Pop Processing
The Digitalization of Musical Time and Space

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PhD Dissertation
Til Elise
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Introduction

Twenty-first century pop music

This dissertation is based on two shifts in twenty-first century popular music: first, the practices and aesthetics of hip-hop and EDM are increasingly assimilated into pop music. Second, these practices are fostered and revitalized by a new generation of the digital audio workstation (DAW). From a quantitative perspective, mainstream popular music has undoubtedly changed; hip-hop or EDM-related artists have almost dominated pop charts in the last decades. From a qualitative perspective, the compositional practices, styles and aesthetics of hip-hop and EDM are permeating not only hip-hop and EDM-related tracks, but pop in general (for a discussion on defining "popular music", see e.g. Middleton, 2000, pp. 3–7).

Historically, technologically and culturally, hip-hop and EDM are intertwined and mutually constituent. However, since their origins, distinctions and separations have gradually developed (Collins, Schedel, & Wilson, 2013). Hip-hop has been a central part of popular culture since the 1980s, when it began to challenge rock’s dominance in popular culture. It spawned massive hits and created new superstars in the 1990s, but, arguably, it was not until the 2000s that hip-hop performers, producers and aesthetics began to dominate pop music.1 Trap hip hop can be traced back to the 1990s, but during the 2010s, trap emerged as the perhaps most popular musical genre of the decade (Bennett, 2020). Performers like Drake, Future, 6ix9ine, Post Malone and Travis Scott became pop stars, and trap’s signature sparse soundscape of syncopated, fast hi-hat figures, tuned kick drums (that often also function as boomy bass) and Auto-Tune became almost ubiquitous in pop.

1 Eminem was globally the best selling artist of the 2000s (Montgomery, 2009). Billboard also named him artist of the decade on U.S charts, Timbaland was songwriter of the decade with Pharrell Williams coming in second, while his producer duo, Neptunes, was Billboard’s producer of the decade (Caulfield, 2009). Timbaland and Neptunes concurrently produced some of the most successful albums for the most successful pop artists, such as Justin Timberlake’s Justified (2002) and FutureSex/LoveSounds (2006) and Madonna’s Hard Candy (2008).
The term EDM has been used as a somewhat heterogenous catchall genre-label for a plethora of electronic subgenres. It arguably originates from the so-called disco continuum, which, via house and techno, comprises a multitude of styles and subcultures (Brewster & Broughton, 2000; Fikentscher, 1996; Lawrence, 2003; McLeod, 2001; Reynolds, 1998; Rietveld, 1998). The 1990s saw a broad array of EDM artists, producers and bands enter the mainstream. However, these were arguably more like genre-demarcated novelties rather than a qualitative assimilation of EDM into pop music. In the 2000s, after being mainly a European phenomenon, festivals of house and dubstep-derived EDM began to gain massive popularity in the US (Gálvez, 2019; Holt, 2017; Michaelangelo Matos, 2015). During the 2010s, a line of highly successful DJ-producers such as Calvin Harris, David Guetta, Tiësto, Avicii, Diplo, Skrillex, Martin Garrix, Marshmello and Zedd began to break down barriers between DJing and producing, as well as distinctions between EDM and pop. They became part of the go-to elite of hit-making producers and became stars themselves. In 2014, Mark Butler (2014) argues that EDM has “emerged as a label for recent, commercially popular genres such as dubstep” (2014, p. 5 f.4). He emphasizes that popular as well as academic writing since the 1990s has generally used the term to encompass all genres within the category of electronic dance music, and that this definition should not be confused with the narrower, more recent one. To separate the general label EDM from the more recent iteration, I use the label EDM pop (as do Holt, 2017 and James, 2015). It defines mainly house and dubstep-inspired, drop-based electronic music that in a recorded music context abides to a pop single length, format and function.

2 These include, for example, bigbeat artists like The Prodigy, Fatboy Slim, Chemical Brothers, the trip-hop of Massive Attack and Portishead, or the so-called Eurodance of Ace of Base, Aqua and 2 Unlimited!, as well as the more techno and drum-and-bass-like Aphex Twin or French House of Daft Punk or Air. Artists like Björk and Moby also produced hits that can be heard as or inspired by electronic dance music.

3 I am acutely aware of the blasphemic potential of – for some fans of electronic dance music – merely naming Aphex Twin and David Guetta in the same context. Mandy-Suzanne Wong (2013) writes that many authors feel that EDM outside clubs and raves is an aesthetical failure (2013, p. 195). My purpose and focus here is not a comparison, but to track changes in pop. The sometimes rather protective tendencies in some electronic music cultures perhaps also bears witness to certain high and low authenticity-driven distinctions. The EDM pop that I am here describing is indeed often approached with critique or even disdain – both within and outside EDM environments. From this perspective, it is also striking how little musicological research there is on EDM pop.
With trap and EDM pop almost dominating the pop landscape in the 2010s, it can indeed be heard as a time of upheaval. This is, of course, somewhat of a generalization that partially leaves out, for instance, rock and R&B. However, as I will argue throughout this dissertation, trap and EDM pop are frontrunners in a shift in pop music production. While other styles within pop might not fit this perspective, they are arguably also subject to the new production practices that stem from the logic, sensibility, aesthetics and not least the technologies of hip-hop and EDM.

Music production theory

In popular music studies, music production research saw a couple of influential publications in the 1990s and early 2000s (Gracyk, 1996; Lacasse, 2000; Moylan, 1992; Théberge, 1997; Zak III, 2001). During the 2000s and 2010s the field began to form with the yearly Art of Record Production conferences (since 2005) its journal (since 2007) and a number of monographs as well as anthologies (Bayley, 2010; Brovig-Hanssen & Danielsen, 2016; Burgess, 2013; Cook, Clarke, Leech-Wilkinson, & Rink, 2009; Frith & Zagorski-Thomas, 2012; Moorefield, 2005; Strachan, 2017; Walther-Hansen, 2020; Warner, 2003; Zagorski-Thomas, 2014). However, this work is mainly based on the perspective of the physical studio and the practices of recording sound.

The production practices of hip-hop have almost exclusively been researched from a hardware-based perspective (Chang, 2006; Katz, 2012; Krims, 2000; Rose, 1994; Schloss, 2004; Williams, 2013). Similarly, the practices of EDM and DJing have been covered in a long line of important work, yet it is also mainly based on the perspective of clubs and the dance floor (Brewster & Broughton, 2000; Butler, 2006, 2012, 2014; Garcia, 2005, 2013, 2015; Hove, Martinez, & Stupacher, 2019; Lawrence, 2003; Poschardt, 1998; Reynolds, 1998; Rietveld, 1998, 2013, 2018; Sicko & Brewster, 2010; Thornton, 1995). More recent research into various types of electronic music, including laptop performance, does engage with digital practices and programming. However, it often does so from either live-electronics perspectives (through various forms of computational interactive compositions) or more recently by focusing on code-based programs (for example ChucK, Max or SuperCollider) (Chadabe, 1984; Collins, 2003; Demers, 2010; Kimura, 2003; McLean & Dean, 2018; Wanderley & Orio, 2002; Wang & Cook,
In other words, the work that is studied in terms of its digitality generally differs somewhat substantially from popular music in practices and aesthetics.

Yet pop music that was previously recorded in analog studios is now increasingly produced using practices developed in hip-hop and EDM, and is made on software that not only makes programming accessible but adds a digital logic to music production. For music production theory, this raises some challenges, because the shift also entails a move from the recording and treatment of live practices to programming. Physically, the closed environment of the recording studio and its analog hardware logic is supplemented or replaced by the logic of software.

It is hardly coincidental that the changes in pop music coincide with the almost explosive popularity of two new DAWs, namely FL Studio (formerly FruityLoops) and Ableton’s Live. Since the beginning of the 2000s, they have taken the logic and practices of sequencing and looping to the digital realm which has bridged, mutually vitalized and changed hip-hop, EDM and digital music production. The DAW has gone from a digital organizer, where software and hardware meet in recording, arranging and treating sound, to a stand-alone app that works across laptops, mobile phones and clouded-based networks. This has spawned new and different kinds of music production, as well as producers who are supplementing or directly overtaking pop music with different approaches, practices and aesthetics. In recent years, there has been an increased interest in the practices of new musical software including the DAW (e.g. Bell, Hein, & Ratcliffe, 2015; Bell, 2015, 2018; Bennett, 2018; Marrington, 2011, 2016, 2017, 2019; Möllenkamp, 2019, 2014, 2017). However, FL Studio and Live are often only mentioned briefly or are entirely absent in published musicological research.

Fundamentally, it seems as if the shift that I am describing entails some fairly specific production practices, but in a very different context. The implications, however, seem quite important. For one, a programming paradigm at the expense of a recorded performance paradigm involves two very different types of mediatization. One is based on utilizing hardware and treating recorded sound. The other is based on control of metadata and cloud-based databases. One rests upon a medial transformation, whereas the other entails the media itself as an environment; this is again part of networked computational culture. One is based on human agency, and the other substantially utilizes distributed agency that includes digital automation to a degree where loops and, more generally, processes form interrelational algorithmic structures.

In other words, the digitalization of pop music production has substantial consequences for some of its most fundamental parameters. From inception to dissemination to reception, pop
is increasingly defined by an innately digital logic. Its compositional practices are not isolated, but partake in a networked ecology. Music production begins to resemble a new media structure.

**New media studies**

New media studies, or what is sometimes also called “digital studies” or “digital culture” (Manovich, 2001, p. 36) is a heterogenous field. However, it profits from a high level of interdisciplinarity where researchers from a multitude of backgrounds – including computer science, social sciences, the humanities, culture and the arts – research aspects of how media determine contemporary society. This entails an approach to media in which they are not dismissible, “neutral or transparent, subordinate or merely supplemental to the information they convey.” (Mitchell & Hansen, 2010a, p. vii). While the focus is on how new media affect our social life, perspectives from a variety of societal, philosophical and aesthetic positions are approached as mutually constitutive. In other words, the substantial societal changes spurred by new media fundamentally alters how we perceive and conceive of things after the so-called computational revolution. This entails device-agnostic, interface-controlled, networked, pervasive use of computing – or what is often just referred to as ubiquitous computing (ubicomp) culture (see e.g. Beigl, 2005; Ekman, 2013; Greenfield, 2006; Weiser & Brown, 1997). This has spawned more – albeit interconnected – specific focusses such as network studies (e.g. Galloway & Thacker, 2007; Mackenzie, 2010; van Dijck, 2013), interface studies (Galloway, 2012; Manovich, 2001) and algorithm studies (Bucher, 2018; Parisi, 2013), and has spurred or reinvigorated discussions on, for example, posthumanism (e.g. Braidotti, 2013; Hayles, 1999), media archaeology (e.g. Ernst, 2013, 2016; Huhtamo & Parikka, 2011), and ontological perspectives on the digital (e.g. Hansen, 2004; Hui, 2016).

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The study of new media entails a rethinking of some of philosophy’s disciplines. This includes the actualization of some philosophical directions and the critique of what is lacking in others. Generally, the shift from the idea of human agency to distributive agency involves a renewed interest in the ontology of materiality, connecting new media studies with various new materialisms. These philosophical underpinnings are indebted to a broad but interconnected line of relational thought. This includes actor-network theory (Latour, 2005; Law, 1999; Michael, 2017; Mol, 2010) and the process philosophy of not only Gilles Deleuze and Felix Guattari (Deleuze, 2001; Deleuze & Guattari, 2001), but also Henri Bergson (1911, 2004, 2007) and not least Alfred North Whitehead (1978). A common theme is that digital media shape the way time and space are constituted and fundamentally condition our perception of them (Hansen, 2013, 2015; Lury, Parisi, & Terranova, 2012; Mitchell & Hansen, 2010b; Parisi, 2019).

Keeping beat-oriented, almost solely programmed pop music in mind, renewed perspectives on time and space do indeed seem appropriate. Questions of musical time and temporality include some of the most fundamental characteristics of music such as rhythm and structure. Similarly, space in recorded music has been the subject of substantial interest in music production theory.

Within digital humanities, various types of digital methodologies have been utilized in a broad spectrum of musicology. For example, music information retrieval (MIR) allows for analyses of musical characteristics across big data. Furthermore, the recent musicological proliferation of methodologies from cognitive psychology and neuroscience often utilize different forms of computational data treatment to research, for example, either cerebral or corporeal activity in relation to musical stimuli. Aspects of mediation, posthumanism and digitality have also been discussed consistently in musicology, and new media research (or related) has occasionally approached music or sound, albeit somewhat sporadically (e.g. Ernst, 2019).

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5 Process philosophy can be interpreted as originating with Heraclitus and his view of the world's changeable flux which is encapsulated in his famous quote, “one cannot step twice into the same river” (Rescher, 1996, p. 9). Other exponents include Gottfried Wilhelm Leibniz, Charles Sanders Peirce and William James. Process philosophy represents a departure from an Aristotellean bias in favor of “things or objects”. Instead, process has primacy over things. Objects are constellations of processes, and this ontological shift also entails a fundamental de-hierarchization of subjects and objects (see e.g. Rescher, 1996, 2000 for introductions to process philosophy).
2010, 2011; Massumi, 2002). Additionally, process philosophy (of mainly a Deleuzean variety) has informed a long line of musicological work.\(^6\)

However, the more recent perspectives from new media studies – including analyses of ubicomp culture – are more or less absent from popular music research. At the time of writing this, there seems to no published systematic new media approaches to twenty-first century popular music.

**Research design and methodology**

**Research questions**

To reiterate my main points up till now: there is surprisingly little musicological research that deals with the transferal of compositional practices from hip-hop and EDM to the digital logic of newer DAWs, and even less that does this in a pop or mainstream setting. Therefore, given the processual nature of hip-hop, EDM and digital culture, new media research and its utilization of process philosophy should offer new insights to recent developments in the production of pop, particularly in relation to time and space.

My research questions are therefore as follows:

- In pop production, how have the practices of hip-hop and EDM informed practices in newer DAWs such as FL Studio and Live, and how do new media practices inform this adaptation?
- What are the temporal consequences of this adaptation in relation to the interpretation of repetition, groove, form and time?
- What are the consequences of the shift to digital processes for the interpretation of sonic space and materiality?

\(^6\) The perhaps most consistent example is Christopher Hasty’s (1997) influential work on meter and rhythm that relies solidly on Whitehead as well as Bergson and Deleuze. Here, processual focus on becoming informs his account of the continuity of temporal objects, such as melodies, in “tonal classical music.”
**Tentative challenges and roads not taken**

The actuality, cross-disciplinarity and scope of the topic presents some challenges. Contemporary pop music is a heterogeneous entity that can represent many different things to different people. Additionally, its evolving character encourages an impetus to keep the perspective as actualized, recent and close to contemporary music culture as possible. This means that it is also, so to speak, a moving target that is constantly changing. Analyzing it entails a risk of privileging entities that might swiftly become banal or obsolete while missing other essentials. This also presupposes a certain level of subjectivity. Had this been carried out by someone else or at a slightly different time, the focus, perspectives and music in question would be different. Additionally, there is a lack of theory on many of the aspects covered – for example the practices of the DAWs (particularly FL Studio) that I seek to describe. I will therefore include non-academic sources such as journalism, YouTube-videos and online forums.

Furthermore, the introduction of new media studies to digital music production theory is, as mentioned, a fairly new endeavor that could mutually benefit both disciplines. Yet this is beyond the scope of this dissertation. The subject is contemporary pop music production, and it is this field to which I seek to contribute. As this dissertation is defined by advances in technology, technology-essentialism is lurking in the background. New media studies and technology-research in general can potentially fall into narratives of linear periodic historicity, which can be interpreted as (Western) neoliberal (Andersen and Pold, 2015) or overtly modernist (Ernst, 2018, p. 178). (This is particularly paradoxical since part of my argument is how pop music challenges orderly principles of temporal succession.) I do argue that “something is new” (technology-driven even), but it is not a question of pure replacement. Media are produced in accordance with human action and their significance varies between groups and parts of society (Jansson, 2015). Instead of media-specificity, I aim to elucidate the specificity of use of different media in multi-level transformative processes and the mutual dynamics between media and practice (Hepp, 2013). The digital pop music production that I focus on is part of plural, parallel and complimentary practices that do not necessarily fit into any strict linearities. It is within this give-and-take of the previous and the new that the digital in music production is emerging.

Given the cultural history and ancestry of the music I am investigating and the processual nature of the aforementioned particular temporalities and spatialities of digital
culture, Afrodiasporic perspectives seem to meet new media studies precisely in digital pop music. The particular relationships between Afrodiasporic culture and technology has a certain place in music as well as in music theory (Weheliye, 2012, 2014, 2017), and algorithm theory in particular can potentially articulate interesting intersections with Afrodiasporic culture. Additionally, music, including popular music, empirically exemplifies and exposes these intersections very well. However, a Black studies perspective to new media studies — or vice versa — requires a sustained endeavor, so it will only briefly be discussed in relation to temporality in this dissertation.

**Production, work, analysis, practice**

The distinction and relationship between the poietic (production), the work and the esthetic (experience) is a fundamental part of popular music theory and not least music production theory (Brackett, 2000, pp. 9–17; Zagorski-Thomas, 2014, pp. 2–4, 2018, pp. 117–118). However, the

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7 While resistance to any essentialisms of the “Afrodiasporic”, “African-American” or “Blackness” is more than justified, Paul Gilroy (1995) and Gayatri Spivak (2006) respectively argue for an anti-anti-essentialism and strategic essentialism. Spivak posits that while essentialism is problematic, there is sometimes a need for a term to refer to the strategy that nationalities, ethnic groups, or minority groups can use to present themselves. Genres and music cultures that are commonly considered Afrodiasporic – for instance, blues, jazz or hip-hop – do share fundamental characteristics that present particular renditions of, for example, repetition, time, teleology and signification.

8 I mainly call the practice that I am describing “production” rather than “composition.” To produce music is part of a compositional practice. I use the terms “produce” and “production practices” in relation to what is, in most cases, the basis of most pop tracks, which is the beat not understood solely as a rhythm, but more as the fundamental idea that shapes the song (Seabrook, 2015). As I will discuss throughout this dissertation, the role and content of the beat is something that has shifted due to various changes partially spurred by cloud-based production. So have the roles and the amount of people involved in composing pop music. On one hand, Tin Pan Alley or Motown-like production teams (from top-liners that make the melodies and hooks to specialized beat-makers to vocal producers to lyricists to one or several producers overseeing everything) complement each other more efficiently than ever in networked music production. On the other, the producer in the digital is more self-sufficient, has everything at hand, and elements such as performance (including vocals) become supplementary to the production (see, e.g., Future Music’s YouTube-video from 2012 with Avicii who almost casually drag-and-drops vocals and samples into his FL Studio project).
nature of the music at hand sets up some particular relationships between these distinctions. Building on Georgina Born (2005) and what she calls the provisional work, Mark Butler (2014) discusses the ontology of DJ and laptop performance: “The ontological extravagance of DJ and laptop performances reveals, ultimately, that the essence of this improvised music is not a matter of whether it is a process or a product, but rather how its mutually implicated capacities as both process and product coexist and interact” (2014, p. 64). The centralization of the particular and somewhat ambiguous relationship between improvisation and work, process and product is not less interesting when transferred to a pop format, and this relationship between processual ephemerality and the static is a discussion that will inform the dissertation throughout.

This leads me to the musical analyses. The six tracks that are discussed in the two last articles have been chosen to confirm, but also to expose irregularities in the theories and my argument. They are all from the 2015-2019, as I have tried to keep the perspective as recent as possible. Furthermore, I have chosen tracks that represent different practices, or practices utilized in different ways. To some extent, these can be heard as representative of contemporary pop music at the time of writing. They therefore exemplify some of the genre-offsprings mentioned earlier – trap and EDM pop – while others represent more traditional pop sensibilities yet still include practices that can be interpreted as related to hip-hop or EDM.

