who are placed inside of the story. Throughout The Intruder, players' subject positions shift back and forth between different and opposing sides in the same story, sometimes assuming the position of the male character, sometimes controlling the female character.* "[293]

5.6.3.4 Gamification

A widely used definition of gamification was introduced in 2011 by *Sebastian Deterding*, *Dan Dixon*, *Rilla Khaled* and *Lennart Nacke*: "*Gamification is the use of game design elements in non-game contexts.*"[294] The authors make it clear that this definition primarily applies to games, which they understand as a subset of play activities: gamification makes use of rules and competition, it affords goal orientation. Concerning the game design elements, the authors acknowledge the ambivalence of the term, as individual elements generally do not constitute a game, and also can usually be found in different, i.e. non-game, contexts as well; they propose a limitation to elements that are characteristic to games. Concerning non-game contexts, the authors reference "*other purposes than their normal expected use for entertainment*" and refrain from a limitation to particular application contexts.

Ian Bogost has a reputation for criticizing many flavors of gamification, as well as the specific

[293] Boo05.
[294] Det+11.

rhetorics associated with the term; he proposes a different notion, *exploitationware*: " *And as a concept, exploitationware has numerous rhetorical benefits:*

It disassociates the practice from games. *This is the most important position of all, because it makes room for games to move into the same areas of application while giving them a natural response to the gamification option. "What about gamification? That seems cheaper and easier." "Oh, you mean exploitationware? It's great if you don't mind swindling your customers."*

It connects gamification to other, better known practices of software fraud. *These include malware, spyware, and adware. While some uses of -ware still have positive or neutral associations (shareware, freeware), people are more familiar with the more nefarious variants, thanks to negative press coverage of software exploits.*

It kicks the fulcrum out from under gamification's lever. *Gamification is appealing to consultants and organizations because it's easy, cheap, and replicable. It's high leverage. Some companies will follow any trend, but most are smart enough to understand the medium- to long-term cost of bad decisions. Just the threat of negative customer perception of gamification techniques offers a good method to argue against them.*

It allows us to situate gamification within a larger set of pernicious practices in the high-tech marketplace. *These include the general practice of extracting personal information from customers by pretending that one's product is actually one's customer. Google and Facebook's seemingly free services also could be called exploitationware of a different kind, since they use the carrot of free services (their purported product) to extract information that forms the real basis for their revenues (their real product). For more on this subject, read Siva Vaidhyanathan's book The Googlization of Everything.*

It opens the door for more earnest, beneficial uses of games. *Characterizing gamification as exploitationware gives games-as-systems advocates an opportunity to present alternatives. Doing real, meaningful things with games is hard and risky, but it offers considerable reward, reward that responds to the underlying shift away from the logic of industrialization that gamification takes for granted.* "[295]

In our previous work, productive gaming was mainly distinguished from gamification based on its goal-oriented play: " *Finally, we dissociate productive gaming from gamification ([...]) because the latter usually aims at goal-oriented play: "Finally, academic as well as industry critiques of gamified applications have repeatedly emphasized that these focus almost exclusively on design elements for rule-bound, goal-oriented play (i.e., ludus), with little space for open, exploratory, free-form play (i.e., paidia)"*[296] "[297]

However, there are additional distinctive features; most importantly, gamification is usually considered as a design process for specific purposes: more often than not, it is deployed as an instrument to improve the work effectiveness of employees, in many cases with questionable results. *Raph Koster* points out that reward systems, when deployed as sole game design element, are insufficient: " *There is a design practice called "gamification" which attempts to use*

[295] Bog11.
[296] Det+11.
[297] BS16.

the trappings of games (reward structures, points, etc.) to make people engage more with product offerings. Does it miss the point of games? It is often layered on top of systems that lack the rich interpretability of a good game. A reward structure alone does not a game make."[298]
Productive gaming on the other hand basically qualifies playing activities leading to some kind of productive output; these playing activities potentially involve, but are not limited to, digital games. Consequently, digital environments promoting productive gaming may originate from gamification processes.
Concerning goal orientation, gamification may or may not involve player-determined objectives, whereas for productive gaming user objectives are the be-all and end-all: distinctive player creations depend on their creativity, fueled and at the same time limited by the rules.

5.7 Productive gaming

Summarizing, as illustrated in figure 5.49, productive gaming relies on three specific cornerstones: relevant digital environments, particular playing activities, and tangible results.

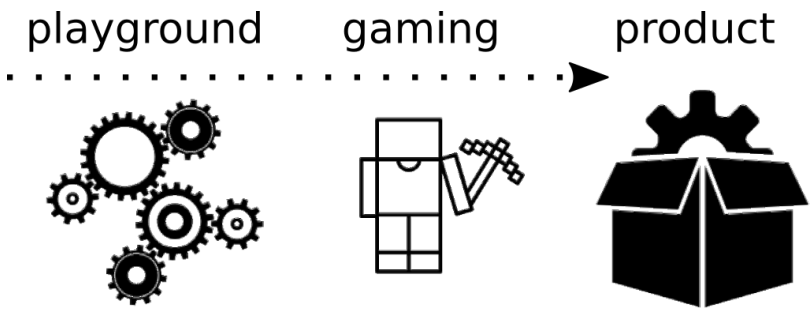


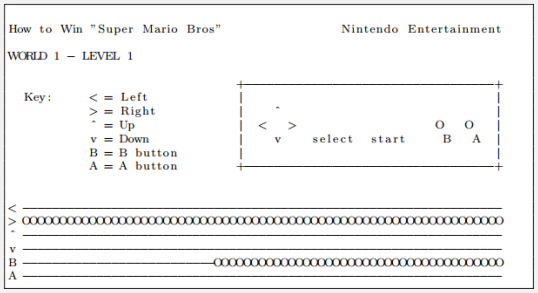
***Figure 5.49*: Productive gaming in a nutshell** (Figure icons are licensed CC-BY, attributions: Gears by Lisa Oregioni, minecraft by Lars Meiertoberens, product by Rafael Garcia Motta, from the Noun Project)

5.7.1 Digital playgrounds

Concerning digital playgrounds, they are usually based on software simulations: they are abstractions of particular processes, involve complex systems, and are both limited and limiting. Relevant digital environments bring about and automatically enforce rules; these rules limit, define and structure possible player interactions, and by doing so become catalysts for player creativity. Productive gaming can occur with games, but also with non-games / software-toys, with productivity software, with video game modifications, and with particular electronic devices. In this context, a central requirement for the digital playgrounds is to account for and to enable more Paidia-aligned, i.e. free-form, playing activities: players require the freedom to set their own creational goals, which, in the case of digital games, are seldom aligned with in-game goals. A nice example concerning the disassociation of creational goals and in-game goals can be found in the work **How to Win "Super Mario Bros"** by *Alex Galloway*.

[298] Kos05.

Artwork XVI: How to Win "Super Mario Bros"



Artist: Alex Galloway

Year: 2003

Object-made recording of the game controller interactions of a successful Super Mario Bros playthrough

Image 5.50: How to Win "Super Mario Bros"

For this work, Galloway recorded his playing through by filming his hands and later transformed the sampled controller input into a sheet-score. Here, the score, completely available as downloadable text-files[299], can be regarded as the result of the productive gaming activities concerned with his artwork. Projects enabling or encouraging productive gaming in some cases intersect with the domain of interactive art; relevant strategies often involve self-expression (i.e. Strategy of Instrument for music / media production) and, in the case of games (Strategy of Game), a meta-discursive character. Projects attributable to the former category in many cases feature extraordinary interface design. Innovative interfaces in particular, but also fresh ideas concerning mechanics or concepts, encourage the player willingness to engage into a ludic attitude. A brief illustration concerning common properties of productive gaming playgrounds is shown in figure 5.51.

[299] For instance, the first part is available here: https://artport.whitney.org/gatepages/artists/galloway/1-1.txt, last accessed 2020-09-02

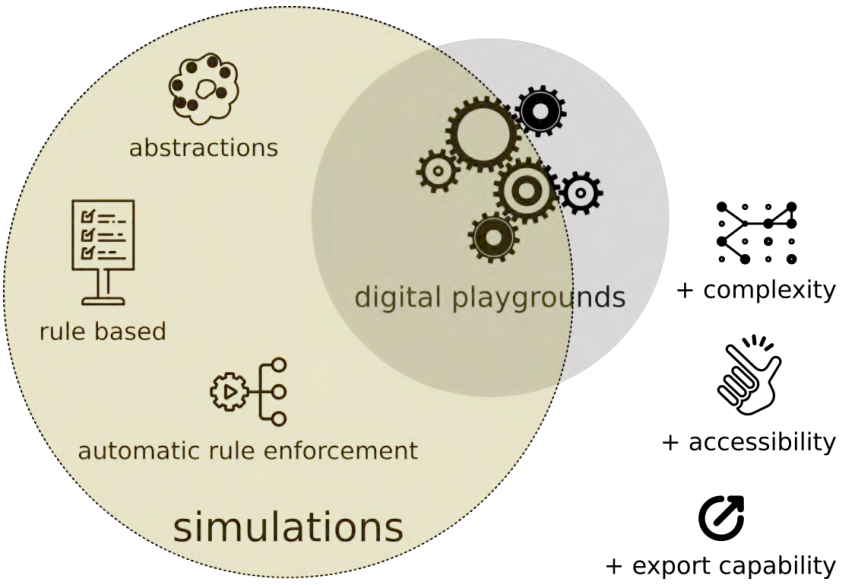


***Figure 5.51*: Productive gaming playgrounds** (Figure icons are licensed CC-BY, attributions: automatically by Adrien Coquet, Flower by Natalia, Complexity by SBTS, snap by Yash Gohel, export by Landan Lloyd, rule board by Maxicons, Software by angelina, from the Noun Project)

5.7.2 Digital play

Concerning the playing activities, productive gaming involves several requirements: ideally, they are rewarding on their own, i.e. players enjoy spending time with relevant projects even without the ambition to produce considerable results. In order to be appealing, an adequate simulation complexity is required, as are elements inducing uncertainty. Productive gaming involves different play phases, including learning phases, experimentation phases, free-form production and goal-oriented production phases. These play phases oscillate, e.g. players discover new techniques while experimenting, and apply their findings to new pieces. Very often, the learning phases are considered as fun. Concerning temporal framing, productive digital play activities are not limited to leisure time, potentially they can also be pursued / occur in work contexts. Still, as the use of toys does not automatically condition playing activities, the same applies to environments suitable for productive gaming. The relevant features concerning digital play for productive gaming are illustrated in figure 5.52.

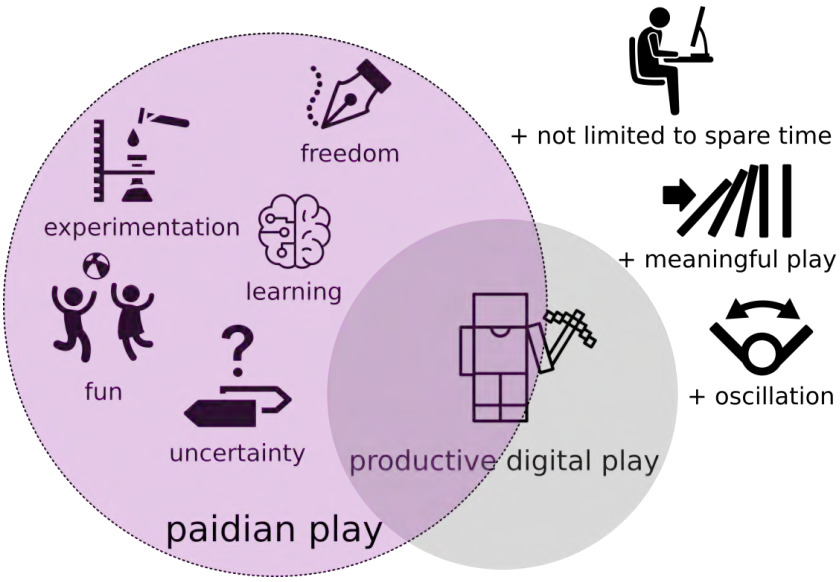


***Figure 5.52*: Productive digital play** (Figure icons are licensed CC-BY, attributions: dominoes by Erik Arndt, decision making confusion icon by Delwar Hossain, Work by Adrien Coquet, Freeform Pen Tool by Fabiano Coelho, Children Playing Ball by Gan Khoon Lay, Learning by Justin Blake, minecraft by Lars Meiertoberens, experiment by Ian Rahmadi Kurniawan, oscillation by Taylor Melody, from the Noun Project)

5.7.3 Productive gaming results

Productive gaming results often constitute digital artifacts; still, non-digital results, including 3D-printed models, are also possible. A particular requirement is their tangibility - while improving language skills using an educational game is worthwhile and precious, productive gaming has a particular value proposition: by pursuing playing activities, objects are created. These products may involve a monetary worth, aesthetic values, a sense of achievement, and they may be used on their own or as parts of other projects. Relevant products can be used beyond the virtualities of the digital playgrounds they were created with, and ideally can be appreciated even without the knowledge concerning their creation processes. Very often, productive gaming results in music, or in audio-visual pieces; concerning the latter, audio-visual synchronization and Synchresis effects are common. However, digital results may implicate complex issues concerning intellectual property rights, e.g. when using the game Spore to create 3D models, the associated EULA prohibits any appropriation other than personal use. An overview concerning the special considerations for productive gaming results is shown in figure 5.53.

***Figure 5.53*: Productive gaming results** (Figure icons are licensed CC-BY, attributions: Reuse by NeMaria, achievement by Adrien Coquet, Value by Bartama Graphic, Arrow Through by iconsmind.com, Award by ahmad, Puzzle by Adrien Coquet, film reel by parkjisun, restrictions agreement by corpus delicti, teamwork by Turkkub, from the Noun Project)

6 foreverloops

The ambition with foreverloops was to create a productive gaming playground aimed at media production: users are able to create audio visual collages, sound sculptures, rhythmically composed visuals, and of course music, by pursuing playing activities.
foreverloops was realized as a commercial product by Marlene Brandstätter and myself over the last six years: we were profoundly convinced by the potential of the underlying metaphor and its utility for audio-visual composition, so we applied for funding (aws Impulse XL) and soon afterwards funded our company *foreverloops Gmbh* based in Linz. As a project team, we complement each other very well: either of us has a background in computer science, programming experience (research projects, art projects, work experience), and concerning technical expertise an individual setting of priorities - whereas Marlene focuses more on the visual aspects (video decoding, user interaction), the author concentrates more on audio processing. Still, the realization of a commercial product (or rather a product family, as foreverloops is available in the three editions BEATS, LONGPLAY, and STUDIO) made it necessary to involve quite a few contributors, including graphics design experts, people who would provide us with appropriate sample and demo material, consultants for product development, marketing and sales, a film studio for the creation of a commercial video, testers, library developers, etc..
In our previous work, we discussed the advantages of an interface-centric design approach,[300] but also presented the properties and benefits of the underlying paradigm[301] - extending the circular sequencing paradigm by adding interaction and construction patterns derived from the field of mechanics: *Many computer-aided music composition tools provide the capability for loop construction, including specialized input metaphors in the form of circular sequencers. Music videos and live VJ performances are usually built on already finished music, using contrasting acoustic patterns or cued spots as synchronization anchors. The act of composing music and the production of video material is considered work and usually involves the use of professional software that requires specific training and experience.*
We propose a novel game interface for use in audio-visual composition. It extends the circular sequencing paradigm by adding interaction and construction patterns derived from the field of mechanics. Users can specify event frequencies (as opposed to event timings) by playfully manipulating virtual gear trains to arrange, program, and perform audio-visual events.
A short electronic music composition presented as a typical foreverloops scene (excluding GUI elements) featuring the gear metaphor is shown in image 6.1

[300] SBM17.
[301] BBS16.

***Screenshot 6.1*:** foreverloops scene

foreverloops is not designed as a game: neither does it dictate goals, nor involve victory or losing conditions. However, it may qualify as a game, e.g. it suits the previously mentioned definition for *creative-based music games* by *Thomas Studley*, *Richard Vella*, *Nathan Scott* and *Keith Nesbitt* perfectly: " *For 'music', 1) the core gameplay activity must be predicated on musical decision-making and 2) the player must be able to influence the production of music through the direct use of game mechanics. For 'creative-based', 3) the player must plausibly be able to mentally frame their use of the mechanics as having created new music in all instances of play. For 'game', 4) an 'unnecessary obstacle' must be enforced by an automated game mechanic, and 5) the player must 'exert effort' to achieve a self-imposed 'aesthetic goal', the value of which is mediated by their personal music bias, and for which the emotional 'consequences' are both self-negotiated and 'optional'. Finally, 6) the 'game' must be apprehended as an activity rather than an object.*"[302]
Following this definition, with foreverloops
1) the core game-play activity definitely is predicated on musical decision-making,
2) the player uses game mechanics to produce music,
3) new music is usually created when playing (with the exception of compositions mimicking existing songs),
4) the automated game mechanics are highly unusual, and therefore can be considered an obstacle to experienced musicians,
5) the achievement of an aesthetic goal requires effort, every audible event is a direct result of player interactions, and
6) using foreverloops is a playing activity.

In the following, the motivation, project influences, properties, capabilities and design considerations, advantages and drawbacks, as well as relevant outcomes will be described in detail.

[302] Stu+18.

6.1 Motivation

The creation of foreverloops was motivated by several ideas: first, we wanted to create an environment that makes music and media composition more accessible. Everyone with a certain willingness to engage foreverloops with a playful attitude should be able to use it in mere minutes. The idea of user empowerment is not new - e.g., *Marshall McLuhan* and *Barrington Nevitt* conceived the idea of *Prosumers*, i.e. consumers turned into producers, for electronic technology in 1972.[303] As discussed previously, in the domain of video games it also has become a common practice to provide players with toolkits to extend or modify ready-made video games; still, modding, asset creation, software development are usually considered activities related to work, and not so much as play activities. With foreverloops, the ambition is to bring digital play and productivity closer together: players experiment with foreverloops to discover new techniques, and apply them to original results at their own pace, without dictating goals and at the same time preserving unrestricted player authority over their creativity. Player creativity is at same time restricted but also incited by the capabilities of the software simulation. As pointed out by *Silvia Lindtner* and *Paul Dourish*, **"***[...] "productive" play does not end with economic or social value generated in the game [...] nor with the material production by players themselves, turning them from consumers into producers of content [...].***"**[304]

Second, we wanted to escape more traditional time-based approaches towards composition using a non-linear attempt based on frequencies. To that end, we deploy the proposed design paradigm based on virtual gears, enabling but also enforcing non-linear media production. A related concept can be found in *Espen J. Aarseth*'s concept of *cypertext*, *a machine for the production of variety of expression.*[305] Of course, a play session with foreverloops will always result in a linear piece of music, image sequence, video, or a mixture - the same is true for cybertext, as *all texts are produced as a linear sequence during reading.* However, analogous to cybertext, the non-linearity stems from the source, from how the music is made, from where the text fragments are read from. Using foreverloops, creating a piece of music usually involves a performative element, a selection concerning which part to play when. On the other hand, foreverloops relies on the representation of periodic sequences as gears, and like physical gears, they can be put in relation, affecting tempi and sequencing. This paradigm is well suited for specific objectives, including incremental loop construction and realizing poly-rhythms, but also discourages traditional time-based composition.

Third, we wanted to combine ideas from the gaming domain with productivity software, in order to make learning and becoming proficient with it more fun, but also to let composing media feel more like playing a musical instrument. *Raph Koster* argues that learning, and especially learning games, is an intrinsically fun activity, one that may actually be the reason for games being appealing for so many.[306] foreverloops provides a new approach towards composition, which limits the value of prior knowledge: it shuffles together ideas from physics, math, and music,

[303] MN72.
[304] LD11.
[305] Aar97.
[306] Kos05.

and forces players to experimentally become acquainted with the system, and perhaps even un- and re-learn things they already knew. Over time, oscillation effects of different play phases set in: learning phases alternate with goal-oriented composition, with performances, with creative application. These phases, and their interactions, are also relevant for learning musical instruments. Another common ground with musical instruments is the relinquishment of objectives - players are to set their own goals, at their own pace.

Fourth, we wanted to realize foreverloops as a commercial product, for several reasons: on the one hand, we figured we could reach a wider audience, and as a consequence benefit from more feedback, including bug reports, ideas, and feature suggestions. Also, we are genuinely interested in what users do and create with foreverloops. Anything created and shared by the players is unswayed - any shared foreverloops piece by a user was made and uploaded by her own free will, without an extra encouragement. A related key advantage is, due to the availability of foreverloops as a product, that everyone can have it: gamers, musicians, streams, teachers, and so on. With interactive art, a common practical disadvantage is that it can only be experienced for a limited time at specific locations. Furthermore, we figured we could use the revenue generated by the commercial product to realize the project to its full potential: at the beginning, we had but a basic understanding of the underlying gear-based paradigm. Without a similar project, it was necessary to generate feedback that could than be used to further define and refine our product. We were practically forced to apply evolutionary prototyping, to host workshops, participate at summer schools, conferences, symposia, and to engage with applied research. There were a multitude of challenges we had to face, including software design / development, project management, interface design, loads of bugs and workarounds, marketing and distribution.

Fifth, we knew that foreverloops, enabling productive gaming, would intersect with several areas of tension: as a software simulation without dictated goals, we had difficulties in determining if it was a game or not. At the same time, a bulk of relevant game studies publications coincided in productivity and games forming a difference set. Additionally, we suspected that our approach was scientifically interesting, but also commercially promising, as it not only lacked competitors, but also had a unique approach in mixing game design paradigms with practices from productivity software. Of specific interest was the qualification of user interaction, the determination of subjective user engagement, the relevance of individually set goals, and in particular the question whether playing with foreverloops is considered a work or rather a leisure activity. Initially, we also considered the question of authorship an issue: are players the sole authors of their pieces? Very soon, we would consider a yes as the only response, despite the disagreement of several video game companies on this matter. Often, video game streamers are required to sign specific contracts before being allowed to create videos of / with certain games; these contracts would admit a share of stream revenues to the game companies, but also acknowledge curatorial rights: in case a player would criticize a game in a video, the video could than be queried and removed from relevant platforms. For foreverloops, being a software aimed at productivity and the creation of creative content, such practices would have self-defeating effects. These practices are very much opposed to our intentions, so we addressed this issue by specifically adapting the

EULA[307].
Sixth, we figured that having realized a commercial-level product and having first-hand insight into the entertainment industry would not be detrimental to our CV's: the founding and running of a newly created company, the creation and publication of a complex software simulation with audio-visual focus, the fostering of a community, are only a few examples for accountable and comprehensible feats we achieved over the past years. We consider these as remarkable qualifications and unique assets, they are likely to be of tremendous advantage for future professional opportunities.

6.2 Influences

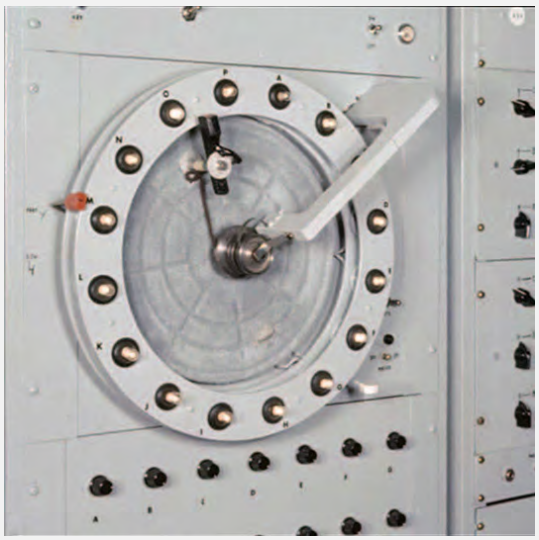
The creation of foreverloops took several years, and was heavily influenced by related projects, particular games and software, but also by several game studies articles and in general the fields of tension between playing and productivity. Very influential was the aforementioned work of Toshio Iwai, with SimTunes in particular: it features a unique set of rules and adequate complexity, encourages its players towards experimentation, and aims at the creation of audio-visual compositions. Players delve into it at their own pace, can acquire more skills and expertise by experimentation, and have to determine their own ambitions, as SimTunes does not dictate goals. With foreverloops, we tried to provide the users with these exact qualities as well.
Concerning the play experience, the game Spore was also a source of inspiration: its primary game mechanic involves a character editor resembling and simplifying 3D-modeling editors. Although the visual appearance of Spore creatures have a limited effect on how the game evolves, playing with particular features and shaping virtual objects is a soothing, creative and rewarding experience by itself. Our ambition was to make equally rewarding experiences possible with foreverloops. In addition, we were influenced by several projects in the domain of interactive art that enabled a degree of creative creation by self expression, e.g. the Very Nervous System by David Rokeby. From a more formal point of view, more mathematical simulations such as the Game of Life left a mark, especially concerning the property of Turing completeness: although we do not consider foreverloops as a visual programming language, the particular feature of Leibniz gears (discussed in more detail in a subsequent section) allows players to implement counting and branching. The capability for real conditional branching, a pre-condition for Turing completeness, is not yet available in foreverloops; still, we like to ponder on possible, conceptually consistent realizations and effects of such a feature.
Also, user and expert feedback, requests and requirements from musicians, player expectations, design considerations and software development had lasting effects.
Besides the games, artworks and projects discussed in previous sections, one of the most influential approached can be found in the **Circle Machine** by *Raymond Scott*, the first circular sequencer. The Circle Machine will be discussed in more detail in the following.

[307] understandably enough, we were asked repeatedly by foreverloops users if they really had authorial control over their creations.

6.2.1 Prototypical circular sequencer

foreverloops builds upon and extends the circular sequencer paradigm. As discussed in our previous work,[308] the Circle Machine by Raymond Scott can be considered the first circular sequencer for applications in music-making: *In design terms, the Circle Machine resembles an analog clock, comprising a disc and a rotating arm that scans a circular grid on the disc at a specific tempo. The number of segments is fixed at 16, and as there is a single ring there are 16 total programmable events. Scott used adjustable lamps to indicate events, and a photo-electric cell to read them. This made it possible not only to switch notes on and off, but also to specify the instrument pitch.*

Artwork XVII: Circle Machine



Artist: Raymond Scott

Year: 1959

First viable circular sequencer, using photo-electric cells for user interaction

Image 6.2: Circle Machine

Irwin Chusid and *Jeff Winner* summarize the Circle Machine as follows: *Around 1959 Scott designed and built a more compact electronic sequencer he called the Circle Machine. Berklee Music Synthesis professor Dr. Thomas Rhea, who visited Scott many times in the early 1970s, remembered it as "an analog waveform generator that was this crazy, whirling-dervish thing. It had a ring of incandescent lamps, each with its own rheostat, and a photo-electric cell on a spindle that twirled in a circle above the lights." The intensity of each bulb was individually adjustable, as was the rotation speed of the photocell. As the lights brightened, the pitch ascended. Arm rotation speed governed the rhythm. The lights could be staggered in brightness, and depending on the pattern, the tone sequence generated would change accordingly. The Circle Machine was capable of a wide range of unearthly sounds, as evidenced by numerous commercial jingles Scott recorded during the late 1950s and early 1960s (many heard on MRI).*[309]

[308] BBS16.
[309] CW01.

Scott presented it this way: "*The Ferris Wheel-like device, at the left, is what we've named the Circle Machine. Here is a closer shot of the Circle Machine — an original development of ours, by the way. And now, a darker picture that will help me better explain how it works. The intensity of each light in the circle is individually adjustable. At the tip of the arm, which I don't think is too clear in this picture, there is a photocell. This cell is part of an electronic sound generating system, so adjusted, that the more light the cell sees, the higher the pitch of the sound produced. The cell also moves around in a circle at adjustable speeds. One of the controls above the circle of lights — and I guess you can't see that, or maybe you can in this picture — changes the pitch center of the complete cycle when required. As you can notice, there are many variable functions possible. [...] I would like to demonstrate a practical use of the Circle Machine. Problem: Create a sound to go with the sequence in a TV spot in which a storage battery is dying because the electrolyte is rapidly evaporating, ending in a short circuit. This tape demonstration starts with a Circle Machine impression of a dying battery. To keep the sounds generic in this commercial, the Circle Machine is also used in a punctuation matter. [...]*"[310]

Summarizing, the Circle Machine was first presented 1961. Its primary purpose was to let composers program recurring sequences. Still, these sequences could be altered in various ways: first, for every onset event, it was possible to select and alter its pitch: brighter lights induced higher pitches. And second, the rotation speed was adjustable, and directly corresponded to the beats measure. However, the number of segments was fixed to 16, and there was only one sequence at a time. At present, circular sequencers are widely used, but it does not constitute the dominant sequencing paradigm.

6.3 Properties and capabilities

foreverloops provides its users with a productive gaming playground: a sandbox concerned with simulating virtual gears to unite music, creativity and play with mathematics, logics and physics. These gears interact with each other like physical gears, they form meshes with different transmission ratios, relevant rotation orientations are adapted accordingly. Unlike physical gears, the virtual gears can be programmed with media events, including sound samples and video loops, causing individual gears to behave like circular sequencers.