The main challenge for these auditive analyses is disentangling the processes of the productions. As the extrication of production methods utilized are often heavily interrelated and generally demand substantial experience with digital music production, definitive claims are difficult to make. But, as will argue throughout the dissertation, it is through infinitesimal details and mutually affecting processes that aesthetical value is created, highlighting how new analytical methods are needed in popular music analysis. Mark Butler (2014) also discusses the challenges of analyzing improvised music. He sees two analytical orientations: one focusses on the decisions made and the processes involved from the perspective of the performer-creator, and the other concentrates on the sounds, considering the results of the improvisation from the perspective of the listener (2014, p. 205). The level of intricate, interrelational processes that constitute some of the tracks I am analyzing almost automatically affords an analytical perspective akin to the latter in Butler’s orientations. However, a reoccurring point is exactly that – that the origin and general identification of sounds is evasive or subject to complicated processes. This means the perspective shifts from focusing on individual sound sources to their ongoing processual negotiations, their particular interrelations and what these processes signify.
Practice theory entails a focus not only on media themselves, but on the practices associated with them (Schroeder, 2015; Shove, 2007). To that end, my approach can be seen as practice-based. On practice-based research, Candy and Edmonds write: “In the creative arts, including new media arts, the emphasis is on creative process and the works that are generated: Here, the artifact plays a vital part in the new understandings about practice that arise” (2018, p. 63). My focus is on the novel practices of pop production, and due to the increasingly networked character of these practices, it would be missing the point only to look at media singularly. Instead, a key point is that music production takes part in a broader spectrum of practices that relate and connect to ubicomp. Yet there is a difference between practice-based and practice-led research. Since my contribution is not a creative artifact, but new understandings about practice, it is more practice-led. The dissertation is essentially based on several recontextualizations that heuristically work to inform my objective, pop music production. I explore practices from both hip-hop and EDM as well as new media studies to inform a perspective, a terminology, or, more fundamentally, an approach. I apply these to my musical analyses that again inform my practice-led extrapolation and interpretation of pop music practices. However, philosophical considerations are an innate part of new media research, and process philosophical perspectives inform my discussion on the practices throughout.

The articles and the structure of the dissertation
A key tenet in this dissertation is Kittler’s famous notion of how media determine our situation (Medien bestimmen unsere Lage, Kittler, 1986, p. 3). The same goes for the structure of this dissertation. I have chosen the media – or perhaps rather format – of an article-based dissertation. This is still a fairly new format in the humanities and particularly in the institution that this is written from, The Department of Arts and Cultural Studies at University of Copenhagen. The time frame is three years employment including the equivalent of six months teaching and six months of courses, conferences and seminars. This leaves two years’ work for the dissertation itself. This is also why I carry no illusions of thinking that this dissertation can constitute anything more than a tentative new take on the digitalization of contemporary pop music production. My approach is partially heuristic. I am following a trajectory that in many ways raises more questions than it provides answers. Rather than attempt any exhaustive conclusions, I seek to offer new perspectives, albeit on some of the most fundamental issues of not only pop
music, but music in general. This is also the first reason why I have chosen the article format. The three articles essentially engage with each of the three research questions. This format allows me to follow particular perspectives within the framework of an academic article. They are trajectories within a trajectory.

An article-based dissertation is a fairly free format that mainly entails an introduction, the articles and a conclusion. In some places I have felt a need to set up some of the theory before the articles, and at other places I have felt the article needed further discussion. I call the parts leading up to an article an “Intro” and further discussions are labelled “Outro”. Accordingly, apart from this introduction and a concluding chapter, this dissertation consists of three main chapters built around the articles, and these are simply called “The DAW,” “Time” and “Space.”

The first chapter’s Intro briefly sets up some of the issues in music production theory that I engage with in the article. The article is called “Who let the DAWs out? The Digital in a New Generation of the Digital Audio Workstation” and it introduces what I call the recording studio paradigm of music production theory. I am fairly critical towards the hegemony of this recording studio logic, and move on to discuss the practices of FL Studio and Live. After that, I explore their relationship to network culture and cloud-based production. The article concludes that this 2.0-version of the DAW is based on an intrinsically loop-based logic where sprint-like compositions connect with network culture. This causes a de-hierarchization of the relationship between (recorded) data and metadata, in which functions are mutually constitutive in a processual macro-synthesis.

The second chapter, “Time”, further develops my processual approach to pop music production. This engages with a long line of different theory within and outside popular musicology. In the Intro, I therefore introduce some of the main theoretical and philosophical threads that my second article, “Pop as Process: The Digitalization of Groove, Form and Time”, engages with. The article argues that the digitalization of pop production represents particular and novel temporalities, and these are examined in three analysis of three recent pop tracks, namely “Scared to be Lonely” by Martin Garrix and Dua Lipa, “rockstar” by Post Malone and “Chained to the Rhythm” by Katy Perry. I conclude that the tracks’ processual nature suggests that groove is based on the signification of particular technologies, and that the digitalization of pop time suggests new heterogenous temporalities that both reflect and negate ubicomp temporalities. Furthermore, I argue that the processual character of pop manifests on a prereflexive level akin to the tacit knowledge of algorithmic structures. In the chapter’s Outro, I
further discuss some of the philosophical implications of digital culture’s processual character. This includes a critique of overt phenomenological approaches to temporality in ubicomp culture and an exploration of the differences between transhumanism and speculative posthumanism.

The third chapter begins with the article, “Pop Materializing: Layers and Topological Space in Digital Pop Music.” It argues that hip-hop and EDM-approaches to layering textures represent a departure from traditional notions of interpreting space according to sound-sourcing and “natural”, semantic images. Instead, signal processing such as compression and frequency filtering mutually connect and arguably constitute the main space makers in pop production. This is examined on three musical analyses: The Weeknd’s “The Hills, Katy Perry’s “Hey Hey Hey” and Billie Eilish’s “bury a friend”. I argue that pop spatiality can be heard as a mediatized massification that essentially can be interpreted as a topological space that challenges traditional notions of proximity, sound source individuality, hierarchies and fidelity. In the chapter’s Outro, I further discuss timbral perspectives to this mediatization of space and its consequences for pop music’s sonic materiality.9

The last chapter contains my conclusion and perspectives for further research. I conclude that the practices of hip-hop, EDM and new media theory offer new perspectives to music production theory and more generally to the understanding and appreciation of contemporary pop music. These new perspectives offer insight into some of the most essential and constitutive parts of music and music theory – time and space. As such, the dissertation offers new directions for not only music production theory or popular music, but musicology in general. Further, I discuss streaming culture (“the other side” of music’s digitalization) and how that can be understood in light of some of the perspectives in the dissertation, including prereflexive listening modes and various degrees of embodied listening.

Overlapping information in this article format is difficult to avoid, yet the articles do represent a progression in my argument. From the shift in DAWs’ practices discussed in the first

9 The three articles have not been submitted yet but written for particular journals and therefore abide to different US or UK spelling and formats. “Who Let the DAWs Out? The Digital in a New Generation of the Digital Audio Workstation” is written for Popular Music and Society (US). “Pop as Process: The Digitalization of Groove, Form and Time” is intended for Popular Music (UK), and “Pop Materializing: Layers and Topological Space in Digital Pop Music” is for Organised Sound (UK). They will all be submitted medio November 2020.
chapter to the process-paradigm discussed in the second chapter to the resultant sonic materiality discussed in the third chapter, the articles connect and interrelate.
Chapter One: The DAW

Intro

The DAW

Robert Strachan (2017) suggests three epochs of the digitalization of music technology: the exploratory, the expansive and the convergent. The first mainly took place from the 1950s to the 1970s in institutions such as Bell Laboratories, publicly funded research facilities or major universities. The expansive period “took place from the early 1980s to the mid-1990s and was characterized by a rapid digitization of analogue instrumentation and studio technology” (Strachan, 2017, p. 4). Strachan’s third and last period, the convergent, began in the mid-1990s and is defined by the “the coming of age of the computer-based digital audio workstations (DAWs)” (Ibid., p. 7).

Definitions of DAWs vary in focus and level of detail. Strachan writes that DAWs are “all-in-one applications installed on computers, which provide a visual interface and collection of functions whereby recording, sound generation, editing and mixing are able to be undertaken within a singular virtual environment” (Ibid., p. 7-8). Brøvig-Hanssen and Danielsen call it “a software recording workstation running on computers with the possibility of audio and MIDI interface hardware” (Brøvig-Hanssen & Danielsen, 2016, p. 2). Joe Bennett offers slightly more detail:

The DAW in its current form (as of 2018) can be defined as a computer software application that enables the user to record and store musical gestures or audio, and then manipulate these stored elements to achieve the desired sound. DAWs are multitimbral (many sounds at once) and feature virtual instruments and effects that enable the synthesis of electronic sounds, sample playback of prestored sounds, and the processing of audio playback in real time. The most common layout of a DAW screen display is in a two-dimensional grid, the horizontal axis representing time,
scrolling from left to right during record or playback, and the vertical axis representing individual sounds—audio or instrument “tracks.” (Bennett, 2018, n.p.)

While he includes synthesis, “sample playback” and “processing of audio playback in real time”, his definition (which is based on ProTools and Logic) and the others seem to miss some of the fundamental new characteristics of more recent DAWs such as FL Studio and Live. These include a focus on intricate sequencing, the intersection of loops and a fundamental privileging of signal processing as the perhaps main compositional parameter across recording, sampling, sequencing and synthesis.

Jay Hodgson focusses on lateral dynamics processing, including techniques such side-chain pumping, ducking and envelope following in experimental hip-hop. But generally, even outside hip-hop, these techniques are as common “as ‘tapping’ and ‘power chords’ once were in heavy metal” (Hodgson, 2011, n.p.). Hodgson also airs a fairly harsh critique of popular music studies’ lack of research in signal processing:

The present paucity of research on specific signal processing techniques signals the field’s institutional basis much more than its nascent state, in my opinion. Insightful and challenging studies of signal processing have indeed emerged in the last two decades, but these studies usually address the analytic priorities and concerns of disciplines that remain completely uninterested in musical technique per se, like cultural studies,

10 The prevalence of various DAWs is difficult to measure. MusicRadar.com, a website for musicians and music equipment, did a poll among their users in 2018 asking them to “pick the best DAW in the world right now” (MusicRadar, 2018). The survey’s users – a number “in the thousands” – voted FL Studio the best and Live second best. The online education website for Apple-users, macprovideo.com, conducted similar surveys in 2015 and 2017, in which they asked what their users’ preferred DAW was (Sethi, 2015, 2017). In both surveys, Live came in as the primary DAW among 25,000 and 30,600 votes respectively. However, a website for Apple users will be prone to DAWs such as Live that have a history of working best on Apple computers. Online-polls, surveys and their problems aside, there seems to be a general discursive perception of Live and FL Studio increasingly becoming the most popular DAWs for composers across genres and levels of success, from electronic subgenres to the top 40 mainstream. For instance, in a 2015 interview, electronic composer Hudson Mohawke stated: “If you were to look at the actual top ten Billboard songs, I guarantee eight of them were probably made on FruityLoops” (Red Bull Music Academy, 2015).
sociology, media studies, cultural anthropology and political-economics. If it is
mentioned at all in these studies, signal processing usually only registers as a site for
social, cultural and industrial struggle; only a select few researchers offer much in the
way of musical and technical details about the process. Not surprisingly, then, signal
processing has failed to register as a fundamentally musical concern in the vast majority
of published research on popular music practice. (Hodgson, 2011)

Without rehashing any (old) debates for or against so-called “new musicology” and cultural or
practical “turns”, it does seem that popular music research, including music production research,
has been sleeping on a development that has been ongoing for a couple of decades. This
development includes the partial centralization of signal processing in newer DAWs. However,
as this development and these DAWs abide by and connect to the heterogenous logics of
ubicomp, it would also be mistaken not to include cultural perspectives. As such, this is one of
the things I seek to do in this first article on the practices of the new generation of DAWs: to
begin an academic study of how the complexities of working with or inside the DAW connect
with and resemble the digital life outside the DAW.

A tenet in software culture is the departure from “‘documents,’ ‘works’, ‘messages’ or
‘recordings’” (Manovich, 2013, p. 33). Fixed inscription is replaced by signal flow and
“algorithmic data migration” (Ernst, 2016b, p. 100), as “new media is characterized and defined
by a material fluidity where fully manipulable, digital data is not anchored to a specific material
support” (Hansen, 2004, p. 31). In fact, it represents a de-hierarchization and an undoing of
distinctions between recorded data and the algorithms that control them as they are treated as a
single environment (Gillespie, 2014, p. 169). This challenges the recording perspective as it is
formulated by, for example, Simon Zagorski-Thomas (2014), who argues how the block
diagram-visualization “would seem to encourage the user to think in terms of sound as an object
rather than a stream” (2014: 134). This atomization, he writes, encourages scrutiny and
technological perfection at the expense of aesthetic considerations (Zagorski-Thomas, 2014, p.
135). Similarly, Strachan writes on visual representation of waveforms and MIDI-information:
“Sound as frozen in time leads to a conceptualization of musical material into distinct,
temporally located blocks of musical information rather than unfolding in terms of melody and
In fact, the art of composing not only becomes “live” in the ongoing signal processing of loops, but the ongoing scrutiny turns into its art.11 As Mike D’Errico (2016) argues, it is a culture where we interact with “software performances” – or, in the case of music production, where the “ongoing, iterative cycle of production and reproduction prioritizes the performative aspects of sound manipulation rather than the inscriptive aspects of sound recording” (D’Errico, 2016, p. 47).

This move from a recording logic to the ongoing process of signal flow, of material fluidity in essentially algorithmic functions is the defining factor of what I call the DAW 2.0.

**Networked music production**

Different kinds and levels of networked music production are at stake. One is the directly collaborative as it is also described by Theberge and Nick Prior (2009).12 Songwriters, producers, lyricists, performers etc. can connect and collaborate globally across time and space. A second is the commodification of musical material in the cloud-based sharing and sale of parts of productions (often beats). A third is the communities. FL Studio and Live foster particular communities made possible by online culture. “Music’s capacity to animate imagined communities” (Born, 2011, p. 381) intersect with “postsocial environments” (Cetina, 2001). José van Dijck (2015) discusses how new media connect and unify users across geography, blurring boundaries between the social, the community and the individual. He suggests that we should replace the term “social media” with “connective media”, because “the culture of connectivity” is multi-layered – not just connectivity between humans but “automated connectivity through platforms” (2015, p. 1). Indeed, communities and the social are defined by a hybridization of people and the networks that connect them (Bucher, 2018, p. 50). They are social hybrids that are destabilised and intersect across each other. For example, the abstract community of FL

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11 The turn from the recording as the essential building block is arguably perfectly exemplified by what has been built into Live since its 9th version, namely the swift conversion of audio into MIDI-information.

12 Examples of this can be found in The New York Times’ documentation of the intricate networked collective work processes of Justin Bieber’s “Where Have Ü Been” (Jensen, Roberts, Desantis, & Parshina-Kottas, 2015) and “The Middle” by Zedd, Maren Morris and Grey (Coscarelli, 2018).
Studio users intersects with other communities, such as the community of SoundCloud users, which has been central in the recent resurgence of trap hip-hop.

As such, the web in networked music serves as more than just a transmission medium. Instead, it is, as Brian Kane (2007) argues, a “unique opportunity to create artworks that investigate the implications of the network’s affordances for shaping new artistic practices” (Kane, 2007, n.p.).

With this dual perspective of both human-computer interaction (HCI) and networked communities, I will resume with the first article.
Article 1: Who let the DAWs Out? The Digital in a New Generation of the Digital Audio Workstation

Abstract:

*Pop music is increasingly assimilating the compositional practices of hip-hop and EDM (electronic danse music). This shift is driven by a new generation of Digital Audio Workstations (DAWs) such as FL Studio and Ableton’s Live. The new DAWs are less based on a traditional recording studio logic and more a combination of electronic music’s focus on loops and the networked logic of contemporary computational culture. In other words, the signal processing and programming of sequences and sampled loops engage with cloud-based music production in novel ways. Via new media theory, this article discusses how the practices of hip-hop and EDM are becoming digital in the DAW, and what it means for pop music production. I consequently argue that the new DAWs entail fundamentally new practices in pop production that can better be understood as a control of metadata that define interrelational running processes.*

Keywords: Music production; pop; DAW; ubicomp

Introduction

The 20-year-old producer and college student Tank God is sitting in a recording studio explaining the creative process behind one of his tracks. Working in FL Studio 11 on a laptop with stickers on it, he explains how the drum-programming, compression, pitch-shifting, EQ, melodies, and vocals came together. Like most of the videos on YouTube where producers explain and demonstrate how they created a hit track, this one also takes place in a recording studio. But Tank God is not really using it. In fact, he has put a wood plate on top of the recording studio’s mixing desk – to hold his laptop. The track Tank God is demonstrating is
2017’s “rockstar” by Post Malone. The trap hip-hop-infused song went on to break Apple Music’s first week streaming record, became the 3\textsuperscript{rd} most-streamed track ever on Spotify, and made Post Malone the biggest new male popstar of the second half of the 2010s (Sanneh, 2020).

Pop music and its production practices have indeed changed. DAWs (digital audio workstations) like FL Studio and Ableton’s Live are increasingly based on practices stemming from electronic music production and a logic of looping, sampling, and synthesizing rather than recording audio. These practices are increasingly dominating mainstream music. The genres that have arguably had the biggest impact on recent pop music – trap and EDM pop – are molded mainly in either FL Studio or Live (Brett, 2019; D’Errico, 2016; Fintoni, 2015; Jackson, 2015; Weiss, 2016).

The consequences of the digitization of popular music production has been researched in a broad range of musicological research (Bayley, 2010; Brøvig-Hanssen & Danielsen, 2016; Burgess, 2013; Cook et al., 2009; Moorefield, 2005; Prior, 2018; Strachan, 2017; Théberge, 1997; Toynbee, 2000; Walther-Hansen, 2020; Warner, 2003; Zagorski-Thomas, 2014). However, these tend to prioritize the perspective of the physical recording studio. Research on the practices of hip-hop and EDM (electronic dance music) rarely engages the consequences of their assimilation into pop. The methodologies are often either historical or ethnographical, exploring the subcultural practices of DJ cultures (Brewster & Broughton, 2000; M. J. Butler, 2006, 2014; Lawrence, 2003; Poschardt, 1998; Reynolds, 1998; Rietveld, 1998; Sicko & Brewster, 2010; Thornton, 1995) or hip-hop’s cultural roots (Chang, 2006; Katz, 2012; Krim, 2000; Rose, 1994; Schloss, 2004; Williams, 2013).

However, the formation of this second generation of DAWs coincides with the rise of ubicomp (ubiquitous computing) culture (Beigl, 2005; Ekman, 2013; Greenfield, 2006; Weiser & Brown, 1997). Device-agnostic, interface-controlled, networked, and pervasive computing increasingly defines the DAWs that work across and between the interfaces of laptops, tablets, and smartphones – and which are cloud-connected to endless libraries and services that initiate, support, and distribute music. In other words, pop music has assimilated new genres with different technological rationalities, and these changes entail novel ways of producing pop music that are innately digital.

Conceptualizing media is contextual and involves plural, parallel, and complimentary histories and practices. It is not a matter of one rationality replacing another, but of the emergence of new rationalities that affect and are affected by the previous rationalities. However, instead of understanding digital music production as a remediation of analog recording
studio practices, this article will discuss how changes in compositional practices can be understood as a new media logic in music production. I will argue that changes sparked by the use of newer DAWs characterize a fundamental shift towards a logic of controlling interrelational processes. Essentially algorithmic in nature, the sequencer and loop paradigms are connected to network culture and represent a new type of compositional practice based on controlling processual macro-synthesis of metadata rather than working with individual recorded sound sources.

I start by discussing and critiquing musicological approaches to the digitalization of music production. I argue that the consequences of newer DAWs’ practices have been overlooked due to an analog recording studio perspective that clings to music production theory. Instead, I turn to the sequencer logic and loop practices of FL Studio and Live. I argue that they represent a shift from sound material’s embedded value and meaning to a processual negotiation controlled by metadata. Next, I turn to an analysis of how the new DAWs integrally connect to network culture. I discuss how this has created a faster, game-like trial-and-error compositional practice that is also supported by new cloud-based services that offer loops, presets, and production services. Counter to arguments about standardization, I argue that this essentially puts the emphasis on how processes interconnect, shifting complexity from individual characteristics to the unfolding multiplicity of interrelational processes. In conclusion, I sum up how what I call the DAW 2.0 relates to and differs from the traditional recording paradigm.