The style of bar representation is compact, it is based on event frequencies rather than the time domain, it allows real-time manipulation, and its combination of gear mechanics, media production, and gaming yields emergent behavior unanticipated by the authors. Players can incrementally change, improve and create new variations of rhythmic and melodic patterns. A typical composition session may consist of creating, adapting, extending, and organizing, individual gear trains with specific themes.

The underlying rules of the simulation are easy to understand, the more difficult and interesting part is to make use of their properties for compositions and performances. In the following, relevant properties and capabilities of foreverloops are discussed, along with the capabilities of

[310] Sco17.

the underlying simulation.

6.3.1 Gear metaphor

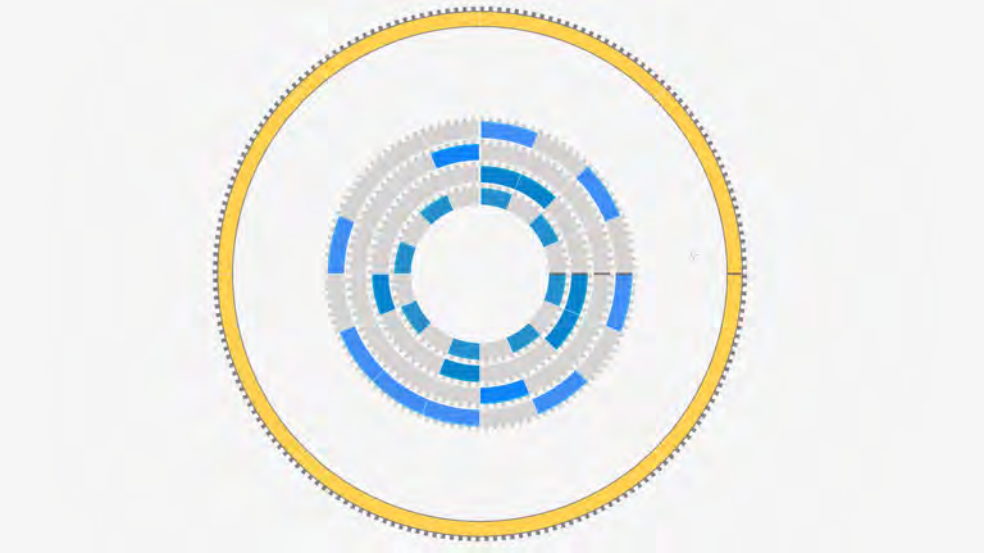
In our previous work, we have presented a preliminary assessment concerning the benefits of a gear representation for music creation: "*When Raymond Scott presented his Circle Machine 1958, he introduced a progressive and nowadays widely used sequencing paradigm: musicians would set events to mark tone attacks within a ring with a fixed number of segments representing the metrum. In playback mode, an internal clock would jump from segment to segment and trigger the playback of the preset audio events. The circular arrangement implies phasor semantics. Composers program event frequencies and phase shifts instead of event timings, and start and end times are determined solely by interactions, as the times are variations in and extensions to the initial programming. When analyzed as a bar representation, the circular layout is both easy to understand and to interact with. We therefore used this as the foundation for our approach: adopting the circular sequencer layout and combining it with the metaphor of interconnected gear wheels following the laws of mechanics.*"[311]
Summarizing, in foreverloops, gears combine mechanical principles (i.e., transmission, stacking, driving) with the virtuality of a software simulation to afford many opportunities for audio–visual creations. Since than, we were able to realize this proposition as a commercial product family, to observe users interacting with it, and to improve upon it due to the feedback and requests by the players.

Subsequently, the overall ideas of the gear representation, the grouping / meshing capabilities and their consequences, the ideas and linking effects of the available gear types, and the mechanisms in place for synchronization, are examined in more detail.

6.3.1.1 Gear representation

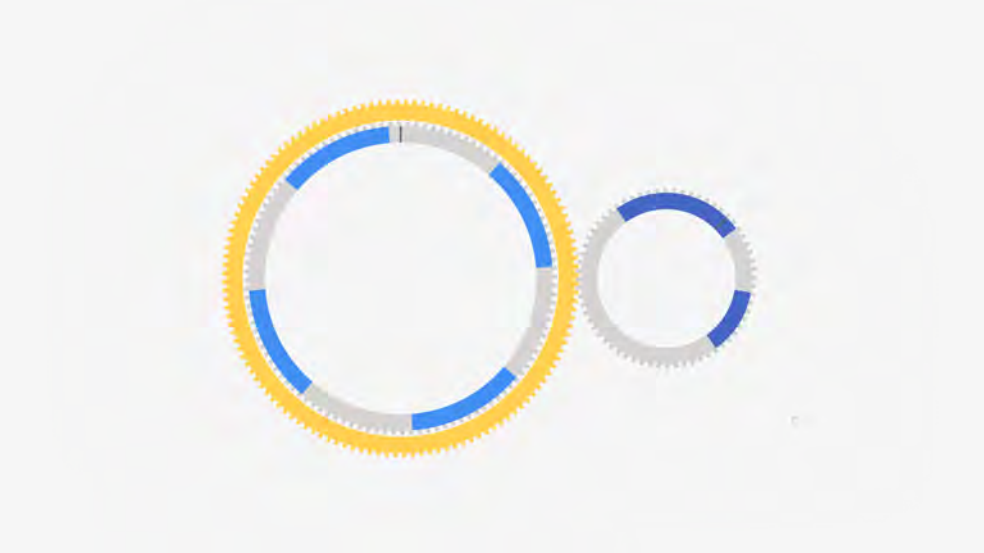
We consider the gear metaphor as an intuitive representation of a score, for several reasons: first, it builds upon the cyclic sequencer paradigm, which stresses periodicity and regularity and displays clarity and comprehensibility. This becomes apparent when inspecting image 6.3: here, a foreverloops scene featuring a basic rhythm is shown as simple circular sequencers with equal subdivisions.

[311] BBS16.



***Screenshot 6.3*:** circular sequencer in foreverloops

Even without having used a circular sequencer before, its function becomes intelligible immediately, as does the structure of the specific rhythm.
Second, the differences and interactions of multiple meters and tempi are displayed via mechanical transmissions in an intuitive manner, inviting experimentation. E.g., image 6.4 depicts once again a basic rhythm, this time involving gear transmission.



***Screenshot 6.4*:** gear transmission in foreverloops

Assuming the yellow gear on the right, a so called drive gear, requires four seconds for a full convolution, the inner left gear consequently also requires four seconds; the smaller gear on the right however is only half the size of the gear it is attached to, therefore a full convolution occurs twice as fast, i.e. every two seconds. By using mechanical transmissions to display and to interact with meters, players can make use of their prior knowledge concerning gears. Also,

the application of basic mechanical laws in a new context invites experimentation and incites a ludic attitude.

Third, with the exception of rather simple foreverloops scenes, the gear representation generally cannot be used as a sheet score. Image 6.5 shows a more complex scene involving a lounge music composition: it not only uses a fairly complex gear mesh with several transmissions, but also a second independent graph that is played back in parallel.

***Screenshot 6.5*:** foreverloops demo composition

Although in this example it is still possible to follow the sequences and playbacks of individual sounds when running it, by just examining the image it is impossible to make even a rough assessment of how it sounds. Even worse, it is virtually impossible to estimate basic musical parameters, including the overall tempo, the volume, the music style, and the base rhythm, by looking at a screen-shot alone.

Fourth, with virtual gears individual patterns can be represented in multiple ways; the different possibilities have diverging advantages and drawbacks. E.g., one gear mesh may be more compact, another one is maybe more easily understood, a third flavor may be more easily modified, and another mesh may involve a specific technique. In image 6.6 one particular rhythm pattern is realized in five different ways.

***Screenshot 6.6*:** one pattern five times in foreverloops

The first setup on the top-left features a straight-forward approach: one drive gears powers three sequencer gears, stacked on top of each other. As their axial connection suggests, every sequencer gears rotates at the same speed, they also have the same numbers of subdivisions, 16. Per convention, not per necessity, each sequencer gear is programmed with one sound sample. In total, there are four gears, 48 programmable cells, 13 have a setup audio event, and there are three different sounds. Should one alter the speed or direction of the drive gear, all the sequencer gears are affected accordingly.

The second setup, as seen top-middle, is based on three independent gear meshes, each of them with individual drives. Again, each sequencer gear is programmed with one sound sample. Here, we have six gears, but only 20 programmable cells (four plus eight plus eight), seven have a setup audio event, and there are once again three different sounds. The drives however operate at different speeds - the left drive is twice as fast as the middle one, whereas the right drive is only half as fast. Compared to the first setup, this one is both more complex as well as more simple: it uses more gears, but requires less programmable and active cells. Also, the speed of particular sequences can be modified individually, e.g. the snare drum playing back four time as fast; depending on how they are used, this can be a good thing or a bad thing.

The third and the fourth setup, shown bottom-left and bottom-middle, combine some of the features of first two representations. There is only one drive gear each, and three sequencer gears, 20 programmable cells (four plus eight plus eight), seven have a setup audio event, and there are once more three different sounds in play. The bottom-left pattern makes use of gear transmission involving acceleration: the big sequencer gear has an axial connection with the drive, and therefore the same rotation speed, whereas the one top-right is half as big, and the one on the right only has a quarter of the size, therefore they rotate twice respectively four times as fast. A disadvantage of this setup are the overlapping sequencer gears, making the event programming more difficult. The bottom-middle pattern uses gear transmissions involving

deceleration: again, one sequencer gear has an axial connection with the drive, and the others with different sizes are attached to small one, applying transmission, but avoiding overlaps of the programmable areas. In contrast to the second setup, the individual gear speeds are apparent due to the use of transmission.

The fifth setup, shown bottom-right, involves programmable drive gears (Leibniz gears): here, attached gears are only activated while the gears are interlocked. There are five gears in total, but only ten programmable cells (one plus one plus eight) with only five audio events, again with three different sounds. The small gear in the middle is required to realize a one-to-four transmission. Of all shown setups in image 6.6, this variant is the least-redundant, although there still may be more compact ways to represent this pattern using foreverloops. At the same time, it is more difficult to understand and to use, but more interesting to observe.

Fifth, due to the cyclic sequencer paradigm, players setup events with specific frequencies rather than with timings. It is very easy to setup events that are triggered 60 times per second, but also with infrequent intervals, e.g. once every hour. At the same time, it is very difficult to use foreverloops in conjunction with a classical linear approach towards composition, involving strophes, dramatic progression, or multiple parts. Put another way, the pure gear-based paradigm is impracticable for pre-programming fully developed pieces.

Sixth, by using virtual gears, melodic and rhythmic motives as well as image and video sequences can be experienced immediately and interactively. As a real-time system, changes in foreverloops scenes take effect immediately. These changes may involve the gear topologies, i.e. attaching / detaching / deleting or creating new gears, and individual gears, concerning event programming, quantization / subdivision parameters, volume, or effect parameters. Besides inciting playfulness and experimentation, it also encourages performance activities: as discussed before, linear composition is almost impracticable with foreverloops. However, it is possible to record full songs by first arranging sets of tracks geared to each other, and than performing[312] the scene while recording.

Seventh, gears and gear meshes are put on an open canvas, which not only enables virtually unlimited tracks, but also allows the players to freely arrange their scenes. For instance, users can arrange scenes to fit in with a video, or to resemble objects, like a spaceship (for Spacenight-like music), as shown in image 6.7.

[312] i.e. modifying parameters like power, mute, solo, tempi, sample selections, or track topologies, or effects.

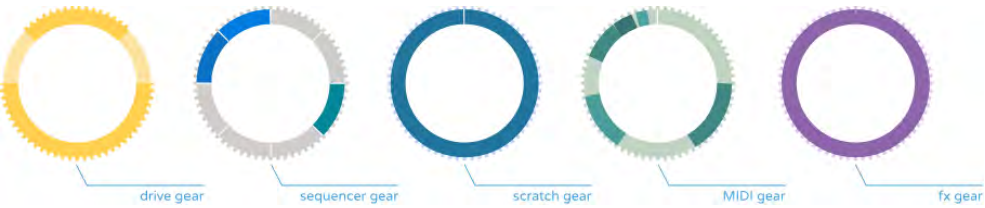
Screenshot 6.7: foreverloops scene resembling a spaceship

It also allows users to develop and exercise their own conventions, like separating instruments into specific regions, or structuring gear meshes in the order they are meant to be performed, or to even hide away optional parts. Relating to this, foreverloops provides a customizable graphical user interface, consequently individual windows can be moved around freely and be deactivated or hidden at any time.

6.3.1.2 Gear types

With the most feature-rich version of foreverloops (i.e. foreverloops STUDIO), there are a total of five different gear types available:

- drive gears
- sequencer gears
- scratch gears
- MIDI gears
- FX gears



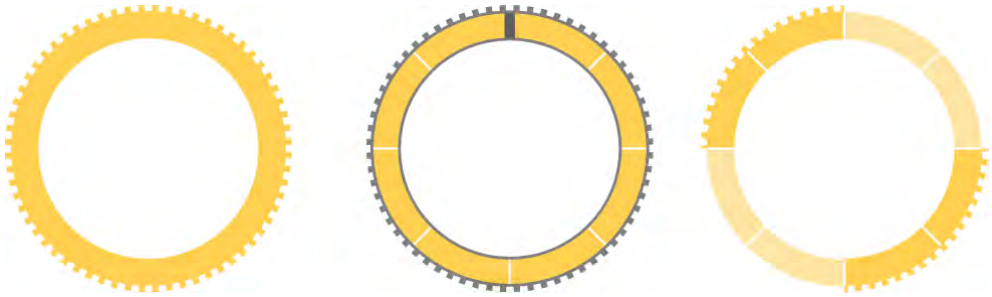
Screenshot 6.8: foreverloops gear types

As shown in image 6.8, they involve different visual representations and color codes. These five types can be categorized into three core types: drive gears, media gears, and fx gears. Drive gears can be used to manipulate rotation speeds, whereas media gears embed and play audio files, images, and video samples, whereas fx gears modify the output. Drive gears (but also scratch and MIDI gears) activate gear trains and are responsible for the tempo. Sequencer gears and scratch gears can be setup with media samples (audio, video, image), effecting their playback as the gears rotate. MIDI gears can be programmed with MIDI notes, i.e. instrument notes that can be recorded from external MIDI instruments, via the virtual on-screen keyboard (using so called SoundFonts), or directly set using the circular note editor. FX gears can be setup with effects that can be parametrized in real time. They apply to all currently connected gears.

In the following, the characteristics of the available gear types[313] are discussed in more detail.

a) Drive gears

Drive gears, as shown in image 6.9, are used to activate gear trains: they determine the playback speed of any intermeshed media gear, respecting relevant transmission ratios.



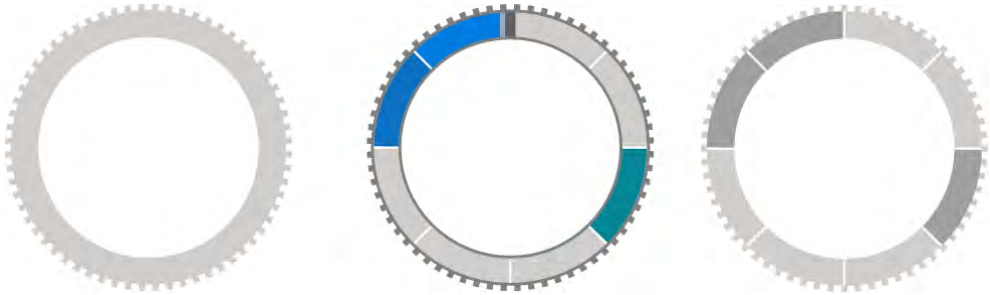
***Screenshot 6.9*:** foreverloops drive gears

They are programmable: users are able to activate or deactivate particular segments, and consequently introduce timing behaviors in intermeshed gears. In case drive gears are programmed, they are referred to as Leibniz gears, and enable similar capabilities as their real-world counterparts, the Leibniz wheels; e.g., using Leibniz gears, it is possible to implement counters.
Drive gears can have different sizes, affecting the speed ratios of attached gears, and they can be used in conjunction with other drives; concerning the latter, the effective torques are summed up, considering their direction of rotation. Consequently, in case two drive gears with the same rotational speed are intermeshed, they effectively cancel each other out and induce a deadlock.
Drive gears cannot contain or play back media samples by themselves.

[313] Disclaimer: the textual descriptions and illustrations originate and were adapted from the manual of foreverloops STUDIO (accessible online via https://www.foreverloops.com/pages/manualSTUDIO.html).

b) Sequencer gears

Sequencer gears, as shown in image 6.10, are used to play arbitrary media samples, including audio files, images, and videos.



***Screenshot 6.10*:** foreverloops sequencer gears

The playback of a programmed sample is only triggered when its cell passes the sweeper, i.e. the twelve-o-clock position. With sequencer gears, samples are always played back in normal speed, they are not re-sampled to match the current gear speed; audio samples are played concurrently, they are automatically routed into a software mixer, whereas video samples involve a different semantic: only the most recently triggered video is displayed.
Sequencer gears can contain arbitrary samples, even different media types can be mixed; however, only one sample can be programmed into one cell at a time.
Sequencer gears cannot activate gear trains by themselves.

c) Scratch gears

Scratch gears, as shown in image 6.11, can also be programmed with / play back arbitrary media samples.

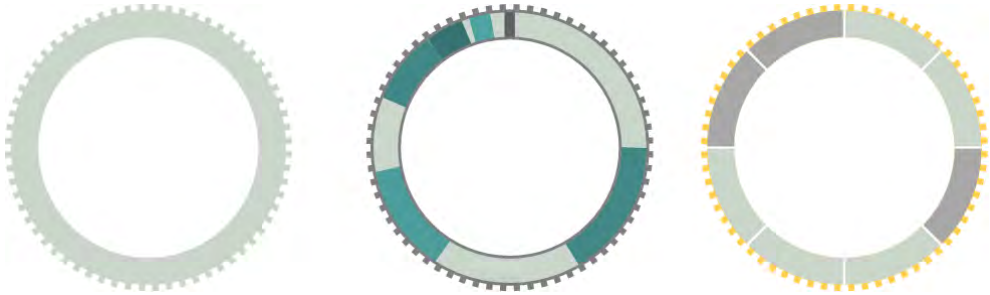
***Screenshot 6.11*:** foreverloops scratch gears

However, there are several differences in comparison to sequencer gears: first, scratch gears can be programmed with only one sample. Second, the sample is used with a re-sample semantic: with faster gear speeds, the samples are played back faster as well, or even in reverse direction. A detached programmed scratch gear defaults to a speed corresponding with the sample duration. Third, as a difference from the sequencer gear scratch gears can activate gear trains. Therefore,

a gear train attached to a scratch gear programmed with a drum loop sample is automatically synchronized to its duration. A scratch gear cannot become a Leibniz gear by itself, i.e. it cannot activate attached gear trains with programmable logics; still, it can very easily be combined with an extra Leibniz gear to that end.

d) MIDI gears

MIDI gears, as shown in image 6.12, are used to play instrument notes.

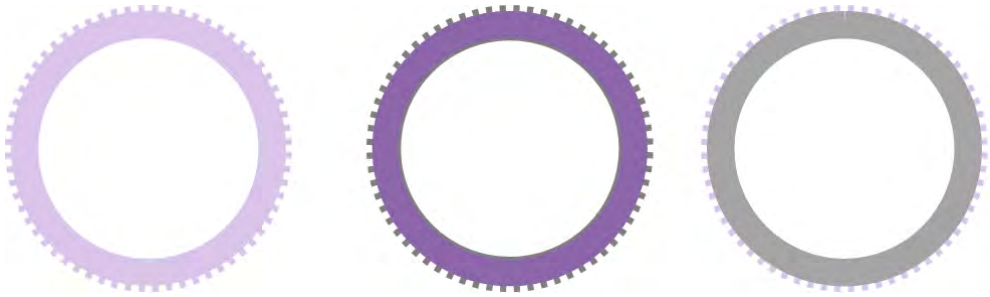


***Screenshot 6.12*:** foreverloops MIDI gears

They can be programmed in multiple ways: by using an editor, or by directly recording MIDI notes, either from an external MIDI input device, or from the virtual midi keyboard. MIDI gears also can activate gear trains, and involve the same limitations as scratch gears concerning programmable logics.
Every MIDI gear is setup with a musical instrument (i.e. a preset), that can be altered any time. The duration and playback speed of a MIDI gear depends on the way it is programmed: in case it is activated by different drive gears, a duration derived from the current topology is applied; in case it is not active, its duration is dependent on the recording duration.

e) FX gears

FX gears, as shown in image 6.13, are used in conjunction with media and MIDI gears in order to modify the audible output.



***Screenshot 6.13*:** foreverloops FX gears

They may affect sequencer, scratch and MIDI gears, as well as FX gears that are generators:

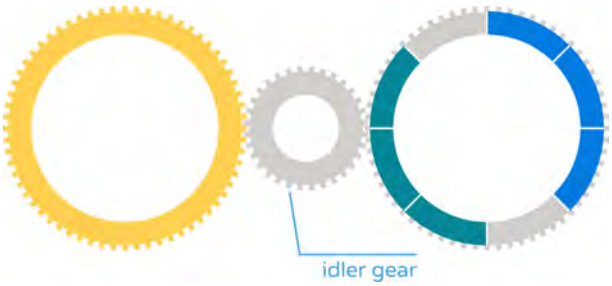
generators are synthesizers that can be used in conjunction with MIDI gears - instead or in addition to the normal MIDI presets, FX gears can also be used to render notes. An FX gear affects the entire gear train it is attached to. Also, it is possible to realized so-called effect chains with a stack of FX gears. FX gears can only be programmed with one effect each, they cannot activate gear trains be themselves. Also, they can be interfaced with external plug-ins (VST3 effects and instruments).

6.3.1.3 Grouping, meshing and consequences

The virtual gear representation has several characteristics. First, it provides a structuring element: rhythm patterns, as shown in previous examples, involve different tracks, bar measures and tempi as well as sound samples, and they are usually played back poly-phonically. With virtual gears, the rhythm patterns can be organized as gear meshes, and as a consequence manipulations affect the whole pattern: four out of the five setups featured in image 6.6 allow a centralized change of playback speed - playback speeds are adjusted by modifying the yellow drive gears, and of course all meshed gears are affected. Also, these four patterns can be moved as a group, and even be attached to other gear meshes. The aforementioned open canvas is also useful for arranging more complex pieces - different groups, like percussions or organ melodies, can be put into spatial proximity, making it easier to combine prepared pieces during a performance.
Concerning composition, the capability to form gear trains facilitates several possibilities:

- multiple gears / circular sequencers at the same time enable polyphony.
- Stacking gears with different bar measures facilitate poly-rhythms.
- Meshing gears with different bar measures and sizes (transmission) make poly-meters possible.
- Meshing gears with different bar measures to a Leibniz drive enables a specific form of canon - *Leibniz canons*.

In each instance, the general laws of mechanics concerning gears and gear transmissions apply; of particular interest is the rotation orientation change that occurs when two gears are meshed. Obviously this also inverts the playback direction, and makes specific measures for track synchronization necessary. As a player, this effect can easily be bypassed by inserting idler gears, as shown in image 6.14.



***Screenshot 6.14*:** foreverloops idler gear

Concerning meshes, the simulation ignores gear slippage for the sake of simplicity and usability. Also, the number of cogs is always assumed to be proportional to the circumference of the gears.

In the following, poly-rhythms, poly-meters and canon structures will be examined in more detail.

a) Poly-rhythms

Generally, poly-rhythms are tracks with different bars played at the same speed.

Eve Poudrier and *Daniel Shanahan* summarize poly-rhythms as follows: *Such rhythmic complexity is often identified as one of the central features of twentieth-century Western art music. In particular, the use of poly-rhythm, that is, the superposition of two or more contrasting rhythms, meters or speeds, seems to have increased significantly both in prevalence and scale. Before the turn of the twentieth century, apart from a few isolated cases (e.g., Mozart's simultaneous use of three different orchestras, each playing in a different meter in a scene from Don Giovanni, 1787), poly-rhythms were generally used locally or as a means to create special accompaniment textures (e.g., Chopin's Etude No. 1 from Trois Nouvelles Études, 1840).*[314]

In *Mozart*'s opera **Don Giovanni**, as shown in image 6.15, two orchestras are performing at the same time using different meters: two to four and three to four.

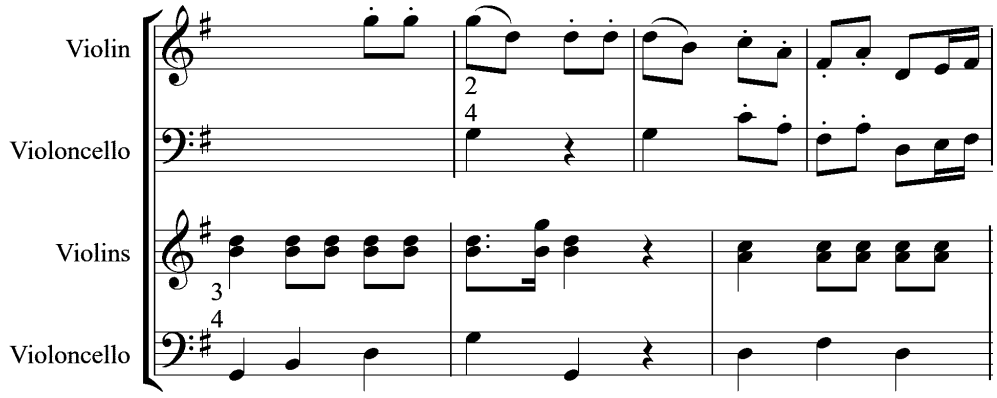
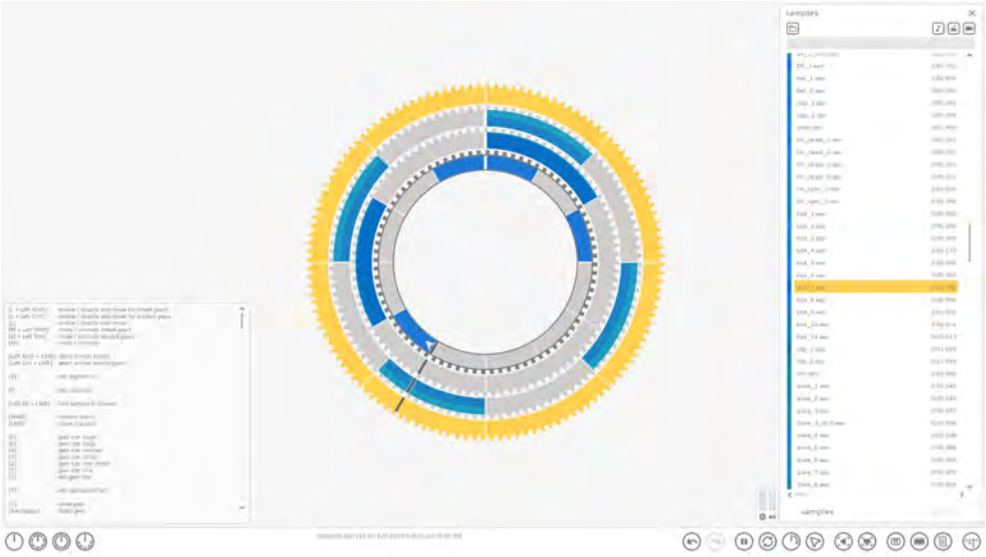


***Image 6.15*:** Poly-rhythm Mozart, Don Giovanni Dances from Act 1, Scene 5, **Mozart**, 1788

Using virtual gears, there are many ways to achieve poly-rhythms. The most straightforward

[314] PS18.

way is to stack and program tracks with different segmentations, as shown in image 6.16.