The Recording Studio Paradigm

The first iterations of DAWs were released in the late 1980s and early 1990s. In 1989, Digidesign (now Avid Audio) and Steinberg released the first versions of Pro Tools and Cubase, respectively, and an early version of Logic Pro was released in 1993.13 Throughout the 1990s, Pro Tools became the industry leader; their setup combined hardware and software in complete packages. In 1991, that hybrid cost nearly $6,000 (Future Music, 2011) which was a considerable price tag and commitment for most recording studios. However, the combination of

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13 For clarity, I am not including a long line of other programs, e.g., PreSonus’ Studio One, Cockos’ Reaper, Renoise and Reason Studio’s (formerly Propellerhead) Reason.
software bundled with hardware offered the opportunity to transition to digital with high sound quality and stability in an environment and logic not too far from the analog.

DAWs initially worked mainly as supplements to the tape-based recording studio, but Pro Tools and its competitors eventually overtook the functions and thereby also the metaphors and infrastructure of the studio. With knobs and faders as symbolic handles, the mixer, the channel strip, the effects rack, and the playback panel (with the analog tape recorder functions of play, stop, fast-forward, rewind, and record) were all visualized in the interface. DAWs also included MIDI (Musical Instrument Digital Interface), a music industry standard protocol introduced in 1983 that allows digital instruments such as drum machines, synthesizers, sequencers, and controllers to communicate and synchronize. In the DAWs’ interface, the ability to both program and record MIDI’s metadata became a lot easier. It offered new ways of editing, because performance information could be corrected after the performance and before it was applied to sampled or synthesized sound. The opportunity to sequence data parameters such as timing, duration, velocity, and pitch-bend in the gridded piano roll broke down barriers between performance, notation, and programming.

However, the logic of the recording studio in the DAWs’ interface was still often defined by a high level of skeuomorphism, as previous hardware-based machines’ layouts and controls were visualized in the interface (for more on the skeuomorphism in music production software, see e.g. Bell, Hein and Ratcliffe, 2015; Marrington, 2016; Lagomarsino, 2017). From this perspective, early DAWs can be interpreted as remediators (Bolter & Grusin, 2000), as they mainly refashioned the logic of prior media forms onto new media.

The conclusion correspondingly follows that the emergence of musical software is primarily a matter of representation, where music software mostly functions as interface-control of the hardware. Accordingly, “so-called digital media technology in the field of music production is better understood as an analog rather than as a digital revolution” (Kvifte, 2007, p. 105). Paul Théberge begins his 2015-essay on music’s digitalization with a likeminded statement: “The digitalization of music is not a ‘revolution’” (2015: 329). Yet, somewhat contradictorily, the essay’s last sentence explicates that digitization is “a phenomenon that permeates virtually every aspect of how we think about, make and experience music in contemporary culture” (2015: 337). Similarly, Brøvig-Hanssen and Danielsen write in the introduction to their 2016 book, Digital Signatures: The Impact of Digitization on Popular Music Sound: “Digital technology has actually offered relatively few operations that are entirely new” (2016: 15). Arguably, there seems to be an impetus in music production research to not
only adapt a perspective centered on the analog recording studio, but also to downplay or ignore the consequences of music production’s digitalization.

Discussions concerning (new) media’s revolutionary impact versus its amplification of previous media is far from new (Kittler, 1999). Wendy Chun (2016) fittingly warns against the assumption that everything that has to do with new media is a revolution. Yet, Chun also reminds us that new media matter most when they do not seem to matter at all – when they become habitual, embedded in our lives. A similar argument can be made about the development of the new generation of DAWs. As I will argue, a new production logic is now habitual for a different kind of composer. New practices are emerging, and they suggest substantial aesthetic consequences and potentialities for twenty-first century pop music.

Generally, maintaining a perspective based on the analog or the traditional recording studio when understanding digital pop music production thus seems increasingly problematic. To begin with, a perspective based on the logic of recording studios might miss or apply less value to new creative and aesthetic potentials of digitalization. It might even implicitly privilege particular musical genres. For example, Mark Marrington (2019) writes about how certain DAWs inherently imply particular musical practices that inform the character of the music they are used to create (2019: 55). As an example, he looks at Pro Tools’ appeal to sound engineers whose focus is on recording musical performances, and claims that “the conservatism of its interface basically reflects this” (Marrington, 2019: 56; see also Möllenkamp, 2019, who in his typology of DAWs describes the "studio paradigm" of Pro Tools, Cubase, and Logic that caters mainly to audio engineers and producers). Similarly, the recording studio paradigm applies more to popular music genres that are based on recording multitrack band-based practices, such as rock. However, the convergence of practices between music software and digital culture has

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14 The industry of recording studies is indeed changing and has been for the last couple of decades. “The professional studio business that remains today is what cannot be done at home: live recording and mixing”, the owners of the celebrated and Pro Tools-based Unique Recording Studios told Billboard when they had to shut down in 2004 (Walsh, 2004). But recording studios, big and small, still exist and cater to everything from the amateur indie band to high profile artists (Rogers, 2013; Watson, 2016). However, studios increasingly serve more as a creative space for song writing, programming, and recording vocals. Arguably, this also entails elements of romanticism and nostalgia towards the traditional analog studio and band-based recording sessions. In his doctoral thesis, “The Evolution and Decline of the Traditional Recording Studio”, Philip Ronald Kirby (Kirby, 2015) quotes
created particular emergent features that fundamentally differ from previous rationales. Instead of software defined by hardware, the DAW 2.0 is based on connecting, controlling, and determining data with data, software with more software. It involves relations between almost purely digital functions.

Still, while I am arguing for a distinction between a first and second generation of DAWs, they do adapt and copy functions between each other and share many fundamental characteristics. This “feature creep” (Bessell, 2014: 408) is increased as software allows faster updates in commercial competition. For example, Logic Pro X 10.5 (2020) comes with the added feature Live Loops, a nonlinear organizer of loops very similar to Live’s Session View. Additionally, it is not uncommon for composers and producers to be native users of multiple DAWs to an extent that allows them to switch according to the need at hand. A track might be initiated in one DAW and finished in another. In other words, it could be argued that the differences between the first and second generation of DAWs are becoming increasingly smaller.  

However, the DAW 2.0 is more about new compositional logics across programs. These stem mainly from specific programs (FL Studio and Live) that combine practices from electronic music (hip-hop and EDM) and ubicomp culture.

This change is spurred by the combination of a surge in computational power and falling prices. The need to invest in large computers to run musical software has declined substantially, resulting in laptops increasingly hosting so-called “in-the-box” music production. DAWs have accommodated this development by becoming more all-encompassing, constantly improving their sound quality and operational functionalities. This further decreased the need for added (and expensive) hardware or software. While the notion of the desktop or bedroom

15 This is fittingly exemplified in three seemingly contradictory statements about the prevalence of various DAWs in the 2000s: “In 2007 […] virtually every studio seemed to offer some form of Pro Tools compatibility” (Théberge, 2012, p. 85); “FL Studio became the defining music software of the ‘00s” (Fintoni, 2015, p. 1); and “in the mid-2000s, Live became the dominant software for electronic music producers working across genres” (D’Errico, 2016, p. 23).

16 It could be argued that there recently has been a certain return to hardware. This can be seen in not just the fetishization of vintage analog equipment, but also in the variety of various performance controllers that are made

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music journalist, writer, and ex-record company owner Paul Morley: “There’s an almost sentimental even superstitious attachment to the idea of making the sounds in traditional studio buildings” (Kirby, 2015, p. 324).
producer, or the so-called home-based “project studio,” is far from new, the difference is that DAWs can be run on cheaper laptops that are not necessarily designated music computers.

This shift to the multipurpose laptop is somewhat organologically paradoxical. From one perspective, the DAW-based laptop and its one-object character seemingly fits conventional understandings of a musical instrument better than notions of “playing” the physical recording studio as an instrument (Bell, 2018; Watson, 2017). Yet, from a different perspective, the DAW on a laptop defies boundaries and traditional definitions of what constitutes a musical instrument. Instead, it entails a merge between music studio, music software, and music instrument, and browsers, games, social media, streaming, e-mail, and uploads/downloads, etc. Operational practices bleed into each other in an ongoing exchange of information that often includes other devices such as tablets and smartphones. Music production has become part of a media topology that permeates and defies strict separations of local, defined “environments.”

**Processual macro-synthesis**

*The instant expandability of digital sequencing*

Image-Line, a Dutch-Belgian software company, focused mainly on adult games such as Porntris when their first iteration of FruityLoops was released in 1998 (Jackson, 2015). At first, it was a basic 4-channel MIDI drum program for Windows, but in 2003 it toned down its playful fruit-themed interface and changed its name to FL Studio (even though it is often still referred to as FruityLoops by its users). The popularity of FL Studio grew, and it gradually began to replace what had perhaps been hip-hop production’s main instrument since the 1990s, the Akai MPC (a combination of drum machine, sampler, and sequencer in one pad-based playable box). While most other DAWs can perform more or less the same functions as FL Studio, it took the sequencing logic of the MPC and made it accessible for a new and digitally native generation of beatmakers. Sequencing had already been an integral part of electronic music, but in FL Studio specifically to connect and perform with DAWs. Ableton has for example released Ableton Push, where 64 gridded, backlit squared buttons with changing colors connect with Live thereby enhancing the haptic performative elements of the DAW. Yet, here hardware serves mainly as controller of a software logic.
the grids of the interface’s multiple pop-windows made it easy. Here, “all you needed to do was drag together colorful blocks of sound to create compositions” (Jackson, 2015).

Sounds are triggered and controlled by the small, squared, ticked boxes. They are miniature monoliths of metadata that can be used in unlimited ways; one can additively stack the same figure to activate or control samples or synthesis. The sequencing of FL Studio is essentially based on a logic of constantly negotiating an interconnected taxonomy of repeated patterns. Like a Russian doll of loops within loops, a snare-sample is active through ticked boxes on the piano roll, and that group of ticked boxes is then visually represented as a sequence where it is grouped with more boxes that form the arrangement of the song. It is the instant expandability of the digital. Automated multiplicity permeates every step. Actions and edits are duplicated across the arrangement, thereby producing a new kind of direct synchronization between the detail and the whole.

Paradoxically, FL Studio has been pivotal in the birth of two seemingly different electronic music genres in recent popular music: EDM pop and trap. The exchange and teleological shaping of additive patterns was an essential part of the EDM pop that entered the charts around the beginning of the 2010s by FL Studio users such as DJ-producers Martin Garrix and Avicii (EDM pop had been very popular at festivals for almost a decade at that time, see Reynolds, 2012; Matos, 2015; Holt, 2017; Gálvez, 2019). Conversely, the characteristic stuttering hi-hat rolls and circular beats that originated in trap and rose to near-ubiquity in current pop music are the sounds of digital sequencing. The quantized trap-beats are the grid gridding. Another reason for this dual genre-appeal is perhaps that FL Studio’s standard BPM is 140 and not 120 like other DAWs. The faster tempo lends itself to EDM-related genres, whereas the slower tempos of trap are often based on a tempo-activation where the pulse is felt as half the of BPM (Bennett, 2020).

**Processual fitting**

Live, like FL Studio, can do more or less the same as other DAWs, but its loop-based *Session View* offers a fundamentally different function. Its other component, *Arrangement View*, is more or less the same as traditional DAWs, but *Session View* differs in that it essentially eschews the start/stop-operationality of the recording studio. It is instead based on performing directly with running loops by triggering, swapping, manipulating, or interconnecting sound material represented in a grid of colored, modular squares. Anything from short percussive clicks to whole albums can be drag-and-dropped into the real-time flow of the composition.
When Berlin-based Ableton released its first version of Live in 2001, it was originally aimed at more techno-oriented, club-based live practices. However, many composers quickly began to bridge the gap between DJing and producing electronic music, and it grew to become perhaps the most influential and popular DAW of the twenty-first century (D’Errico, 2016; Brett, 2019). It arguably bridges DJ-practices with more code-based programs’ ability to program on-the-fly (Wang & Cook, 2017). While the more patching or code-heavy operations of programs like ChucK (or similar programs like SuperCollider or Max) appeal more to programmers of electronic music, Live is accessible to users without experience in either music or coding.17 Compared to the additive process of recording, loop-based composition quickly establishes a starting point, an initial material to work from, and the subsequent work is a matter of subtracting and adjusting. Additionally, Live has continually added a long line of functions that eases impromptu use. For example, it was the first music software that could beat match audio samples and MIDI sequences into loops, thereby reducing programming to drag-and-drop spontaneous operationality.

In this loop-paradigm, the relationship between object and process has been turned around. It is about the authoring of processes themselves (D’Errico, 2016: 44). Working with loops is less about inscriptive value of musical material represented as static objects in block diagram-visualizations. It is an ongoing adjustment, manipulation, or “re-performance of material” (D’Errico, 2016: 46). For example, making sampled elements groove will often entail tweaking the loop’s so-called “braces” (the beginnings and ends of the loop) while they are running. Producing in Live is therefore based on a constant ongoing adjustment, not just of the choice of the material being looped and its combinations, but in a fundamental fitting of running processes.

This could be interpreted as reducing detail and diminishing the required talent of the producer, but it affords new and different levels of complexity. As digital culture theorist Luciana Parisi argues, “computational nature divides the Parmenidean infinitesimal continuum into finite small details particles, or atoms, within which complexity is contained” (Parisi, 2017b: 80). In other words, the digital affords a new level of detail which can be subject to discrete

17 Live 8 incorporated Max into their Live Suite (Max for Live) in 2009 making not only Max accessible to Live users, but also offering a new level of flexibility to Live.
variations that cause new levels of complexity. This demands new kinds of attention, skill, and talent from the producer. Virtual graphical visualizations of sound waves are still integral, but in process-based production, the representational design is mostly based on connecting sampled loops and sequences, while creating filter sweeps and controlling dynamic compression, etc. The composer’s scrutiny turns to the stream, the event, and less so the object itself. Adjustments are done solely according to the main underlying question: how does it affect the work’s composite ongoing processes? This is a move away from the singular sound as the main component of composition and towards not only the loop, but loops in plural, and how they work together.

**Postrecording**

This is emphasized by the interface’s blurring of distinctions between sound and metadata. Between databases and algorithms, signals are equalized, ignoring the kind of information they represent (Fagerjord & Storsul, 2007, p. 20; Gillespie, 2014, p. 169). From this perspective, music production begins to reflect some fundamental characteristics of computational culture that emphasize the fluidity of manipulable data and the patterning of information rather than material instantiation (Hansen, 2004: 31; Hayles, 1999: 2). Media archaeologist Wolfgang Ernst argues that the focus turns to digital signal processing itself instead of essences, narratives, or documents with inscribed meaning (Ernst, 2012, 2016a, 2018). Audio turns into programmable data regardless of the differences and hegemonies between audio, MIDI, sampling, synthesis, sound, and the metadata that controls it.

Digital music production becomes less about sound objects being transformed and more about transformation itself. This challenges the privileged position of “the recorded take” or “the perfect sample.” The operationality of recording (choosing a recording environment, microphone, setting it up, setting up cables, choosing a microphone amplifier, wiring hardware

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18 As a concrete example of the increasing lack of distinction between matter and code, Bitwig Studio, a DAW released in 2014 by former Ableton employees, offers four track types: Audio, Instrument (MIDI-programmed), Effect, and a Hybrid track. The latter can host both audio and MIDI at the same time, thus making it possible to make programmed information into audio whilst keeping other parts of the same track programmed as MIDI. Additionally, like many other newer DAWs, Bitwig supports touchscreens. Its outline is akin to Live’s, but it is built around a more synthesis-like interface where the touchscreen affords faster and easier connections between modules.
effects, etc.) rests on a notion of a mediatized “source” which implicitly implies an original, a premedial condition. The DAW 2.0 is more based on the processual unfolding of sounds and a mediatization that relinquishes notions of original sources. It is a move away from traditional musical performance and the craftmanship of recording, towards a logic of an interface-environment that on a macro-level begins to resemble an interconnected processual synthesis.

However, it is not just the “pre” in premedial that is punctured. The centralization of interconnected metadata and the opportunity to constantly edit performance information gives rise to a new kind of fluid relationship between production and postproduction. Sound sources exist as negotiable references that are submitted to processual mediatization. Here, human performance is increasingly modified to technology (not vice versa). An example can be heard when singers adapt and copy the distinct vibrato of Auto-Tune. In this way, developments in digital composition exceed the McLuhanistic notion of media adapting to the human (such as prostheses), and are instead examples of the human adapting to media.

The Networked DAW

Digital culture holds a particular disposition for a game-like or lusory sensibility (Dippel & Fizek, 2017; Galloway, 2006; Hjorth, 2011). Similarly, the combination of newer DAWs’ accessibility and their innate embeddedness in networked digital culture encourages a particular game-like or sprint-like compositional practice. In the loop-based workflow of fast creation, subtraction, and adjustment, many beats or instrumental backing tracks can swiftly be made for sharing or selling online. Here, others can supplement or take over (by adding melody, vocals, rap, more production work, etc.) in a shared, digitally-connected workspace across time and geography. Furthermore, FL Studio initially gained much of its popularity through (often illegal) filesharing; “the internet’s favorite production software” (Weiss, 2016) spread fast on

19 Hip-hop culture can also be interpreted as being rooted in a competitive culture through rap and DJ battles (Forman, 2002; Perry, 2004; Katz, 2006). However, the more recent digital composition-as-sprint practice I am describing here differs substantially from the time-consuming hip-hop connoisseurship of diggin’ in the crates which includes finding and sampling from old, unusual, or rare vinyls (see e.g. Demers, 2003; Katz, 2010; Schloss, 2004).
applications such as Kazaa, Napster, and Pirate Bay, which were new in the 2000s. Other users just used the demo version of FL Studio that offered a full version of the software, but with the catch that you could not save the project for later work. Instead, you had to complete the track and bounce everything down to one finished file. In other words, the work had to be completed fast in one session, which again encouraged sprint-like compositions.

Like the democratizing and anti-elitist potentialities of new media (Bolter, 2019), FL Studio in particular can be seen as embodying anti-establishment tenets. As producer Porter Robinson argues, FL Studio made music production available to “pretty much underage gamers” (quoted in Weiss, 2016). It spawned a compositional ethos that didn’t identify with established producers perfecting pop sounds in big recording studios with expensive Apple computers. Similar to much software in gaming culture, FL Studio until recently only worked on computers run by Windows. As in most of the rest of the creative industry, Apple has been the dominant supplier of computers to the established music industry (the first release of FL Studio for Apple’s iOS came in 2018). A new segment of digitally native users that views and approaches computation differently was given an opportunity to become composers.

In the interface, music production exists as an app-icon. Across laptops, tablets, and smartphones, the production of music, the distribution of music, and the reception of music inhabit the same gridded space as logoed thumbnails in the interface’s postmedial versatility. It is part of the same system and algorithmic logic that connects and couples ubicomp network infrastructures. Here, the DAW-composer is increasingly self-sufficient, able to do everything herself, creating a paradoxical practice that is both extremely individual and extremely socialized. In web-based compositions, pivotal parts of a track such as a sample, a loop, a beat, or a lead vocal are shared and downloaded on the fly, thereby blurring the boundaries between creative collaboration, file sharing, and online retail.\textsuperscript{20} The resurgence of trap\textsuperscript{21} around the

\begin{thebibliography}{9}
\bibitem{20} The ephemerality of internet-connected recording studios has also been considered by Paul Théberge (Théberge, 2004). The recording studio – professional or an amateur home studio – “should perhaps also be considered as a kind of “non-place” - a world relinquished “to solitary individuality, to the fleeting, the temporary and the ephemeral” (Théberge, 2004: 763; see also Prior, 2009).
\bibitem{21} Trap can be traced back to the 1990s (Bennett, 2020), but its recent insurgence is closely related to and often conflated with what is often called SoundCloud Rap. It spread in the 2010s on SoundCloud.com, where artist would

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beginning of the 2010s was born out of web 2.0 logic with its trial-and-error uploads of homemade beats, tracks and mixtapes. Hip-hop’s tendency toward “rebecoming analog” (Shaviro, 2003: 45) is thus partially suspended in this new wave of trap, arguably making it the first genre in musical pop culture that is purely conceived, distributed, and received digitally.

**Cloud-based music production**

Concurrently, cloud-based music production is increasingly becoming the norm in pop music production. Endless libraries of samples, presets, virtual instruments and mixing tools – or even complete works for remixing – can be accessed copyright-free through subscriptions to services like Splice, Noiz, or Loopcloud (Shelvock, 2020). These cater to the loop-based, postrecording practices of the DAW 2.0. Similarly, so-called “type beats” are becoming increasingly popular and common. These are basically instrumental tracks based on the producer’s ability to imitate a popular artists’ sound. Type beats are sold, leased, or ripped on webpages like typebeats.com, beatstars.com, and YouTube. The name of the beat often mentions the type of artist that the beat was inspired by, making it easy to find. Similarly, sites like Landr.com sell instant mastering services based on algorithms making the music ready for streaming services such as Spotify and SoundCloud. In other words, pop music’s increasingly networked character changes the traditional logistics that connect creation with publication.

*upload often rough mixes of their songs. New York Times music critic Joe Caramanica has called SoundCloud rap “the most vital and disruptive new movement in hip-hop” (Caramanica, 2017).*

22 When Justin Bieber released his 2020 album, *Changes*, he was accused of stealing a sample in the track “Running Over.” As it turned out, the sample came from a royalty-free sample-pack on Splice.com that the young Bristol-based producer Laxcity had uploaded. The melodic sample, made in FL Studios stock synthesizer Wasp, has been used for multiple other songs before and after Bieber’s use.

23 The first pivotal example of the currency of type beats came in 2018. YoungKio, a teenage producer in the Netherlands made a beat (based on a sample from the rock-band Nine Inch Nails) in FL Studio and uploaded it to beatstars.com. A year later, 19-year-old college-dropout and rapper, Lil Nas X, leased it for $30 and made the track “Old Town Road.” In various remixed versions, including one with country-singer Billy Ray Cyrus, the track became a viral hit and is at time of writing this the longest-reigning number one song (17 weeks) in the 61-year history of the Billboard Hot 100 (Breihan, 2019).
Furthermore, its DIY-culture is a culture based on uploading tracks or parts of tracks that are not necessarily completely finished. This trial-and-error character is extended to the work itself, depriving the work of a sense of completion. Like a screenshot, the final so-called “bounce” of a musical project materializes the immaterial looped information. Yet, it is still available for upgrades. The finished musical work is less about a final result that entails passive storage in a physical medium, since streaming culture allows artists to edit works swiftly and continuously (for instance, HBO deleting an accidental Starbucks-cup in a Game of Thrones-episode, or Kanye West’s ongoing corrections to his 2016 album *The Life of Pablo*). This constant work-in-progress mentality begins to mimic how online platforms are constantly developing and invisibly A/B-testing different versions as a source of information for making product decisions (Bucher, 2018). The nature of the digital destabilizes the musical work. It becomes ephemeral, a constant beta-version, a pilot – nothing is ever completed, always ongoing, subject to upgrades.

It is also in this light that we have to understand the interface, its operationality, and skeuomorphism. With music production’s arrival on networked computers and touchscreens, the interchangeable interface of the DAW becomes more than just the virtual operation of traditional recording studio logic. The interface is just a level or threshold that, on one hand, reduces and simplifies complex systems, but on the other, connects events, phenomena, and actors across time and space (Bratton, 2015: 228; Cetina, 2014). From this perspective, interfaces afford more than operations at hand or practical means to an end goal. Instead, the DAWs interface-operationality suspends differences between localized objects and the globally connected flow of cloud-based computing.

**Standardization and tactical media**

In addition to cloud-based access and distribution of sounds and loops, the compositions in newer DAWs are often made with the DAWs’ default sounds. This is first and foremost a result of the overall improvement of the sound quality and the accessibility of the software. However, combined with the game-like composition-as-sprint practice, it is perhaps also part of a particular aesthetic sensibility. Trap often consists of a constant, looped beat, a singular timbral environment, and a basic concept, idea, or premise that bears repeating. This could be interpreted as standardization. Indeed, the EDM pop that hit mainstream culture around the early 2010s was also based on some very particular characteristics (e.g. four-on-the-floor kick-drum, grand
synthesizers, and sidechain compression). Similarly, trap revels in distinct stock sounds like the Roland TR-808 drum machine’s kick-drum (which can simultaneously function as the characteristic boomy bass), its short closed hi-hat (which works perfectly for the abundant fast-rolling hi-hat figures), Auto-Tune, and a general disposition for distortion. A more specific example is the metallic sound of the “young chop snare” from the producer Young Chop’s sample library that has been almost ubiquitous in trap and trap-related tracks (including Post Malone’s “rockstar”).

From this perspective, the culture and compositional practices around FL Studio resemble what Garcia and Lovink (1997) call tactical media. It is a type of “cheap media” exploited by people who feel aggrieved or excluded from the wider culture, made possible by the revolution in consumer electronics and new forms of distribution. Building on de Certeau (2011), they further explain tactical media as a set of practices rather than a domain of texts or artefacts, thus shifting the emphasis to uses of representation rather than representation itself. Bridging so-called desktop producers or bedroom artists, type beats, and mainstream charts, the fast and standardized practices of FL Studio and Live could be seen as an aesthetic discharge of tactical media. Writing about 1950s garage rock, Zagorski-Thomas (2014) argues that if professional-quality sound is a signifier for the “establishment”, then “the rejection of it – the choice to go lo-fi – becomes a political statement: a marker of difference” (Zagorski-Thomas, 2014, p. 89). Echoing early punk music’s deliberate (mis)use of standardized instrumentation, particularly FL Studio has spawned a raw, DIY-based musical sound, as well as culture. The emancipatory elements of tactical media become an aesthetic trademark realized in FL Studio’s disposition for fast, course, sparse, and standardized sounds that provide an alternative to pop perfection.24 Yet, it would be a misunderstanding to view this as premised on a lack of skill or access to technology. It is first and foremost an aesthetic choice where complexity and detail is created through how sounds are treated and interconnected rather than their individual characteristics.

24 This is further emphasized with the music culture’s extensive use of overdriven Auto-Tune. While it was originally made for improving vocal performances through subtle pitch correction, it is instead used in a way that results in its very characteristic distortion. Making overdriven Auto-Tune sound good demands time, skill, and experience, but it can ironically be heard as a signifier of rapid production.
Conclusion: Defining the DAW 2.0

In this article, I have analyzed a new kind of digital audio workstation. It represents a shift from a recording paradigm to a processual programming paradigm that reflects and connects with networked computational culture. I will try sum up some of the main characteristics of this 2.0-version of the DAW.

First, it is device-agnostic, running on all operating systems across laptops, tablets, smartphones. Second, it is intrinsically loop-based. Whether it is sequencing MIDI-information in the piano-roll or audio-loops, production is centered around loops within loops in algorithmic processes that interconnect and mutually affect each other. Since sound material can be generated fairly quickly (due to access to various cloud-based libraries of samples, loops, and presets), production shifts from a logic of addition to one of subtraction. Combined with the democratization of music production, the game-like ethos of digital culture, and developments in networked cooperation/distribution, production has become fast or sprint-like. Complexity is created in the infinitesimal digital details between loops and interrelational functions across sound sources. Distinctions between recorded sound, sample, and synthesis, as well as between pre- and post-production, blur. It is the interrelational juggling and adjustment of metadata rather than inscriptive value that is augmented.

Pop tracks are, in other words, almost solely produced or defined by data that never leaves immaterial code until its playback. It is less about analog to digital transfer, and more about 1s and 0s that combine – from inception to distribution to the playback device – to finally realize the song as physical vibrations. In fact, even though the tracks do become physical sound waves when played back, the notion of “recorded music” seems increasingly misleading.

Popular music still entails many genres and practices that include or are solidly based on recording (studio) practices. But developments in pop music’s increasingly digital nature represent a type of music that does not fit solely into traditional interpretations of popular music, nor does it fit those of various types of electronic music. However, as I have argued here, pop music production has bridged some of the logics of electronic music production and the logics of new media. This shift and ongoing development is innately hosted by the type new digital audio workstation – the DAW 2.0. Yet, the emphasis is on the digital and less so on the audio. Maybe it should be called a digital music workstation instead?
Chapter Two: Time

Intro
This second chapter demands a slightly longer introduction because it rests upon a somewhat extensive and disparate body of theory. The point I am essentially trying to make is that technology has an agency of its own. This challenges the human performance logic of groove theory as well as musicological interpretations of time in general. It represents a departure from correlationism and phenomenological interpretations of musical time and instead – from the perspective of ubicomp culture’s distributed agencies – topology and heterogeneous temporality signify new process-bound interpretations of musical time. In advance of the article, I will tentatively unravel some of its theoretical main threads.

Groove theory
A fairly large body of work has discussed aspects of performed groove in various musical forms. However, arguably the most influential researcher in groove theory (or groovology), Charles Keil, is himself hesitant to call it a separate field or discipline (Keil, 2004). Nonetheless, his theory of what he calls “participatory discrepancies” is quite formative for the study of what makes groove groove. To Keil, it is “the little discrepancies between hands and feet within a drummer’s beat, between bass and drums, between rhythm section and soloist, that create the groove and invites us to participate” (1987, p. 277). Music is a communal or social activity and for it to be “personally involving and socially valuable, [it] must be ‘out of time’ and ‘out of tune’” (Ibid., p. 275). Expanding on jazz scholar Andre Hodeir (1956), Keil argues that listeners engage in corporeal participation through “vital drive”. These timing inconsistencies at a

25 To name some of the most influential according to genre: African music (Chernoff, 1979), jazz (Hodeir, 1956; Prögler, 1995), funk (Hughes, 2003) and rock (Middleton, 2000; Moore, 2001).
microrhythmic level “are where the juice, the groove, the funk, and the delights of music, and of life, are” (Keil & Feld, 1994, p. 171).

The rhythm section’s primary goal is to “create as much ‘vital drive’ as possible, to build a groove or track for the soloist to get into and this is done by pulling against the pulse” (1966). John Miller Chernoff, in discussing African polyrhythms, also writes that “there is vitality in rhythmic conflict” (1979, p. 169). James Brown’s repetitive grooves on Payback from 1974 is an example of this. Here, “the focus turns inward, as if a sensibility for details, for timing inflections and tiny timbral nuances, is inversely proportional to variation on a larger scale” (Danielsen, 2006, p. 189).

The drum kit partially grew out of second-line parades in late-twentieth-century New Orleans where it combined Afrodisasporic syncopation and improvisation with what Peter Shapiro (2009) calls the militaristic marching band’s regimentation and rigidity (2009, p. 81). This unique combination later contributed to the rhythms of jazz, R&B and funk (Stewart, 2006), but also the “machine-like compulsion” of rock (Reynolds, 2000, p. 32). The drum kit thus on one hand upholds a temporal grid via the up and downbeat created by feet and hands, and on the other hand is capable of a corporeality that more than any other instruments is based on timing combined with velocity and timbre inflections. Researcher (and drummer) Jeff Greenwald (2002) takes a corporeal approach when he notes that it is the drummer’s four limbs that create the groove, emphasizing how physical, gestural and tactile drums are compared to other instruments. Keil also describes how the drummer’s four limbs are almost independently grooving entities (Keil & Feld, 1994, para. 98).

Yet, at the same time, drums can be interpreted as limited in terms of expressivity. Compared to, for example, a violin or the human voice, the amount of expressive control differs fundamentally just by the sheer distance of sticks and pedals that mainly denote onset values in time and volume. From an organological perspective, the production of sound in drumming does not include the same opportunities for expressive factors such as vibrato, portamento, intonation and slides. Additionally, the physical proximity and corporeal basis of singing, the tactility of playing a piano or the proximity of a violin is different compared drumming, which is based on velocity, timbre and the binarity of drumsticks on drumheads and cymbals (not including brushes). However, few would question the expressive potentiality of drumming, and drum performance can beyond doubt be – perhaps partially thanks to its heightened corporality – indeed very human.
**Mechanic grooves**

The question of groove begins to change in electronic repetition. The relationship between humanly performed groove and various iterations of technical repetition has been interpreted in different ways. In 1988, Andrew Goodwin, argued that developments in pop production have progressively removed “any immanent criteria for distinguishing between human and automated performance”, since machines mimic human performers through displacement and small changes in tempo to create what he calls “feel” (Goodwin, 1988, pp. 224–225). Simon Zagorski-Thomas (2010) similarly writes that human performers have tried to sound like machines since the 1970s, and, conversely, programmed music has attempted to sound like human performers (Zagorski-Thomas, 2010, p. 197). Anne Danielsen (2019) argues that performed and machine-generated music are now so interconnected that it would be wrong to speak of a hybridization – it is not only impossible to distinguish between the two, but irrelevant (2019, pp. 603–4). When discussing 1990s electronica artists such as Aphex Twin and Squarepusher, Danielsen writes that their fast and even hi-hats evoke high technical skills for a human performer, citing it as an example of “the exaggerated virtuosity of the machine” (2010, p. 2).

Kodwo Eshun (1999) argues slightly differently when he writes that “the movement from funk to drum machines is an extremely incredible one: people's whole rhythmic perception changed overnight. And people of course pretended that nothing had happened, but it was a major shift” (Eshun, 1999, p. 186). Mark Butler (2006) writes that the seemingly mechanical four-to-floor-based disco of the 80s and 90s was actually not particularly electronic or for that sake artificial, but actually made in record company studios with session musicians (2006, p. 38). On the other hand, building on the advent of mid-1980s samplers like the SP-12 from E-mu Systems, Joseph Schloss (2004) argues that hip-hop’s brief use of live instrumentation was “merely a deviation, a capitulation to circumstance, rather than a step in hip-hop’s evolution” (Schloss, 2004, p. 35). Furthermore, Schloss rightfully reminds us that hip-hop does not eschew quantization but seeks to find a balance between mechanic precision and overt looseness.²⁶ Yet

²⁶ Furthermore (and somewhat ironically), algorithmic functions are often used in electronic music production to add seemingly “human-like” deviances from the grid. For instance, the *humanize* function randomly adds temporal
aesthetic celebration of irregular beat-making runs deep in hip-hop culture. In fact, for particular hip-hop subcultures, it seems to signal an authenticity that is almost fetishized. Mike D’Errico (2015) connects hip-hop’s preference for unquantized beats to the productions of the producer J Dilla who excelled in producing intricately crafted loops that blurred any notions of steady meter. Similarly, Simon Reynolds writes: “The gist of what Dilla did [...] is to avoid quantizing and go for a looser, human feel, fitful and fallible, sometimes pushing ‘off-beat’ to the edge of plain wrong” (Reynolds, 2009; see also Hodgson, 2011).

However, it seems that the idea of discrepancies that was so important to the tension-based creators of “vital drive” has been imported to interpretations and evaluations of electronic music. Brigid M. Costello (2018) argues that a lack of nuance in electronic music’s rhythms can lead to a lack of vitality (2018, p. 155). Instead, linking discrepancies with vitality and the human, she argues that “rhythmic vitality, then, is associated with movement and particularly with subtle deviations, imprecisions and nuances that mimic the rhythms performed by organic living things” (Costello, 2018, p. 157). While it is never directly expressed as such, it seems, in groove theory, as if there exists a hegemonic relationship between “even rhythm on the grid, on the one hand, and deep, groovy rhythmic designs, on the other” (Danielsen, 2019, p. 596). As Robert Fink writes: “The distrust of the surface runs deep in structuralist music theory” (Fink, 1999, p. 104). Similarly, Russell Potter (1998) attempts to make a distinction between what he calls blank repetition and repetition with a difference. Garcia (2005), however, duly criticizes Potter for claiming that a certain acceptable level of repetition elevates jazz, blues and rap at the expense of the more quantized grooves of disco, techno and other dance music genres (2005 para. 2.20).

Phenomenology and syntax

Musicological interpretations of time essentially – directly or indirectly – rest upon phenomenological interpretations of time. If we follow the phenomenological approach to

and/or velocity deviations. The swing feature (first made popular with the Linn LM-1 drum machine) allowed the user to set a swing parameter to add an exact amount of swing to a quantised pattern (Frane, 2017; Exarchos, 2019). This quantized swing paved the way for very particular types of groove that bend the distinction between clear and transparent swing often utilized by hip-hop compositions.
temporality, Husserl explains that the experience of time is embedded in what he, in “The Phenomenology of Internal Time-Consciousness” (1964), calls “the temporal object”. He uses a melody as an example of a temporal object; it becomes a surrogate for consciousness because it allows consciousness to grasp its own construction as an ongoing flux. He distinguishes between what he calls retentions and protentions. A primary retention is what has just passed but which has not yet become part of memory. It is not part of immediate experience but a phase in the perceptual retained in our consciousness. Secondary retention is the common notion of memory of past experiences. Protentions are expectations of the next moment. Our perceptual self constitutes intentionality through retention, the immediate present and protention. While exterior objects such as paintings and statues offer less in terms of temporal phenomenality, music does due to its particular temporality. Consciousness constitutes the melody as a temporal object through both memory and expectation, so that each moment of listening projects the coherence of the melody between what has just passed and what is expected.

The line of argument in the case of music (and music theory) that follows from this is that music evokes emotions based on choreographing anticipation where the body prepares for resolution that can either be accommodated or foiled (Bryant & Knight, 2019; Huron, 2006; L. B. Meyer, 1961). Similarly, phenomenological philosopher Paul Ricoeur (1984) explicitly relates time to narrative. The idea is fundamentally that it is syntax that affords intentionality (Cumming, 1997; Margulis, 2013).

The interpretation of syntax in repetitive music does, however, differ. Richard Middleton distinguishes between musematic (short units such as riffs) and discursive (phrases and sections) repetition (Middleton, 1983, 2000, 2006). Building on Middleton and Cumming, Rebecca Leydon (2002) argues that contrast and hierarchy between loop types forges “particular subjective identities” (2002, para. 14). This presents a challenge for music that seemingly lacks hierarchies (Fink, 1999). In EDM, Butler (2006) hears a particular textural clarity in which individual sounds have individual layers that blend more than they stand out in the DJ’s mix. This could be heard as a lack of subject-time creating tension, yet Garcia (2005) finds in it a new

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27 Mads Walther-Hansen’s (2015) analyses how music production can create “sonic narratives” (see also Liu-Rosenbaum, 2012; Harden, 2019). By analyzing a track by the rock band Queens of the Stone Age, he demonstrates how studio-based sound production and what he calls “sound events” form a particular diegetic, narrative framing.
kind of subjective orientation. To him, EDM looping “provides opportunities for listeners to insert themselves into the looping process” and to “plot pathways between these points of attention, mapping out a landscape of shifting creation pleasure while prolonging the process pleasure of an ever-changing same” (2005, para. 4.4).

**Ubicomp time**

From a sociological perspective, Couldry and Hepp (2016) argue that every aspect of the social today is constructed by technology-based processes of mediation in what they call an age of deep mediatization (Couldry & Hepp, 2016; see also Hepp, 2020). They hesitate to resign the unilinearity of temporal development, but instead posit that “we inhabit a social world characterized by the pluralization of temporalities, on the one hand, and the complexification of technological systems for the coordination of temporality, on the other” (2016, p. 107).

Indeed, time is ambiguous in ubicomp culture. On one hand, exactness thrives. Media have become “the social metronomes of the everyday” (Neverla, 2010, p. 183). Instantaneity, coordination and synchronization rule as the local links to the global. Digital media plants temporal flags with exact precision and divides time with infinitesimal accuracy. On the other hand, time is also permutating, evolving, ephemeral.28 Persistence meets flux.