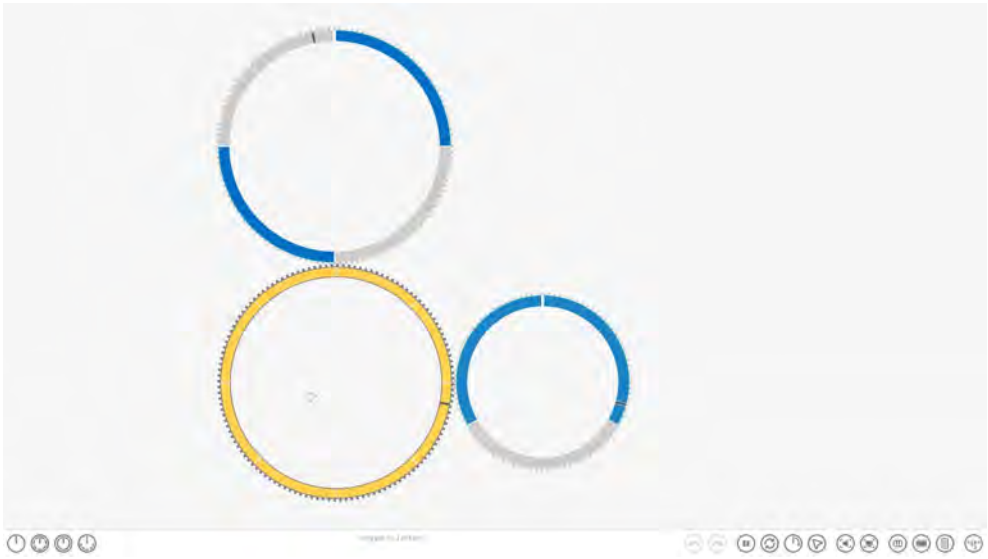
***Screenshot 6.16*:** a poly-rhythm

In this manner, the underlying structure of the poly-rhythm becomes apparent immediately. Again the gear representation is comparably compact: when determining the meter for poly-rhythms, the lowest common multiple is used, e.g. seven against eight would necessitate 56 beats using a metrical grid. With virtual gears supporting custom bars, just two sequencer gears with seven respectively eight subdivision are required. The poly-rhythm in image 6.16 features eight, six and twelve subdivisions, here the lowest common multiple amounts to 24 beats. Other ways to represent poly-rhythms via gear representation include using multiple gear meshes at different speeds, transmissions, and programmable drive gears.

b) Poly-meters

Briefly summarized, poly-meters are the combination of different bars with aligned strokes. Conceptually, they are closely related to poly-rhythm, and even poly-tempos, as pointed out by *Martim Galvao*: *"I will [...] distinguish between rhythms that recur every measure (measure-preserving) and those that recur at a phrase level (beat-preserving) by referring to them as poly-rhythm and poly-meter, respectively. The main difference is the scope over which the superposition of rhythm happens – poly-rhythms syncing up every measure and poly-meters syncing up every time the simultaneously occurring meters reach the lowest common multiple between them. If we wish to abstract the concept of poly-rhythm, poly-meter, and polytempo even further, though, it is not difficult to see how the same results may be achieved by using any of these techniques. A 6:4 poly-rhythm [...], in which superimposed quarter note rhythms align every measure, may also be presented as polytempo, in which case we can observe the poly-rhythm as two simultaneously occurring tempos with a 6:4 relationship (ex. 180 bpm for the 6/4 pattern and 120 bpm for the 4/4 pattern). We may likewise suppose that the polytemporal situation is also polymetric, though*

if we ignore meter the difference would be imperceptible."[315]
In order to achieve poly-meters using virtual gears, gears with different sizes and an amount of segments corresponding to the gear ratio can be used. As an example, in image 6.17 the ratio is three to four, the larger gear has a bar of fourths, the smaller is setup with a bar of thirds.



***Screenshot 6.17*:** a poly-meter

Represented in a metrical grid, the poly-meter corresponds to the subsequent score[316]:

```
X . X .|X . X .|X . X .|
O . O|O . O|O . O|O . O|
```

In this example, the transmission ratio establishes beat synchronicity of two distinct bars. Again, the period is determined by the lowest common multiple, here it amounts to 12 beats, or three full convolutions of the larger gear, and consequently four full convolutions of the smaller one.

c) Canons

Timothy A. Smith provides a useful definition for musical canons: "*Canon comes from the Greek word for rule or law. Musically, it designates the strictest form of counterpoint in which one voice is bound to imitate the rhythm, and interval content of another voice.*"[317]
Also, he points out central requirements: "*To qualify as a canon three conditions must be met:*

1. *The 2nd voice must be an exact repetition or a contrapuntal derivation of the 1st.*

2. *The 2nd voice must enter later than the 1st (cancrizans and proportional canon excepted)*

[315] Gal14.
[316] In this example, events of the top gear are labeled as 'X', events of the bottom-right gear are labeled as 'O', and pauses as '.'
[317] Smi.

3. *The 2nd voice may not deviate from the 1st voice or its contrapuntal variations. Thus, the 2nd voice is thought to be strictly generated by the 1st. The two voices of a canon have been called dux/comes, antecedens/consequens, or proposta/ risposta; but this study uses the terms leader and follower.*

If all of the above conditions are met, the canon is said to be strict. If liberties are taken with one or more of the above conditions, the canon is said to be free."

Rachel Hall and *Paul Klingsberg* approach canons, and especially rhythmic canons, more formally. They define rhythm cycles as follows: "

- *We say that two periodic rhythms are equivalent if one is a shift of the other*
- *We call the equivalence class consisting of all cyclic shifts of a rhythm pattern a rhythm cycle.*

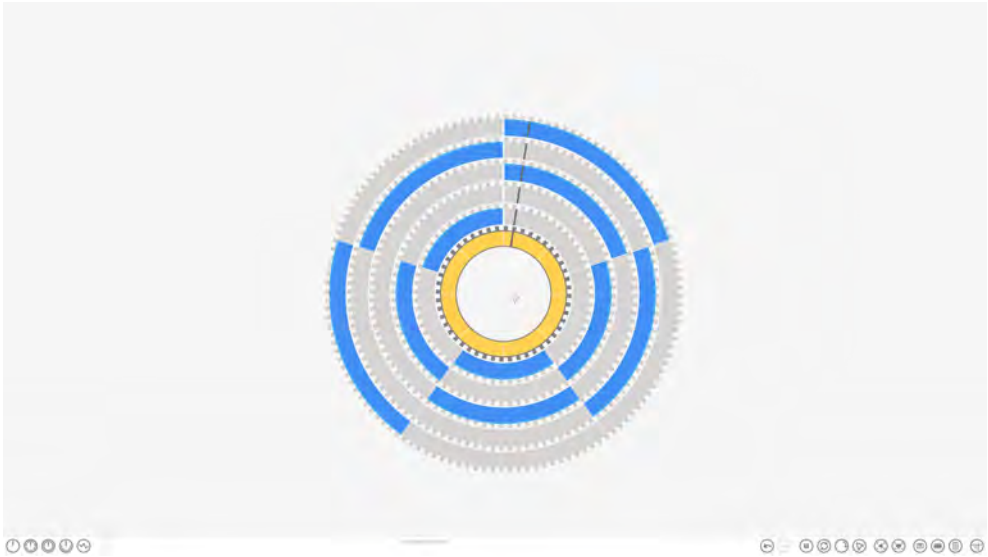
"[318]

E.g., given a simple 5-periodic rhythm

```
X . . X .
```

the corresponding rhythm cycle would comprise these patterns:

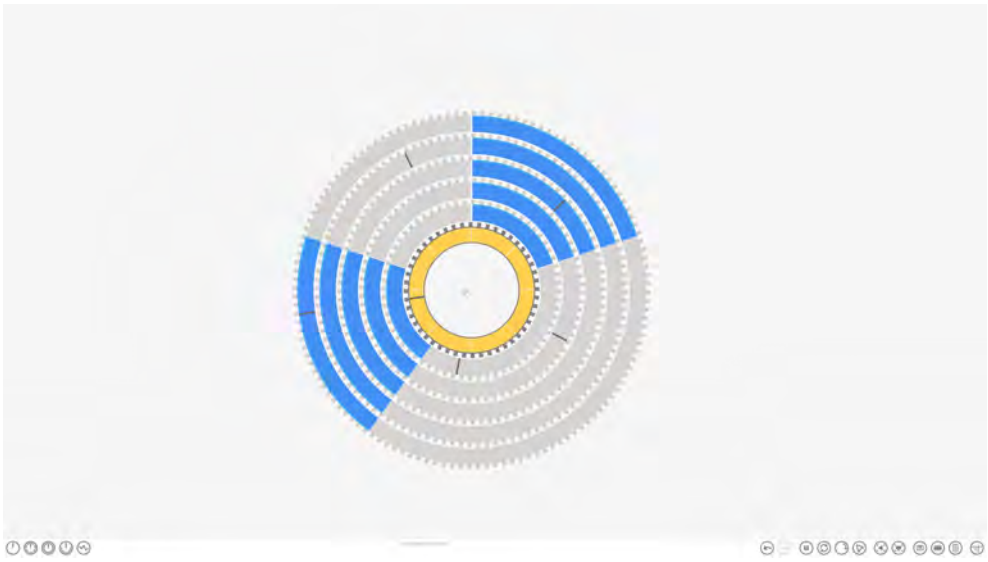
```
X . . X .       | 0
. X . . X       | 1
X . X . .       | 2
. X . X .       | 3
. . X . X       | 4
```



***Screenshot 6.18*:** 5-periodic rhythm cycle

[318] HK05.

Image 6.18 shows this exact rhythm cycle realized with foreverloops, using a single virtual gear stack: in order to cover the possible manifestations, the rhythm is shifted with decreasing gear size. The same rhythm cycle can also be represented in a more straightforward way, by setting bar offsets, as shown in image 6.19



***Screenshot 6.19*:** 5-periodic rhythm cycle using offsets

Hall and *Klingsberg* also describe the concept of a binary necklace:

”

- *A binary necklace is an equivalence class of finite binary sequences, where two sequences are equivalent if one is a cyclic shift of the other*
- *Binary necklaces are also represented as necklaces of black and white beads equivalent under rotation. Turning over a necklace (inversion) is not allowed.*
- *Every rhythm cycle is represented by a unique binary necklace.*

”

With virtual gears, binary necklaces can easily be formed; when doing so, it is important to stick to one specific sample per sequencer gear, a limitation that is not enforced by the simulation. By altering the segment offset, the available permutations can be experienced in a simple and interactive manner.

Hall and *Klingsberg* characterize rhythmic canons and rhythmic tiling canons as follows:

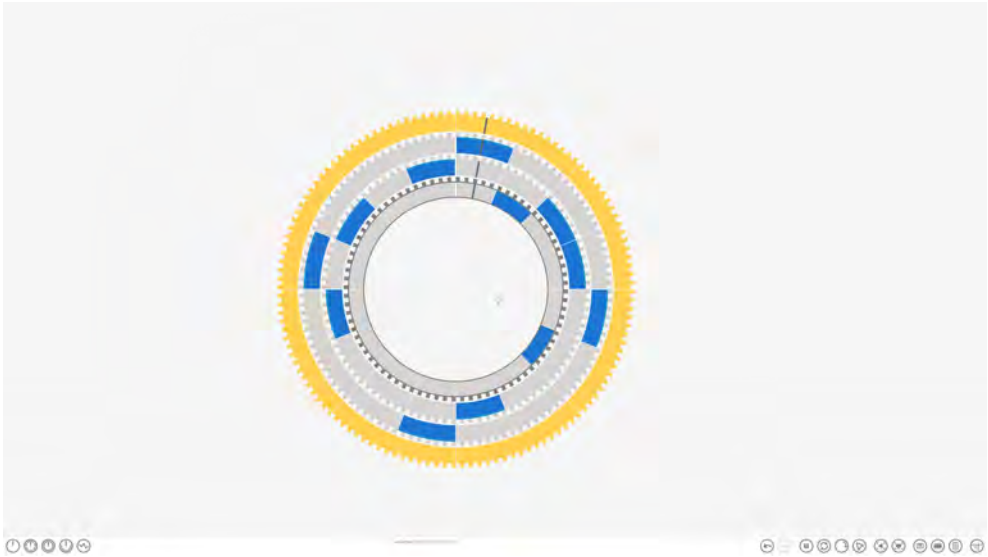
”

- *Messaien (1992) coined the term rhythmic canon, which is produced when each voice plays a rhythm pattern (the inner rhythm), and the voices are offset by amounts determined by a second pattern (the outer rhythm).*

- *A rhythmic canon is called complementary if, on each beat, no more than one voice has a note onset.*
- *A rhythmic tiling canon is a canon of periodic rhythms that has exactly one note onset per beat*

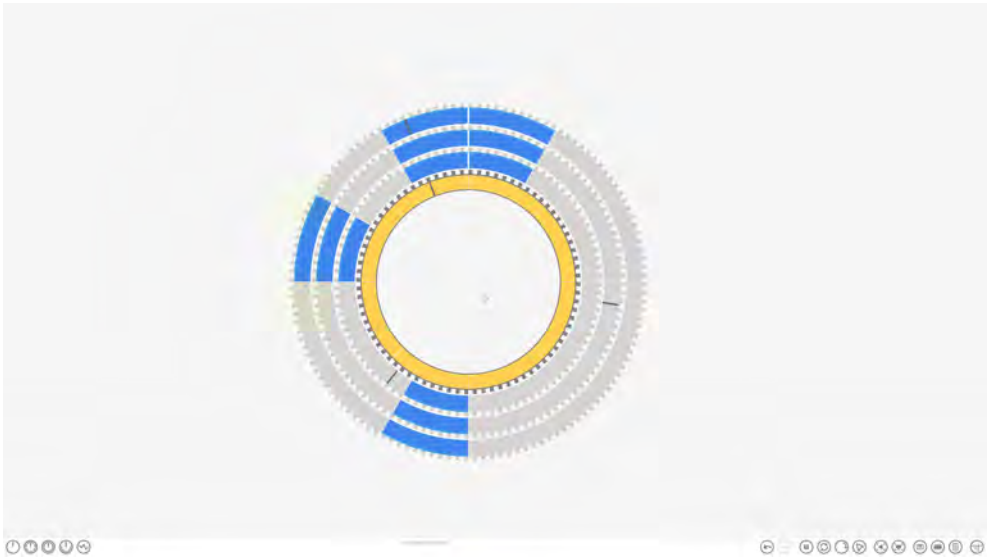
”

Although foreverloops does not provide the means to specifically create either rhythmic canons or rhythmic tiling canons, they can be setup rather conveniently. E.g., in image 6.20, a 16-periodic complementary rhythmic canon is shown. By visual inspection, it can easily be verified that there are no parallel onsets in the different tracks.



Screenshot 6.20: complementary rhythmic canon

On the other hand, visual verification becomes more difficult when using bar offsets, as shown in image 6.21.



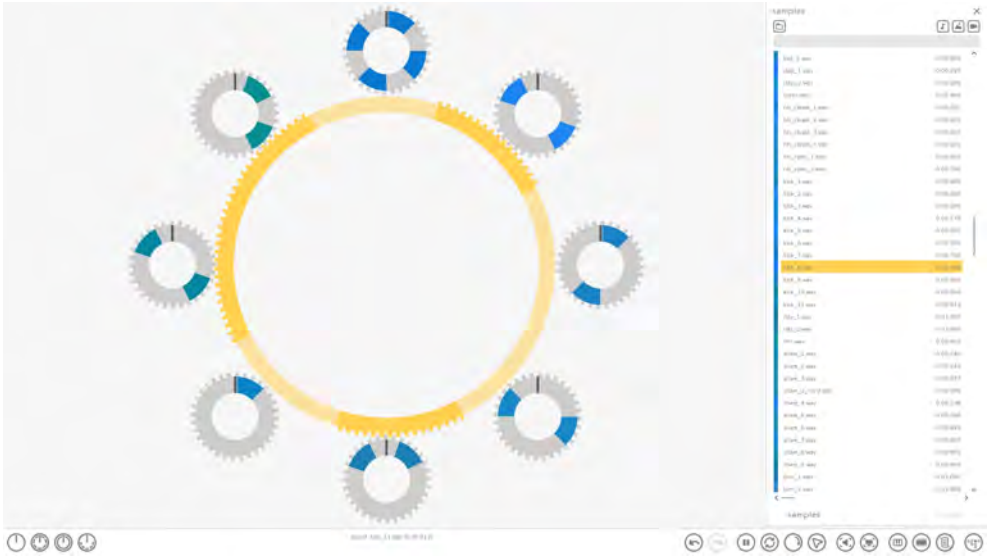
***Screenshot 6.21*:** rhythmic tiling canon using offsets

Here, a 12-periodic rhythmic tiling canon is setup using the following 3-asymmetric rhythm cycle:

```
X . . . . .|X . . X . X
```

As postulated, there is exactly one note onset per beat, a matter that can be experienced interactively.

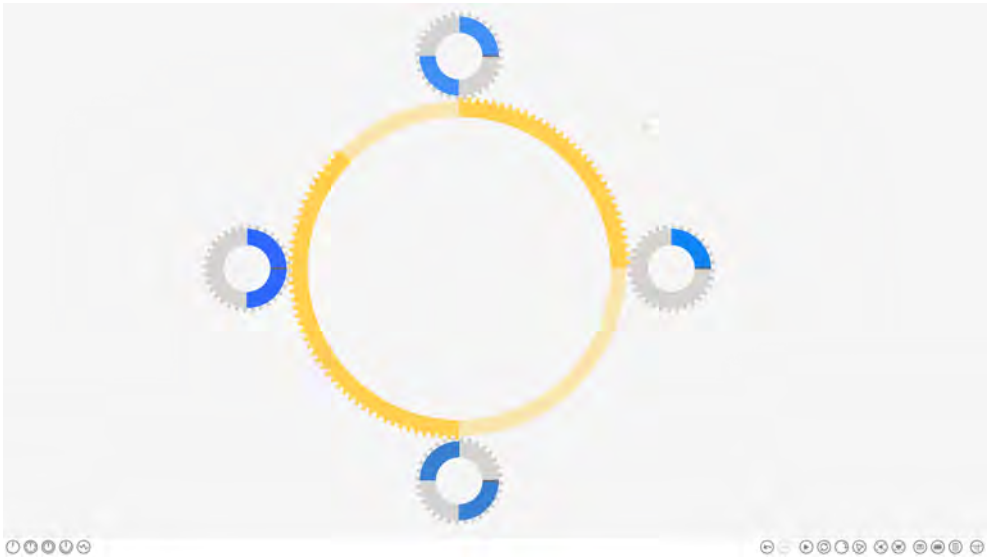
The combination of the score representation as virtual gears with programmable drives make a new kind of canon possible: the *Leibniz canon*. The basic idea is as follows: multiple tracks, represented as gears, are intermeshed with a Leibniz-drive, as shown in image 6.22.



***Screenshot 6.22*:** Leibniz canon

The individual tracks are not necessarily binary, i.e. they can contain more than one particular sample. Also, although implied by the image, they do not have to involve uniform diameters, so

different transmission ratios, and consequently tempi, are possible. The basic principle is best explained with the more basic example shown in image 6.23.



***Screenshot 6.23*:** basic Leibniz canon

Here, the central Leibniz drive once again has a rotating speed of PI, i.e. a full convolution takes four seconds. The Leibniz drive involves eight segments, but only five of them are active, inducing temporal pauses in the intermeshed gears. This Leibniz drive represents the following outer rhythm:

```
X X . . X X X .
```

The attached sequencer gears share the same number of segments - four -, and due to the size ratio of one to four, they rotate with a speed of a full convolution per second, if active, i.e. if they are currently intermeshed. Their rhythm cycles (inner rhythms) are as follows:

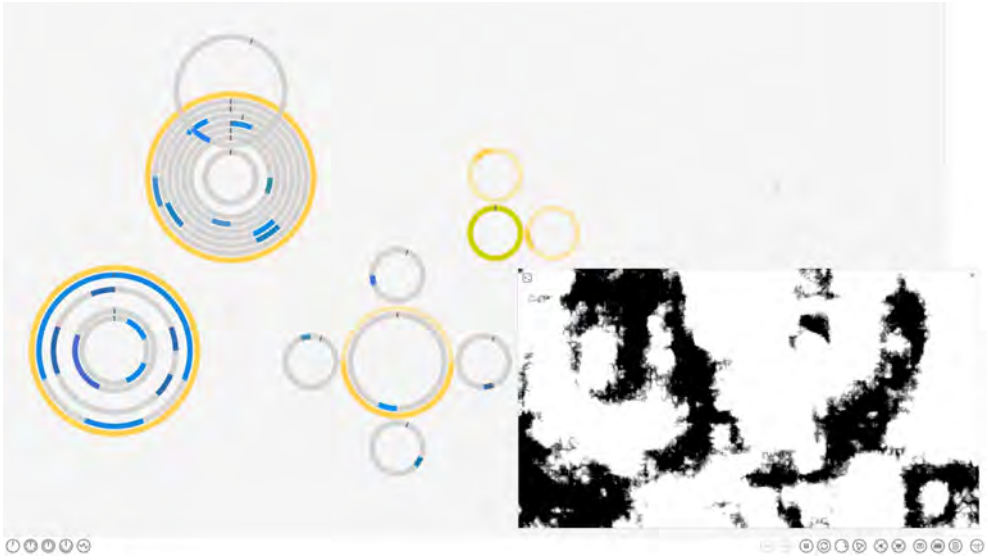
```
X . X .             | top
X . . .             | right
. X . X             | bottom
X X . .             | left
```

Unfolded, this setup leads to the following pattern:

```
X . X .|. . . .|X . X .|X . . .|X . X .|. . . .|X . X .|X . . .         | top
. . . .|. . . .|X . . .|. . X .|. . . .|. . X .|. . X .|. . . .         | right
. X . X|. X . .|. X . X|. . . .|. X . X|. X . .|. X . X|. . . .         | bottom
X . . .|. X X .|. . . .|. X X .|. X X .|. . . X|X . . .|. . . X         | left
```

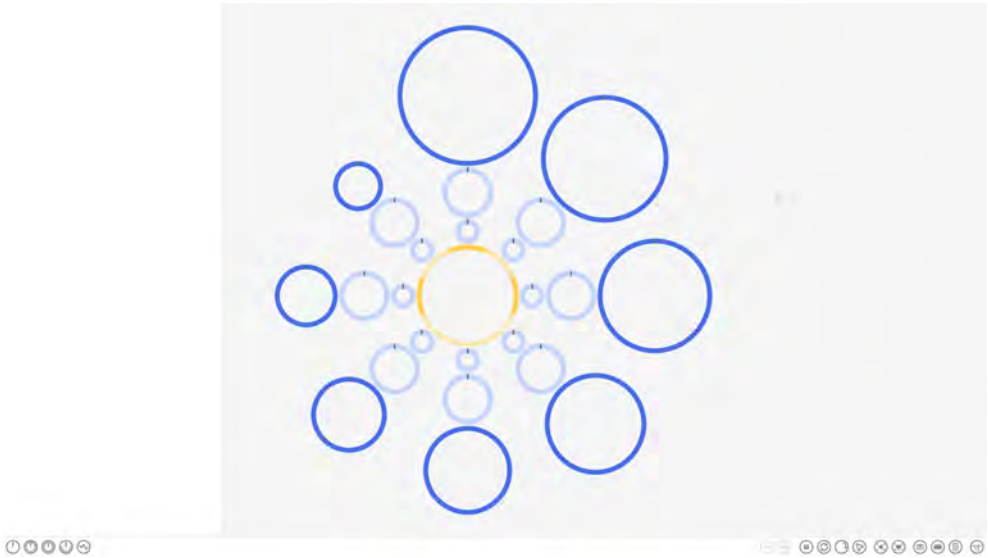
Evidently, Leibniz canons allow a compact representation of rather complex rhythmic structures. Also, they facilitate an interactive generation of phrasings and variants, and prolong pattern

periods, i.e. the time until the first repetition. They allow the generation of rhythms rich in variety in but a few clicks, still, their application is not limited to the creation of musical rhythms. With foreverloops, it is possible to use them in conjunction with different media types, not just audible on-set samples. E.g., image 6.24 shows a more involved scene with a musical Leibniz canon structure, but also with a Leibniz train for non-linear video playback (top-right gear train).



***Screenshot 6.24*:** complex scene with Leibniz canon and non-linear video playback

In this example, Leibniz drives are used to temporarily alter the video playback speed, even to a degree causing backwards playback. Another application of Leibniz canons can be found in sound synthesis, as shown in image 6.25.



***Screenshot 6.25*:** Leibniz synthesis

In this scene, a Leibniz drive is used in conjunction with scratch-gears, i.e. gears that can manage a single sample only, but their playback speeds are dependent on the actual rotation speeds. The

drive has three out of eight active segments, causing three tracks to be played back in parallel, with a temporal shift. There are also eight scratch gears with different sizes, containing the same track all over, and some gear transmissions to enable this particular setup (due to their sizes, the media gears make such arrangements necessary). Assuming the playback speed of the sample in the gear with the same size as the drive gear is one, the other playback speeds are 1.125, 1.25, 1.375, 1.5, 0.625, 0.75, and 0.875, starting from 1.0 in clockwise direction. Another assumption for the sake of simplicity: if the sample was but a sine tone with a frequency of 440 Hertz, the change of the respective playback speed also induce relative changes of note pitches, i.e. 495, 550, 605, 660, 275, 330, and 385 Hertz respectively. The particular configuration of the Leibniz drive ensures that three notes are played back at the same time, e.g. 440, 550 and 660 Hertz, and than 495, 605, and 275 Hertz, and so on. This synthesis is based on additive synthesis, as the frequencies are added up due to the parallel playback, but it also enables temporal changes with a programmable chronology.

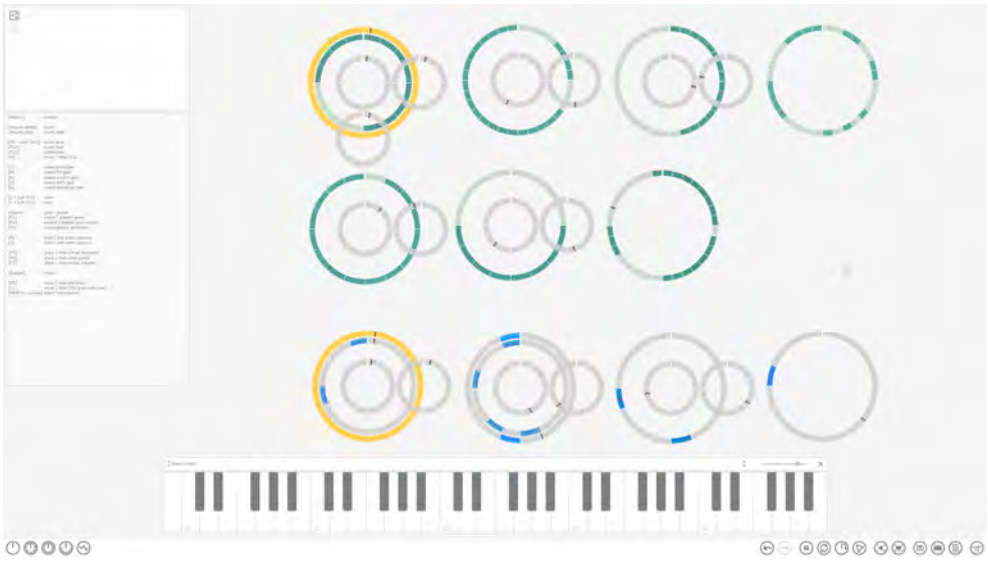
6.4 foreverloops and productive gaming

In the following, the relation of foreverloops with the aforementioned three cornerstones of productive gamings is explained: the digital playground, relevant playing activities, and the results that can be achieved with foreverloops. In a nutshell, foreverloops presents itself as a software simulation environment with particular and automatically enforced rules. These rules at the same time restrict and stimulate player creativity. Also, the underlying paradigm, as well as the interface design, are aimed at inducing a playful state of mind. Game-play is biased towards free-form play and experimentation, learning is a part of the entire experience. Relevant play phases are comparable to the mastering of musical instruments, player productivity is tied to the central play mechanics. Play results are usable outside the playground, in the form of musical compositions or videos; they may be complete pieces on their own, or be a part of other projects, e.g. game designers composing game music with foreverloops. Finished creations may involve economic, personal, and aesthetic values, they may be sold as products, shared with an online audience, be released for free, and be used for arbitrary intents.

6.4.1 foreverloops as a digital playground

The central paradigm of foreverloops can be found in interconnected virtual gears, and their possible application to the domain of media creation / production. Consequently, foreverloops provides a simulation concerning gear mechanics: it effectively is a sandbox concerned with simulating virtual gears that interact with each other like physical gears. As a simulation, particular facilities of the real-world capabilities are emulated, including transmissions, changes in rotation orientations, axial-connections, as well as gears with sawed-off teeth. At the same time, quasi as simulation limitations, specific disadvantageous principles are circumvented, e.g. wear marks or gear slippage. foreverloops introduces the capability of interfacing virtual gears with digital media, a capacity not available to real-world gears. Hence, the abstraction simplifies particular

real-world occurrences, but also provides enhancements, as it introduces new possibilities lacking real-word equivalents. Concerning the simulation rules, a large part is deduced from the characteristics and features of gear meshes: foreverloops provides an open canvas that enables the creation of virtually unlimited gears and gear meshes, freely arrangeable by its users. However, the artificial interconnection with the domains of music composition and media production determines and at the same time necessitates additional rules, including rules from domain-specific conventions (e.g. reasonable bar measures for sequencer gears, or compliance with HCI best practice), rules to enhance the overall usefulness (e.g. the automatic adaptation of MIDI gear durations when recording, or the limitation to specific gear sizes), rules to improve the accessibility (e.g. gear meshing involves automatic / implicit gear synchronization), and rules to encourage free-form play (e.g. multiple drives in a single mesh). These rules in their entirety, both limited and limiting, define the simulation system, possible player interactions, and become the catalyst for player creativity and productivity.
foreverloops refrains from dictating player goals, and from using victory / losing conditions: the system does not award points for well-made user compositions, and refrains from suggesting particular work-flows. Also, in order to learn to use foreverloops, a particular ludic attitude is required: players have to experiment in order to discover its capabilities, as foreverloops abstains from providing in-game tutorials. On the other hand, users at their wits' end can use the provided manual, look at the available tutorial videos, ask questions in the forum, view makings of other players, or use the available demo scenes as a starting point. An example for a scene included with foreverloops can be found in "ConnectMe", as shown in image 6.26.