This essentially alters our idea of time as something irreversible. From Edison inventing the phonograph, this is a fundamental part of mediatization that makes it possible “to liberate ourselves from the dictatorship of the time axis” (Winkler, 2009, p. 3). Yet the digital amplifies this heterogeneity, and the sheer level of detail and complexity entail fundamental challenges to

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28 Similarly, a new kind of remix culture has sometimes challenged traditional definitions of a musical work. Songs are made in various versions in which (often famous) singers add vocals and thereby create new versions of songs that are already hits. For instance, Ed Sheeran’s “Perfect” (2017) gained by Beyoncé and had its title changed to “Perfect Duet” (2017), “Despacito” was supplemented by a remix version featuring Justin Bieber, and beforementioned “Old Town Road” (2019) by Lil Nas X gained vocals by Billy Ray Cyrus in a remix version. It is a tendency that not only challenges definitions of remix culture, but also notions of the finality of musical works. It evokes earlier moments of popular music history in which singles were supplemented with remixes to keep the interest going and the song on the charts.
anthropocentric interpretations of time. This also manifests in music, an art form entrenched in temporality. Paul de Man wrote on the mutually constituent character between time and music that “the field of music is time” (de Man, 1983, p. 129). It is time that affords music its “field”, its character, its condemnation to “exist always as a moment, as a persistently frustrated intent toward meaning” which also what “prevents it from remaining within the moment” (ibid.).

To account for the heterogenous yet essentially topological character of time in ubicomp, and for the particular distributed agencies that it also entails, I turn to process philosophy’s centralization of temporal flux. While Alfred North Whitehead, Henry Bergson and Gilles Deleuze indeed differ, they all define a view of the universe as essentially eventful. Here, subjects and objects appear, but they are neither primary or originary (Whitehead, 1978; Deleuze, 2001; Bergson, 2004). To Whitehead, arguably the dominant figure in recent process philosophy (Rescher, 1996, p. 20), most entities – including subjects and objects – have equivalent status. This view has inspired different approaches to technology. For instance, in Bernard Stiegler and Deleuze, we find two approaches to what the former calls technics. Deleuze, highly influenced by Bergson, refuses the instrumentalization of the technical object and, instead, affords the object a material agency of its own.

The following article is essentially based on a discussion on how pop’s digital processuality both reflects and negates a process ontology.
Article 2: Pop as process: the digitalization of groove, form and time

Abstract:
This article argues that the digitalization of pop music production has profound temporal consequences. Instead of performance-based and essentially phenomenological interpretations of the relationship between time, groove and form, it hears music production as innately digital as well as informed by the practices of hip-hop and electronic dance music (EDM). This perspective is examined in three analyses of pop tracks. New media theory is included to account for digital culture’s temporalities in relation to the tracks’ differing types of repetition and teleology. Firstly, I conclude that the essentially processual nature of contemporary pop music suggests the signification of particular types of technology more than tension-based human performance. Secondly, I conclude that pop music’s digital nature holds particular novel aesthetic potentialities that both exemplify and negate digital culture’s ambiguous temporalities, and that this encourages prereflexive sensations of heterogenous, digital unfoldings of musical time.

Keywords: Pop; digitalization; process philosophy; music production

Introduction
‘Time has changed in the wake of the digital computational revolution’ (Hansen, 2009, p. 295). New media theorist Mark Hansen even calls it a banal proposition because of the ‘extensive work of temporalizing that is currently carried out by technical artifacts in our world today.’ (2009, p. 298). Arguably, music also holds a particular relationship to time. In philosopher Susanne Langer’s words: ‘Music makes time audible, and its form and continuity sensible’ (Langer, 1953, p. 110). Then what does the computational revolution mean for music’s
relationship to time? Or, more specifically, how does digitalization affect temporal features of music such as groove, form and teleology?

These questions are particularly relevant in relation to pop music. Pop is, arguably more than any musical form, inherently entangled with this computational shift because digital versions of electronic music cultures are increasingly dominating pop music. In other words, electronic genres such as hip-hop and electronic dance music (EDM) and their temporalities have not only moved to the pop single format, they have also found a new home or even realisation in the age of the algorithm.

The article begins with a critical discussion of the temporal-tension paradigm in popular music theory. I then examine the hip-hop and EDM-derived characteristics of contemporary digital music production, which are further discussed in three analyses of pop tracks: Martin Garrix & Dua Lipa’s ‘Scared to be lonely’, Post Malone’s ‘rockstar’ and Katy Perry’s ‘Chained to the rhythm’. These present very different kinds of temporal discrepancies and teleologies, which I argue are part of a shift towards an ontology of musical process. I further discuss this by including theory from new media studies. Ubicomp (ubiquitous computing) culture displays new temporal properties that are defined by automatization, heterogeneity and inhuman scale. I conclude that music production’s increasing shift towards a digital process-ontology challenges anthropocentric, performance and difference-based interpretations of agency and time, and I argue that rhythm and teleology in pop are better understood as digital processes that signify particular technologies and their practices. These processes encourage process-based listening that represents new relationships between time and music.

**Repetition, difference and technology**

A key question in popular music theory is the relationship between rhythm and time. In performed popular music rhythm theory, the combination of repetition and spontaneous irregularity is part and parcel of the temporal push or drive. This is probably best described in Charles Keil’s influential work on rhythm, in which he describes what he calls ‘participatory discrepancies’ (Keil, 1987; Keil & Feld, 1994; Keil, 1966). For Keil, these discrepancies are corporeally bound and create the music’s ‘vital drive’.

Similar thoughts can be found in Anne Danielsen’s extensive research into groove and time in performed (2006) as well as digital music (e.g. 2010, 2018, 2019, 2020; Brøvig-Hanssen
and Danielsen, 2016). She argues that computer-based rhythms also depend upon an inner
dynamic drive and the ability to move the groove forward (2018, p. 45). Rhythm is always
experienced as an interaction between sounds and a virtual reference structures (Danielsen 2006,
p. 47). For Danielsen, drive can be made via microrhythmic tension or through structural
tension, for example, the tension created by counter-rhythms such as the 4:3 pattern (ibid; see
also Butler 2006, chapter 2). Even though the groove might be digitally exact on the grid, these
counter-rhythms produce ‘compelling interaction’ between the rhythmic layers (Brøvig-Hanssen
& Danielsen, 2016, p. 112). Whether a groove is actually heard as repetition with a difference or
sameness depends on the listeners’ resolution and experience, because ‘a low-resolution, non-
confident listener will probably tend to hear the ‘same thing,’ despite considerable differences
from one repetition to the next (Danielsen, 2018, pp. 40–41). In other words, from this
essentially phenomenological perspective, it is the microrhythmic or structural tension that
affords (the confident) listener the feeling of groove, of time and the work moving forward. This
resembles the analysis of traditional ‘tonal classical music’ and its dialectic of tension and
release. For instance, Lawrence Kramer (1988) writes that repetition affords a certain focus
where attention is directed toward ‘those musical aspects where the linearity unfolds, such as
melodic contour, harmony, the use of different registers, and, in some cases, the dynamics’
(Kramer, 1988, p. 38).

However, to Danielsen, electronic repetition is based upon particular kind of repetition
and not least difference. She turns to Gilles Deleuze (2001) who argues that artists will seek to
make repetition unstable. Groove-based music is then a process of putting the stable repetition
under constant pressure through a ‘stable unstable’ (Danielsen, 2006, p. 135). From this
perspective, repetition of the same affords its contrary, namely the coveted difference.

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29 Robert Fink (2011) critically discusses notions of rhythmic “dissonance” - inherited from “tonal music” – that
‘rests on the assumption that listeners mentally project a regular metrical grid onto music; “dissonant” rhythms are
those which cut across this grid and are thus “anti-metrical.” […] the metrical grid provides the expectations, and
deviations from the grid the resistance that encodes information’ (2011, p. 199). Fink also mentions Robert Walser’s
critique of Western music theory’s lack of tolerance for unresolved tension: ‘Terms like “metric disso-
nance” and “dissonant strata” suggest that rhythmic conflicts must always be resolved, whether in performance or analysis.
There seems to be no place for tensions that remain unresolved, differences that can coexist’ (Walser, 1995, p. 214,
n. 20).
Nevertheless, to Danielsen, in the end, it is not decisive whether a groove is exact or not, because even in ‘music performed by machines and not human beings—every repetition may be experienced as repetition with a difference, because the time is different’ (2018, p. 49; see also Danielsen, 2006, p. 162).

Danielsen’s scepticism towards exact, ‘non-different’ repetition is fairly common in groove studies. As Luis-Manuel Garcia (2005) argues, exact repetition has been the subject of a devaluation, it is put in a position of ‘the Other’ compared to repetition with a difference (2005 para. 2.20). The status of goalless music in music theory is perhaps most clearly stated in Afrodiastropic cultural theory. For instance, James Snead (1984) famously argued that repetition in European culture had to be managed and controlled into accumulation and growth. But in black culture ‘repetition means the thing circulates […] If there is a goal (Zweck) in such a culture, it is always deferred; it continually ‘cuts’ back to the start in the musical meaning of ‘cut’ as an abrupt seemingly unmotivated break’ (Snead, 1984, p. 67, italics in original). In other words, the goal-deferring reset and abruptness of the so-called ‘African cut’ both confronts and celebrates rupture, leaving room for the possibility of teleology-defying circularity.30

Mark Butler’s research on EDM switches the perspective from human performance to technology. To him, EDM sidesteps the timing variations that tend to inform human performance and instead actively models technology (Butler, 2014, p. 188). This turns exact repetition into ‘an intentionally cultivated creative strategy’ (ibid.). Instead of negating the existence of repetition without difference, exact repetition can be valued for what it does, and ‘it then becomes possible to appreciate its epistemological reality’ (2014, p. 190). He furthermore divides EDM-rhythm into two: the machinic gridded four-to-the-floor beats, and the breakbeats that sample performed music, including its discrepancies. For Butler, microrhythm in EDM mainly comes from the latter’s recorded performances and their performed discrepancies.

Yet the discrepancies of hip-hop grooves do present a type of tension, or, perhaps rather a particular negotiation of tension. Mike D’Errico (2015) writes: ‘When a rhythmically dissonant moment is repeated, what was previously a rupture in the coherence of the groove becomes

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transitional material, enhancing the effect of the anacrusis and solidifying the stability of the beat’ (2015, p. 287). What D’Errico is arguing for exceeds Danielsen’s ‘stable unstable’. It is the unstable becoming its exact opposite through looped repetition. The consequence of D’Errico’s argument is that instability, rupture and discrepancies within the loop actually reinforce the stability because the amount of detail being repeated with exact precision emphasizes its inhuman perfection.

Instead of understanding discrepancies as signifiers of human performance, this perspective allows us to see temporal signification as intricately bound to technology. Various types of grooves have very specific origins in practices that are equally historical, genre-related and directly embedded in specific types of music technology. As Joseph Schloss (2014) writes on hip-hop rhythm: ‘The circuitry and programming of different models of samplers are believed to impart special characteristics to the music (perhaps the best known of these characteristics is the legendary ‘MPC swing’, a rhythmic idiosyncrasy first noted in the Akai MPC 60 sampler, circa 1988)’ (2014, p. 202). In other words, particular music technologies afford particular rhythms, and hip-hop aesthetics is based on a variety of technology-bound grooves: from the early turntable-cuts between breakbeats on vinyl to drum machines to early samplers and MPC’s to the multiplicity of the sequencer-grid in the DAW. In other words, the technological frames – the instruments shaping hip-hop as well as EDM’s loops – have many (inter)faces, each with their own temporalities.

New temporalities

The first generation of 1990s DAWs (digital audio workstations) were based on a logic stemming from the analogue recording studio (Möllenkamp, 2014; Strachan, 2017; Théberge, 1997). Industry leading programs such as Pro Tools, Cubase and Logic had interfaces that were built on recording, organising and editing sound and MIDI through skeuomorphic representations of the recording studio. Among other things, this included virtual effect racks and mixing desks, and a tape-recorder logic of start, stop and record. The recording timeline was horizontal, an axis of time upon which sound events could be stacked vertically. Steve Goodman writes: ‘As with European musical notation’s inheritance from written text, digital audio software sequencers have inherited the habit of left-to-right visual scanning. The timeline constitutes the spatialization of the clock into a horizontal time’ (Goodman, 2008, p. 257). The
timeline of the first generation of the DAWs thus seemingly represents a traditional linear temporality, yet, as Goodman also argues, the temporal homogeneity begins to dissolve in the operations of the interface: ‘A temporal sequence of sounds suddenly occupies an area of the computer screen. What is opened up by this spatialization is the ease of temporal recombination’ (ibid.). He concludes that this facilitates nonlinear digital editing, which is different from analogue fast-forwarding and rewinding.\(^{31}\)

However, recent developments in digital music production extend beyond temporal juxtapositions of cut-and-paste techniques and manipulating time by, for example, time-stretching (changing the speed without changing pitch) or pitch scaling (changing pitch without changing speed). The dissolution of temporal linearity has been taken a step further in a new generation of highly popular DAWs such as FL Studio and Ableton’s Live, which put grid-based sequencing of interrelational parts and algorithmic processing at the centre of music production. FL Studio can essentially perform the same functions as traditional DAWs, but it is based on fast, intuitive and beat-centred sequencing. While the time-axis-bound regime of the time-cursor does to some extent prevail in the sequencer, it does so almost multidimensionally, across windows of loops within loops, time within time. Like wheels in an engine, a drumbeat is arranged in one window, which is part of another group of beats in another window that again forms a sequence in a third window – with the timeline cursor running in all windows. A new automatised relationship between detail and the whole is therefore created; singular edits potentially apply to functions across both parts and the whole track. It is a practice based on a fast, programmable multiplicity that interconnects temporal events. As Rosalind E. Krauss argues (in the context of modernist art), grid-aesthetics blur or even eliminate traditional conceptions of time, context and history (Krauss, 1985, pp. 9–22).

Live offers a perhaps even more conspicuous alternative to the traditional timeline. Consisting of two view types and concurrent work modes – *Arrangement View* and *Session View* – the latter offers an innately loop-based operationality. Anything from short sound bites to

\(^{31}\) Goodwin’s argument echoes media theorist Friedrich Kittler’s (1993) perspectives on time axis manipulation. Sybille Krämer (2006) interprets his mantra ‘only that which is switchable is at all’ (*nur was schaltbar ist, ist überhaupt*) as a argument for time axis manipulation and claims that the irreversibility of the flow of time is in technology subject to manipulation, since temporal order is movable and reversible.
whole albums can be triggered, manipulated and interrelated on the fly via a grid of coloured squares. As the DAWs name implies, it is a musical practice that is based on a live and improvisational approach to producing music. While *Session View* in many ways works as a virtualisation of the logic of an MPC, its mouldable interface control and connectivity of processes differs. Music production becomes processual – something ongoing, running. The final product, the track, is like a screen-dump, as all the running processes are bounced down, frozen and committed to a definitive format.

This shift in practices in music production has happened almost concurrently with pop music’s assimilation of hip-hop and EDM aesthetics and practices. EDM festivals had mainly been a European phenomenon, but in the 2000s, the US experienced a surge in the number of highly successful EDM pop festivals (Reynolds, 2012; Matos, 2015; Holt, 2017; Gálvez, 2019). This spawned a new generation of DJs that became super-stars, and the sound began to move into the mainstream. This new type of DJ-Producer became massively sought after in the music industry’s ‘song machine’ (Seabrook, 2012). The skills, technology and aesthetics of DJing was thus imported to the pop charts, adding the role of DJ to Paul Thebergés’ definition of the ‘hyphenated musician’, which already encompassed a combination of a singer-songwriter-producer-engineer-musician-sound designer (Théberge, 1997, pp. 221–222). To track and exemplify the assimilation of hip-hop, EDM and digital temporalities, I will analyse three tracks, beginning with one by one of the most successful contemporary DJ producers, Martin Garrix.

**Interrelational algorithms: ‘Scared to be lonely’ (2017)**

Garrix and English singer Dua Lipa’s hit ‘Scared to be lonely’ is an example of the pop format’s adaptation of EDM’s ‘break routine’. This is a passage consisting of three elements: breakdown, build up and the climactic ‘drop’ (Butler, 2006). The parts between these elements are clearly demarcated leading to the drop via an intense use of framing devices (Solberg, 2014). Traditional EDM DJ sets might last hours and a break routine usually takes between twenty minutes and hours (Butler, 2006), so even though this form is always moving towards the drop, parts may very well be experienced as stand-stills (Rietveld, 2018). However, the timeframe changes when the break routine is imported to the three or four-minute musical format of a pop track (or what Butler calls ‘the domain of the miniature’, 2006, p. 177). ‘Scared to be lonely’ has three climaxes in 3:40 minutes. Because there is significantly less time between the breakdown and the drop, EDM pop tracks often display intense momentum-building and contrasts between breakdown,
build up and the drop, spawning the formal label ‘the pop drop’ (see Sloan and Harding, 2020, chap. 4). EDM pop often displays very intricate formal recombinations that blur distinctions between pre-chorus, chorus, post-chorus and the pop drop (Peres, 2018). ‘Scared to be lonely’ mainly abides to what Alyssa Barna (2020) calls the ‘dance chorus’. Here, an additional drop-like module follows the chorus (as opposed to a drop that replaces it). 32

From one perspective, this form represents an almost parodic teleology with its overt and relentless revelling in setting up formal difference, announced extensively by framing devices. ‘Scared to be lonely’ sets up its drop-like dance chorus with a drum-roll effect in the kick drum, a drum roll and a break. From another (macro)perspective, the break routine’s formal units in the shorter pop format produce an element of formal circularity exceeding the traditional verse-prechorus-chorus formula. The listener begins to predict the formal units’ circular unfolding. Because of the formalic order and its dramatization, everything is expected. The track’s ‘now’ runs in a circle too. In other words, it involves both highly goal-oriented forward-pushing linearity and formal circularity. 33

If we turn to the track’s rhythmic elements, we hear that the climactic drop-like dance chorus is defined by a wall of bass and synthesizers that all display the same envelope (understood as the way the sound changes over time). They do this in a very unusual manner. It ostensibly sounds like an example of EDM pop’s affection for sidechain-compressing synths and bass. Sidechain compression is essentially an algorithmic process of setting one sound’s transients to trigger a compressor that controls (and essentially ducks the volume of) one or several other sounds. In EDM, this is often done so that a four-on-the-floor kick drum activates a compressor that ducks the volume of bass and synths. The result is that the wall of sound (and thus most of the track) bounces back up on the offbeat. In ‘Scared to be lonely’ the wall bounces to a different rhythm. It is difficult to aurally disentangle exactly how the interrelational dynamic

32 Robin James (2015) also discusses the arrival of EDM structure in pop. She calls the upward/forward-moving sweeps a ‘soar’ and hears EDM-pop songs ‘score hits by soaring to climaxes or dropping to nadirs’ (2015, p. 29).

33 Ragnhild Torvanger Solberg (2014) makes a similar point when she suggests that the dynamics of the break routine encourages ‘an auditive expectancy based on gravity of what will happen when something ascends, descends and becomes intensified. Through repetitive encounters with objects reaching their maximum energy potential, we can imagine and predict the process and the outcome’ (Solberg, 2014, p. 64).
processes are set up, but it is likely either an LFO-tool, a volume modulation plugin, or one or several sidechains with one of them being a so-called ghost sidechain trigger. The latter is a sound trigger that is not sent to the main output, so it is not heard, but it still works as a trigger for a sidechain compressor. The ghost sidechain triggers on the 8ths, but with one or several beats lifted or missing resulting in the synth/bass-layer’s uneven bounces. This irregular feel is amplified by the envelope settings’ fairly slow attack and decay creating particularly slow swells and ducks adding to the irregularity and fundamentally unnatural feel of the wall’s collective envelope. Regardless of the various production methods mentioned, the wall is essentially created and shaped by a chain of algorithms. A compressor’s operationality is basically algorithmic in its logic: ‘if the sound’s volume exceeds threshold X, then attenuate the signal by the ratio Y’. The manner of its process (shaped through settings of factors such as ratio, envelope, knee-type, etc.) is part and parcel of its creative use. Additionally, another algorithmic and common production technique is used on Lipa’s lead vocal. The reverb and delay of her vocal is subject to an automatic ducking whenever her dry vocal sounds. This allows large amounts of wet effects on a vocal without drowning it, since the vocal and the reverberation/delay never sound at the same time (Hodgson, 2011).