Screenshot 6.26: ConnectMe demo scene

Concerning the development of foreverloops, particular importance was placed on the interface design: the graphics design is meant to be appealing and appetizing for new players, whereas experienced gamers and power users are provided with an undisturbed and visually clean experience. Particularly, distractions caused by gear rotations were minimized by only shadowing

forth cogs. User interface elements are kept to a minimum, they can be hidden individually and entirely, generally are separated by concerns, and are put forward with maximized consistency in mind. Using foreverloops, the primary user interactions occur with the virtual gears: they are created, resized, parametrized, programmed, intermeshed, stacked, and moved.
For long-term-use, a central feature is the capability to import user assets, including audio-samples, images, videos, and Soundfonts; also, if available, players can import the external Vst3 plugins they are accustomed to. At the same time, users can export (and re-import) their creations at any moment.

6.4.2 foreverloops playing activities

When playing with foreverloops, players are required to determine their objectives themselves; possible ambitions include the creation of audio visual collages, sound sculptures, rhythmically composed visuals, lounge-music, a series of consistent tracks for the video game they are currently developing, etc.. foreverloops provides the necessary features to follow through the realization of such ideas. Still, the underlying paradigm and its consequences for media-productions, the rather unconventional HCI, and especially the differences from relevant standard productivity software makes a learning phase, or even several learning curves, necessary: especially for creating music, players have to engage and to rethink usual approaches. As discussed previously, the virtual gear representation is very capable of realizing particularly complex musical structures, including poly-rhythms and poly-meters; at the same time it is very difficult to use foreverloops with a mindset directed at linear music creation.
Luckily, players consider learning foreverloops as a fun activity; although experimentation is practically forced, it also is rewarding: players enjoy a knowledge gain, the success of figuring out a complex system on their own, a phase of self-expression, a sense of achievement, but also particular results. The learning phases are not only necessary for figuring out the rules, but also to find ways for a productive use of the simulation: e.g. for the creation of a piece of lounge music, it is often useful to setup a basic rhythm, and than arrange the piece around it. Relevant rules are of course restricting; still, particular freedom concerning Paidia-play is maintained: users are intended to develop and exercise their own conventions, including the spatial arrangement of their meshes, the ability to affect individual gears, stacks or entire meshes with particular modifications, etc.. A central design concept made use of in foreverloops is *meaningful play*: user actions effect comprehensible system outcomes, a precondition for the player eagerness to experiment.
As soon as players have acquired a fundamental set of skills, free-form experimentation and learning phases can be taken over by more goal-oriented approaches: users are able to deploy foreverloops in order to achieve individual ambitions. Still, due to the complexity of the underlying simulation, learning and experimentation will never cease to be relevant; consequently, oscillation effects are relevant to experienced players as well as to beginners.

6.4.3 foreverloops results

As the majority of the examined examples for productive gaming, foreverloops aims at the creation of digital results, involving audio, but also video. Results are either pieces of music (or sound experiments), or videos (usually involving sounds / music); as stipulated by the concept of productive gaming, these results can be used without foreverloops, and possibly even without the knowledge about the software: assuming a player creates a piece of electronic music with foreverloops that is featured in a club - neither is the person who runs the club required to own foreverloops, nor is it necessary for the patrons to know about its creation process in order to appreciate it.
This piece of music may involve a monetary worth, e.g. its author may license it to a label and receive financial compensation, it may exhibit particular aesthetic values, or it might convey a sense of achievement to its creator; also, it may be a final product on its own, or be part of another, potentially bigger project, e.g. the intro-music of a video game. Unexpected or unlikely usage scenarios are also possible: for instance, the author used an early pre-release version of foreverloops as presentation software at a scientific conference; also, an available facility for unexpected usage can be found in the capability of the software to output MIDI notes, enabling external software to react to the proceedings within foreverloops.
A particular strength of the gear metaphor in conjunction with media processing is the ensuing audio-visual synchronicity: visual events can easily be programmed along audio samples, making the exploitation of Synchresis effects possible and accessible.
Contrary to other productive gaming examples aiming at digital results, foreverloops explicitly addresses the issue of intellectual property rights: users are allowed to use it for arbitrary purposes, including commercial usage, without having to fear legal repercussions.

7 Results

As stated in the introduction, the realization of foreverloops as a product with accompanying research is advantageous: " *on the one hand, we gain feedback, like user interactions, including comments in the public discussion forums, reviews, and user-generated results, data that enables the qualification of productive gaming. On the other hand, using our product we were able to host several workshops and participate in events that would allow us to hand out questionnaires to our target audiences.* " The objective of this chapter is to show the validity as well as the implications of the junction of gaming and productivity based on the data accumulated with foreverloops. Relevant data primarily originate from quantitative approaches: parallel to the development of foreverloops, we conducted several workshops with the aim to both learn about the reception of productive gaming and to determine the directions of the ongoing project development.
Concerning the latter, qualitative laboratory studies with experts and testers were conducted regularly, however, these were mainly conducted in order to make foreverloops more stable and accessible; as their consequences mainly affected the technical realization as well as the overall project development, they are not included in this thesis.
Besides the workshop questionnaires, we will also present specific user data such as usage times and impartial user reviews. Concerning a more qualitative point of view, besides the inclusion of textual feedback of survey participants, relevant user-created compositions will also be examined.

7.1 Quantitative evaluation

Concerning the quantitative evaluation, the underlying data originates from surveys filled out by workshop participants and players who spent significant time with foreverloops at various fairs. Usually, attendees would receive a brief introduction to foreverloops, and consequently experiment and play without pre-defined goals; they would apply their discoveries and personal techniques to their compositions and performances. In many cases, the players would also record and obtain captures of their creations, so to speak as a souvenir.
The original questionnaire was designed in consultation with **Kathrin Anzinger**, depending on the target audience however, they were subjected to minor adaptations, reflecting age, language proficiency, and expected musical skills. The relevant questionnaires are included in the appendix of this thesis. Concerning survey conduction, a total of nine workshops were held over time with varying audiences, in addition to participations at four different game fairs that were also used for data acquisition. The workshops and introductions were held by **Marlene Brandstätter**, **Simon Schmuckermaier**, **Roland Richter**, **Gregor Woschitz**, and myself.
Concerning questionnaire evaluation, several research questions were first identified, formulated as hypothesis, and later evaluated using statistical tests, including the *Wilcoxon rank-sum* test, the *Spearman* test, and *Fisher's exact* test. The evaluation process was designed in consultation with **Helene Hochrieser**, who also conducted the testing of the hypothesis[319], as well as the

[319] The relevant statistical computing was realized using the **R Project** (https://www.r-project.org/).

analysis.

7.1.1 Survey participants

In total, we received filled out questionnaires from more than hundred participants over the course of thirteen events with different target audiences (the primary groups are gamers, musicians, and pupils).

***Table 7.1*:** foreverloops workshop conductings

group	event	date	participants
musicians	Anton Bruckner University	2017-04-04	13
artists	Arts Santa Monica	2017-06-12	8
pupils	Europagymnasium Auhof	2017-07-04	5
	Kinderuni JKU	2017-07-11	9
	BaKip Kreuzschwestern	2017-12-07	6
	Khevenhüller Real	2018-02-15	19
	Khevenhüller Culture	2018-02-15	15
	Kinderuni JKU	2018-07-17	7
gamers	Radius festival	2016-07-23	6
	PlayAustria	2017-09-14	5
	Vienna GameCity	2017-10-14	3
children	Reversed festival	2017-07-07	2
non-descript	ICT4D workshop	2017-12-14	6

The average age of the participants is 19, their nationalities and genders are shown in figure 7.1 and figure 7.2.

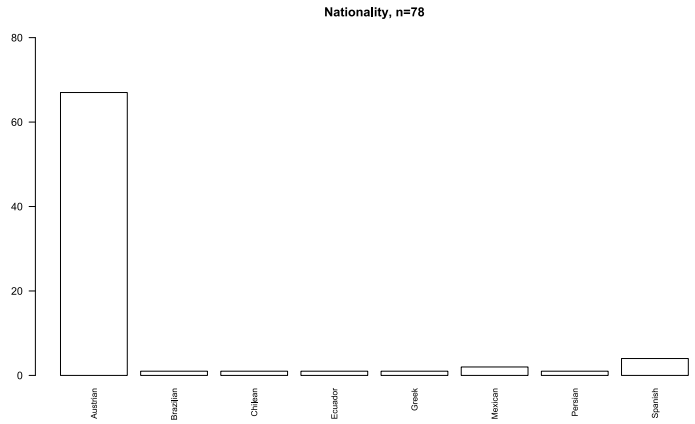


***Figure 7.1*: study participant nationalities**

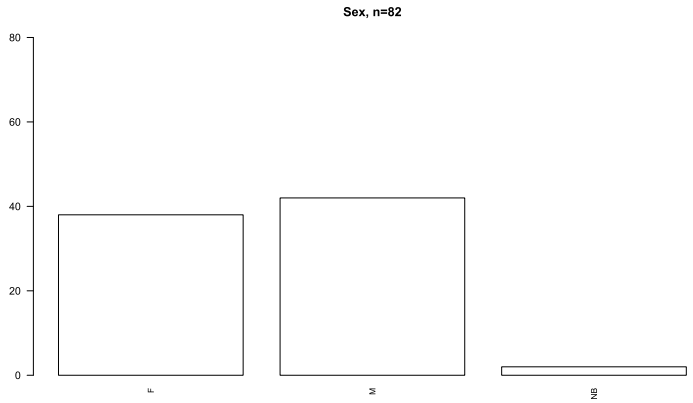


***Figure 7.2*: study participant gender**

7.1.2 Methodological shortcomings

The continuous development of foreverloops makes a discussion of particular methodological shortcomings and weaknesses of our approach necessary: as the project evolved from session to session, the survey participants were using heterogeneous versions of the software; although the basic principles stayed the same, the overall stability, accessibility and functionality of foreverloops improved over time. Also, several shortcomings identified by the workshop attendees were addressed during project development, e.g. the included sample library was interchanged and extended over time, favouring later workshop attendees. Relevant improvements include

- the visual representation and graphics design,
- the provided sample material (pre-release, early release, post-release),
- core functionality (MIDI / effects / virtual instruments / group operations / sample swapping / more segments / snapping / ...),
- the availability of tutorials / demos / user created content / documentation,
- overall software stability,
- and the user interaction facilities.

The severity of the changes overtime become apparent with examining the evolution of the overall interface design, as shown in image 7.3.

***Image 7.3*:** foreverloops design evolution, **foreverloops Gmbh**, 2020

Besides the project itself, heterogeneous workshop conditions have to be accounted for as well: the attendees were different from workshop to workshop, they had different levels of musical expertise, heterogeneous education backgrounds, ages, genders, and nationalities (and consequently primary languages). Therefore, the questionnaires were slightly adapted from session to session, based on the target audience; relevant adaptations include translations, relinquishment from technical vocabulary, but also an eschewal of particular questions (e.g. musicians were asked about the music genres they produce, a question not posed to pupils). Additionally, the overall conditions of the workshop conductions differed from session to session: participants were using their own computers or the ones available in laboratories / lecture halls, they would use their own headphones and audio equipment or the provided hardware, they were meant to discover foreverloops on their own or received guidance, and sometimes even different levels of background noises became an issue (especially in the context of fairs). Also, with more experience our competence concerning workshop conduction increased. Concerning the different nationalities, not only were the different levels of language ability an issue, but potentially also the understanding of particular key words; e.g. in English, it is easy to distinguish between the notions game and play, as there are two different words, whereas in German, there is only one.
In order to achieve comparability and validity for later analysis, in all held workshops we ensured the fulfillment of particular preconditions:

- during an introductory phase, we ensured that all participants attained a level of expertise sufficient for basic musical compositions (under guidance, they used foreverloops for at least 30 minutes and could ask questions any time).
- Workshop attendees could only use the provided sample material, user-generated samples were generally refrained from.

Another issue can be found in the actual filling out of the questionnaires: in many cases, the

available time frames were too narrow for the participants, leading to the omission of particular items. Also, as the questionnaires were given out on paper sheets, the attendees would use their handwriting, which turned to be very difficult to decipher in a few cases, inducing additional blanks in the available data. To make matters worse, the manual process of survey digitalization is susceptible to errors as well, considering personal handwriting, editing and erasing, but also typing errors in conjunction with data entry.

7.1.3 Premise

The fundamental prerequisite of the quantitative evaluation in the context of this thesis can be found in the question if using foreverloops is indeed a playing activity (**H1**). Consequently, a series of relevant survey questions were dedicated to this question, they are shown along with their evaluation in the following:

Table 7.2: Survey questions concerned with the perception as playing activity

		mean		significance
question	N		p	
Using it feels like experimenting (q53)	71	4.648	<0.001	Y
I like playing with foreverloops (q49)	41	4.183	<0.001	Y
Composing with foreverloops feels like playing rather than working (q4)	83	3.771	<0.001	Y
With foreverloops, one can achieve compositions with free-style play and experimentation (q10)	13	3.962	0.049	Y
I feel challenged by foreverloops (q50)	8	4	0.015	Y
I like that foreverloops does not dictate goals (q55)	8	3.625	0.06	N

The layout for this table, as well as the subsequent tables, is as follows:

- the *question* refers to the question posed to the study participants, either literally or as an analogous translation.
- *N* refers to the number of answers received for the relevant question; there are two main reasons for the number variations: first, only a subset of participants may have answered the question (e.g. due to the limited time frames available), and second only a subset of the participants may have been asked the question (e.g. specific questions for musicians).
- The *mean* value represents the averaged agreement. The scale ranges from one (total disagreement) to five (total agreement), a value of three expresses indifference.

- The p value represents a probability measure for the validity of the hypothesis; in case the value exceeds the threshold of 0.05, it does not mean that the hypothesis is wrong, but that we cannot assume validity of the hypothesis with the available data. In some cases, additional samples may yield different results. The calculation of the p value does not use the mean value (although correlations are likely); instead, it is based on ranks (rank-sums), and tests for values bigger than three.
- The *significance* indicator simply compares the p value with the threshold of 0.05; the result is either Y (yes) or N (no).

The analysis clearly indicates that workshop participants perceived using foreverloops as playing activity, therefore our premise can be deemed valid.

7.1.4 Evaluation of central hypothesis

In conjunction with the previously established premise the primary question is if playing with foreverloops is considered as a productive activity by its users (**H2**). Therefore, like before, this issue was approached with a series of survey questions, shown in the following:

Table 7.3: Productiveness survey questions

question	N	mean	p	significance
Nice results can be achieved with foreverloops (q54)	8	4.125	0.009	Y
With foreverloops, good results can be achieved fast (q9)	84	3.667	<0.001	Y
I would like to use foreverloops for my own practice (q29)	13	3.538	0.04	Y
foreverloops is suitable for goal-oriented composition (q11)	13	2.846	0.666	N

The analysis indicates that foreverloops can in fact be used productively, and that it is a suitable tool for musical expression and creation. Due to its use in the context of workshops with limited time frames and scope for exploration, a specific methodological fuzziness has to be accounted for; in particular, there is an interrelationship between user satisfaction with the results achieved over the course of the workshop sessions, and the subjective sense of enjoyment. The relevant survey question evaluation is shown subsequently:

***Table 7.4*:** foreverloops workshop result satisfaction and users liking foreverloops

		mean		significance
question	N		p	
I am satisfied with the compositions I achieved (q3)	75	3.36	0.002	Y
I would like to continue using foreverloops (q22)	82	3.829	<0.001	Y
I like playing with foreverloops (q49)	41	4.183	<0.001	Y

As shown in the figures 7.4 and 7.5, a certain correlation is apparent[320].

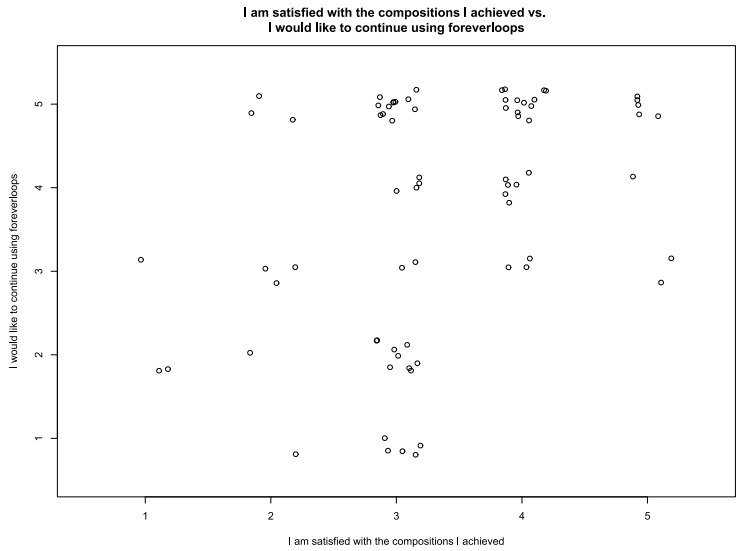


***Figure 7.4*: foreverloops result satisfaction vs continued usage**

[320]The visualization of the scatter-plots makes use of an artificial jitter; as the underlying values are integers in the range from one to five, the artificial jitter is used to convey an understanding of the relevant quantities.

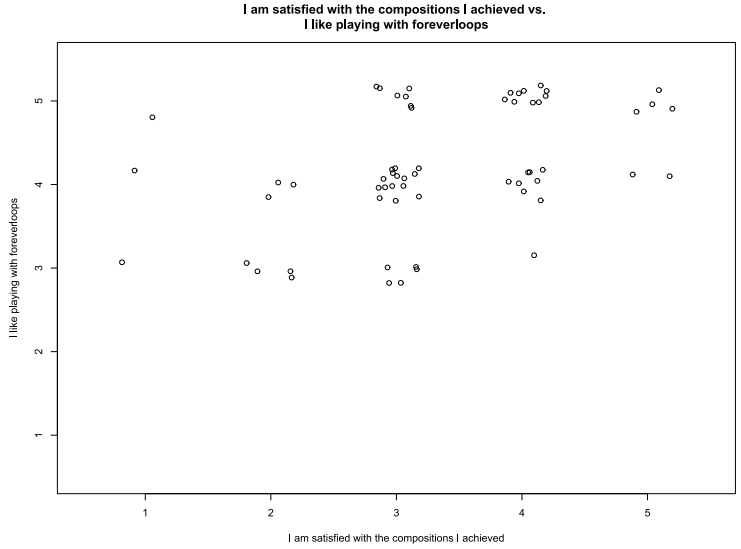


***Figure 7.5*: foreverloops result satisfaction vs playing**

As a means to quantify the correlation of *users that are content with their makings like foreverloops better* (**H3**), we obtained the relevant Spearman correlation matrix, shown in the following:

***Table 7.5*:** Spearman correlation matrix of user result satisfaction vs liking foreverloops

	q3	q22	q49
q3	1.00	0.38	0.45
q22	0.38	1.00	0.36
q49	0.45	0.36	1.00

In the matrix, the label q3 corresponds to the question *I am satisfied with the compositions I achieved (q3)*, q22 to *I would like to continue using foreverloops (q22)*, and q49 to *I like playing with foreverloops (q49)*.
The correlation coefficients are evaluated as follows: values in the range between zero and 0.2 indicate no or very small correlations, a value of 0.5 refers to a moderate correlation, 0.8 indicates a strong correlation, and a value of one corresponds to perfect correlation; negative values in the range between 0 and minus one indicate inverse correlations.
Here, there is a moderate correlation: users who are more content with their results enjoyed their time with foreverloops more, and are more inclined to use it again.

7.1.5 Evaluation of secondary hypothesis

For the qualification of productive gaming via foreverloops, additional aspects require examination: for one, as productivity and playing are interwoven, it is necessary to consider the learning experience. Another matter is the user perspective on the topic whether foreverloops is a game or not. Also, gender biases are worth considering, as is the perception of users whether a musical

formation is advantageous.

Concerning the learning experience and especially the questions if the players consider learning foreverloops as fun (**H4**), again a series of relevant questions were posed to the study participants, they are shown subsequently.

Table 7.6: Learning experience survey questions

		mean		significance
question	N		p	
Learning foreverloops is fun (q51)	8	3.875	0.027	Y
I am curious about what others do with foreverloops (q56)	71	4.155	<0.001	Y
I want to become better with foreverloops (q67)	61	3.869	<0.001	Y
I understand the concepts of foreverloops and I am able to apply them (q5)	13	3.923	0.001	Y
There is still a lot to learn about foreverloops (q52)	8	4	0.028	Y

Summarizing, the analysis indicates that study participants enjoyed learning foreverloops, and that there is a genuine interest concerning the capabilities of foreverloops.

The question whether foreverloops is regarded a game (**H5**) has become less relevant over time: although productive gaming can be realized by digital games, it is not restricted to games, as it primarily qualifies specific playing activities. Also, the multitude of available and commonly used game definitions leads to an inconsistent assessment. However, the analysis of the available survey data does not better the valuation, as shown subsequently:

Table 7.7: foreverloops game / software qualification survey questions

		mean		significance
question	N		p	
foreverloops is a game (q1)	83	3.012	0.443	N
foreverloops is a productivity software (q2)	75	3.533	<0.001	Y

Consequently, based on the data it is not possible to make an authoritative statement on the issue. Still, we examined if there is a correlation of the estimation whether foreverloops is a game and the weekly time spent by the attendees with games: our hypothesis was that users who play games more often do rather refrain from a classification of foreverloops as a game (**H6**), as it is very different from typical popular video games. A statistics concerning the weekly playing times

of study participants can be seen in figure 7.6, whereas figure 7.7 features the weekly playing time versus the classification of foreverloops as a game.

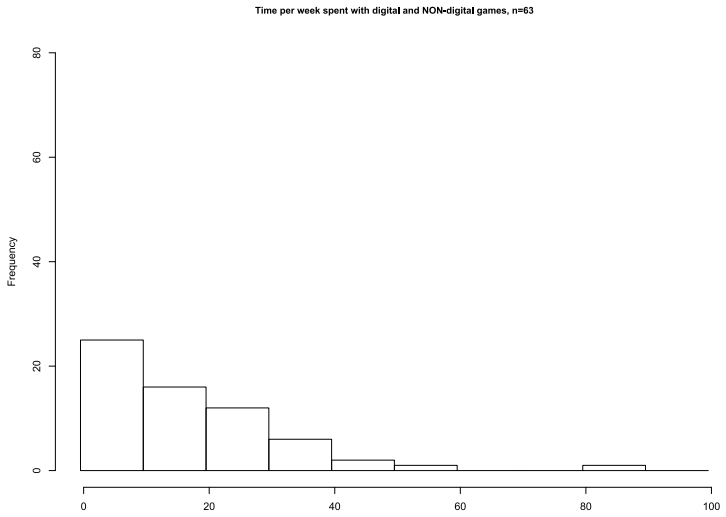


***Figure 7.6*: study participant weekly playing time**

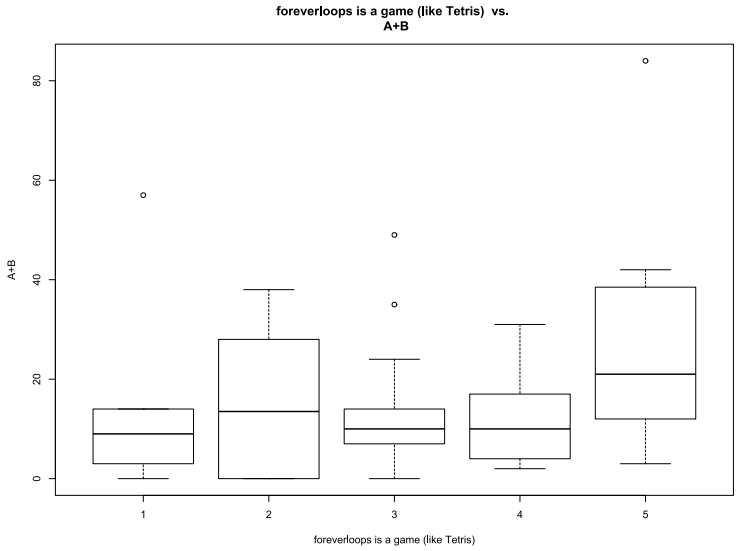


***Figure 7.7*: classification of foreverloops as a game vs time spent with games**

Here, our hypothesis turned out to be wrong, as there is a weak correlation in the opposite direction: a correlation coefficient of 0.247 indicates a certain inclination of regular gamers to rather consider foreverloops as a game.

Concerning the question whether there is a gender bias in the perception of foreverloops (**H7**), we evaluated the questions *I would like to continue using foreverloops (q22)* and *I like playing with foreverloops (q49)* with the genders of the study participants (quite a few attendees did not state their gender, or qualify it as non-binary; relevant samples were discarded in the context of

this hypothesis), as shown in the following:

***Table 7.8*:** foreverloops continued usage and survey participant gender

		mean	significance	
question	N		p	
I would like to continue using foreverloops (q22)	82	3.829	<0.001	Y
I like playing with foreverloops (q49)	41	4.183	<0.001	Y
female participants	38			
male participants	42			

For *I would like to continue using foreverloops (q22)*, the hypothesis concerning the lack of a gender bias was tested using *Fisher's Exact Test*: the resulting p-value of 0.09 makes a rejection of the zero-hypothesis impossible. Figure 7.8 shows the relevant distribution.

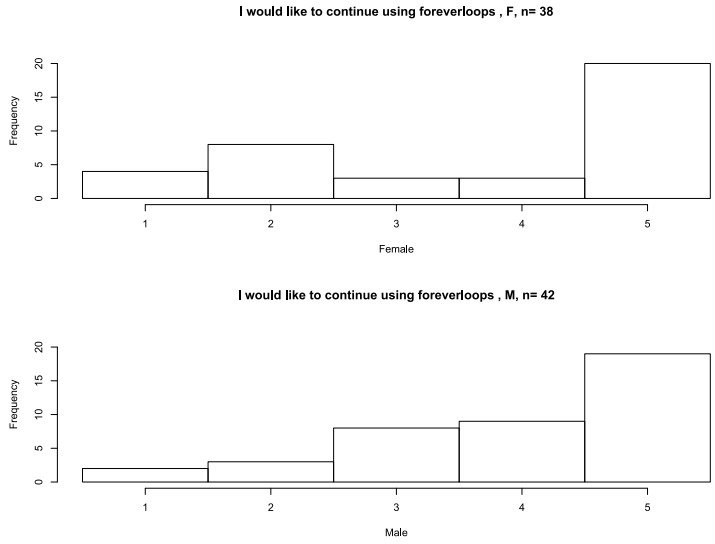


***Figure 7.8*: foreverloops continued usage by gender**

Also, *I like playing with foreverloops (q49)* was evaluated in the same fashion: again, the resulting p-value of 0.19 makes a rejection of the zero-hypothesis impossible. Figure 7.9 shows the relevant distribution.

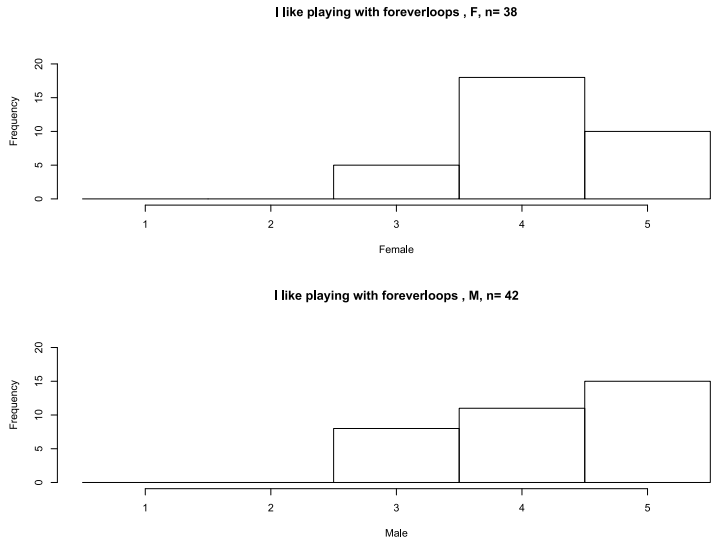


***Figure 7.9*: foreverloops continued playing willingness by gender**

Finally, there is the question whether workshop participants consider having a musical background as advantageous (**H8**). To that end, we evaluated the question *users with musical background have an advantage using foreverloops (q13)* against the user proficiency, approximated by the question *I work with software for musical composition / production on a regular basis (q48)*, as shown in figure 7.10.

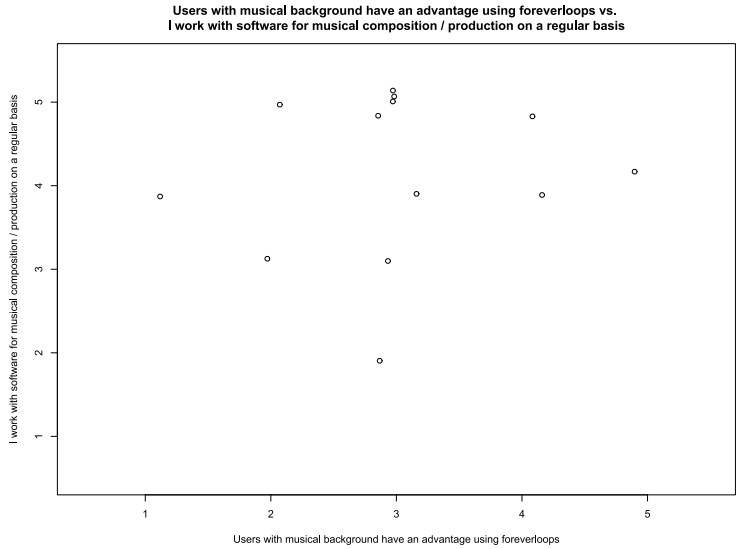


***Figure 7.10*: foreverloops usage advantage vs musicality**

The relevant survey questions are shown subsequently.

***Table 7.9*:** foreverloops user musicality and advantage assessment

question	N	mean	p	significance
I work with software for musical composition / production on a regular basis (q48)	13	4.154	0.003	Y
Users with musical background have an advantage using foreverloops (q13)	20	3.5	0.038	Y

As shown above with *q13*, there is a weak inclination of workshop participants towards believing a musical foundation is advantageous; however, users with musical background do not think so, as the resulting Spearman correlation coefficient of 0.087 (almost no correlation) indicates.

7.1.6 Summary

In the following, the discussed hypothesis, our assumptions, and the analysis results, are summarized:

hypothesis	assumption	evaluation
H1: using foreverloops is a playing activity	applies	applies
H2: playing with foreverloops is productive	applies	applies
H3: users that are content with their results like foreverloops better	applies	somewhat applies
H4: learning foreverloops is fun	applies	applies
H5: foreverloops is a game	somewhat applies	undecidable
H6: gamers are more likely to not consider foreverloops as a game	applies	rejection, there is a weak / moderate correlation to the opposite
H7: there is no gender bias	applies	applies
H8: using foreverloops, having a musical background is considered advantageous	applies	conditional result: musicians do not agree, otherwise weak consent

7.1.7 Additional survey material

In addition to the original surveys used in the relevant workshops, the appendix of this thesis features additional prepared data, including:

- study participant self assessment concerning creativity, technical and musical skills
- study participant estimation of suitable / unsuitable music genres for foreverloops

- study participant classification of foreverloops as a game vs time spent with digital and non-digital games
- study participant result satisfaction correlated with their liking foreverloops
- study participant willingness to invest in their foreverloops skills

7.2 Qualitative evaluation

Analogous to the quantitative evaluation, the objectives of the qualitative analysis are two-fold: on the one hand, as foreverloops facilitates productive gaming, we aim at drawing conclusions about the latter by examining results, reactions, and feedback concerning the former. On the other hand, we are also interested in improving our software using the knowledge gained.
To that end, qualitative feedback of study participants, but also of foreverloops customers is examined in more detail in the following. Additionally, attention is also drawn to particular foreverloops results / products (concretely to the compositions created and shared by foreverloops users).

7.2.1 Study participant feedback

As discussed in previous sections, foreverloops was created with a particular design metaphor: interconnected virtual gears are used as structuring / representation elements for creating and performing compositions involving multiple digital media. To our knowledge, apart from relevant project predecessors, this is a unique characteristic of foreverloops. Consequently, due to the lack of similar products, users are required to engage this paradigm without the ability to fall back to prior knowledge: in order to use foreverloops productively, players have to first learn and familiarize themselves with the software. As shown earlier, when using foreverloops skills concerning contemporary music creation are of secondary importance at best.
Only after the study participants completed the learning phase, they were asked about their personal associations with foreverloops; they are shown below:

***Table 7.11*:** Qualitative feedback on the workshop attendee associations with foreverloops

what study participants associated with foreverloops (q41)	N
specific music software / hardware	7
mathematical / mechanical / logical thinking	6
DJing / music creation	5
specific games	5
gears	4
childhood	3
specific development environment / programming activities	2
movie creation	2
retro scenes	2

what study participants associated with foreverloops (q41)	N
time	1
Dichai	1
the love of music; can use it all day and forget about depression and anxiety	1
specific feelings	1

Generally, the associations with foreverloops are consistent in the sense that they mirror the fields of application: it is a specific software involving mechanical principles and gears, enables the creation of music, as well as image / video sequences, and it encourages free-form exploration and experimentation, principles that are also common to toys. At the same time, they are inconsistent, as no specific association came up twice or more often; to give a few examples, foreverloops was associated with "*an old game*", the "*reactable*", the software "*fruity loops*", a "*submarine control*", "*Lego*" bricks, the "*Scratch*" programming environment, the software "*Garageband*", "*Nintendo-DS games*" in general, or "*an particular app on my mobile phone*".

We also inquired after the key advantages and significant drawbacks:

***Table 7.12*:** Qualitative feedback on the advantages of foreverloops

what study participants liked about foreverloops (q36)	N
simplicity / user friendliness	21
idea / metaphor	16
efficient loop / music creation and rhythm / music capabilities	16
experimentation encouragement	11
playfulness / creative freedom	10
graphic design	10
user interface	10
included sample library	8
achieved results	5
media capabilities	5
learning experience	5
commercial availability	2
co-creation with colleagues	1

***Table 7.13*:** Qualitative feedback on the drawbacks of foreverloops

what study participants disliked about foreverloops (q37)	N
included sample library	12
limited audio functionality (pitch-shifting, sound editing, notes, drag and drop, editing, fixed gear sizes)	10
learning curve / complexity	8
user interface: feedback / score view / media labeling	9
bugs	6

what study participants disliked about foreverloops (q37)	N
metaphor (limited use for linear progressions)	5
interface colors	4
achieved results	3
price	1

Here, contrary to our expectations, the received answers show several major inconsistencies:

- the sample library was criticized by twelve participants as being too limiting, whereas eight users commended the selected sounds.
- 16 participants enjoyed the underlying metaphor and its capabilities, whereas five considered it as too restricting, especially with the creation of music with linear progression in mind.
- 11 users commended the free-form approach and its encouragement for experimentation, whereas eight workshop attendees deemed the associated learning curve as too steep.
- Ten participants specifically cared for the interface design, whereas nine criticized specific aspects or had a bias for more traditional software interfaces.
- Five workshop participants explicitly emphasized their contentment with the achieved results, whereas three expressed their disappointment verbally.
- 16 users considered foreverloops as a powerful tool for the creation of music, whereas ten requested particular additional features.

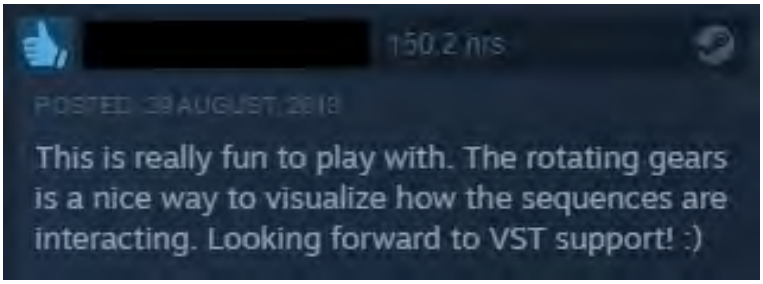
Still, the received feedback influenced the project development of foreverloops significantly:

- concerning the sample library, with version 1.03 it was extended heavily, in addition to the capability of utilizing instruments (via MIDI / SoundFont).
- Concerning the metaphor, as well as the capabilities for music creation, the gear system was made more powerful over time by the introduction of additional gear types and basic transport capabilities.
- Concerning the learning curve, several video tutorials were created and made available.
- Concerning the interface design, several tweaks and improvements were made based on received feedback.

A more complete list of changes made to foreverloops since its initial release can be found in the appendix.

7.2.2 Reviewer feedback

A key advantage of the approach of realizing foreverloops as a product is the availability of additional feedback channels: not only do relevant customers have the ability to ask for help via e-mail, they also can discuss particular features, ideas and concepts on a public forum [321], and therefore involve the community.
Additionally, they can post feedback in the form of reviews, and either issue a recommendation, or advise against the product. However, similar to the workshop attendees, product reviewers involve heterogeneous backgrounds, ages, genders, nationalities, primary languages, and skills with music making. Aside from that, reviewers also feature different degrees of engagement willingness: there are uses who cease playing after 20 minutes, but also players who spend more than hundred hours, as shown in image 7.11.



***Screenshot 7.11*:** foreverloops review of a power-user (user name blackened out)

In our experience, the majority of foreverloops users are *silent users*: they buy and use foreverloops, but do not participate in discussions, leave feedback, or contact technical support; for us, it is impossible to determine how they are using it. The gaming industry has established the number of game reviewers as a useful estimation metric to appraise the commercial success of particular titles, as roughly two percent of the customers on digital stores are inclined to leave reviews. This estimate is congruent with our experience.
Content-wise, foreverloops reviews are fairly consistent: there is a general agreement on the perception of foreverloops as a fun / interesting software toy that challenges its players towards creativity. A list of frequent relevant key-words, based on the available reviews in English language at the time of writing, is shown in the following:

***Table 7.14*:** Qualitative Steam reviewer associations with foreverloops

reviewer associations with foreverloops	N
fun / interesting	6
creative	3
unusual	3
poly-rhythms	3
mechanics	2

[321] The public discussion forum for foreverloops can be found here: https://steamcommunity.com/app/725610/discussions/

reviewer associations with foreverloops	N
experimentation / relaxation	3
confusing	2

A complete list of user reviews in English language can be found in the appendix.

7.2.3 User compositions

To this point, the evaluation was more focused on the concept and the user experience: arguably, these aspects are of central importance to the productive playing process. In the following, relevant results achieved by players unknown to us will be qualified. Although foreverloops very much focuses on musical compositions, only audio-visual outcomes in the form of videos are considered in this section, for several reasons: verification of the claim the composition was in fact made with foreverloops, visual inspection of the creation / performance process, and qualification of the used software features. As pointed out in a previous section, the capability of relevant software, simulations and digital games to export results is a key feature concerning productive gaming; without the possibility to conveniently capture and record foreverloops performances as videos or audio files, publicly available user-created foreverloops compositions would be far less common.
The examined pieces were retrieved using a Google search for videos in conjunction with the keyword foreverloops: consequently, the players made their pieces available to the public for personal motivations, they can be perceived as online-videos at any time.
Concerning the user willingness to share results, a relevant question was included in the questionnaires:

Table 7.15: Study participant result sharing willingness

	Yes	No
question		
If you were to continue using foreverloops, would you share your results (Facebook, YouTube, Twitter, ...)? (q63)	21	38

This question in particular received quite a few interesting remarks:

- some users would only share their results if they were very content with their results.
- Some would consider sharing results once they achieved a specific level of expertise.
- Some would use foreverloops to create samples for re-selling purposes.
- Some would upload their results as videos, but be reticent about its creation process and involvement of foreverloops (fearing the convenience of foreverloops would cheapen their makings).

Regarding the ratio of users sharing their results against users not sharing, we do not have the means to verify the numbers. The only statement that can possibly be made on this topic is that the number of users uploading resulting videos that are tagged with foreverloops is much lower than the survey indicates, it levels out at less than one percent.
The overall structure of the examined videos is potentially influenced, if not motivated, by the available foreverloops tutorial videos [322] and demos [323]. A few such examples will be discussed in the following.

7.2.3.1 naturegirlLoop1

The chronologically first relevant piece *naturegirlLoop1*[324], created by **onelight** in December 2017, already forms an exception: it is the only user-made piece that does not feature virtual gears - at no time does it show or otherwise indicate its creation process.

Image 7.12: foreverloops user composition "naturegirlLoop1", **onelight**, 2017

The result can perhaps best described as a melodic music video. Its author remixed several video clips from different sources, and used foreverloops in conjunction with additional piano samples for musical composition and audio-visual synchronicity. With a duration of 1:31 it is a rather short piece; concerning the audio composition, there are several short parallel tracks that start at different times: it can be assumed that the author first prepared the tracks in a composition step, and later performed the scene be enabling / disabling relevant gear trains to achieve musical progression. To our surprise, the author stated that naturegirlLoop1 was the first music piece

[322] The available foreverloops video tutorials can be found here: https://www.youtube.com/channel/UCWZcM997e6oae9iGfJu2lOw

[323] e.g. *forStep* by **Gregor Woschitz** (https://www.youtube.com/watch?v=PRyEpFR5MLI&list=PLcBvZWnA8Esf3rgNXoublqb3xB76slG8A&index=4), or *Retro loop* by myself (https://www.youtube.com/watch?v=DsxvdI5M4uc)

[324] The piece was uploaded to Vimeo: https://vimeo.com/245616210, last accessed 2020-09-15

she ever created.

7.2.3.2 foreverloops BEATS

foreverloops BEATS[325], created by **NoobStar** in November 2019, has the same name as the particular foreverloops version used for the creation of the piece.

Image 7.13: foreverloops user composition "foreverloops BEATS", **NoobStar**, 2019

This video only uses the sample library included with the software, it can perhaps be described as a short atmospheric music-video. Structurally, it is organized into several gear trains, one dedicated to the video clips, the others to music. Concerning the latter, NoobStar uses different transmission ratios, and therefore makes use of the virtual gear paradigm. Visually, the music trains are arranged in close proximity, superficially they appear as a single train forming a cycle. However, lacking a performative element, the entire scene is played back as-is, and consequently lacks musical progression. With a duration of 0:36, this is the shortest piece examined.

7.2.3.3 Early Morning Reflecto

foreverloops "Early Morning Reflecto" AV2020 06 26[326], created by **VJ FRANZ K** in June 2020, features a similar structure as the available foreverloops demos: a ready-made scene with several tracks is modified in real-time, facilitating a performance that is recorded for later use.

[325]The piece was uploaded to YouTube: https://www.youtube.com/watch?v=wN4AGAAWApg, last accessed 2020-09-15

[326]The piece was uploaded to YouTube: https://www.youtube.com/watch?v=4dxTjSu42Yc, last accessed 2020-09-15

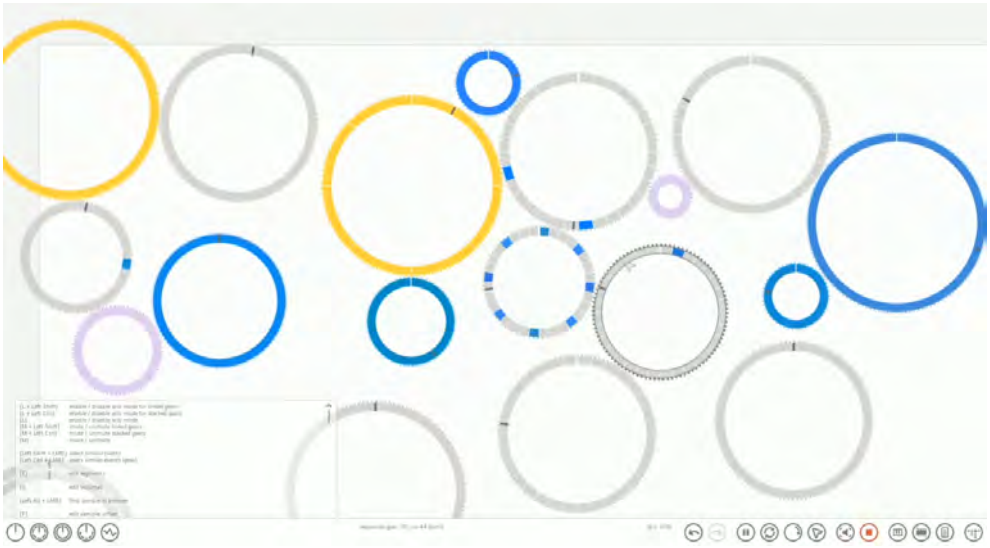


***Image 7.14*:** foreverloops user composition "Early Morning Reflecto", **VJ FRANZ K**, 2020

Early Morning Reflecto is an audio composition, it does not make use of video- or image material besides the foreverloops interface. Concerning the performance, VJ FRANZ K, while recording, regularly alters the gear topology: attaching gears to different trains with different playback speeds affects the relevant playback tempi - here, audio samples are even played backwards. Although different transmission ratios are used, the author refrains from stacked gears and axial connections. In addition to the changes to the topology, specific foreverloops features like scratching or modifying drive speeds are used as well. With a duration of 4:53, Early Morning Reflecto is one of the longer pieces; it features very well our intended way for music creation with foreverloops: a scene with pre-arranged loops, atmospheric sounds and melodic sequences is modified and recorded in real-time. These modifications make for the performances, i.e. individual tracks as well as entire meshes are muted or played back at different paces, they are interwoven and mixed with other musical structures, enabling musical buildups and compositional phases.

7.2.3.4 Concoction

Concoction - A Foreverloops Composition[327], created by **JamesMorningstar** in July 2020, can perhaps be best described as an audio-visual collage, with a slow and irregular rhythm and an orientation towards spherical sounds. Again, only samples included with foreverloops are used, also it is played back as-is, without any user interaction for performance reasons. In contrast to the previous examples, a Leibniz gear is used to power a single gear train.

[327]The piece was uploaded to YouTube: https://www.youtube.com/watch?v=dQzRU1Oxz4g, last accessed 2020-09-15

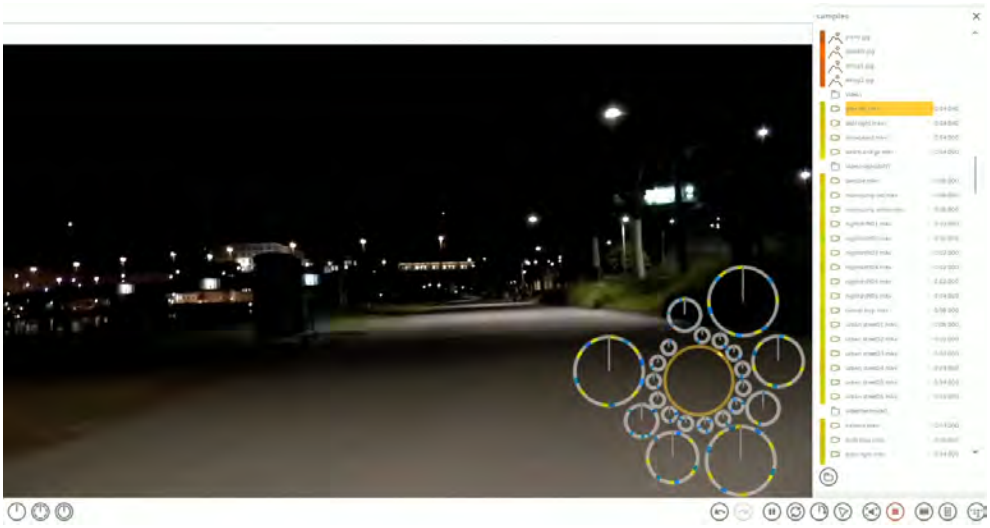


***Image 7.15*:** foreverloops user composition "Concoction", **JamesMorningstar**, 2020

This Leibniz gear powers and disables the 22 attached media gears on a rotating basis, and consequently gives variety to the piece; due to the different transmission ratios in conjunction with the Leibniz gear, the cycle duration, i.e. the time until first repetition, is very long (at a rough estimate at least 100 minutes). The actual duration of the piece is 2:23.

7.2.3.5 Foreverloops Workflow and Sample Browsing

Foreverloops Workflow & Sample Browsing[328], created by **Tobias Homburger** in September 2020, features a comparably simple musical composition presented as a tutorial: the main idea is to give an introduction to foreverloops, accompanying a review article published by Bonedo[329].

[328]The tutorial was uploaded to YouTube: https://www.youtube.com/watch?v=7bCtGzkpyqI, last accessed 2020-09-15

[329]The review article was written in German language, and can be found here: `https://www.bonedo.de/artikel/einzelansicht/foreverloops-studio-test.html`, last accessed 2020-09-15

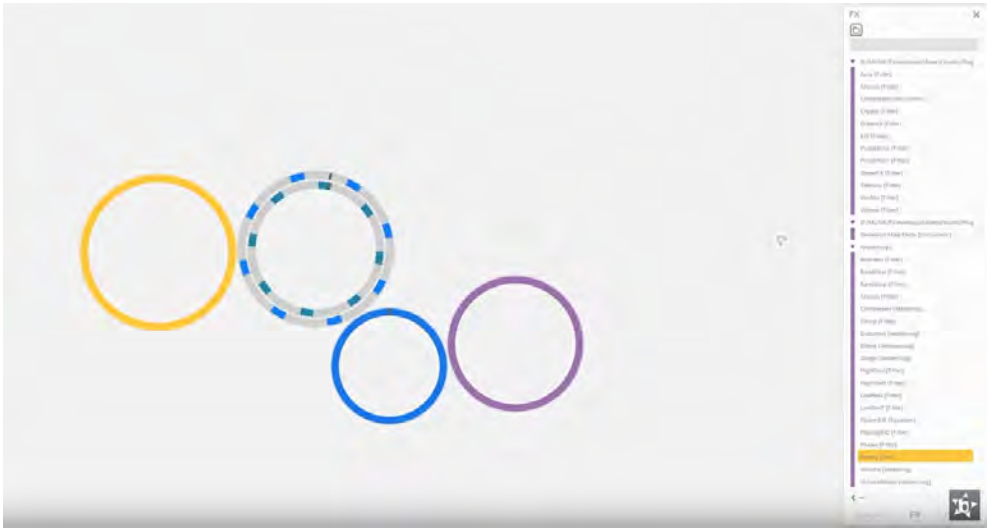


***Image 7.16*:** foreverloops tutorial screen-shot, **Bonedo workshop / Tobias Homburger**, 2020

Here, the musical composition is created from scratch, the programming of every audio track used in the piece is shown in the video. Genre-wise, it can be classified as minimal techno music. While the entire video has a duration of 6:08, the composition is only shown until 2:20, from there the tutorial focuses on the available samples, and on how users can interact with the sample library. Again, the piece only consists of the sample material shipped with foreverloops, the cycle duration amounts to 48 seconds.

7.2.3.6 Summary

In the following, relevant characteristics of the examined pieces are summarized:

***Table 7.16*:** Properties of foreverloops user videos

piece	features foreverloops	external sample material	uses videos	performance	features used	gear trains used	duration
naturegirlLoop1	no	yes	yes	likely	audio-video synchronization	unknown	1:31
foreverloops BEATS	yes	no	no	no	transmission ratios	assumably 3	0:36
Early Morning Reflecto	yes	no	no	yes	transmission ratios, real-time gear topology changes	two active at a time	4:53
Concoction	yes	no	yes	no	audio-video synchronization, Leibniz gear	one	2:23

piece	features foreverloops	external sample material	uses videos	performance	features used	gear trains used	duration
Foreverloops Workflow and Sample Browsing	yes	no	no	build-up	gear stacking, transmission ratios, effect gears	one	2:23

Taken all together, these user compositions rather focus on music creation, with the exception of naturegirlLoop1 they are limited to the sample library shipped with foreverloops, and feature the user interface of foreverloops. Generally, they do not exhaust the capabilities of foreverloops: the authors do not make use of group operations (e.g. muting of entire gear trains), gear stacks, MIDI gears, or effect gears involving VST3 effects or generators. Except Early Morning Reflecto, the examined user compositions do not feature a performance phase: as ready-made pieces, they were recorded without further user interaction.
Consequently, from the perspective of technique, these creations do not involve more advanced, or even unexpected usage of foreverloops peculiarities. However, they certainly afford different surprises: particularly moving is the piece naturegirlLoop1, as its author was persuaded by foreverloops to create and share a music video for the first time of her life. Also, it is astonishing how the apparently more experimental Early Morning Reflecto performance makes the piece fit together without a moment of noticeable asynchrony.

8 Conclusion

The ambition of this thesis is the exhaustive characterization of productive gaming, i.e. digital play activities bringing about products. Over the course of this work, central notions were examined in detail, including game, play, digital play, simulation, software-toys and non-games. Particular emphasis was placed on the value propositions of relevant and related approaches; these can be attributed to several domains, including digital games, interactive art, music software, toys, and many more. The relevant / related projects were mainly discussed in the main chapter, along with related concepts, key influences, topical scientific contributions, and their relation to productive gaming. As a practical application, foreverloops was created. It is a productive gaming playground aimed at media production, and represents a prototypical project facilitating productive gaming. The considerations embraced three cornerstones of productive gaming: the digital environment, i.e. the properties and rules of the simulation, a characterization of relevant playing activities and their reception, as well as a qualification of the particular results that can be achieved with foreverloops.
Concerning the digital environment, its underlying metaphor, i.e. interconnected virtual gears and their possible application to the domain of media creation / production, was introduced as the defining trait for the conception of relevant simulation rules: on the one hand they are limited and limiting, on the other hand they are also empowering and challenging - in the end, they define the simulation system, possible player interactions, and become the catalyst for player creativity and productivity.
Concerning the playing activities, they were discussed from a design perspective, and subjected to statistical analysis and evaluations. Due to the unconventional interface, concepts and work-flows of foreverloops, the role of experimentation is not only emphasized and elevated, but becomes a persistent aspect of the play experience. Experimentation also becomes a primary source for player satisfaction: users enjoy their knowledge gain, the success of figuring out a complex system on their own, a phase of self-expression, a sense of achievement, but also particular results. The user willingness to engage in experimentation is encouraged by the concept of meaningful play: user actions effect comprehensible system outcomes. The evaluation of user surveys lays particular emphasis on the importance of experimentation when using foreverloops, as shown in the subsequent table:

***Table 8.1*:** foreverloops and experimentation

		mean	significance
question	N		p
Using it feels like experimenting (q53)	71	4.648	<0.001 Y

Concerning the results, when playing with foreverloops, players are required to determine their objectives themselves; usually, players aim at creating pieces of music (or sound experiments), or videos (usually involving sounds / music). These digital products can be used without forever-

loops, and possibly even without the knowledge about the software. They may involve a monetary worth, exhibit particular aesthetic values, or convey a sense of achievement to its creators; they may constitute finished pieces or products in a large sense on their own, or be part of other projects. Particular results of foreverloops users without affiliation were discussed and examined in more detail; without encouragement, the players made their compositions and performances available to the public.

Concerning the development of this thesis, a unique characteristic can be found in the practice of accompanying research with the realization of a product, i.e. the commercially available foreverloops; this approach made it possible to both address and handle central research questions, but also to refine and to further develop the project. With foreverloops, substitutionary by other projects facilitating productive gaming, the following hypothesis were evaluated:

***Table 8.2*:** quantitative evaluation results

hypothesis	evaluation
H1: using foreverloops is a playing activity	applies
H2: playing with foreverloops is productive	applies
H3: users that are content with their results like foreverloops better	somewhat applies
H4: learning foreverloops is fun	applies
H5: foreverloops is a game	undecidable
H6: gamers are more likely to not consider foreverloops as a game	rejection, there is a weak / moderate correlation to the opposite
H7: there is no gender bias	applies
H8: using foreverloops, having a musical background is considered advantageous	conditional result: musicians do not agree, otherwise weak consent

The accompanying of research with the realization of a product made additional information channels accessible, including comments in the product discussion forums, reviews, and user-generated results, also the availability of foreverloops as a product allowed the hosting of several workshops, participations at fairs, and generally connections with relevant communities. As suggested at the very beginning, *this rather unusual approach turned out to be highly effective for substantiating productive gaming: true to the multi-disciplinary field of game studies, different research methods were used, as were the interactions of basic research, user feedback, product development, and constant evaluations.*

8.1 Outlook

This thesis kept many approaches combining playing activities and creativity under review. It is quite evident that players and people engaging with digital play activities exhibit creative power and inventiveness; still, the bulk of relevant activities originates from spare-time activities: player-created game modifications are primarily developed by players apart from their

occupations, Lego-bricks are mainly used as toys by kids, and the main audience of foreverloops still are gamers instead of professional musicians. For the most part, projects used for productive gaming are based on misappropriation: very often it is artists who re-purpose existing technology for artistic expression; relevant examples include the aforementioned q3apd, a Quake3 Arena modification by Steven Pickles and Julian Oliver, and the Nybble-Engine by Margarete Jahrmann, Max Moswitzer, et al.. Other projects aimed at more accessible environments for creativity and self-expression, including SimTunes by Toshio Iwai and Super Mario Maker by Nintendo, seldom find their ways into professional studios.

Still, the growth of the entertainment industry, the powerful technological foundations, the favorable player attitudes, the rising number of Paidia-aligned simulation games, the extensions of fandom throughout the scenes, are all auspicious signs for the advent of productive gaming: digital play activities involve a multitude of value propositions, including entertainment, education and knowledge transfer, socializing and networking, solving particular scientific problems (with human-based computation games), raising awareness for specific grievances, or advertisement. The particular added value of productive gaming is its capability to bring about products by playing activities, realizing a new form of expression; playing activities are considered fun, involve learning and experimentation, yield a particular appealing persuasiveness, and are capable of advancing typical work experiences.

Gamification is a different approach often used to create a bridge between work and play: in many cases, it amounts to the brute-force introduction of synthetic reward structures, aimed at the increase of employee productivity. Although digital environments promoting productive gaming may originate from gamification processes, the former requires its players to autonomously determine their objectives: *distinctive player creations depend on their creativity, fueled and at the same time limited by the rules.*

Summarizing, productive gaming proposes a concept to dispose of digital playing and productivity in marriage. The claim that it is still in its infancy is likely an exaggeration: relevant projects have not yet reached a level of technical sophistication that enables a sufficient level of complexity to maintain long-term player interest on the one hand, and the technical capabilities to afford deployment in professional environments on the other hand. With foreverloops, a productive gaming playground aimed at media production, the ambition was to improve upon this situation.