From a groove perspective, the gridded drums and the wall’s unusual envelope interconnect in a very particular way. While perhaps not qualifying as a groove from a traditional perspective, the wall does, however, display very tangible discrepancies. But instead of the communality of performed music, the connectivity is intricately programmed. The gridded drums supply a background that the wall both bounces to and differs from in character and envelope. The discrepancies still act according to the exactness of the digital grid. This inherent controlling of processes puts the producer’s agency in a particular place where performance, control and programming meet. It relies on digital algorithms’ ability to predict dynamic fluctuations and allows for precision and control to an unprecedented degree. The craft or creativity consists of setting, editing and adjusting interrelational algorithmic processes through

\[^{34}\text{Plugins such WavesFactory’s Trackspacer, Cableguys’ VolumeShaper or Polyverse’s Gatekeeper offer intricate volume modulation control that expand the accessibility and possibilities of traditional use of lateral dynamic processing (such as the compressor, gate, limiter, expander). Various transient-shaping plugins can control the transient response and envelope curve of an audio signal.}\]
combinations of metadata. The art lies in the shaping of the automatic processes and how they combine.

Recent developments in hip-hop do, however, display some substantially different characteristics that I will now discuss with an example of trap’s presence in pop music.

**Suspended difference: ‘rockstar (feat. 21 Savage)’ (2018)**

Post Malone’s ‘rockstar’ is grounded in and defined by an excessive sameness. Except for the introduction of the rapper 21 Savage and minor variations, the arrangement, dynamics and mood stay the same for its almost four minutes long duration. Arguably, it revels in its restrained lack of variation. For instance, more than half of the track consists of the same two-bar melody. The lyrics do change, but they are sung with an unusual lack of variation which is amplified by the heavy use of Auto-Tune. The beat is a typical trap beat with rolling hi-hat figures, the metallic ‘young chop snare’ (from the producer Young Chop’s sample library), and a boomy 808 kick-drum and a bass (which is probably a pitched kick-drum with a long decay). The timing and timbral differences due to the minute velocity variations that traditionally define drum performance are not only quantised and repeated with exact sameness, they are repeated in such a way that the reverb-less dry punches of the hi-hat and snare sound like on-off switches, punchcard coded in the grid of the piano-roll. Taking the practice of sequencing beats into account, where minute squares on the grid activate sounds, it is perhaps not surprising that the aesthetic outcome begins to resemble miniature auditory monoliths. Devoid of performative, corporeal or tactile gesture, it is the sound and signification of the sequencer and its operationality. Instead of imagined narratives of performed, physical, gestural activity, the beat is embedded and defined by automation and digital multiplicity at the expense of human activity and agency.

Except for the intro and outro, the beat loops throughout the track. It breaks occasionally in a way that resembles a DJ turning the music down before a chorus or drop, yet here it is mostly followed by a return to the same continuous lead melody. The minor formal change in the module where the melody changes slightly and goes up is repeated twice by Post Malone leaving it somewhere between a chorus, bridge and prechorus. In this A’, the rhythm in the melody stays more or less the same as in A. In other words, instead of a verse-chorus form, this is basically one idea, one sound, one beat. The verse becomes the chorus and vice versa, and any sign of goal, direction, build-up or variation are punctured by the loop-based sameness.
The main variation is the addition of 21 Savage. His vocal is significantly different, with less reverb, lower frequencies and more compression, which creates a vocal staging with substantially more proximity than Post Malone’s reverberated voice. 21 Savage’s lower frequency range compliments the track’s overall frequency response, and its drier, closer sound offers a sense of relief from Post Malone’s distance. Furthermore, 21 Savage initially abides by the lead melody, but begins to break out and rap or sing more freely, seemingly almost improvisational, which is intensified when the track switches briefly to the A’ before the returning to the lead melody with Post Malone as the lead vocalist. In other words, the introduction of 21 Savage can be heard as a sort of a bridge or solo, and it offers a shift or release in the track’s excessive sameness.

However, instead of the golden-section aesthetics of a verse-chorus form’s bridge, 21 Savage’s shift happens exactly in the middle of the track (1:49 into the 3:38 long track). The palindromic form is not unusual in hip-hop and arguably adds to the overall repetitive nature of ‘rockstar’. It is a principle of addition and division, blocks that fit and connect, loops that stack horizontally and vertically, order that defies formal tension. While Afrodiasporic goallessness (as described by Snead) is indeed present, the reset of the cut, even just its potential, is absent. Indeed, time still passes, but kinesthesia (understood as the sensation of moving) is deferred. It does not create a sense of time-pushing or striving for something else, and it is not based on irregularity or a stable instability. ‘rockstar’ is suspended difference. It aesthetically excels and celebrates stable exactness with a lack of cuts, discrepancies, tension and teleological aspirations.

The temporalities of ‘rockstar’ and ‘Scared to be lonely’ differ substantially. They also signify different kinds of technology and use of music technology. While they were most probably both made in the same DAW (both Martin Garrix and ‘rockstar’ producer Tank God work in FL Studio), the sequencer-signifying repetition of ‘rockstar’ represents a very different use than the interrelational algorithmic processes of the unruly wall in ‘Scared to be lonely’. They signify different music technologies and genres, stemming from EDM and hip-hop respectively. I now turn to a pop track that is based on blending the production practices of both EDM and hip-hop.

**Groove as technology-signification: ‘Chained to the rhythm’ (2017)**

Katy Perry’s ‘Chained to the rhythm’ subscribes to a more conventional form and teleology. It begins with an intro of two bars. Here, the rhythm section of drums, bass and other indistinct
instruments (mainly piano and keyboard) are bandpass-filtered so that only mid-frequencies are left, resembling (a sample of) an old record. When the first verse begins, the song’s main groove is established. It mainly consists of synthetic claps, bass guitar and the indistinct group of instruments from the intro, but it is now panned wide. In fact, this indistinct group of sound sources are grouped together in numerous unusual ways that all support or even define the track’s groove. While the claps are clear and quantised, the indistinct group and its internal rhythmic pattern is submitted to a collective envelope bouncing to a sidechain-compressor. The 95 bpm sway of the song’s groove is built on the sidechained group’s collective envelope (again, it is difficult to decipher the programmed processes, but it sounds as if the sidechain trigger is either the kick drum, a ghost trigger or even the bass). Besides the sidechain, a bandpass filter (different than the one in the intro) in the midrange frequencies adds to the group’s sampled feel.

This is further amplified in the verse after the first chorus. Here, the claps are muted, and the indistinct group is hardly audible, but the frequencies slowly sweep back to include the upper registers due to two separate low-pass filters that gradually open up the threshold so that the respective upper frequencies of the sounds are let through. This sweep-effect is a central part of EDM DJing. In ‘Chained to the rhythm’ it is utilized to create movement and tension towards the pre-chorus, and combined with the sampled feel of the group, it resembles the practice of sampling breakbeats in both EDM and hip-hop (yet, arguably, the slow tempo gives it more of a hip-hop feel).

The track’s groove is thus based less on individual timing from performance, but on a highly mediatized group of instruments devoid of individuality. This is submitted to the algorithmic agency of sidechain and filtering. The groove in the algorithmic processes of ‘Chained to the rhythm’ is less about moving a sound to an earlier or later position on a time axis and more about setting up processes that shape inflections – or a lack of inflections – in ongoing interconnected negotiations (making the title of the track seem almost ironic). Additionally, the track’s groove is fundamentally based on signifying breakbeat-practices that entail particular technological and genre-related practices.

**Perspectives for pop as process**

The production of pop music is increasingly becoming laden with a level of secrecy, a black-boxing of origins. The lack of distinguishable performance-based sound sources decreases the
layman listener’s opportunity to decipher the origins or the intricate technical processes that constitute a pop track. In the following, I will discuss how pop music’s processuality can be interpreted as an intersection of a broad range of practices that entail a shift to process, and I will then compare this to the tracks analysed through the lens of new media theory.

In his analysis of interface-based music production, Mike D’Errico (2016) suggests the term ‘procedural listening’. It is ‘a dominant skill developed by audio producers that allows both musicians and audiences to focus on the process-oriented mechanics of media forms, rather than simply audio content.’ (D’Errico, 2016, p. 77, italics in original). Bridging the producer and the recipient, it connects with the particular ‘listener orientation’ (Butler, 2014, p. 106) of the DJ or laptop-performer, where the processual character of the work installs a position of being both performer and observer. D’Errico argues how this entails a shift in the focus and the creativity towards the formal mechanics of the computational system (D’Errico, 2016, p. 96). It is essentially a position and approach that stems from hip-hop and EDM’s intertwined histories. The preference for loops and process-control rests upon both the creative (ab)use of particular technologies and the Afrodisporic adoration for the negotiation of the ongoing. Joseph G. Schloss (2004) describes how the aesthetics of sample-based hip-hop is based on a veneration for processual mastery, where it is less about the significance of the individual sound objects and more about producer’s skill in manipulating them (Schloss, 2004, p. 159). It is a combination of particular cultural and aesthetic sensibilities that are met, hosted and expanded upon in particular usages of technology.

In contemporary pop production, the use of samples and prepacked loops has been taken to a new level in cloud-based music production. When producers across the globe can access and use the same downloadable presets, samples and full loops (for instance through subscriptions to services such as Splice, Noiiz or Loopcloud) the creative emphasis is put on their use and relation to other parts. Fundamentally, this is a shift to processual interconnectivity. In a sense, this is a practice or logic that is already embedded in the modularity of sound synthesis. Essentially, analogue sound synthesis is based on fluctuating voltage used to shape and control other kinds of fluctuating voltages. In other words, it is a system of signal processing through the interconnected modelling of sound across parameters. From this perspective, music production is a macro-synthesis of sound works as a hybrid algorithmic structure. It is not just in its basis on loops, but in the conjunction of multiple automated functions that interrelate and define each other mutually. Processes affect the processes of other processes.
This has interpretive consequences for notions of groove, time and how they relate. In his analysis of the interaction between humans, data and nonhumans, sociologist Mike Michael (2004) describes what he calls ‘co(a)gents’: ‘The value of particular co(a)gents rests not so much on their empirical ‘accuracy’ as on their capacity to illuminate otherwise hidden processes’ (2004, p. 10). In other words, characteristics such as timing carry less meaning than the processual assemblage they help constitute. What’s important is the way that details repeat. Correspondingly, groove has less to do with the discrepancy of, for instance, a snare drum, and more to do with what technological process the discrepancy signifies as part of an interrelational material whole. What does this type of looping signify?

The timing characteristics of the three songs analyzed above all signify very concrete technological practices that again signify genre. In other words, in a step away from humanistic interpretations of music production, groove in contemporary digital music production is produced by a particular entanglement between timbre and media materiality as they are defined by processes.

**Prehensions in the grid**

The grid rules in all the songs analyzed above. Arguably, it is most fully present in the gridded trap-beat of ‘rockstar’, but it also works as very active but to some extent silent partner in ‘Scared to be lonely’ and ‘Chained to the rhythm’ (often literally silent since the controlling triggers and various processes don’t actually make a sound, but control sounding instruments). Groove is thus created in a push and pull between quantised rigidity and sounds that divert according to the grid. In other words, the sounds and the virtual reference structure are directly connected. In this type of grid-based music, where the grid literally grasps its sounds, we need to account for this new relationship between the reference structure actually interfering and how it does so.

The grid-deviations of the wall in ‘Scared to be lonely’ and the sample-like group in ‘Chained to the rhythm’ do seem paradoxical. From a performance-based perspective, they hold substantial discrepancies. Yet, these are shaped against and according to the grid – intricate, detailed and complicated in very inhuman ways. They demonstrate multiple algorithmic agencies that interrelate and create levels of complexity that are humanly impossible, and these are then repeated verbatim. The unruly and somewhat unpredictable is repeated with digital accuracy.
according to the exactness of the grid. In other words, exactness manifested on very different levels and in very different ways, and these relate and connect in specific ways.

This processual intersection of agencies begins to resemble the process philosophy of Alfred North Whitehead. His fundamental concept of ‘how an actual entity becomes constitutes what that actual entity is’ (1978, p. 23, italics in original) does indeed seem to resonate with contemporary culture.35 A central tenet in his process philosophy is his concept of ‘prehensions’ that are ‘concrete facts of relatedness’ (Whitehead, 1978, p. 23). Transported to new media, they grasp, connect, include and exclude, and transform data, thereby defining what an entity is and how it relates to others (Parisi, 2013, p. xii).36

Adding this perspective to the interpretation of digital pop music’s processes puts the emphasis not on static entities, but the mutually constitutive character of shaping sound. How are individual sounds shaped by combinations of functions? For instance, the staging of Dua Lipa’s vocal is defined by not only reverb but reverb combined with particular types of dynamic compression and gating. It is also a process of grasping, including, excluding and transforming through operations that entail agencies of both subjects (Lipa and the producer) and objects (the essentially algorithmic processes of the DAW). Interpreting the wall of ‘Scared to be lonely’ is an analysis of how the grid grasps the functions of one or several sidechain compressors that control the envelope of multiple sounds. Interpreting pop music thus becomes an analysis of how entities specifically relate across microcosm and macrocosm. While ‘rockstar’ demonstrated less

35 New media researchers have, in various ways, employed the process-relational philosophy of Alfred North Whitehead to account for computational culture and contemporary society in general (e.g. Shaviro, 2009; Hansen, 2015; Bucher, 2018). For instance, Steve Shaviro writes: ‘In a world where everything from music to DNA is continually being sampled and recombined, and where the shelf life of an idea, no less than of fashion in clothing, can be measured in months if not weeks, Whitehead’s question is the truly urgent one’ (2009, p. X). Luciana Parisi’s engagement with Whitehead in various ways deals with the aesthetics of algorithmic structures in relation to how they reveal the limits of rationality and perception (Parisi, 2013, 2015, 2016, 2017a, 2017b).

36 In ‘A Thousand Plateaus’ (2002) Deleuze and Guattari introduce similar post-Bergsonian notions of what they call ‘striated’ and ‘smooth’ space, or, as Luciana Parisi defines them, metric (striated) vs. vectorial and projective or topological (smooth) space (2013, p. x). While they are not oppositional, they exist only in mixed forms and relate in reciprocal presupposition. Yet, Parisi finds the mutualism between the two insufficient to explain what she calls ‘the mode of extension produced by the ingress of computation into culture’ (p. xi) and therefore turns to Whitehead.
direct interrelations, it still revelled in the multiplicity of functions across the particular and the general.

New essential questions arise: what is the relationship between individual sounds and the grouping of them and how are they grouped? With, for example, MIDI, many seemingly different sources – pitch-control information (e.g., Auto-Tune or Melodyne), dynamic control (such as compression) or frequency filters – can become similar or even one (like the grouping of sounds in ‘Scared to be lonely’ and ‘Chained to the rhythm’). Conversely, one source can become many when the same meta-data is applied to various sources (for instance if performance data is sent to different sounds). Grouping is not a new thing (e.g., grouping drums on a mixing desk), but connecting, interrelating and multiplying in the DAW is not just easier, but part and parcel of the compositional practice. When sounds increasingly interrelate or are subject to master effects, it blurs distinctions and creates a de-hierarchisation of individual sounds and metadata. This turn to the assemblages of prehensions therefore involves a shift of focus towards how data (audio or metadata) multiply across a track, how algorithmic processes interrelate and which patterns they form.

**Topology and suspended difference**

However, the shift to processes engages with the teleology and dynamics of the three tracks discussed here in very different ways. They are all fundamentally based on setting up, controlling, editing and adjusting running processes. Even so, the outcomes are very different. In ‘Scared to be lonely’, the overtly teleological ‘time-stretched’ break routine is seemingly a stark contrast to the suspended difference of ‘rockstar’. So, if contemporary society is indeed increasingly subject to an emerging rationality of topological culture (Lury et al., 2012), ‘Scared to be lonely’ can be heard as a reflection of this. Yet in ‘rockstar’, suspended difference seemingly defies this. Static or circular music is far from new, but ‘rockstar’ is innately digital from inception, distribution to reception. It gains a different value coming from the inside of the digital’s topological nature. From this perspective, the trap track begins to exemplify what Wolfgang Ernst (2018) calls the true luxury of today’s temporal economy: the resistance towards permanent change. Instead, this ‘suspension from mobility’ reflects a ‘katechontic impulse of pausing’ (Ernst, 2018, p. 173). In other words, the excessive difference-defying sameness afforded by digital music production and exhibited in ‘rockstar’ not only connects with a societal shift towards precision and synchronisation. It is at the same time an aesthetic opposition to
society’s topological flux. As music as well as an algorithmic structure, the excessive negation of difference in ‘rockstar’ bends and negates its doubled topological nature.

The substantial differences and embedded temporal ambiguities of the pop tracks seems to reflect similar ambiguities in new media networks’ temporalities. They are defined by a duality between a relentless presence and a constant evolution. ‘Contents of the media seem to oscillate between process and stasis, rigid and fluid, storage and transmission/processing in a regular manner’ (Winkler, 2009, p. 9). Ephemeral and ubiquity. Concurrently, our access to the past and its juxtaposition with the present is changed by the expansion of information. We work polychronically, engage in multiple activities simultaneously and place less value on temporal order (Lee & Sawyer, 2010, p. 301). Temporality becomes heterogenous as it is both defined by a pluralization and at the same time new levels of coordination and synchronization (Couldry & Hepp, 2016, p. 107). Again, like gridded pop prehensions, the ambiguous meets exactness and precision.

Agency, algorithms and the human scale
In contemporary society, the issue is not so much a lack of time to react, but a lack of time for interpretation or making narrative sense (Couldry & Hepp, 2016, p. 114). For Wolfgang Ernst, this ‘crisis in the narrative memory of culture’ (Ernst, 2012, p. 251) liberates music from both semantics and hermeneutics, but also the conventional time domain (Ernst, 2012, 2016b). Ernst’s media materialism defies direct reference, but still holds signifying capabilities beyond direct conscious attention. This does not mean that Ernst rejects social, political or economic factors. But, in line with the ontology of Whitehead (and among others Latour 2005), he proposes a media materialism that accounts for a lack of human gesture. Digital processes flatten the hierarchy and levels the ground between the affective, human body and its coexistence with the nonhuman.

Ernst’s media materialism is heavily influenced by a German media studies and particularly Friedrich Kittler (and to some extent also Foucault’s reading of media). Kittler’s influential writings traced the invention of the alphabet to the distinct emergence of analog media (such as the gramophone) that again lead to digitalization and the computer (Kittler, 1999). For Kittler, the move is from the symbolic order to one that essentially rules out human perception and thus also hermeneutic sense-orientation as well as phenomenological strategies (Kittler, 2017).
For pop music, the de-hierarchisation of subjects and objects is particularly embedded in its hybrid assemblages of algorithms. Agency is innately entangled with, divided and dispersed to actors outside the human realm which challenges the pedestal of the human subject and its perception. The (essentially Kantian) claim that phenomena depend upon the mind to exist is suspended. This arguably presents some challenges for phenomenological understandings of digitalization. Digital theorist Mark Hansen has, in a long line of publications, critiqued overtly phenomenological interpretations of twenty-first century media (e.g. Hansen, 2012, 2013, 2015, 2016). He fundamentally argues that ubicomp culture disjoins worldly temporalization from human temporalization. Sheer speed and infinitesimal detail can be adjusted and repeated beneath the threshold of human attention. It is a question of scale and complexity that creates the sensation of something not wholly biotic but irreducibly technical (2013, p. 72). ‘Ubiquitous culture has made the microtemporal sensuous’ (Hansen, 2013: 74). Similarly, pop’s digital temporality, its scale, its automated interrelational agency, its level of complexity including the staging of the microtemporal also innately challenges overt anthropocentric interpretations.