A Appendix

A.1 Questionnaires

In the following, the questionnaires used for the quantitative studies are listed, in the following order:

- Original survey
- Bruckneruni questionnaire 2017-04-04
- Arts Santa Monica questionnaire 2017-06-12
- Europagymnasium Auhof questionnaire 2017-07-04
- Reversed festival questionnaire 2017-07-07
- Kinderuni JKU questionnaire 2017-07-11
- PlayAustria and Vienna GameCity questionnaires 2017-09-14
- BaKip Kreuzschwestern questionnaire 2017-12-07
- ICT4D workshop questionnaire 2017-12-14
- Khevenhüller Real and Culture questionnaire 2018-02-15
- Kinderuni JKU questionnaire 2018-07-17

Introduction

Research topic: productive gaming

- ongoing PhD project (Interface Cultures, University of Art and Design Linz)
- combination of SW (tools) and digital game activity (play)
- main focus: utilization of play
  - for productivity
  - (for learning)
- productive gaming =
  - play and thereby create something
    - specific play activity, facilitated by specific titles
    - players produce artifacts that are valid beyond the game
  - few relevant titles (SimTunes, PrintCraft, foreverloops, Spore, Sims, …)

About the survey

- multiple play sessions
  - up to 20 minutes
  - with screen capture
  - and ongoing observation
  - and a few questions (strongly disagree <-> strongly agree)
- brief interviews after the play sessions
  - covers formal questions and informal dialogue
- research subjects include
  - work vs. play
  - contentment with achieved results
  - play phases

The session will last about two hours and conclude with a sum-up interview.

SimTunes session

Explain process

- brief intro / video
- unguided play session
  - some questions during the session (strongly agree <-> strongly disagree)
  - interview afterwards
  - manual activity tracking
  - open to questions any time
- goals:
  - game / play
  - play / work
  - play phases
  - result contentment
- video capture

Brief intro

SimTunes = software toy by Toshio Iwai / Maxis, from 1996; primarily meant for children

Create doodles and let them be played

Brief introductory video:

https://www.youtube.com/watch?v=r-SS8WIREPQ

SimTunes activity grid

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

SimTunes play session questions

	strongly disagree	disagree	neutral	agree	strongly agree
I like playing with it	○	○	○	○	○
It feels like playing rather than working	○	○	○	○	○
Learning SimTunes is fun	○	○	○	○	○
Nice results can be achieved	○	○	○	○	○
Nice results can be achieved fast	○	○	○	○	○

SimTunes comments / questions during the play session

SimTunes questionnaire

	strongly disagree	disagree	neutral	agree	strongly agree
SimTunes realizes productive gaming	○	○	○	○	○
I was in a FLOW	○	○	○	○	○
I liked it	○	○	○	○	○
I am curious about what others do with SimTunes	○	○	○	○	○
I will use it again	○	○	○	○	○
I am content with the results	○	○	○	○	○
I feel challenged by SimTunes	○	○	○	○	○
I often had specific goals in mind	○	○	○	○	○
Using it feels like experimenting	○	○	○	○	○
It feels like playing a musical instrument	○	○	○	○	○
It feels like doodling	○	○	○	○	○
It feels like using a software (Paint / Photoshop)	○	○	○	○	○
It is easy to use	○	○	○	○	○
There is still a lot to learn about SimTunes	○	○	○	○	○
I like that SimTunes does not dictate goals	○	○	○	○	○
To achieve nice results with SimTunes, one must set her own goals	○	○	○	○	○
SimTunes is a game	○	○	○	○	○
SimTunes is a productivity software	○	○	○	○	○

SimTunes comments / questions after the play session

How would you characterize the achieved results?

foreverloops play session I

Explain process

- brief intro (basic concepts)
- unguided play session
  - some questions during the session (strongly agree <-> strongly disagree)
  - interview afterwards
  - manual activity tracking
  - open to questions any time
- goals:
  - learning process playfulness
  - game / play
  - play / work
  - compare to SimTunes
  - realizes productive gaming
  - result contentment
- video capture

Brief intro

foreverloops = [company / software] by Marlene Brandstätter and myself

Create audio-visual compositions by playing

Short intro to explain:

- gear creation
- attaching / stacking / trains
- programming
- gear context (menu)
- video / UI

foreverloops activity grid session I

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

foreverloops play session I questions

	strongly disagree	disagree	neutral	agree	strongly agree
I like playing with it	○	○	○	○	○
It feels like playing rather than working	○	○	○	○	○
Learning foreverloops is fun	○	○	○	○	○
Nice results can be achieved	○	○	○	○	○
Nice results can be achieved fast	○	○	○	○	○

foreverloops comments / questions during the play session I

foreverloops session I questionnaire

	strongly disagree	disagree	neutral	agree	strongly agree
foreverloops realizes productive gaming	○	○	○	○	○
I was in a FLOW	○	○	○	○	○
I liked it	○	○	○	○	○
I am curious about what others do with foreverloops	○	○	○	○	○
I will use it again	○	○	○	○	○
I am content with the results	○	○	○	○	○
I feel challenged by foreverloops	○	○	○	○	○
I often had specific goals in mind	○	○	○	○	○
Using it feels like experimenting	○	○	○	○	○
It feels like playing a musical instrument	○	○	○	○	○
It feels like playing digital Lego	○	○	○	○	○
It is easy to use	○	○	○	○	○
There is still a lot to learn about foreverloops	○	○	○	○	○
I like that forever-loops does not dictate goals	○	○	○	○	○
Learning foreverloops is fun	○	○	○	○	○
It is more challenging than SimTunes	○	○	○	○	○
I prefer foreverloops results to SimTunes results	○	○	○	○	○
To achieve nice re-sults with forever-loops, one must set her own goals	○	○	○	○	○
foreverloops is a game	○	○	○	○	○
foreverloops is a productivity software	○	○	○	○	○

foreverloops comments / questions after play session I

How would you characterize the achieved results?

foreverloops play session II

Explain process

- same as session I, BUT
  - tasks
  - learning phase „complete“

Tasks

- Pre-create two independent gear trains
  - Create trains with different transmission ratios
  - Create some drum pattern
  - Alter the playback speed / direction of the drum pattern
- Create a composition without sound (only video / images)
- Create a musical composition with only synth effects and pads
  - Alter event volumes for better results
- Create a musical composition by using only drive and scratch gears
- Create a composition where visible events are played back at the same time as audible events

foreverloops activity grid session II

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

foreverloops play session II questions

	strongly disagree	disagree	neutral	agree	strongly agree
I like playing with it	○	○	○	○	○
It feels like playing rather than working	○	○	○	○	○
Learning foreverloops is fun	○	○	○	○	○
Nice results can be achieved	○	○	○	○	○
Nice results can be achieved fast	○	○	○	○	○

foreverloops comments / questions during the play session II

foreverloops session II questionnaire

	strongly disagree	disagree	neutral	agree	strongly agree
foreverloops realizes productive gaming	○	○	○	○	○
I was in a FLOW	○	○	○	○	○
I liked it	○	○	○	○	○
I am curious about what others do with foreverloops	○	○	○	○	○
I will use it again	○	○	○	○	○
I am content with the results	○	○	○	○	○
I feel challenged by foreverloops	○	○	○	○	○
Using it feels like experimenting	○	○	○	○	○
It feels like playing a musical instrument	○	○	○	○	○
It feels like playing digital Lego	○	○	○	○	○
It is easy to use	○	○	○	○	○
There is still a lot to learn about foreverloops	○	○	○	○	○
I did like having tasks	○	○	○	○	○
I solved the tasks	○	○	○	○	○
Tasks help me learn foreverloops	○	○	○	○	○
Tasks help me achieve even better results	○	○	○	○	○
It is easy to achieve good results with foreverloops	○	○	○	○	○
foreverloops is a game	○	○	○	○	○
foreverloops is a productivity software	○	○	○	○	○

foreverloops comments / questions after play session II

foreverloops session II topics

Does the playful approach provide added value?

What I like about foreverloops:

What I do not like about foreverloops:

How foreverloops could be improved:

Productive gaming closing interview questions

Time per week spent with NON-digital games	
Time per week spent with digital games	
Do you consider yourself a creative person?	
Do you consider yourself a musical person?	
Do you consider yourself a technical person?	
Age	
Sex	
Nationality	
Educational level	
Will you recommend SimTunes?	
Will you use SimTunes again?	
Will you recommend foreverloops?	
Will you use foreverloops again?	
Did you prefer foreverloops session one or two?	
If you were to continue using SimTunes / foreverloops, would you share your results (Facebook, YouTube, Twitter, ...)?	

	strongly disagree	disagree	neutral	agree	strongly agree
Users with musical background have an advantage using foreverloops	○	○	○	○	○
SimTunes facilitates compositions that are difficult to achieve with other tools	○	○	○	○	○
foreverloops facilitates compositions that are difficult to achieve with other tools	○	○	○	○	○

Music (genres) I like to listen to:

foreverloops reminds me of:

Potential additional usage scenarios for foreverloops:

Who uses SimTunes?

I think of SimTunes as [product / media art / toy / game]

Who uses foreverloops?

I think of foreverloops as [product / media art / toy / game]?

FOREVERLOOPS RESEARCH QUESTIONNAIRE

	strongly disagree	disagree	neutral	agree	strongly agree
foreverloops is a game (like Tetris)	○	○	○	○	○
foreverloops is a production software	○	○	○	○	○
I am satisfied with the compositions I achieved	○	○	○	○	○
Composing with foreverloops feels rather like playing than working	○	○	○	○	○
I understand the concepts of foreverloops and I am able to apply them	○	○	○	○	○
I like the underlying ideas of foreverloops	○	○	○	○	○
foreverloops is easy-to-learn	○	○	○	○	○
foreverloops is hard-to-master	○	○	○	○	○
With foreverloops, good results can be achieved fast	○	○	○	○	○
With foreverloops, one can achieve compositions with free-style play and experimentation	○	○	○	○	○
foreverloops is suitable for goal-oriented composition	○	○	○	○	○
foreverloops makes an initial training phase necessary	○	○	○	○	○

	strongly disagree	disagree	neutral	agree	strongly agree
Users with musical background have an advantage using foreverloops	○	○	○	○	○
foreverloops facilitates the creation of compositions that are difficult to achieve with other tools	○	○	○	○	○
I consider “frequency-based composition” a promising idea	○	○	○	○	○
foreverloops enables “frequency-based composition”	○	○	○	○	○
foreverloops realizes compositions for multi-media	○	○	○	○	○
foreverloops is easy-to-use	○	○	○	○	○
foreverloops interaction is plain and simple	○	○	○	○	○

I consider foreverloops suitable for the following music genres:

I consider foreverloops unfit for the following music genres:

FOREVERLOOPS PRODUCT QUESTIONNAIRE

	strongly disagree	disagree	neutral	agree	strongly agree
I would like to continue using foreverloops	○	○	○	○	○
I like the playful concepts of foreverloops	○	○	○	○	○
foreverloops is suitable for live / real-time performances	○	○	○	○	○
foreverloops is a stable software	○	○	○	○	○
I discovered several bugs in foreverloops	○	○	○	○	○
I like the graphical design of foreverloops	○	○	○	○	○
I like the name foreverloops	○	○	○	○	○
I would like to use foreverloops for my own practice	○	○	○	○	○
I would recommend foreverloops	○	○	○	○	○
Video / image capabilities are useful	○	○	○	○	○
The capabilities for gear structuring and arranging are sufficient	○	○	○	○	○
Manual scratching is a very important feature for foreverloops	○	○	○	○	○

	<= 10	10 – 20	20 – 40	40 – 60	>= 60
Age-groups relevant for foreverloops	◯	◯	◯	◯	◯

Additional features I would like to see in foreverloops:

What I like about foreverloops:

What I dislike in foreverloops:

Music genres I like to listen:

Music genres I produce / play:

How much should foreverloops cost in the current version:

foreverloops reminds me of:

The default sample library should include the following:

	strongly disagree	disagree	neutral	agree	strongly agree
foreverloops should be available on Apple computers	○	○	○	○	○
I would like to see a portable version for mobile phones / tablets	○	○	○	○	○

ATTENDEE INFORMATION

Age:

Nationality:

Sex:

	strongly disagree	disagree	neutral	agree	strongly agree
I work with software for musical composition / production on a regular basis	○	○	○	○	○

○	I agree to the evaluation of the compositions I created today with foreverloops for research purposes	
○	I am ok with / would like to be cited by name in relevant publications	[MY NAME]
○	I am ok with / would like that compositions I created today are included in research articles	[MY PC STATION]

foreverloops questionnaire

	strongly disagree	disagree	neutral	agree	strongly agree
I like playing with foreverloops	○	○	○	○	○
I feel challenged by foreverloops	○	○	○	○	○
Learning foreverloops is fun	○	○	○	○	○
There is still a lot to learn about foreverloops	○	○	○	○	○
It feels like playing rather than working	○	○	○	○	○
Using it feels like experimenting	○	○	○	○	○
I will use it again	○	○	○	○	○
Nice results can be achieved	○	○	○	○	○
Nice results can be achieved fast	○	○	○	○	○
It is easy to use	○	○	○	○	○
I like that foreverloops does not dictate goals	○	○	○	○	○
I am curious about what others do with foreverloops	○	○	○	○	○
foreverloops facilitates compositions that are difficult to achieve with other tools	○	○	○	○	○
I discovered several bugs in foreverloops	○	○	○	○	○
Users with musical background have an advantage using foreverloops	○	○	○	○	○
foreverloops is a game	○	○	○	○	○
foreverloops is a productivity software	○	○	○	○	○

Attendee information

Time per week spent with NON-digital games	
Time per week spent with digital games	
Do you consider yourself a creative person?	
Do you consider yourself a musical person?	
Do you consider yourself a technical person?	
Age	
Sex	
Nationality	
Educational level	
Will you recommend foreverloops?	
Will you use foreverloops again?	
If you were to continue using foreverloops, would you share your results (Facebook, YouTube, Twitter, …)?	

Does the playful approach provide added value?

What I like about foreverloops:

What I do not like about foreverloops:

How foreverloops could be improved:

Music (genres) I like to listen to:

foreverloops reminds me of:

What foreverloops results are like:

I think of foreverloops as [product / media art / toy / game]?

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

07-07-2017 – 09-07-2017 reversed festival // ZOOM

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele analoge Spiele (Brettspiele / Karten / …)	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

15-02-2018 Khevenhüller

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

15-02-2018 Khevenhüller

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	
Mit foreverloops verbrachte Zeit	Stunden

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

Fragen zu foreverloops

	NEIN	eher nicht	neutral	eher schon	JA
foreverloops macht mir Spaß	○	○	○	○	○
foreverloops ist einfach	○	○	○	○	○
Ich möchte bei foreverloops besser werden	○	○	○	○	○
Bei foreverloops ist es wichtig, damit zu experimentieren	○	○	○	○	○
Ich bin sehr zufrieden mit meinen Kompositionen	○	○	○	○	○
Mit foreverloops kommt man sehr schnell zu guten Ergebnissen	○	○	○	○	○
Mich interessiert, was andere mit foreverloops machen	○	○	○	○	○
foreverloops ist ein Spiel	○	○	○	○	○
foreverloops ist Anwender-Software	○	○	○	○	○
Bei foreverloops verschwimmen Lernen und Spielen	○	○	○	○	○

Was mir an foreverloops gefällt:

Was mir NICHT an foreverloops gefällt:

foreverloops erinnert mich an:

foreverloops Kompositionen würde ich so beschreiben:

foreverloops würde ich so beschreiben:

foreverloops ist eher für [Kinder / Jugendliche / Erwachsene / ALLE]

Persönliche Angaben

Alter	Jahre
Geschlecht	
Ich spiele	Stunden / Tag
Ich spiele Computerspiele (auch Handyspiele, Konsolenspiele, etc..)	Stunden / Tag
Ich bin kreativ	
Ich bin musikalisch	
Mich interessiert Technik	
Ich würde foreverloops weiterempfehlen	
Ich möchte foreverloops auch in Zukunft verwenden	
Ich würde meine foreverloops Kompositionen teilen (Facebook, WhatsApp, YouTube, Twitter, …)?	
Mit foreverloops verbrachte Zeit	Stunden

Musik, die mir gefällt:

Meine Lieblingsspiele (Computerspiele, Familienspiele, Brettspiele, ...):

A.2 Additional survey data

In the following, complementary survey data concerning the study participants is shown.

Figure 1.1 features the self-assessment concerning study participant creativity.

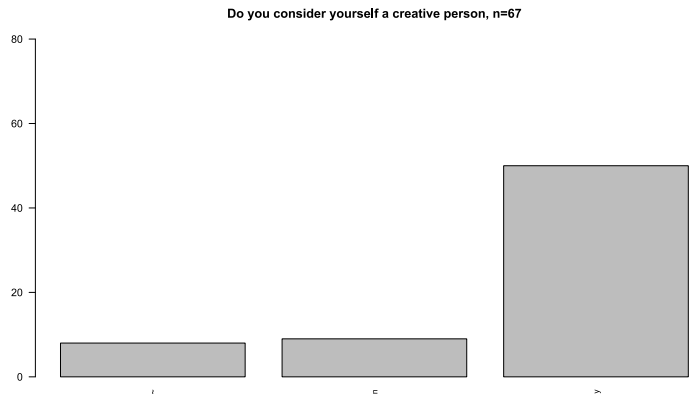


***Figure 1.1*: study participant creativity self assessment**

Figure 1.2 features the self-assessment concerning study participant musicality.

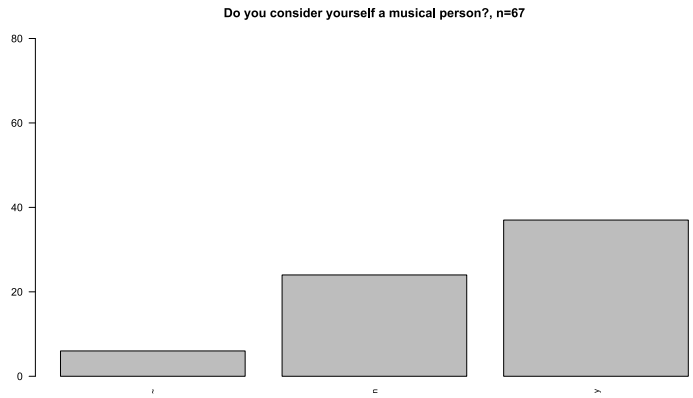


***Figure 1.2*: study participant musicality self assessment**

Figure 1.3 features the self-assessment concerning study participant technical skills.

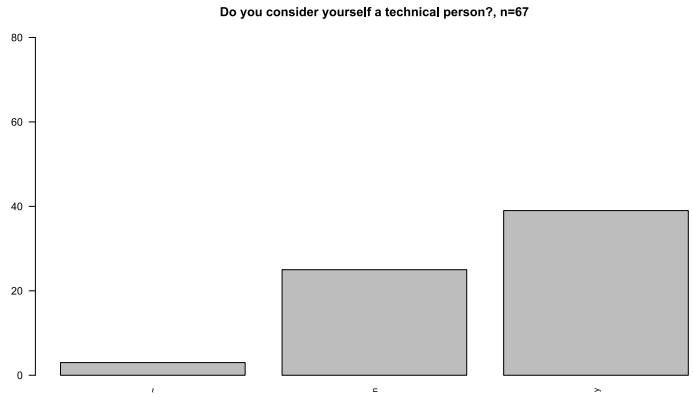


***Figure 1.3*: study participant technical skills self assessment**

Figure 1.4 features the classification of foreverloops as a game, in relation to the time study participants spend with non-digital games.

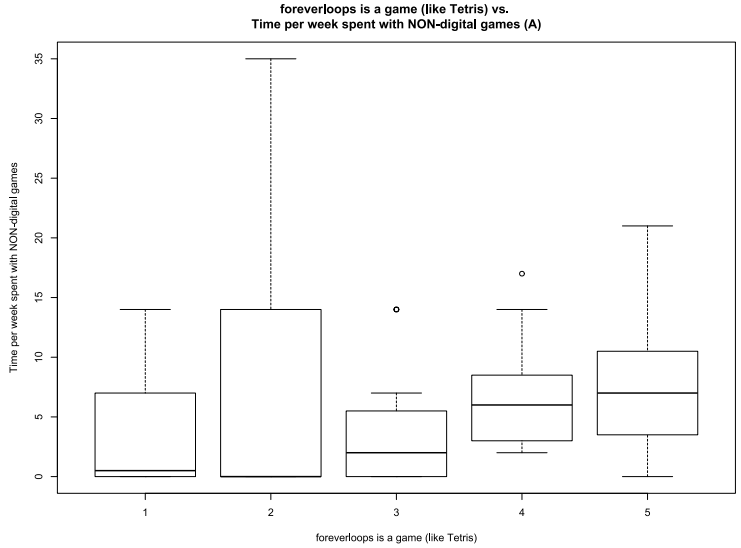


***Figure 1.4*: classification of foreverloops as a game vs time spent with non-digital games**

Figure 1.5 features the classification of foreverloops as a game, in relation to the time study participants spend with digital games.

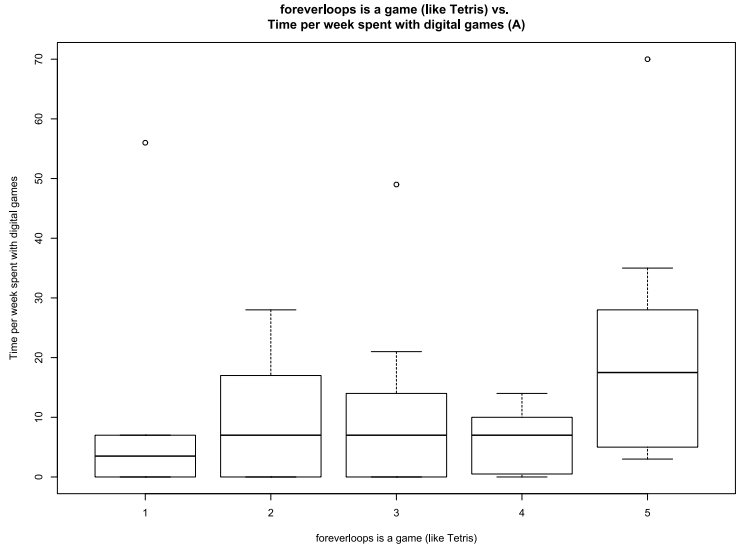


***Figure 1.5*: classification of foreverloops as a game vs time spent with digital games**

Figure 1.6 features the study participant results satisfaction, in relation to how much they enjoyed using foreverloops.

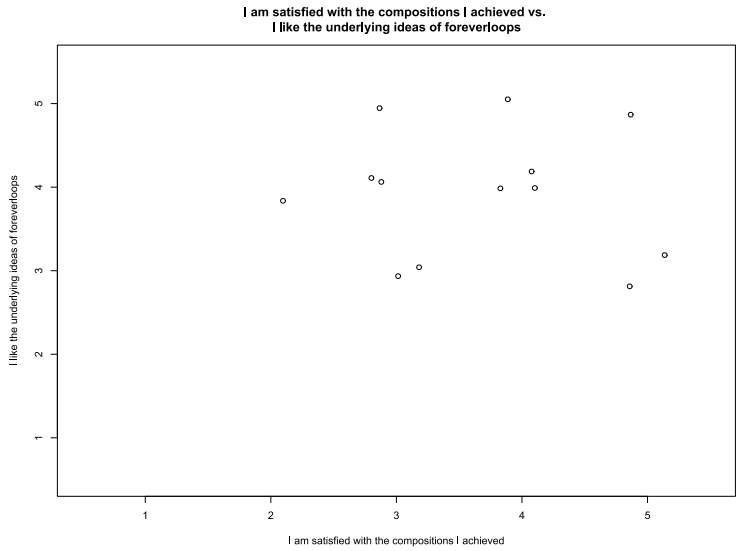


***Figure 1.6*: foreverloops result satisfaction vs liking**

Figure 1.7 features the study participant play enjoyment, in relation to their willingness to use foreverloops in the future.

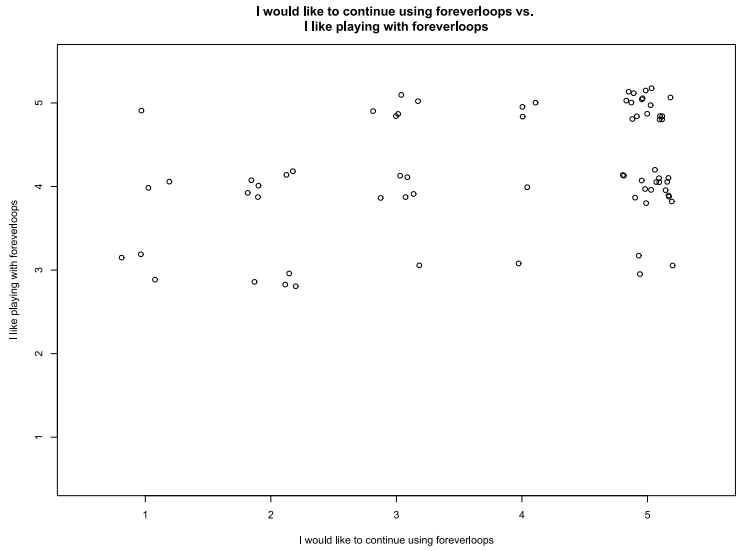


***Figure 1.7*: foreverloops playing vs continued usage**

Figure 1.8 features the study participant willingness to become better with foreverloops.

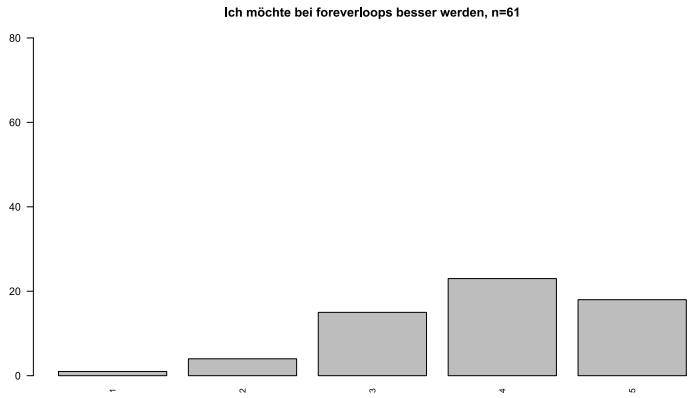


***Figure 1.8*: study participant willingness to invest in their foreverloops skills**

Figure 1.9 features the relevant age groups for foreverloops, according to the study participants. A value of one corresponds with an age up to ten years, two corresponds with the age group of ten to 20 years, three with 20 to 40 years, four with 40 to 60, and five with plus 60.

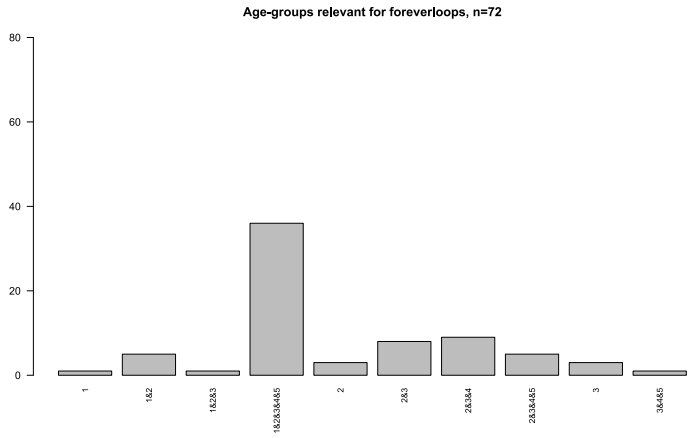


***Figure 1.9*: relevant foreverloops age groups**

A.3 Steam user reviews

In the following, the user reviews available in English concerning foreverloops (LONGPLAY) are reprinted.

A.3.1 VJFranzK (recommended, posted 2020-06-26)

"*"What goes around comes around!" It's interesting and unusual, a non-standard music making program. it may take some time to figure it out, the user interface is different than others you have used before.* "

A.3.2 Braids Cabal Minion (recommended, posted 2020-06-08)

"*I love the gear design! I especially love the fact that you can easily do odd time signatures and polyrhythms!!!* "

A.3.3 IMeantToDoThat (recommended, posted 2020-05-07)

"*If you find yourself lost in the process of creating music without much end product to come of it and that fact doesn't bother you – foreverloops is for you.* "

A.3.4 LargeCar (not recommended, posted 2020-01-12)

"*It seemed good at first but when I paid for it and the dlc's I find it does nothing. DLC's show but don't work and are not available to use. It could be simplified, the circles? well.. Not needed.*

Not happy with this program. Don't wast your money. Free sound programs are much better and eaiser to use. "

A.3.5 deezero7 (recommended, posted 2019-10-04)

"*Totally Worth the Money. When you u gonna fully discover it, it's lot more than what they Charge. MIDI sound r awesome* "

A.3.6 Editfish (not recommended, posted 2019-07-03)

"*It would be nice to have a built-in tutorial of some sort. It's very difficult to figure out. :/* "

A.3.7 jtreser (recommended, posted 2019-06-23)

"*You have to try this thing, its amazingly fun. Super easy to get some simple sounds going. Check out the you tube channel to get a idea of how it works.* "

A.3.8 M310DY (recommended, posted 2019-06-06)

"*This is a fun system if you're not looking to do serious work on it. The gear setup, while fun, is unnecessary and even confusing. Your traditional DAW works much better. I would like to see it simplified for better access to budding musicians as well as have display options, there's so much white on white now that everything turns into a blur after a while. The creators are very active and appear to be updating and making changes regularly though.* "

A.3.9 rampapandiontinling (recommended, posted 2018-08-29)

"*This is really fun to play with. The rotating gears is a nice way to visualize how the sequences are interacting. Looking forward to VST support! :)* "

A.3.10 Deviation (recommended, posted 2018-05-20, updated 2020-01-03)

"

I'd like to start off my review for foreverloops with a bit of a disclaimer. I am not musically inclined whatsoever; I somehow got away with an 80 in music throughout middle school despite never once bringing my instrument to class. I don't know how to read sheet music, nevermind making it. However, foreverloops is an interesting game/software that allows it's user to make their own music using gears, even one as musically handicapped as myself.

Graphics Visually the game is very minimalistic and I really wouldn't want it any other way. There are no fancy distracting visuals (yet), just an open blank canvas and some gears. The UI is also very minimalistic, isn't an eyesore and, most importantly in software, doesn't clutter

your screen. There are some optional visual samples you can add to the background of your track/project, however, I chose not to use them because I found them distracting.

Audio Soundtrack Audiowise there isn't much to talk about due to the fact that you're the one making the music. There is an expansive audio sample library that you have availible to you (which I used during my testing of the software, there are tons of other sample libraries availible on the internet) that is full of standard samples that cover anything you'd really want to use.

"Gameplay" It took me a little bit to get used to foreverloops. For the first little while, I had no clue what I was doing: I didn't know how to add song samples to the actual gears or how to connect them together to make a long chain that would eventually become a song. Although it did take me some time to get used to the interesting concept of the gears and music, once you get a hang of the mechanics you can very easily start making your own music that doesn't sound half bad (the foreverloops team has tutorials uploaded on YouTube). If you're looking for a relaxing product that will help you keep your mind off the stresses of everyday life while also learning something new then I'd recommend you give foreverloops a go.

Final Thoughts Overall foreverloops is a great experimental game/software that I'd recommend you check out. It has a lot of Zen-like properties that were really helped relax me while I tinkered with the program. If you some cash lying around and are looking for a relaxing minimalistic music/audio based software, then look no further than foreverloops. *This review was made possible by Yolo Army Reviews. I received a reviewing copy of this game for free. However, my review is honest. Skip to the bottom for my Final Thoughts*

I'd like to start off my review for foreverloops with a bit of a disclaimer. I am not musically inclined whatsoever; I somehow got away with an 80 in music throughout middle school despite never once bringing my instrument to class. I don't know how to read sheet music, nevermind making it. However, foreverloops is an interesting game/software that allows it's user to make their own music using gears, even one as musically handicapped as myself.

Graphics Visually the game is very minimalistic and I really wouldn't want it any other way. There are no fancy distracting visuals (yet), just an open blank canvas and some gears. The UI is also very minimalistic, isn't an eyesore and, most importantly in software, doesn't clutter your screen. There are some optional visual samples you can add to the background of your track/project, however, I chose not to use them because I found them distracting.

Audio Soundtrack Audiowise there isn't much to talk about due to the fact that you're the one making the music. There is an expansive audio sample library that you have availible to you (which I used during my testing of the software, there are tons of other sample libraries availible on the internet) that is full of standard samples that cover anything you'd really want to use.

"Gameplay" It took me a little bit to get used to foreverloops. For the first little while, I had no clue what I was doing: I didn't know how to add song samples to the actual gears or how to connect them together to make a long chain that would eventually become a song. Although it did take me some time to get used to the interesting concept of the gears and music, once you get a hang of the mechanics you can very easily start making your own music that doesn't sound half

bad (the foreverloops team has tutorials uploaded on YouTube). If you're looking for a relaxing product that will help you keep your mind off the stresses of everyday life while also learning something new then I'd recommend you give foreverloops a go.

Final Thoughts Overall foreverloops is a great experimental game/software that I'd recommend you check out. It has a lot of Zen-like properties that were really helped relax me while I tinkered with the program. If you some cash lying around and are looking for a relaxing minimalistic music/audio based software, then look no further than foreverloops. "

A.3.11 CueZero (recommended, posted 2018-04-22)

"

Foreverloops gives us an entirely new look at the way digital music can be shaped and arranged, it's a seriously awesome creative toy for pretty much any skill level. It uses an easy visual system of gears to drive the rhythm behind each little sample/instrument you play with and pretty much any one can use it and get creative.

This is a damn fun audio/visual tool that can be taken to great lengths to create sprawling and complex series of sound sculptures and rhythmically composed visuals. They all move together in tandem to create naturally occurring collages of your greatest imagining. Thanks to a visually creative and adaptive musical creation system actually using Foreverloops is damn near as meditative as the pulsing, looping, grinding and whirring rhythms you create.

Drive gears are the building blocks to your song, as they literally "drive" the time signatures of your sample gears that hold the sounds you compose. Setting the desired speed sets the rhythm for all connected samples/instruments/loops, using simple and short but easy to conceptualize in your head circle visuals to chart it all out.

An accessible and playful alternative to the linear routine of DAWs, the circular nature of your work space does obviously lead to shorter and more repetitive compositions and this would be more appropriately categorized as a really robust creative music sandbox toy than a professional tool. However, all of the options are in place to really stretch your creations out and assemble multiple arrangements of loops and rhythms for longer more contextualized soundscapes for those with the patience, and with how abstract and interesting an experience it is to use foreverloops the results can be extremely rewarding.

Images and short video segments can be alternated sporadically and connected to the timing of your drive gears, creating timed collages that thrive to the beat of your very creation for incredibly cool visual accompaniment that can easily be assembled on the fly. The supplied images and video clips are experimental at best, and just like the sounds and samples have a very stock quality to them but with around 150 samples packed in there's more than enough to get started with especially for those on the lower skill spectrum (like myself).

The real creative fun in this tool, however, comes with the ability to select and use any of your own .wavs as samples and any images or videos of your own to upload and edit using the innovated

and unique formula of gears. Just like any good audio tool the possibilities are endless with the ability to import all of your own samples and visuals, and the prospect of stringing together multiple short past projects into a larger composition of imported rhythms and sounds you've createdon an assemblage of gears makes for some grand ideas.

Final Thought

Foreverloops is a creative tool that is worth checking out if you're the curious and exploratory type who like to experiment with sound moreso than compose serious arrangements, it performs exactly as its supposed to and without a hitch.

For such an abstract and minimal looking tool it has an incredible wealth of options, features, and little manipulations to utilize that I'm admittedly still on the long road to learning all of and I'll be updating this review with all of the finer details as I discover them. As for now, I have immensely enjoyed my time getting lost in the different spinning gears and the patterns and soundscapes I can easily plot out with them.

This review made possible through the consideration and contribution of IndiePromo and the developer.

Email contact@dnbmedia.co for requests game promotions Foreverloops

Foreverloops gives us an entirely new look at the way digital music can be shaped and arranged, it's a seriously awesome creative toy for pretty much any skill level. It uses an easy visual system of gears to drive the rhythm behind each little sample/instrument you play with and pretty much any one can use it and get creative.

This is a damn fun audio/visual tool that can be taken to great lengths to create sprawling and complex series of sound sculptures and rhythmically composed visuals. They all move together in tandem to create naturally occurring collages of your greatest imagining. Thanks to a visually creative and adaptive musical creation system actually using Foreverloops is damn near as meditative as the pulsing, looping, grinding and whirring rhythms you create.

Drive gears are the building blocks to your song, as they literally "drive" the time signatures of your sample gears that hold the sounds you compose. Setting the desired speed sets the rhythm for all connected samples/instruments/loops, using simple and short but easy to conceptualize in your head circle visuals to chart it all out.

An accessible and playful alternative to the linear routine of DAWs, the circular nature of your work space does obviously lead to shorter and more repetitive compositions and this would be more appropriately categorized as a really robust creative music sandbox toy than a professional tool. However, all of the options are in place to really stretch your creations out and assemble multiple arrangements of loops and rhythms for longer more contextualized soundscapes for those with the patience, and with how abstract and interesting an experience it is to use foreverloops the results can be extremely rewarding.

Images and short video segments can be alternated sporadically and connected to the timing of your drive gears, creating timed collages that thrive to the beat of your very creation for incredibly

cool visual accompaniment that can easily be assembled on the fly. The supplied images and video clips are experimental at best, and just like the sounds and samples have a very stock quality to them but with around 150 samples packed in there's more than enough to get started with especially for those on the lower skill spectrum (like myself).

The real creative fun in this tool, however, comes with the ability to select and use any of your own .wavs as samples and any images or videos of your own to upload and edit using the innovated and unique formula of gears. Just like any good audio tool the possibilities are endless with the ability to import all of your own samples and visuals, and the prospect of stringing together multiple short past projects into a larger composition of imported rhythms and sounds you've createdon an assemblage of gears makes for some grand ideas.

Final Thought

Foreverloops is a creative tool that is worth checking out if you're the curious and exploratory type who like to experiment with sound moreso than compose serious arrangements, it performs exactly as its supposed to and without a hitch.

For such an abstract and minimal looking tool it has an incredible wealth of options, features, and little manipulations to utilize that I'm admittedly still on the long road to learning all of and I'll be updating this review with all of the finer details as I discover them. As for now, I have immensely enjoyed my time getting lost in the different spinning gears and the patterns and soundscapes I can easily plot out with them.

This review made possible through the consideration and contribution of IndiePromo and the developer.

Email contact@dnbmedia.co for requests game promotions "

A.3.12 Helen (recommended, posted 2018-04-18)

"

As of writing this, this is my first day with it, so take this with a grain of salt. Support is wonderful, took around 3 minutes for a response via email, and the person I talked to was very patient and polite. Aside from that,

- *there's plenty of stuff to work with*
- *a really smooth UI*
- *plenty of documentation if you find it confusing via a README file, their website, and video tutorials here on the forums.*
- *lots of functionality with a simple look*

As of writing this, this is my first day with it, so take this with a grain of salt. "

A.3.13 Kylo Ded (recommended, posted 2018-01-13, updated 2018-01-22)

”

'foreverloops' is software that uses rotating gears allowing for the looping of sounds, pictures and video in a truly creative way. 'foreverloops' is fledgling software with great potential. Think different.

Anything else I should know before buying this? The short answer:

1. *A novel and simple visual interface to a basic Euclidean polyrhythmic sequencer that does not require a digital audio workstation (DAW).*
2. *Synchronisation and extension of audio polyrhythm to visual polyrhythm.*
3. *A stable and creative tool in its most barebones beta state with massive potential, but not yet useful for musicians. Will the developers have sufficient staying power required to flesh this product out? Will a bigger studio pick this up?*
4. *Very expensive for what you get – essentially a 'cool toy' at this moment. Think of this as 'Early Access' or 'Kickstart'; you are paying to develop this software. Note there is a 'Pro' version on the way...*

Anything else I should know before buying this? The long answer for musicians: 'foreverloops' is software that allows looping of sounds independent from meter; a Euclidean sequencer to be precise. A rotating gear is equivalent to a bar, all gears/bars rotate at the same speed independent of the number of beats in each bar.

Could 'foreverloops' offer something that is not already available for Ableton Live or Reaktor? Yes.

1. *Increased creativity through a low barrier interface that is completely 'new' will allow musicians and visual artists to create a 'new' kind of composition....*
2. *'foreeverloops' has a very quick and simple interface while Ableton Live or Reaktor have very steep learning curves and a dense interface.*
3. *'foreverloops' could remain relatively inexpensive. Existing software and hardware solutions are extremely expensive for audio polyrhythmic creations. See addendum.*
4. *If anybody knows of software for visual polyrhythmic expression please post in the comments.*

What is missing that would make 'foreverloops' truly interesting to a musician?

1. *The 'Gears' need to be more detailed to make this a truly superb sequencer – more choices of steps, better control over speed, polyrhythmic vs polymetric etc....*
2. *The provided library of audio loops is rudimentary; acquire a library elsewhere.*

3. *Audio loops need to be malleable at least at the basic level like pitch, stretch, start and stop points; stuff available in a basic DAW.*
4. *At this time not interface able with anything. (VST plug-in, MIDI etc. . .)*
5. *Missing audio export controls: high quality audio (24bit/96kHz) and export MIDI files.*
6. *This list is very long and easily fixable, there is so much audio engineering talent available.*

Long answer for visual artist: A very interesting toy. . . the potential is huge.

1. *This is so different than the linear approach in a video workstation that I believe one day its true value could be in rendering images and video more malleable to accompany music; think performance, advertisements, interactive experiences that could respond to user input.*
2. *Wish list: composing a video in real time to accompany a speech, a performance, or to sit down and 'paint' a video for fun. Think Ableton Live and Push for visual images; midi controllers for layering in/out images and video, playing with color balance and filters in real time; the possibilities are truly endless if developed.*

[...] 'foreverloops' on PC / Steam Score: 10/10 for insightfulness and developer bravery, 6/10 for functionality.

'foreverloops' is software that uses rotating gears allowing for the looping of sounds, pictures and video in a truly creative way. 'foreverloops' is fledgling software with great potential. Think different.

Anything else I should know before buying this? The short answer:

1. *A novel and simple visual interface to a basic Euclidean polyrhythmic sequencer that does not require a digital audio workstation (DAW).*
2. *Synchronisation and extension of audio polyrhythm to visual polyrhythm.*
3. *A stable and creative tool in its most barebones beta state with massive potential, but not yet useful for musicians. Will the developers have sufficient staying power required to flesh this product out? Will a bigger studio pick this up?*
4. *Very expensive for what you get – essentially a 'cool toy' at this moment. Think of this as 'Early Access' or 'Kickstart'; you are paying to develop this software. Note there is a 'Pro' version on the way. . .*

Anything else I should know before buying this? The long answer for musicians: 'foreverloops' is software that allows looping of sounds independent from meter; a Euclidean sequencer to be precise. A rotating gear is equivalent to a bar, all gears/bars rotate at the same speed independent of the number of beats in each bar.

Could 'foreverloops' offer something that is not already available for Ableton Live or Reaktor? Yes.

1. *Increased creativity through a low barrier interface that is completely 'new' will allow musicians and visual artists to create a 'new' kind of composition. . . .*
2. *'foreeverloops' has a very quick and simple interface while Ableton Live or Reaktor have very steep learning curves and a dense interface.*
3. *'foreverloops' could remain relatively inexpensive. Existing software and hardware solutions are extremely expensive for audio polyrhythmic creations. See addendum.*
4. *If anybody knows of software for visual polyrhythmic expression please post in the comments.*

What is missing that would make 'foreverloops' truly interesting to a musician?

1. *The 'Gears' need to be more detailed to make this a truly superb sequencer – more choices of steps, better control over speed, polyrhythmic vs polymetric etc. . . .*
2. *The provided library of audio loops is rudimentary; acquire a library elsewhere.*
3. *Audio loops need to be malleable at least at the basic level like pitch, stretch, start and stop points; stuff available in a basic DAW.*
4. *At this time not interface able with anything. (VST plug-in, MIDI etc. . .)*
5. *Missing audio export controls: high quality audio (24bit/96kHz) and export MIDI files.*
6. *This list is very long and easily fixable, there is so much audio engineering talent available.*

Long answer for visual artist: A very interesting toy. . . the potential is huge.

1. *This is so different than the linear approach in a video workstation that I believe one day its true value could be in rendering images and video more malleable to accompany music; think performance, advertisements, interactive experiences that could respond to user input.*
2. *Wish list: composing a video in real time to accompany a speech, a performance, or to sit down and 'paint' a video for fun. Think Ableton Live and Push for visual images; midi controllers for layering in/out images and video, playing with color balance and filters in real time; the possibilities are truly endless if developed.*

[...] "

A.3.14 Snaake (recommended, posted 2018-01-08)

"

If it had effects, phlanges, reverb, or volume controls for components, that'd make it pretty perfect.

I'll be looking forwared to DLC of additional banks of instruments, electronic sounds, or foley effects. If you like synthesizers, sequencers, or tape loops, you'll love this. Foreverloops has a very adequate number of instrument sounds to have some serious fun.

If it had effects, phlanges, reverb, or volume controls for components, that'd make it pretty perfect.

I'll be looking forwared to DLC of additional banks of instruments, electronic sounds, or foley effects. "

A.3.15 demo (recommended, posted 2017-11-29)

"

This software seems to be aimed both at people who have no experience with music production and existing creators who like to experiment with new approaches. I think that used to its full potential, some quite complex sequences are possible. Combined with the ability of the software for using any existing user content, the results should be very rewarding.

Strengths

Very intuitive, a new user can dive right in and start creating. The devs are also creating a youtube channel and set of instructional videos so a good body of reference material is being established for users of the software.

Educational. Associating bars and loops with Gears and trigger points makes the process of building a music loop easy to understand.

Fun. foreverloops comes with a library of ¿ 200 samples and theyre pretty good ones, adding and swapping samples to hear the cumulative effect is a blast.

Flexible. You can use your own .wav sample library and images/video clips in your creations, making foreverloops a powerful tool with unlimited potential.

Projects can be exported as audio-/video sessions.

Comprehensive, The program recognises a wide variety of audio, image and video formats.

Great devs. - When I purchased this I initially refunded because I found a couple of bugs and posted about them in the forum, and as the post wasn't replied to for a few hours I decided to refund. I should have been more patient... Clearly the reason the post wasn't answered straight away was because the devs were busy fixing the issues I'd found. I was suprised and quite blown away to see an answer, accompanied by a software update fixing the issues that same evening, - and a free key for my trouble.

Weaknesses

No DAW compatibilty (yet)

A tad expensive. Foreverloops is an innovative sandbox and tool that takes a new approach to producing rythmic musical loops, combined with video clips and/or changing still images. Audio-visual loops can be built by constructing cog chains, each cog having trigger points which can be linked to your choice of sample, still image or video clip. It comes with a good selection of video clips, images and a comprehensive .wav sample library, but you are not limited to just these as it recognises a wide variety of audio, image and video formats, (meaning you can use your own

content).

This software seems to be aimed both at people who have no experience with music production and existing creators who like to experiment with new approaches. I think that used to its full potential, some quite complex sequences are possible. Combined with the ability of the software for using any existing user content, the results should be very rewarding.

Strengths

Very intuitive, a new user can dive right in and start creating. The devs are also creating a youtube channel and set of instructional videos so a good body of reference material is being established for users of the software.

Educational. Associating bars and loops with Gears and trigger points makes the process of building a music loop easy to understand.

Fun. foreverloops comes with a library of ¿ 200 samples and theyre pretty good ones, adding and swapping samples to hear the cumulative effect is a blast.

Flexible. You can use your own .wav sample library and images/video clips in your creations, making foreverloops a powerful tool with unlimited potential.

Projects can be exported as audio-/video sessions.

Comprehensive, The program recognises a wide variety of audio, image and video formats.

Great devs. - When I purchased this I initially refunded because I found a couple of bugs and posted about them in the forum, and as the post wasn‘t replied to for a few hours I decided to refund. I should have been more patient... Clearly the reason the post wasn‘t answered straight away was because the devs were busy fixing the issues I‘d found. I was suprised and quite blown away to see an answer, accompanied by a software update fixing the issues that same evening, - and a free key for my trouble.

Weaknesses

No DAW compatibilty (yet)

A tad expensive. ”

A.3.16 Dodsfall (recommended, posted 2017-11-28)

”

The gear system is unique in music creation as far as I can tell. Most music creation is done linearly. From what I have experimented with in a short amount of time, this makes the software easy to use but the end result is fairly repetitive since it is simply a continuous loop.

The ability to add your own sound, video, and photo clips makes this software able to create endless variations of multimedia projects.

Pros: Very user-friendly and easy to use Instant results Unlimited potential for unique projects Fun! Potential for live manipulation to vary the loop pattern (This will take some preparation

and skill)

Con: Fairly short video and audio loops make the results repetitive unless used as mentioned above to vary the loops While you can create music and manipulate video with Foreverloops, it is not an all-purpose music creation/video editing tool. At this point it is a creative toy, although quite a powerful one. Very easy to use, a beginner can jump right in and create in a very short amount of time.

The gear system is unique in music creation as far as I can tell. Most music creation is done linearly. From what I have experimented with in a short amount of time, this makes the software easy to use but the end result is fairly repetitive since it is simply a continuous loop.

The ability to add your own sound, video, and photo clips makes this software able to create endless variations of multimedia projects.

Pros: Very user-friendly and easy to use Instant results Unlimited potential for unique projects Fun! Potential for live manipulation to vary the loop pattern (This will take some preparation and skill)

Con: Fairly short video and audio loops make the results repetitive unless used as mentioned above to vary the loops "

A.4 foreverloops version / update history

In the following, the features, versions, and changes concerning the foreverloops product range are shown. Disclaimer: the list originates from the change-log accompanying foreverloops.

A.4.1 1.04.04 / 2020-01

fixes

- *LONGPLAY / STUDIO: fixed various fx initialization issues*
  - *improved load stability for vst3 fx using non-asio sound interfaces*
  - *scene cleanup using asio sound sound interfaces no longer crashes from time to time*
  - *fixed an internal fx issue (in some cases parameters would not be applied automatically)*
  - *saved scenes using vst3 effects / generators properly re-create fx-chain ordering*

A.4.2 1.04.03 / 2019-11 (Steam)

fixes

- *LONGPLAY / STUDIO: fixed MIDI drum kit indexing (now properly accounting for XG-DRUMS)*
- *STUDIO: crash that could occur when removing FX directories no longer happens*

A.4.3 1.04.02 / 2019-09

fixes

- *improved audio effect performance*

other changes

- *muting sequencer gears now applies immediatly*
- *additional audio effect*

foreverloops BEATS version
low-cost, low-entry foreverloops version

- *unlimited tracks*
- *variable tempi*
- *variable segments*
- *supports audio, video and images*
- *can load saves from LP version, LP version can load BEATS saves*

limitations

- *no scratch gears*
- *no MIDI gears*
- *no FX gears*
- *no virtual keyboard*
- *no Leibniz logics for drive gears*
- *no manual scratching*
- *sync mode is always enabled*

foreverloops STUDIO DLC

- *ASIO compatibility*
- *SPOUT compatibility*
- *MIDI out capability*

- *VST3 compatibility (32bit)*
  - *several 3rd party plugins included*
- *additional audio samples*
- *MIDI soundfont rendering can be bypassed*

A.4.4 1.04 / 2019-04

new features LP version

- *FX*
  - *new gear type for effects*
  - *each effect*
    - *has several presets*
    - *can be customized via radial effect parameter editor*
  - *FX gears can be stacked for FX-chains*
  - *FX priorities correspond to connection order*
  - *respect Leibniz semantics*
  - *effect list:*
    - *volume rotate*
    - *echo*
    - *autowah*
    - *volume (with that, volumes of entire trees can be adjusted conveniently)*
    - *phaser*
    - *chorus*
    - *distortion*
    - *compressor*
    - *reverb*
    - *low-pass*
    - *high-pass*
    - *band-pass*
    - *band-stop*
    - *peak-eq*
    - *low-shelf*
    - *high-shelf*
    - *parametric eq*

        * *gargle*
    - *effects can be disconnected and bybassed*

fixes

- *linear Leibniz processing now propagates properly*
- *drive clock is now reset when a new scene is created*

convenience

- *slightly adjusted color scheme*
- *fix rendering for helpers*
- *better label-positioning*
- *automatically swith to relevant browser view on gear creation*
- *additional scenes*

other changes

- *no longer recognizes binary save files from <= 1.02*
- *signed executable, with proper meta information*

A.4.5 1.03 / 2018-12

features

- *MIDI*
    - *new gear type for MIDI*
        * *MIDI gear editor (circular piano roll)*
    - *SoundFont based MIDI rendering*
        * *foreverloops is shipped with the General User GS SoundFont (1.471) by S. Christian Collins*
    - *SoundFont import*
    - *support for MIDI input devices*
        * *option to remap external note inputs to full velocity*
    - *customizable virtual MIDI keyboard*

  - *looped and loose recording (combinable with un- / synched mode)*
  - *quantization / quantized recording*

- *sample replace*
  - *select events using the same sample and replace (for single or all gears)*
- *clock reset*
  - *rewind scene playback*
- *solo mode*
  - *play gears individually*
  - *can be applied to gears, stacks, and trains (combinable with mute)*
- *shortcut window*
  - *show currently available shortcuts*
- *shortcut for adding sample folders recursively (optionally)*

convenience

- *new samples*
  - *100 Samples from the TrapLife Stellar pack (by Phil Gallardo)*
- *faster and tidier media browser*
- *additional scenes*
- *restore last used screen resolution / position on startup*
- *additional shortcuts for several commands (e.g. gear sizes)*

fixes

- *various filesystem fixes*
- *fix interactions of several ongoing commands*
- *avoid crashes when loading scenes with unavailable samples*
- *audio-level visualization fixes (separate channel visualization)*
- *fix rare video-decoding crashes*

- *fix rare sample loading issues / deadlocks*

other changes

- *reduced OpenGL core profile (3.3 instead of 4.3)*
- *xml based scene saves (instead of binary format)*
- *xml-based scene layout file (now includes user sample and SoundFont paths)*
- *increased foreverloops samples' level*
- *ensure widgets are visible after screen resolution changed*
- *consistent naming of several operations*
- *anti-aliasing fixes*

known issues

- *MIDI keyboard:*
  - *window size changes on mouse wheel scroll for larger / smaller keys*
- *Gear graph:*
  - *creating gears via menu bar sometimes retriggers currently active events*

A.4.6 1.02 / 2018-04 (Steam)

features

- *set drive speeds directly*
  - *with a new bpm-based interface*
  - *the old relative approach can still be used via key shortcuts, and still applies for scratch gears*
- *more gear sizes / bigger stacks*
  - *up to 11 gears per stack*
  - *gears are now bigger per default*
  - *improved snapping*
- *more segmentation settings*

  - *up to 64th*
  - *also, any value can now be set (via modifier key, default LEFT-SHIFT)*
  - *improved snapping*

- *improved alter segmentation command*
  - *improved snapping*

- *improved sample browser*
  - *faster*
  - *filters*
  - *play / stop buttons*
  - *search bar*
  - *fold-out directories*

- *improved implicit gear synchronization*
  - *move / attach / detach / stack / unstack*
  - *play / pause*
  - *gear deadlocks*
  - *gear scratching*

convenience

- *bpm based gear speeds*
- *gears that are created on top of a stack now assume the next possible size*
- *show the actual relative gears size when a gear is resized*
- *automatic import save scene folders*
- *more zoom steps*
- *allow selecting gear samples*
- *visually indicate scratch gear activeness*
- *explicit drive synchronization to global clock*
- *better gear / event information*
- *use LRU speed when creating drives*
- *tag unavailable samples (load old scene where used samples are no longer available)*

- *modifier and group modifier key for various actions*

fixes

- *improved anti aliasing*
- *made our file system implementation based on utf8*
- *frame-rate no longer drops dramatically when a sample is hovered*
- *a display bug concerning sample volumes no longer occurs*
- *specific format errors no longer occur with log entries*
- *ensure proper gear distances on gear creation*
- *avoid audio clicks in normal-speed scratch gears*
- *a rare graph bug that could damage the topology no longer occurs*
- *fix synchronization after scratching interaction*
- *fix create gear highlight targets*
- *fix resize gear issue*
- *fix rotation synchronization after scratching*
- *fix gear graph-related crashes*
- *fix issue where scratch gears would still play when stopped or deleted*
- *fix context menu placement after zooming / panning*
- *fix panning / moveTree interaction ambiguities*
- *fix intro not being shown due to timing issues*
- *fix rare crash when loading scenes due to timing issues*
- *fix gear highlighting in conjunction with stack-creation*
- *fix issues when changing to language with a different character set*

other changes

- *less demanding performance profiles*
- *alternate sweeper visualization*
- *avoid audio clippings via floating point precision, if possible*

- *capture audio as .flac files*
- *improve overall simulation precision*
- *remove scratch gear configuration options*
- *remove default drive speed configuration option*

A.4.7 1.01 / 2017-12-20 (Steam)

features

- *gear snapping (enabled via modifier key, default LEFT-SHIFT)*
- *step-wise alter rotation offset mode (enabled via modifier key, default LEFT-SHIFT)*
- *gear-wise volume editing (enabled via modifier key, default LEFT-SHIFT)*

convenience

- *create new gears with most recent segmentation count set*

fixes

- *improved filesystem access stability*
- *improved key binding capabilities*
- *start-up warning in case outdated graphics card driver was detected*
- *better error logging (log file can be found at MyDocuments/foreverloops/log.txt)*

References

[Aar97] Espen J. Aarseth. *Cybertext: Perspectives on Ergodic Literature*. Baltimore, MD, USA: Johns Hopkins University Press, 1997. ISBN: 0-8018-5579-9.