**Tacit knowledge**

From a listening perspective, this means that temporality manifests differently. Like the inherent, immanent character of ubicomp that exists in the peripheral background, beyond or outside human perception, so do the processes that constitute digital pop. However, instead of completely writing intentionality off in a black-boxing of algorithmic processes, Taina Bucher argues that ‘tacit knowledge’ of the underlying logic of the system lingers in background (Bucher, 2017, 2018; the term originally stems from Michael Polanyi, see e.g. 1966;). The same could be argued regarding listening to digital processes. It is a processual unfolding that manifests less in relation to direct or conscious interpretations. In this shift from perception to

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38 In his analysis and comparison of early minimalism and disco, Robert Fink (2005) makes a like-minded argument. He argues how the hour-long repetitions of minimalism and (ecstasy-fuelled) weekend-raves challenge the human scale of classical musical teleology, which is based on goal-direction and ‘a basic phenomenological congruence with the way we perceive quotidian bodily rhythms’ (p. 44). Due to the ambiguous nature of repetition, he suggests the non-binary term ‘recombinant teleology’ (Fink, 2005, pp. 42–7).
sensation, musical referentiality gains an indirect character where it is more subject to prereflexive experience of the logic of the music unfolding. The processual transferral of inscriptive value also offers a somewhat different approach to technological evocations of the past. It adds a temporal element to the opaqueness of mediation, yet it is more akin to Ernst’s prereflexive media archaeology than notions of sonic patina that nostalgically transport the listener to days gone by (Katz, 2010, p. 155) or retromania (Reynolds, 2011). It suggests a palette of technology-embedded temporalities that preconsciously manifest as signifiers of practices and genre. This is not to say that listening to contemporary pop music is devoid of consciousness perception. But, compared to performed music, pop music in the twenty-first century represents a different, digital process-based ontology that – akin to the digital culture that most of us inhabit – suggests different aesthetic potentialities and lends itself to different kinds of listening. This is less about interpretation, semantics, phenomenological intentionality or teleology-inducing difference. It is tacit knowledge lingering in the background of the manner in which processes unfold.

**Conclusion**

I have followed a trajectory of digitality and process. It has involved perspectives from new media studies and process-philosophy. I have given less space to the multiplicities of pop that do not abide by a logic of either digitalization or process. Nevertheless, my main argument here is that contemporary pop displays different kinds of technological significations that reference specific musical practices and genres, and that these manifest prereflexively. Listening to rhythm in pop music is less about intentionally experiencing difference-induced time unfolding; rather, it is defined by heterogenous temporalities inhabited by the listener.

I have discussed how both electronic music cultures and digital culture suggest temporalities that differ from more traditional interpretations of phenomenological time. I have argued that these intersect in contemporary pop music production in its assimilation of the compositional practices of hip-hop and EDM, which are forged by a new generation of DAWs that are conditioned by, reflect and engage with ubicomp.

My three analyses present very different teleologies. ‘rockstar’ presents what I called a suspension of difference and thereby a particular ambiguous teleology of being subject to musical time passing, which is at the same time bent or even negated by digital circularity and
inhuman exactness. ‘Scared to be lonely’ presents an almost overt teleology in its constant set up and push towards the next formal unit. Yet the consistency of this forward motion also installs a kind of formal circularity. It is a different kind of ambiguous teleology, as well as a different kind of rhythmic discrepancy according to the grid where virtual as well as actual entities literally grasp each other.

A strict process-paradigm will deny repetition without difference. However, combining process-ontology with phenomenological listening arguably presents some fundamental problems as the latter is based on a unified (and confident) conscious perception. Deleuze’s process-ontological interpretation of consciousness (and the multiplicities of duration) is essentially Bergsonian (Henri Bergson, 2004; see also Gilles Deleuze, 1991, pp. 117–8;). And a strict process-ontology will also deny the privileging of a unified conscious perception because of the multitude of object-subject independent temporal unfoldings. In other words, the processes of digital pop music afford a distribution of agency and operations on a scale that challenge conscious interpretation towards a tacit experience of the manner in which processes unfold. It puts the emphasis on how music unfolds in time qualitatively. Digital pop music offers some very intricate and particular technology-signifying heterogenous temporalities that are based on a negotiation of the relationship between music and time in a way that is innately digital. To resign the temporalities of digital pop to an overt Heraclitan unilinear flux that does not distinguish between the hows, the manner, the types of unfolding in its distributed agencies, would be a disservice. Because it is perhaps exactly here that – in the ambiguity and complexity of the temporal – that listening pleasure resides.
Outro

This article presents what can be understood as the philosophical core of my argument in this dissertation. It also engages with some of the more ontological consequences of approaching pop as process. However, three musical analysis is not a lot or representative, so before I further discuss the more philosophical implications, I would like to broaden the musical perspective a bit in terms of temporalities, structures and teleologies.

**Pop’s other forms**

An inescapable challenge related to musical analysis it that the music analyzed will never represent any kind of exhaustive version of the subject at hand. I have sought to choose tracks that compliment as well as contrast each other, yet there will obviously still be perspectives that remain untouched. For example, none of my analyzed tracks display jarring juxtapositions, structural jumps, or “African cuts”. It seems that trap hip-hop involves a more unchanging circularity at the expense of the cut than hip-hop has previously revealed in. Cuts do still occur, but often with varying outcomes. For example, Travis Scott’s “SICKO MODE” (2018) abruptly shifts from modes that never reoccur. In comparison, “This is America” (2018) by Donald Glover’s moniker Childish Gambino demonstrates how the sudden shift can be used for dramatic and narrative purposes (which is amplified in the track’s video, when Glover shoots a hooded Black man in the head).

Another perspective is the heterogeneity of various drops within EDM pop. A long line of tracks around the mid-2010s began to excel in anti-climactic, often almost playfully odd drops. The buildup, with risers and a break, leads to a drop that seems to fall deliberately flat. This tendency is sometimes described under the electronic subgenre “future bass”, which includes DJ producers such as Cashmere Cat, Flume and Marshmello.

On a more general level, the pop drop in more traditional verse-chorus structures often changes the chorus’ relationship to the verse. Distinctions between the two are often lacking as

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39 For cuts, listen e.g., to Kanye West’s “Power” (2010), “Ni**as in Paris” (2011) and “On Sight” (2013).
melodies and hooks are shared. Another characteristic reminiscent of the drop or dance chorus is what could be labelled “the dry chorus”. In traditional popular music, there is a trope of going from a smaller or less reverberated space in the verse to a contrasting chorus with a larger and/or more reverberated space (Zagorski-Thomas, 2020, p. 14). However, this is sometimes reversed, akin to the dry drops of EDM pop. For example, the chorus in Dua Lipa’s discoesque “Don’t start now” (2020) follows a reverb-heavy prechorus. The chorus reaches a significant climactic effect due to its dense, drop-like dryness that is almost completely void of audible reverb. Every sound (including Dua Lipa’s vocal) is dramatically switched to the proxemic front exposing every sounds’ dry materiality. This effect can however not solely be attributed to the influence of drop-based music. For instance, ABBA often utilized a similar effect, for example in “Super Trouper” (1980).

I will now move on the some of the more ontological questions raised in this article.

Process philosophy, correlationism and post-phenomenology

Process philosophy challenges the Kantian claim that “phenomena depend upon the mind to exist”. It shares this with speculative realism and its rejection of what Quentin Meillassoux calls correlationism, which he defines as the doctrine that says “we never grasp an object ‘in itself,’ in isolation from its relation to the subject” (Meillassoux, 2014, p. 5). In other words, it is the idea that we only have access to the correlation between thinking and being, and never to either term considered apart from the other. As Graham Harman writes, under correlationism, “everything is reduced to a question of human access to the world, and non-human relations are abandoned to the natural sciences” (Harman, 2009: 156; see also Young, 2020). Phenomenology, with its concept of a fundamental noetic-noematic (intention-object) structure is essentially correlationist (Braver, 2007; Shaviro, 2014). This is challenged by ubicomp. Couldry and Hepp express this with some diplomacy when they write: “The ways in which we make sense of the world phenomenologically become necessarily entangled with the constraints, affordances and power-relations that are features of media as infrastructures for communication” (2016, p. 7).
Mark Hansen has, as briefly mentioned in the article, over several articles and books, meticulously discussed phenomenology’s place in twenty-first century media.\footnote{Hansen sometimes calls his critique “a media-theoretical deepening rather than critical repudiation of phenomenology” (Hansen, 2013, p. 73), and says that “a strong emphasis on the constitutive role of technology could function not simply to denounce but to revalue the project of phenomenology” (Hansen, 2012, p. 45), or simply a “revitalization of phenomenology” (Hansen, 2016, p. 34). He is perhaps most clear in the conclusion of his book \textit{Feed-forward: on the future of twenty-first-century media}: “The inaugural dream of phenomenology – to constitute consciousness at the moment of its self-present happening – has run its course: confronted with the networks of twenty-first-century media, constituted consciousness has been forced to relinquish any operational role it may have in creating sensible presencing” (Hansen, 2015, p. 254).} A returning subject of his critique is Bernard Stiegler’s (1998, 2010) reading of Husserl’s phenomenological explication of time and memory. The Husserlian figure of time-consciousness is, in Stiegler’s media philosophy, adapted to what he calls “technical temporal objects”. Stiegler does this by both rehabilitating and expanding Husserl’s conceptions of primary and secondary retention. Stiegler focusses on audio and video recording in what can be interpreted as a neo-phenomenological model of media. For Stiegler, new experiences increasingly rely on recorded technical memory, which he calls tertiary retention. This shapes our lives as humans from the day we are born, and we have no other option but to rely on what he calls industrial temporal objects.\footnote{Stiegler and the term “the industrial technical object” is highly indebted to Gilbert Simondon’s work on technology and society (see Stiegler, 1998, pp. 66–76; Simondon, 2017)} Hansen sums up Stiegler’s account: “For Stiegler, the appearing of the phenomenon (phenomenology) is strictly synonymous with the experience of time by consciousness (time-consciousness). This synonymy has the effect of instituting lived experience, \textit{la vecu}, at the very heart of the phenomenological method.” (Hansen, 2012, p. 56). Cinema is in Stiegler’s account the exemplary example for a long line of the technical, since it offers a technical support for our experience of time, and consciousness consequently has a cinematographic structure. Time-consciousness is based on a process of selection similar to cinematic editing and depends on the technical objectification afforded by cinematic temporal objects.

Even though the technical temporal object – in its reliance on external memory – differs from the temporal object, in Hansen’s critique it is still based on an internalization of something external into the functioning of consciousness and memory. While acknowledging Stiegler’s
emphasis on technology’s essentiality, Hansen takes Stiegler to task for his correlation between
time and consciousness. This is increasingly problematic in ubicomp culture.

What the constitutive and defining invisibility of ubiquitous computing actually
foregrounds is the centrality of microtemporal and by definition imperceptible
informational flows at the very heart of contemporary sensory experience […]
ubiquitous computational environments can never be brought into the sphere of direct,
conscious attention and awareness; rather, it impacts sensory experience unconsciously,
imperceptibly – in short, at a level beneath the threshold of attention and awareness.
(Hansen, 2013, p. 70, italics in original)

In other words, ubicomp defies the indexing of human consciousness and instead operates “at
scales well outside of what humans can perceive” (Hansen, 2013, p. 76). Human cognition and
computational processes do not share temporality, and consciousness lacks direct access or a
fundamental understanding of it. Hansen therefore turns to Husserl’s student Eugen Fink and his
term Entgegenwärtigung (“depresencing”) and Alfred North Whitehead’s expansion of
experience beyond sense perception as ways to understand new media, which differs from the
old media of storage in Stiegler’s account.

It is also in this light that I engage with tacit knowledge of the underlying system.
Process philosophy’s disbandment of the subject as primary or originary also entails a particular
mode of registering data. In Parisi’s application of Whitehead in digital culture, this entails an
automation of reasoning (Parisi, 2016) and a “sensual or physical and conceptual or non-
sensuous mode of recording the external world” (Parisi, 2019, p. 117). Brian Massumi (2002)
describes the stream-like aspects of experience: “We become conscious of a situation in its
midst, already actively engaged in it. Our awareness is always of an already ongoing

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42 Hansen identifies similar problems in the deconstructive paradigm, and particularly in Derrida, which a lot of
Stiegler’s work is based upon (Hansen, 2013, pp. 75–76). He sums up his critique as follows: “The deconstructive
model fails to the precise extent that it preserves the object-centered, perception-focused, egological approach
facilitated by the traditional (Husserlian) phenomenological reduction” (ibid., p. 76).
participation in an unfolding relation” (2002, p. 231). In other words, participation precedes recognition.

**Transhumanism or speculative posthumanism?**

This diversion or denial of the anthropocentric is reminiscent of posthumanism. The term is not new anymore and by now often used in discourse outside academia. Posthumanism comes in different flavors (Roden, 2015, p. 20). The term often refers to entities that defy human scale, but it can also suggest a lack of distinction between body/technology and consciousness/media. There are in other words many different ideas of what the posthuman entails.

One approach is the transhumanistic, in which technology is seen essentially as an enhancement of human capacities. This can be found in for example Anne Danielsen’s arguments:

> Posthuman expressions are not after or outside of the human repertoire at all. Instead, they should be considered simply the most recent expansion of that repertoire. This would mean, in turn, that the microrhythmic manipulation made possible by the DAW represents, in principle, nothing new, because there is nothing new in the fact that new

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43 For example, Robert Fink (2005, p. 32) discusses how Leonard Meyers’s analysis of the anti-teleological implications of John Cage’s chance music can be understood as a harbinger of posthuman metaphysics. Meyer writes: “Man is no longer to be the measure of all things, the center of the universe. He has been measured and found to be an undistinguished bit of matter different in no essential way from bacteria, stones, and trees. His goals and purposes; his egocentric notions of past, present, and future; his faith in his power to predict and, through prediction, to control his destiny – all these are called into question, considered irrelevant, or deemed trivial” (L. B. Meyer, 1967, p. 83). Wim Mertens (1994) makes a likeminded point writing on Cage, minimalism and how they abolished what he calls the “musical argument” of classical music (Mertens, 1994, p. 88). It is replaced with what he calls a “macro-time” that defies traditional notions of continuity, progression and causality (and thus teleology) as it is traditionally created by dialectical contrasts. It is a “neutralization of time that occurs in traditional music… macro-time is essentially static, and duration is an atomized conglomerate of moments, without relation to past or future” (1994, p. 107).
technology produces new forms of knowledge, expression, and behavior or that it expands the scope of the human imagination. (Danielsen, 2019, p. 603)

From this perspective, technology becomes an extension, a (Heideggerian) tool the for the human. But as I have argued, (digital) technology must be understood as an ensemble of processes. As an ensemble, technology involves more than particular tools or machines. It involves the relations between functions, and relations between them and the human beings who use them, as well as between the materials with which they interact.

Deleuze and Guattari write on the synthesizer: “By assembling modules, source elements, and elements for treating sound (oscillators, generators, and transformers), by arranging microintervals, the synthesizer makes audible the sound process itself, the production of that process, and puts us in contact with still other elements beyond sound matter. It unites disparate elements in the material, and transposes the parameters from one formula to another.” (Deleuze & Guattari, 2001, p. 343). From a transhuman perspective, the synthesizer can be understood literally as a tool, as an instrument that functions as an extension of the performer or composer (and her agency, intention etc.).

But, to engage Jane Bennett and her “vibrational materialism”, transhuman interpretation misses what she calls “thing-power”. It is the power possessed by non-humans to affect and be affected by other beings (Bennett, 2010; see also Wong, 2013, 2015, 2018 for vital materialist approaches to sound). It is a vitality that (in line with Whitehead) defies binary oppositions between life and matter and affords energy to any atom in existence. All forces can become lively, and the static and immovable can possess and create affect as well (Bennett, 2010, p. 117). Algorithmic structures that operate beyond or outside experience and perception can thereby “become a vehicle for exploration that extends beyond the limits of perception” (Terzidis, 2005, p. 72).

Pop production’s processuality raises some fundamental questions regarding control and agency. From a compositional perspective, the digital shaping of time and space – what Luciana Parisi (2012) calls the parametric aesthetics of topological culture – is not just about relying on the capacities of algorithms (Parisi, 2012, p. 167). It is also about “unleashing random events in unlived worlds” (171). In other words, wielding algorithmic processes involves a deliberate stochastic element. For the digital pop producer, this fine line between control and lack thereof demands a certain compositional sensibility that can aesthetically traverse the qualitative experiences of time-space at the border of lived and unlived worlds.
This somewhat more radical approach includes a perspective that is sometimes labelled as speculative posthumanism in that it essentially opposes human-centric thinking about the long-run implications of modern technology (Roden, 2015).

This can sound like a mouthful in relation to pop tracks, but my argument here is that posthuman dilutions of the relationship between the human and technological miss fundamental parts of the aesthetic potentialities of electronic music. The art and pleasure of digital pop is based on the negotiation of human and technological agency; the producer controls and adjusts the algorithmic automations across loops and signal processing. This also entails the transfer of agency to processes with inhuman ontologies that has their own power and aesthetic force.

I now move on to the third chapter that deals with the spatial consequences of this process paradigm. I have not felt a need for an Intro, so we begin with the article.
Chapter Three: Space

Article 3: Pop materializing: Layers and topological space in digital pop music

Abstract:
This article argues that pop music’s increasing assimilation of hip-hop and EDM practices combine with computational automation and this has substantial consequences for musical space. Traditional ‘space-makers’ like reverb or delay are subject to other functions such as frequency-filters and compression that interrelate processual layers of textures. Instead of an active-listener orientated sonic space with distinct source-bonded entities, it is based on a particular sonic materiality. With a new media theoretical approach, I consequently argue that this new type of space can better be understood as a mediatized topological materiality.

Keywords: Pop; recorded space; music production; sonic materialism; digitalization

Introduction
Two interrelated transformations are changing sonic space in contemporary pop music. First, hip-hop and EDM practices are increasingly being assimilated into pop music productions. These music cultures mainly stem from dance floors and sound systems, and their production methods are based on turntablism, samplers, synthesizers and sequencers. Less dependent on recording or faithfulness to source-bonding or physical gesture, they suggest different approaches to the staging of space. Secondly, the practices of hip-hop and EDM are increasingly hosted by a new
generation of digital audio workstation (DAW), which are innately digital and connected with twenty-first century computational culture.

Music theory about recorded space is traditionally based on semantic models of source-bonded sounds. It often rests upon a music-psychological, ecological and corporeal approach to space that presupposes an active listening navigation of a virtual sonic space. The initial models were William Moylan’s Sound Stage (Moylan 1992, revised in Moylan 2015) and Allan Moore’s sound-box (Moore 1993, revised in Moore 2012), which map the virtual spatiality of sound sources based on a live performance-based “natural” image’ (Zak 2001: 145; see also e.g. Lacasse 2000; Zagorski-Thomas 2014).\(^4\) Likeminded notions can be found in theory about musical performance gestures. The sound of musical gestures implies a particular embodiment (e.g., the physicality of a performing drummer) that evokes and emphasises spatial and metaphorical sound-sourcing capabilities (see, e.g. Godøy 2009; Théberge 2016). It has been discussed how recorded music can also suggest unreal (Zagorski-Thomas, 2014) or surreal (Brøvig-Hanssen & Danielsen, 2013) spatialities; these can be created by MIDI, sampling, reverb, delay and the general ability to mix and juxtapose different spatialities, resulting in an ‘unnatural’ space within space. Yet Brøvig-Hanssen and Danielsen argue that this still tends to ‘point the listener toward a real-world physical phenomenon even as it acts to undermine that reality’ (2016: 27). In other words, the listener will always tend to compare unnatural sounding sounds with sounds from actual physical spaces. (Ibid.: 40).

However, these understandings are mainly based on visual interpretations of space, and on rock-oriented recording studio practices.\(^4\) They represent a particular mediatization practice

\(^4\) They are directly or indirectly indebted to ecological conceptualisation of visual perception (James J. Gibson, 1979), which was introduced to music psychology by Eric Clarke (2005). He argues that we actively engage with environments and perceive affordances as potentials for action based on previous experiences. Similar interpretations can be found in Lakoff and Johnson’s (1980) cognitive philosophy. To them, experience is always embodied, and knowledge is based on conceptual metaphors and previous sensorimotor experiences. Movement and spatiality thus form what they call an image schema in the mind (Johnson, 1987; Lakoff, 1987).

\(^4\) I discuss the logic and practices of newer DAWs as opposed to the recording studio paradigm in more detail in the forthcoming article ‘Who let the DAWs Out? The Digital in a New Generation of the Digital Audio Workstation.’
where individual sounds possess spatialities and these are then treated, negated or supplemented with either real or unreal spatialities via, most often, reverb and delay. My main argument in this article is that contemporary pop is less based on real, physical or natural interpretations of space. It is innately electronically produced. Synthesized sounds tell us very little about the sounds themselves (Wong, 2013: 193), and one’s understanding of how they were produced cannot be traced to a single familiar instrument (Butler, 2014: 67). This challenges traditional semantic interpretations of performance-gesture and source-bonding. Instead, pop music, like EDM is increasingly based on a negotiation of texture (Butler, 2006, p. 93).