[Ahn06] Luis von Ahn. "Games with a Purpose". In: *Computer* 39.6 (June 2006), pp. 92–94. ISSN: 0018-9162. DOI: 10.1109/MC.2006.196. URL: https://doi.org/10.1109/MC.2006.196.

[Ant12] Anna Anthropy. *Rise of the Videogame Zinesters: How Freaks, Normals, Amateurs, Artists, Dreamers, Drop-Outs, Queers, Housewives, and People Like You Are Taking Back an Art Form*. Seven Stories Press, 2012. ISBN: 1609803728.

[Arm02] United States Army. *America's Army*. 2002.

[AS12] Reem Altamimi and Geoff Skinner. "A Survey of Active Video Game Literature". In: *International Journal of Computer and Information Technology* 01 (2012).

[AS71] E.M. Avedon and B. Sutton-Smith. *The study of games*. J. Wiley, 1971. ISBN: 9780471038399. URL: http://books.google.at/books?id=-6u1AAAAIAAJ.

[Ass20] Entertainment Software Association. *2019 ESSENTIAL FACTS About the Computer and Video Game Industry*. 2020. URL: https://www.theesa.com/wp-content/uploads/2019/05/2019-Essential-Facts-About-the-Computer-and-Video-Game-Industry.pdf.

[Bae69] Ralph Baer. *television gaming and training apparatus*. US3728480A. 1969.

[Bar07] Pippin Barr. "Video Game Values Play as Human-Computer Interaction". PhD thesis. Victoria University of Wellington, 2007.

[Bar09] Zach Barth. *Infiniminer*. 2009.

[BBS16] Ulrich Brandstätter, Marlene Brandstätter, and Christa Sommerer. "Gears for Audio-Visual Composition: Productive Play with Virtual Mechanics". In: *Proceedings of the Audio Mostly 2016*. AM '16. Norrköping, Sweden: Association for Computing Machinery, 2016, pp. 170–177. ISBN: 9781450348225. DOI: 10.1145/2986416.2986423. URL: https://doi.org/10.1145/2986416.2986423.

[Bet+11] BethesdaGameStudios et al. *Skyrim*. 2011.

[BFS11] Paul Bratley, Bennet L. Fox, and Linus E. Schrage. *A Guide to Simulation*. Springer New York, 2011. ISBN: 9781441987242. URL: https://books.google.at/books?id=XHnkBwAAQBAJ.

[Bio+02] BioWare et al. *Neverwinter Nights*. 2002.

[Bio+09] BioWare et al. *Dragon Age: Origins*. 2009.

[BJ12] Staffan Björk and Jesper Juul. "Zero-Player Games. Or: What We Talk about When We Talk about Players". In: Madrid, 2012. URL: http://www.jesperjuul.net/text/zeroplayergames/.

[Bla11] Lucas Blair. "The Use Of Video Game Achievements To Enhance Player Performance, Self-efficacy, And Motivation". PhD thesis. University of Central Florida, 2011. URL: https://stars.library.ucf.edu/cgi/viewcontent.cgi?article=2826&context=etd.

[Bli+10] BlizzardEntertainment et al. *Starcraft 2*. 2010.

[BM77] Ralph H. Baer and Howard J. Morrison. *Simon*. 1977.

[Bog10] Ian Bogost. *Persuasive Games: The Expressive Power of Videogames*. The MIT Press, 2010. ISBN: 0262514885.

[Bog11] Ian Bogost. "Persuasive Games: Exploitationware". In: *Gamasutra* (2011). URL: https://www.gamasutra.com/view/feature/134735/persuasive_games_exploitationware.php.

[Bog19] Ian Bogost. "Video-Game Violence Is Now a Partisan Issue". In: *The Atlantic* (Aug. 2019). URL: https://www.theatlantic.com/technology/archive/2019/08/video-game-violence-became-partisan-issue/595456/.

[Boo05] Natalie Bookchin. "The Intruder". In: *Frontiers: A Journal of Women Studies* 26 (Jan. 2005), pp. 43–47. DOI: 10.1353/fro.2005.0001.

[Boo99] Natalie Bookchin. *The intruder*. 1999. URL: http://bookchin.net/projects/intruder.html.

[Bra13] Ulrich Brandstätter. "ArtCare Interactive art and health care". MA thesis. University of Art and Design Linz, 2013.

[Bra14] Marlene Brandstätter. *NPC - Non Player Character: Delegated play*. AV Akademikerverlag, 2014. ISBN: 3639472594.

[Bro97] Azby Brown. *Portrait of the Artist as a Young Geek*. 1997. URL: https://www.wired.com/1997/05/ff-iwai/.

[BS16] Ulrich Brandstätter and Christa Sommerer. "Productive Gaming." In: *ICEC*. Ed. by Günter Wallner et al. Vol. 9926. Lecture Notes in Computer Science. Springer, 2016, pp. 260–265. ISBN: 978-3-319-46099-4.

[Cal11] Gordon Calleja. *In-game: From Immersion to Incorporation*. MIT Press, 2011. ISBN: 9780262294546.

[CB61] R. Caillois and M. Barash. *Man, Play, and Games*. University of Illinois Press, 1961. ISBN: 9780252070334.

[Cen04] Carnegie Mellon University Entertainment Technology Center. *Game Innovation Database*. 2004. URL: https://web.archive.org/web/20101027215511/http://gameinnovation.org/.

[Chi94] Michel Chion. *Audio-Vision*. Columbia University Press, 1994.

[Col13] Karen Collins. *Playing with Sound: A Theory of Interacting with Sound and Music in Video Games*. The MIT Press, 2013. ISBN: 0262018675.

[Con70] John Horton Conway. *Game of Life*. Scientific American. 1970.

[Con99] Brody Condon. *Adam Killer*. 1999.

[Cor+17] PUBG Corporation et al. *PlayerUnknown's Battlegrounds*. 2017.

[Cos02] Greg Costikyan. "I Have No Words And I Must Design: Toward a Critical Vocabulary for Games". In: *Computer Games and Digital Cultures Conference Proceedings*. Tampere University Press, June 2002.

[Cos13] Greg Costikyan. *Uncertainty in Games*. The MIT Press, 2013. ISBN: 0262018969.

[Cra84] Chris Crawford. *The Art of Computer Game Design*. Berkeley, CA, USA: Osborne/McGraw-Hill, 1984. ISBN: 0881341177.

[CT49] Ole Kirk Christiansen and TheLegoGroup. *Lego*. 1949.

[Cvi96] Andres Cvitkovich. *Silberland*. 1996.

[CW01] Irwin Chusid and Jeff Winner. "Circle Machines and Sequencers: The Untold History of Raymond Scott's Electronica". In: *Electronic Music magazine* (2001). URL: https://www.raymondscott.net/em-article-2001/.

[Det+11] Sebastian Deterding et al. "From Game Design Elements to Gamefulness: Defining "Gamification"". In: *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*. MindTrek '11. Tampere, Finland: ACM, 2011, pp. 9–15. ISBN: 978-1-4503-0816-8.

[Dou52] Alexander Shafto Sandy Douglas. *OXO*. 1952.

[Dug06] Patrick Dugan. *Hot off the Grill: la Molleindustria's Paolo Pedercini on The McDonald's Video Game*. 2006. URL: https://www.gamasutra.com/view/feature/130980/hot_off_the_grill_la_.php.

[Dys16] Jon-Paul C. Dyson. "Toys". In: *Debugging Game History: A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. The MIT Press, 2016. Chap. 46.

[EAD+06] Nintendo EAD et al. *Wii Sports*. 2006.

[EAP82] Henry Ellington, Eric Addinall, and Fred Percival. *A Handbook of Game Design*. Kogan Page, 1982. ISBN: 9780850385687. URL: https://books.google.at/books?id=GuflnAAACAAJ.

[Eic79] Gert Eichler. *Spiel und Arbeit Zur Theorie der Freizeit*. Friedrich Frommann Verlag - Günther Holzboog Gmbh & Co., 79.

[EM05] Laura Ermi and Frans Mäyrä. "Fundamental components of the gameplay experience: Analysing immersion". In: *In DIGRA. DIGRA*. 2005.

[FN14] Mary Flanagan and Helen Niessenbaum. *Values at Play in Digital Games*. The MIT Press, Cambridge, Massachusetts, London, England, 2014.

[Fra01] Gonzalo Frasca. "The Sims: Grandmothers are cooler than trolls". In: *Game Studies the international journal of computer game research* (2001). URL: http://www.gamestudies.org/0101/frasca/.

[Frö17] Thomas Fröhlich. “Play While You Work: Productive Play for Digital Content Creation”. In: *CHI PLAY ’17 Extended Abstracts*. 2017.

[Gag09] Zach Gage. *Lose / Lose*. 2009.

[Gal14] Martim Galvao. “Metric Interplay: A Case Study In Polymeter, Polyrhythm, And Polytempo”. MA thesis. UC Irvine, 2014.

[Gam14] GamerMuscleVideo. *Killed You With A Wheel - Gamer Muscle Challenge*. 2014. URL: https://www.youtube.com/watch?v=Fl35QCbMi-c.

[Gam17] Epic Games. *FortniteBattlegrounds*. 2017.

[Gar] Andreas Garbe. *Quartett der Videospiel-Skandale*. WASD Bookazine for Gameculture 3 -16.

[Gib16] William Gibbons. “Game Audio”. In: *Debugging Game History: A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. The MIT Press, 2016. Chap. 20.

[glo14] Paul Harter / glowinthedark. *Printcraft*. https://www.printcraft.org/. 2014. URL: https://www.printcraft.org/.

[Gwi14a] Benjamin Gwin. *Dark Souls One Handed Challenge*. 2014. URL: http://www.twitch.tv/bearzly/c/4092128.

[Gwi14b] Benjamin Gwin. *Drum Souls*. 2014. URL: http://www.twitch.tv/bearzly/c/5428798.

[Hee08] Richard Heeks. “Current Analysis and Future Research Agenda on ”Gold Farming”: Real-World Production in Developing Countries for the Virtual Economies of Online Games”. In: *Development Informatics Group* (2008).

[Hig58] William Higinbotham. *Tennis for Two*. 1958.

[Hil15] Richard Hill-Whittall. *The Indie Game Developer Handbook*. Focal Press, 2015.

[HK05] Rachel Hall and Paul Klingsberg. “Asymmetric Rhythms and Tiling Canons”. In: *American Mathematical Monthly* 113 (Dec. 2005). DOI: 10.2307/27642087.

[Hol11] Jussi Holopainen. “Foundations of Gameplay”. PhD thesis. Blekinge Institute of Technology, Jan. 2011.

[HT06] Thomas Hurka and John Tasioulas. “GAMES AND THE GOOD”. In: *Aristotelian Society: Supplementary Volume. 80*. 2006.

[Hui49] Johan Huizinga. *Homo Ludens*. Homo Ludens: A Study of Play-element in Culture. Routledge & K. Paul, 1949. ISBN: 9780415175944.

[ID00] Toshio Iwai and Uruma Delvi. *Bikkuri Mouse*. 2000.

[IN05] Toshio Iwai and Yu Nishibori. *Tenori-on*. 2005.

[Ins76a] Texas Instruments. *Little Professor*. 1976.

[Ins76b] Texas Instruments. *Texas Instruments calculators for students*. leaflet. 1976. URL: http://www.datamath.net/Leaflets/CB-272_US.pdf.

[IS97] Toshio Iwai and Scitron & Art SEDIC. *Otocky*. 1997.

[Iwa+05] Toshio Iwai et al. *Electroplankton*. 2005.

[Iwa+96] Toshio Iwai et al. *SimTunes*. 1996.

[Iwa03] Toshio Iwai. *Phenakisti-scopes of Light*. 2003.

[Iwa05] Satoru Iwata. "Keynote". In: *Game Developers Conference 2005*. 2005.

[Iwa06] Toshio Iwai. *Morphovision*. 2006.

[Iwa92] Toshio Iwai. *Sound Fantasy*. 1992. URL: http://www.see-this-sound.at/werke/78.html.

[Iwa93] Toshio Iwai. *Sound Fantasy*. 1993.

[Iwa94] Toshio Iwai. *Resonance of 4*. 1994.

[Iwa95] Toshio Iwai. *Piano - as Image media*. 1995.

[Iwa98] Toshio Iwai. *Composition on the Table*. 1998.

[Jak11] Mikael Jakobsson. "The Achievement Machine: Understanding Xbox 360 Achievements in Gaming Practices". In: *the international journal of computer game research* (2011). URL: http://gamestudies.org/1101/articles/jakobsson?report=reader.

[Jen13] Graham H. Jensen. "Making Sense of Play in Video Games: Ludus, Paidia, and Possibility Spaces". In: *Eludamos. Journal for Computer Game Culture*. 7 (2013), pp. 69–80.

[JM03] Margarete Jahrmann and Max Moswitzer. *nybble-engine-toolZ*. 2003. URL: http://climax.at/nybble-engine-toolz/.

[JN09] Jesper Juul and Marleigh Norton. "Easy to Use and Incredibly Difficult: On the Mythical Border Between Interface and Gameplay". In: *Proceedings of the 4th International Conference on Foundations of Digital Games*. FDG '09. Orlando, Florida: ACM, 2009, pp. 107–112. ISBN: 978-1-60558-437-9.

[Jor+05] Sergi Jordà et al. "The reacTable*". In: Jan. 2005, pp. 579–582.

[Juu00] Jesper Juul. "What computer games can and can't do". In: *Digital Arts and Culture* (2000).

[Juu03] Jesper Juul. "The game, the player, the world: looking for a heart of gameness". In: *Level Up Conference Proceedings*. University of Utrecht, Nov. 2003. URL: http://www.digra.org/wp-content/uploads/digital-library/05163.50560.pdf.

[Juu13] Jesper Juul. *The Art of Failure: An Essay on the Pain of Playing Video Games*. The MIT Press, 2013. ISBN: 0262019051, 9780262019057.

[Juu16] Jesper Juul. "Playing". In: *Debugging Game History - A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. MIT Press, 2016. Chap. Playing, pp. 351–358.

[Kat50] Josef Kates. *Bertie the Brain*. 1950.

[Kel98] David Kelley. *The Art of Reasoning*. W.W. Norton, 1998. ISBN: 9780393972139.

[Kim+11] Sangbeom Kim et al. "Nintendo's "Revolution"". In: *MITSloan Management* 11.124 (2011), pp. 1–23.

[Klu10] RyszardW. Kluszczynski. "Strategies of interactive art". In: *Journal of Aesthetics & Culture* 2.1 (2010), p. 5525.

[Kno16] William Knoblauch. "SIMON: The prelude to modern music video games". In: *Music Video Games: Performance, Politics, and Play*. Ed. by Michael Austin. Approaches to Digital Game Studies. Bloomsbury Academic, 2016. ISBN: 9781501308536. URL: https://books.google.at/books?id=%5C_TMnjgEACAAJ.

[Kos05] Raph Koster. *A Theory of Fun for Game Design*. Scottsdale, Arizona: Paraglyph Press, 2005, p. 244.

[Kos13] Raph Koster. "Playing with "game"". In: *https://www.raphkoster.com* (2013). URL: https://www.raphkoster.com.

[Lab03] Linden Lab. *Second Life*. www.secondlife.com. 2003.

[LD11] Silvia Lindtner and Paul Dourish. "The Promise of Play: A New Approach to Productive Play". In: 2011.

[Lef17] Isabelle Lefebvre. "Creating with (Un) Limited Possibilities: Normative Interfaces and Discourses in Super Mario Maker". In: *Loading...* 10.16 (2017).

[LES14] Fedwa Laamarti, Mohamad Eid, and Abdulmotaleb El Saddik. "An Overview of Serious Games". In: *International Journal of Computer Games Technology* (2014).

[Lev06] Golan Levin. "The Table is The Score: An Augmented-Reality Interface for Real-Time, Tangible, Spectrographic Performance". In: *Proceedings of the International Conference on Computer Music 2006*. Nov. 2006.

[Li03] Zhan Li. "The Potential of America's Army the Video Game as Civilian-Military Public Sphere". MA thesis. MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 2003.

[Lie08] Michael Liebe. "There is no magic circle : on the difference between computer games and traditional games". In: 2008.

[Min84] Jeff Minter. *Psychodelia*. 1984.

[MN72] M. McLuhan and B. Nevitt. *Take Today: The Executive As Dropout*. Harcourt, Brace, Jovanovich, Incorporated, 1972. ISBN: 9780151878307.

[Mor18] Torill Elvira Mortensen. "Anger, fear, and games: The long event of# GamerGate". In: *Games and Culture* 13.8 (2018), pp. 787–806.

[Mor99] Deanna Morse. *Pre-Cinema Toys Inspire Multimedia Artist Toshio Iwai*. 1999. URL: https://www.awn.com/animationworld/pre-cinema-toys-inspire-multimedia-artist-toshio-iwai.

[MR01] Volker Morawe and Tilman Reiff. *Pain Station I*. 2001. URL: http://www.fursr.com/projects/painstation.

[Mye16] David Myers. "Simulation". In: *Debugging Game History: A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. The MIT Press, 2016. Chap. 46.

[Nan+96] NanaOn-Sha et al. *PaRappa the Rapper*. 1996.

[Ng16] Jenna Ng. "Machinima". In: *Debugging Game History: A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. The MIT Press, 2016. Chap. 46.

[NI06] Yu Nishibori and Toshio Iwai. "TENORI-ON". In: *Proceedings of the 2006 International Conference on New Interfaces for Musical Expression (NIME06)* (2006).

[Nin+05a] NintendoEAD et al. *Animal Crossing: Wild World*. 2005.

[Nin+05b] NintendoEAD et al. *Nintendogs*. 2005.

[Nin+05c] NintendoSPD et al. *Brain Age 2: More Training in Minutes a Day!* 2005.

[Nin+05d] NintendoSPD et al. *Brain Age: Train Your Brain in Minutes a Day!* 2005.

[Nin+06] NintendoEADGroup2 et al. *Wii Play*. 2006.

[Nin+08] NintendoEADGroup5 et al. *Wii Fit*. 2008.

[Nin+09] NintendoEADGroup2 et al. *Wii Sports Resort*. 2009.

[Nin+12a] NintendoEAD et al. *Animal Crossing: New Leaf*. 2012.

[Nin+12b] NintendoEAD et al. *Nintendo Land*. 2012.

[Nin+15] Nintendo et al. *Super Mario Maker*. 2015.

[Nin+92] NintendoRAndD1 et al. *Mario Paint*. 1992.

[NSR16] Steve Nebel, Sascha Schneider, and Günter Daniel Rey. "Mining Learning and Crafting Scientific Experiments: A Literature Review on the Use of Minecraft in Education and Research". In: *Educational Technology & Society* 19 (Jan. 2016), pp. 355–366.

[NSS58] Allen Newell, Herbert Simon, and Cliff Shaw. *NSS Chess Program*. 1958.

[Pea06] Celia Pearce. "Productive Play Game Culture From the Bottom Up". In: 2006.

[Ped13] Paolo Pedercini. "Keynote". In: *DiGRA*. 2013.

[Per+09] Markus Persson et al. *Minecraft*. 2009. URL: https://minecraft.net/.

[PH99] Dirk Paesmans and Joan Heemskerk. *SOD*. 1999.

[Pia04] Claus Pias. "Computer Spiel Welten". doctoralthesis. Bauhaus-Universität Weimar, 2004. DOI: 10.25643/bauhaus-universitaet.35.

[Pic06] Martin Pichlmair. "Pwned-10 Tales of Appropriation in Video Games". In: *Mediaterra conference, Athens*. Citeseer. 2006.

[PK14] Jorge Peña and Eunice Kim. "Increasing exergame physical activity through self and opponent avatar appearance". In: *Computers in Human Behavior* 41 (Dec. 2014), pp. 262–267. DOI: 10.1016/j.chb.2014.09.038.

[Pla16] Dana M. Plank. "Mario Paint Composer and Musical (Re)Play on YouTube". In: *Music Video Games: Performance, Politics, and Play*. Ed. by Michael Austin. Approaches to Digital Game Studies. Bloomsbury Academic, 2016. ISBN: 9781501308536. URL: https://books.google.at/books?id=%5C_TMnjgEACAAJ.

[PO03] Steven Pickles and Julian Oliver. *q3apd - Making Music with Bots in Combat*. 2003. URL: https://julianoliver.com/output/q3apd.html.

[Por10] Cindy Poremba. "Discourse Engines for Art Mods". In: *eludamos Journal for Computer Game Culture* 4.1 (2010).

[Pos16] Hector Postigo. "Modification". In: *Debugging Game History: A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. The MIT Press, 2016. Chap. 46.

[PS18] Eve Poudrier and Daniel Shanahan. "Modeling Rhythmic Complexity in a Corpus of Polyrhythm Examples from Europe and America, 1900-1950". In: *Proceedings of the ICMPC15/ESCOM10* (2018).

[Pur09] Petri Purho. *4 Minutes and 33 Seconds of Uniqueness*. 2009. URL: https://www.kloonigames.com/blog/2009/02.

[Pur16] Jas Purewal. "Intellectual Property". In: *Debugging Game History: A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. The MIT Press, 2016. Chap. 32.

[Rei15] Ramón Reichert. *Amateure im Netz: Selbstmanagement und Wissenstechnik im Web 2.0*. Kultur- und Medientheorie. transcript Verlag, 2015. ISBN: 9783839408612. URL: https://books.google.at/books?id=Z2FPBwAAQBAJ.

[RHD71] Don Rawitsch, Bill Heinemann, and Paul Dillenberger. *Oregon Trail*. 1971.

[RK11] Geoffrey M. Rockwell and Kevin Kee. "The Leisure of Serious Games: A Dialogue". In: *Game studies: the international journal of computer game research* (2011).

[Rok93] David Rokeby. *Very Nervous System*. 1993. URL: http://www.davidrokeby.com/vns.html.

[Rus+62] Steve Russell et al. *Spacewar!* 1962.

[Sal16] Anastasia Salter. "Educational Games". In: *Debugging Game History: A Critical Lexicon*. Ed. by Henry Lowood and Raiford Guins. The MIT Press, 2016. Chap. 46.

[SBM17] Christa Sommerer, Ulrich Brandstätter, and Laurent Mignonneau. "Interface-Centric Art Games". In: *Handbook of Digital Games and Entertainment Technologies*. Ed. by Ryohei Nakatsu, Matthias Rauterberg, and Paolo Ciancarini. Singapore: Springer Singapore, 2017, pp. 805–831. ISBN: 978-981-4560-50-4. DOI: 10.1007/978-981-4560-50-4_14. URL: https://doi.org/10.1007/978-981-4560-50-4_14.

[Sco17] Raymond Scott. *Raymond Scott – Artifacts from the Archives*. Ed. by Irwin Chusid, Jeff Winner, and Piet Schreuders. Basta Music and Reckless Night Music LLC, 2017. URL: https://www.raymondscott.net/artifacts/.

[Sic14] Miguel Sicart. *Play Matters*. The MIT Press, 2014. ISBN: 0262027925.

[Sin14] Brendan Sinclair. "Free-to-play whales more rational than assumed". In: *gamesindustry.biz* (2014). URL: https://www.gamesindustry.biz/articles/2014-04-01-free-to-play-whales-more-rational-than-assumed.

[SM94] Christa Sommerer and Laurent Mignonneau. *A-Volve*. 1994.

[Smi] Timothy A. Smith. *Anatomy of a Canon*. URL: http://www.kunstderfuge.com/theory/smith/canon.htm.

[Smi98] Roger D. Smith. *Encyclopedia of Computer Science: Simulation Article*. 1998. URL: http://www.modelbenders.com/encyclopedia/encyclopedia.html.

[SN78] B.H. Suits and F. Newfeld. *The Grasshopper: Games, Life and Utopia*. Nonpareil book. D.R. Godine, 1978. ISBN: 9780879238407.

[Sni99] Stephen Sniderman. *Unwritten Rules*. The life of games. 1999. URL: http://www.gamepuzzles.com/tlog/tlog3.htm.

[Sof+16] Wube Software et al. *Factorio*. 2016.

[Sof91] Distinctive Software. *4D Sports Boxing*. 1991.

[SS20] Timo Schöber and Georg Stadtmann. "Fortnite: The business model pattern behind the scene". In: *European University Viadrina Frankfurt (Oder) Department of Business Administration and Economics Discussion Paper* 415 (2020).

[Ste09] Robert Stebbins. "Serious Leisure and Work". In: *Sociology Compass* 3.5 (2009), pp. 764–774. DOI: 10.1111/j.1751-9020.2009.00233.x. eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1751-9020.2009.00233.x. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1751-9020.2009.00233.x.

[Stu+18] Thomas Studley et al. "A Definition of Creative-Based Music Games". In: *Proceedings of the Australasian Computer Science Week Multiconference*. ACSW '18. Brisband, Queensland, Australia: Association for Computing Machinery, 2018. ISBN: 9781450354363. DOI: 10.1145/3167918.3167921. URL: https://doi.org/10.1145/3167918.3167921.

[Stu+99] Verant Interactive 989 Studios et al. *EverQuest*. 1999.

[Sut01] B. Sutton-Smith. *THE AMBIGUITY OF PLAY*. Harvard University Press, 2001. ISBN: 9780674005815. URL: http://books.google.at/books?id=U4eTmAEACAAJ.

[Syn+97] International Workshop on the Synthesis et al. *Artificial Life V: Proceedings of the Fifth International Workshop on the Synthesis and Simulation of Living Systems*. @Artificial life. MIT Press, 1997. ISBN: 9780262621113. URL: https://books.google.at/books?id=0J8kQEjXe38C.

[SZ04] K. Salen and E. Zimmerman. *Rules of Play: Game Design Fundamentals*. MIT Press, 2004. ISBN: 9780262240451.

[TA15] Selen Turkay and Sonam Adinolf. "The effects of customization on motivation in an extended study with a massively multiplayer online roleplaying game". In: *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 9 (2015). DOI: 10.5817/CP2015-3-2. URL: http://www.cyberpsychology.eu/view.php?cisloclanku=2015081902&article=2.

[Tan14] Joshua Tanenbaum. "How I Learned to Stop Worrying and Love the Gamer: Reframing Subversive Play in Story-Based Games". In: *DiGRA &#3913 - Proceedings of the 2013 DiGRA International Conference: DeFragging Game Studies*. Aug. 2014. ISBN: ISSN 2342-9666. URL: http://www.digra.org/wp-content/uploads/digital-library/paper_136.pdf.

[Tav09] Grant Tavinor. "The Definition of Videogames Revisited". In: *The Philosophy of Computer Games Conference* (2009).

[Tay03] T.L. Taylor. "Power games just want to have fun?: instrumental play in a MMOG". In: *DiGRA &#3903 - Proceedings of the 2003 DiGRA International Conference: Level Up*. 2003. ISBN: ISSN 2342-9666. URL: http://www.digra.org/wp-content/uploads/digital-library/05163.32071.pdf.

[Tay12] T. L. Taylor. *Raising the Stakes: E-Sports and the Professionalization of Computer Gaming*. The MIT Press, 2012. ISBN: 0262017377.

[The84] Dave Theurer. *I, Robot*. 1984.

[TK14] Selen Turkay and Charles K. Kinzer. "The Effects of Avatar: Based Customization on Player Identification". In: *Int. J. Gaming Comput. Mediat. Simul.* 6.1 (Jan. 2014), pp. 1–25. ISSN: 1942-3888. DOI: 10.4018/ijgcms.2014010101. URL: http://dx.doi.org/10.4018/ijgcms.2014010101.

[Tui14] Kathleen Tuite. "GWAPs: Games with a problem". In: *FDG*. 2014.

[Tur01] Sherry Turkle. "Seeing Through Computers". In: *The American Prospect* (2001). URL: https://prospect.org/environment/seeing-computers/.

[v2l03] v2$_l$*ab*. *Nybble-Engine-Toolz*. 2003. URL: https://v2.nl/lab/projects/nybble-engine-toolz.

[Wal03] Bo Kampmann Walther. "Playing and Gaming Reflections and Classifications". In: *international journal of computer game research* 3 (2003).

[Weg+15] Ulrich W. Weger et al. "Virtually compliant: Immersive video gaming increases conformity to false computer judgments". In: *Psychonomic Bulletin & Review*. 2015.

[Wil17] Andrew Williams. *History of Digital Games: Developments in Art, Design and Interaction*. CRC Press, 2017. ISBN: 9781317503804. URL: https://books.google.at/books?id=nLsrDwAAQBAJ.

[WM00] Will Wright and Maxis. *The Sims*. 2000.

[Wri89] Will Wright. *SimCity*. 1989.

[Zim12] Eric Zimmerman. "Jerked Around by the Magic Circle - Clearing the Air Ten Years Later". In: *Gamasutra* (2012). URL: https://www.gamasutra.com/view/feature/135063/jerked_around_by_the_magic_circle_.php.

List of Figures

CC BY-NC-ND 4.0 International
Namensnennung - Nicht-kommerziell - Keine Bearbeitung 4.0 International