I therefore begin this article by discussing how the practices and techniques of hip-hop and EDM represent different approaches to layering texture at the expense of source-bonded spatial staging. I apply these perspectives to the analysis of three pop tracks to explore how space is actually negotiated and to what end. Based on the analyses, I turn to new media theory. It has been argued that contemporary society is increasingly subject to an emerging topological rationality due to ubiquitous computing (ubicomputer) (Lury et al., 2012). I discuss how this topological character of the computational relates to pop space, and, in conclusion, what consequences this has for pop music’s sonic materiality.

Layering of processes

Layering

Alan Moore (2012) conceptualises four functional layers in rock music that represent groups of sound sources that are hierarchically defined according to their function: the explicit beat layer (drums), the functional bass layer, the melodic layer (usually vocals, but also electric guitar, keyboard or solo instruments that carry most of the song’s identity), and harmonic filler layer (such as rhythm guitars, organs, pianos, voices, orchestras, etc.) (2012: 20–21). It is essentially a principle of making the instruments fit and complement each other. As implied by Moore, the traditional rock-ensemble’s instruments balance and complement each other in terms of the registers and functions they fulfil.

Similarly, mixing music is traditionally a give and take between depicting every individual sound source as acoustically realistically as possible, and fitting them in with the other sounds. This fit is partially defined by avoiding masking, which is when sounds share frequencies in ways that blur clarity and distinction. For instance, a kick drum and a bass will
naturally often share specific frequencies in the lower register. This is resolved with mirrored equalization where frequencies are boosted in one part while the same frequencies are cut in another part and vice versa. Like a lateral game of frequency-Tetris, the highly complicated art of a traditional good mix is a puzzle of finding a place (or several) for each sound.

However, in sample-based music, contrasting space, timbre and texture are in different ways an inherent part of the production practices. This can be interpreted as a process of timbral juxtapositions (Krams, 2000: 73), but Joseph G. Schloss (2004) warns against emphasising fragmentation over textural cohesion. In fact, hip-hop aesthetics is more about ‘a cohesive organising principle than the diversity of the individual elements that fall into its orbit’ (2004: 66). In DJing, the main organising principle is the manipulation of layers within and across tracks. ‘Sliding the faders’ often involves the use of various EQ-filtering techniques for the addition or subtraction of parts; this has been central to DJing techniques since the 1970s (one can find the roots of EDM in disco). 46 Low pass filtering’s subtraction of top frequencies is particularly common in house music, which creates the common ‘underwater effect’ (Zeiner-Henriksen, 2010: 237). Conversely, subtracting lower frequencies (high pass filtering) can add tension, leading to the climactic reintroduction of bass in a ‘drop’ (Solberg, 2014). 47 These filters are often not used statically, but as sweeps across the frequency response emphasising the filter’s resonance. The various filter sweeps and the fundamental notion of shaping sounds through filters is also a central part of sound synthesis. This is augmented by the use of filter resonance that boosts the area where the filter begins to cut the frequencies off, thereby amplifying not only the effect on the sound but adding filter noise and even distortion.

In EDM, it is not uncommon for producers to mix their own material (Devine & Hodgson, 2017). In pop, mixing and mastering are still done separately by highly specialised

46 For example, in 1970s New York DJ Nicky Siano famously experimented with switching separate parts of the sound-system on and off to build variation and tension. ‘I would turn everything off except the tweeter arrays and have them dancing to tss, tss, tss, tss, tss, tss, tss, tss for a while … Then I would turn on the bass, and then I’d turn on the main speakers. When I did that the room would just explode’ (quoted in Lawrence 2003: 108; italics in original).

47 These processes have been made more accessible by desktop-based DJ-software applications such as Serato DJ or Traktor Pro. They visualise energy levels of different frequency ranges within audio material, making it easier to not only identify and predict parts, but also to control and shape them (Grote, 2016: 195).
engineers, but their techniques have increasingly become part of compositional practices. Such techniques are often used creatively and taken almost to extremes. Similarly, trap and other related hip-hop subgenres offer new and almost anarchistic approaches to clarity, masking and mixing with a propensity for distortion, boomy (sub-)bass, downwards pitch-shifted sounds, grainy tape-emulation and degraded sample-rates. The result is often a lack of upper frequencies and natural overtones, which provides a perfect foundation for a rapper to clearly stand out with presence and lyrical precision without masking.48

This also affects interpretations of proximity. Since high-frequencies die quicker over distance than low-frequencies, high-frequency content suggests greater proximity (Zagorski-Thomas, 2010: 203). In other words, the layering approach directly affects notions of distance and space.

Similarly, various types of distortion are increasingly used in untraditional ways. For instance, the highly successful DJ gone pop producer Calvin Harris describes how he (mis)used his Focusrite VoiceMaster Pro channel strip (which includes compression and distortion): ‘The Focusrite was brilliant, because I could really crunch the vocals up and distort them to hell. That was my mixing technique. Distort everything to hell, then you don’t have to worry about things like EQ and balance.’ (Future Music, 2012b). In other words, it enabled him to achieve loudness at the expense of fidelity. Akin to what Tricia Roses (1994) called hip-hop production’s ‘working in the red’ (Rose, 1994: 74), pop production increasingly displays a disregard for fidelity, clarity and consistency and thereby a disregard for recognition and identification.

48 For instance, producer Noah ‘40’ Shebib created Drake’s signature sound mainly by degrading the sample-rate (downsampling) and thereby removing many of the mid and higher frequencies. In a 2016 YouTube-video for Native Instruments he explains his method: ‘I was carving out an entire space in the frequencies, so the artist occupies the top end completely, almost exclusively, and the music sits in the bottom end’ (Native Instruments 2016; see also Tingen 2012). In other words, data compression becomes more than a mean to portability (like the mp3 format) (Kassabian, 2016), where the goal is fidelity (Softky, 2019), but a compositional technique and artistic expression.
Envelope, compression and the master perspective

In electronic music production, the temporal stages of a sound are defined as envelope. The main parameters are attack, decay, sustain, release (ADSR). Setting, tuning, editing and controlling these parameters on sounds, filters and amplifiers (and combining them on individual sound sources as well as on grouped sounds) is integral to creating electronic music. With the perspective and techniques of sound synthesis increasingly informing pop music, envelope control becomes a central parameter in not only the shaping of sounds, but the creation of sounds.

Often, the manipulation of envelope is combined with dynamic control – for example, compression, limiting or gating. Compression is essentially an algorithmic operation in that it is a process of ‘if the volume of a sound reaches the threshold X, then duck its volume by Y’. A compressor’s envelope can also be set as well as other factors such as ratio, knee etc. Since the volume peaks thereby can be controlled, it allows for an overall volume gain, which adds to the coveted perceived loudness. Combined with gating (which shuts off the sound signal when it goes below a set threshold), dynamic control can enhance, remove or create the ‘natural’ spatial characteristics of a sound source. In other words, dynamic control such as a compressor is more than a guard against signal clipping or cancelling noise. It is an integral and creative part of producing and shaping sounds, particularly in relation to their individual or collective space. The operation of dynamic control is almost always in accordance with other effects or processes such as envelope, reverb or delay. A sound source will often have several parallel compressors controlling and shaping its envelope. For instance, when one compressor ducks the most significant volume peaks, it makes it possible for a second to add even more compression

Interestingly, compression suspiciously resembles the human ear’s way of reacting to loud sounds. Just as the compressor algorithmically responds to sound by turning the volume of the signal down, the stapedius muscles in the middle ear contracts in response to loud sounds (Møller, 2012; Popelka & Hunter, 2013). This contraction (also called the acoustic reflex) decreases the transmission of vibrations to the cochlea where they are converted into electronic impulses for the brain. Hearing, so to speak, automatically turns loud volume down. If the process of compression mimics our automatic and involuntary reaction to loud sounds, it follows that hearing compression at work causes a precognitive sensation of loudness. This adds new perspectives to the prevailing ‘louder is better’-paradigm that has been a fundamental parameter in popular music production since the 1950s (Milner, 2010; Taylor, 2017; Vickers, 2010).
without unwanted and uncontrolled dynamic shifts, because the direst peaks have been controlled in the first.

Sidechain compression is another example of this processual dynamic interconnectivity. It is a type of compression where the transients of one signal triggers one or several other compressors on other sound sources and thereby changes their dynamic envelope. The use of compression is therefore often a question of processes that connect and complement each other across individual and collective sounds.

Generally, digital music production is increasingly based on a modularity of patching up anything from synthesized sounds, waveforms, samples, envelopes, pitches, modulations, filters and effects in polyphonic manipulations. DAWs like Ableton’s Live are built around the loop-based master perspective of controlling algorithmic functions as well as running loops. It is a shift from the perspective of the physical studio’s mixing-desk’s aligned channel-strips representing each sound, and the step-by-step process of recording. Instead, it is a hybrid, interrelated macro-synthesis of sounds where adjustments multiply across microcosm and macrocosm. From this master perspective, function, hierarchy, individual character, register and spatial characteristics are negotiable, subject to the interconnected processes. The perspective shifts to the ongoing and simultaneous shaping of the whole through the stereo output.

**Space in the DAW**

In the following, I will analyse three pop tracks that represent different approaches to staging space. The tracks all negotiate or divert from natural or realistic sound environments in relation to their production processes. In discussing The Weeknd’s trap-like track ‘The Hills’, I focus mainly on the lead vocal’s spatial staging in the chorus. It is defined by distortion and its

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50 The effect can be subtle – for instance to make a lead vocal stand out in the mix – or it can dominate a track. The latter is often the case with the intricate beats of hip-hop artists such as J Dilla and Flying Lotus (D’Errico, 2015), or the characteristic ‘pumping’ of sounds on the off-beat in EDM-tracks where the four-on-the-floor kick drum as trigger ducks the volume of synthesizers and/or the bass.

51 I discuss the processual character of recent pop music and its consequences in the forthcoming article ‘Pop as process: the digitalization of groove, form and time.’
sidechained connectivity to the kick drum, and it demonstrates both an ambiguous reduction of sound sources and an inversion of hierarchies between layers. The upper registers are seemingly fairly traditional in Katy Perry’s ‘Hey Hey Hey’, but an intricately sidechained wall of bass and synths in the lower register is unusually unruly and unpredictable. The last track, Billie Eilish’s vocal-laden ‘bury a friend’, is less based on algorithmic interconnectedness and more on an unusual flattened yet ever-changing sonic space that negotiates the intimate and the material character of her many voices.

**Reduction and inverted hierarchies: The Weeknd’s ‘The Hills’**

The Weeknd’s vocal staging in the chorus of ‘The Hills’ (2015) is defined by two fairly radical features. First, the lead vocal is heavily distorted. This adds not only to the song’s hedonistic and nihilistic narrative, but also to a deflation of natural dynamics in his otherwise expressive performance. Instead of natural acoustic overtones, it is the distortion’s overtones that supply the upper frequency register in the lead vocal. Additionally, it lacks frequencies in the lower registers that would normally add body and intimacy to a lead vocal. Second, the vocal’s dynamics are characterised by a sidechain compressor that significantly ducks its volume (as well as the backup vocal and the synth-bass) when the kick drum is activated. To use Moore’s functional layer-terminology, the beat layer is literally ducking the bass and the melodic layer. The layer hierarchy is inverted and established by the sidechain compressor’s interrelational algorithmic automation. The timbral dilution of fidelity in the voice on account of machinic distortion and sidechained compression deflates interpretations of corporeal gesture. Instead, subordinate to the machinic kick drum, the vocal evokes a desubjectivizing material flatness. Arguably, the ducking of the lead vocal and the bass by the kick drum causes a sense of perceived loudness. It also makes an unlikely unity out of the vocals and the bass across not only registers and groups, but also across any divide between the recorded and the synthesized, the human and the machine.

The programmed drums sit dry\(^52\) in the mix contrasted to the lead vocal’s proximity-ambiguous combination of reverb/delay and distortion, which suspends the usual technique of...
mixing the lead vocalist so that she or he is at the proxemic front. The track’s chorus is defined mainly by synth-bass and drum programming. Reminiscent of trap’s affection for distorted bass and the Roland TR-808 drum machine’s fast hi-hat syncopations, the track is mainly built from boomy bass, mid-heavy distorted vocals and trebly clicks of the drum machines’ dry hi-hat and claps. There are other sounds (e.g. drum fills, various sound effects and a squeaky string-like reverb-soaked arpeggio-figure), but the over-all reduction of sound sources means that they almost inhabit their own frequency registers. They fit and complement each other in a way that – despite the heavy use of distortion – creates clarity and makes the vocal stand out.

However, the reduction of sound sources causes the chorus to come to a somewhat paradoxical climax. In traditional formal dynamics, the break before the chorus (and the vocal leading into it) builds tension towards a dynamic release. But in ‘The Hills’, the chorus’s climactic release (or lack thereof) is constituted by the boomy bass and the distorted vocal. This radical reduction, this flattened climax, ends up as a dehierarchized, compressed surface underlining the track’s expressive ambiguity.

**Controlling the algorithmic wall: Katy Perry’s ‘Hey Hey Hey’**

Sidechain compression also plays a central, yet different, role in Katy Perry’s 2017-single ‘Hey Hey Hey’. In fact, it is difficult to disentangle the processes connecting and shaping different sounds, but what follows is an attempt to unravel what is going on in the verse and chorus. A wall of distorted synth-bass, synths and a low-pass filter applied to them are bouncing up and down in volume, constantly rising and dipping in uneven syncopated swells. This unnatural envelope is ostensibly created by a sidechain compressor triggered by the kick drum (the snare might also be ducking the bass-and-synth wall, but the wall’s bounce is probably mainly controlled by the kick drum). The sensation of the wall’s sounds being grouped together is emphasized when the track breaks down and the kick is not ducking the group. Here, a low-pass filter sweep gradually opens the frequencies that are let through, grouping the wall through shared frequency response before the kick-drum-triggered sidechain sets in and groups them again through a shared dynamic envelope.

A kick drum ducking other sounds is not unusual, particularly not on EDM-related music, but it is usually done with a four-on-the-floor rhythm in the kick drum. Here, the rhythm in the kick drum is syncopated, making the dips and swells uneven. This unpredictable nature is emphasized by the envelope settings of the sidechain compressor. It has a fairly slow attack and
a significantly slow release, which means that the swell of the wall does not reach full amplitude before it is ducked again. This results in an unusual irregularity in the bouncing wall of the bass and synths. It is on grid, following the pulse, bouncing up and down, repeating the same irregularity with inhuman precision, but it also diverts from the grid, stretching and bending it with an element of unpredictability, almost treacherousness.

Usually, the bass(-layer) has an anchoring function. As gravitational centre it tells the listener where the tonic is in every chord, builds the groove and supplies the so-called ‘body’ of the music. This is also why bass is typically placed in the centre and often in mono. Here, combined with the synths that are panned wide to each side, the solidity is replaced with something massive, omnipresent. Instead of functioning as a singular instrument anchoring the track, the bass is a layer with a diffuse agency of its own. This uncertainty is further emphasised by the vocal’s lifted prelude in the verses. Perry’s first line and the displacement of the wall creates confusion around where the downbeat is until the second bar.

However, the uncontrollable and deceptive character of the bouncing wall is set against a well-defined contrary in the drums and the vocals. The snare sound is fairly dry, thin, almost like a rim click (except for the pre-chorus’ larger snare). Along with the fairly discrete hi-hat, it has no problem standing out in the mix because, apart from the vocals, there are no other sounds in the higher frequency register. Compared to the blurred and wide wall of bass and synth, its narrow width, dry lack of reverb and high frequencies divert from the traditional staging of drums, appearing in front of, or perhaps rather on top of, the rest of the sound stage.

Around it, Katy Perry’s vocal sits wide and clear. In the chorus, the vocal is double-tracked and the dubs are panned out to both sides, creating stereo width for an instrument that would normally always be in mono. The width of the vocal dubs challenges distinctions between instruments, ensembles and the environment since the width of the wide-panned dubbed vocals sound wider than their reverb.

Fundamentally, ‘Hey Hey Hey’ can be heard as a structure of two vertical macro-layers. There is on one hand the upper, ‘high-passed’ layer: clear, bright, quantised with vocals, snare and hi-hat – keeping time, holding everything together, communicating lyrical content and Perry’s persona. But there is also the underlying, almost ‘low-passed’ layer of the unruly, abstract, algorithmic agency in the bouncing wall of bass and synths.
Unstable space and intimate materiality: Billie Eilish’s ‘bury a friend’

‘bury a friend’ (2019) excels in its lack of depth. Except for the snare-clicks, it is almost devoid of reverb, making every sound source seem transgressively close. Instead, it is based on negotiation and shaping Eilish’s vocal. Blurring distinctions between lead and backing vocals, her many vocal iterations shift eclectically between her being alone to various iterations of her backing herself in a multitude of voices, registers and harmonies shifting between the singular and plural, narrow and wide, intimate and distanced, clear and abstract.

Oftentimes, the backing vocals have a muffled sound (due to pitch-shifting or a low-pass filter). This lack of higher frequencies creates a sense of distance which is contrasted with the lead vocal’s close proximity due to its dryness and compression. Extreme panning of dubbed vocals is not unusual, but the lack of reverberation in ‘bury a friend’ makes the shifts in proximity, width and number abrupt and unnatural. Distinctions between individual sounds, ensembles and the track’s overall environment blur. The constantly shifting spatiality of the track is emphasised by its equally unpredictable form, and it challenges traditional notions of hierarchies between clearly identifiable verses, choruses, etc. Instead, the shuffled beat pumps and pauses unpredictably between and inside its many different formal units. Furthermore, the track’s many non-diegetic sound effects (that often reflect lyrical content, e.g., glass breaking, a dentist drill, a bell ringing etc.) add to song’s sense of disorientation.

‘bury a friend’ excels in the lowpass layering technique of denying instrumental sounds their higher register frequencies and thereby leaving them for the lead vocal. But it adds new narrative dimensions, as the low-passed and down-pitched backing vocals add to the song’s dire lyric that imply conversations with monsters (under the bed), voices in the head and suicide. In other words, Eilish’s treated backing vocals both pose as monsters and voices in the head in unison with her own lead vocal.

These expressive interpretations are met with the potential paradoxes of compressed vocals. Compressing vocals is a good example of how technology can paradoxically make something sound less mediated and more human. Because compression can amplify the smaller sounds of a voice such as breath and sibilants, it can create proximity and intimacy. Yet the

53 This is not unlike the sonic intimacy of ASMR-videos on YouTube, where extreme proximity can produce very direct physical responses (Harten, 2020; Poerio, Blakey, Hostler, & Veltri, 2018; Sterne, 2015, p. 119).
unnatural amplification of sounds in a vocal can also create an acousmatic, dehumanizing effect. Arguably, the result of compressing vocals is often ambiguous, and so is Eilish’s negotiation of her vocal persona in ‘bury a friend’. It is both expressive and persona-driven, but at the same time, the sheer lack of depth on account of surface saturation can be interpreted as an increased sonic materialism. Furthermore, the lack of reverberation and the digital clarity combines with the sound sources’ excessive staccato character. This results in a particular kind of space where sounds have little or no audible attack, release or reverberation. Like the rest of sounds in the track, the vocal turns into a multitude of sonic monoliths that switch on and off horizontally and vertically. This combines with the multitude of vocal iterations that destabilize interpretations of the lead vocal as a unified narrator.

Like the expressive ambiguity of ‘The Hills’, ‘bury a friend’ is both intimate and material, but contrary to ‘The Hills’ it stages an unpredictably and constantly shifting spatiality that excels in a lack of reverberated depth. The lack of depths results in a kind of two-dimensional space in which changes of panning width, frequency registers, number and saturation are constantly shifting.

New space, new materiality

The new space-makers

In ‘The Hills’, the bass and lead vocal form an unusual alliance when they are both ducked by the kick drum transients. In ‘Hey Hey Hey’, filter sweeps as well as sidechain compression puts the bass and synths into the same sonic mould. Interrelational processes work across sound sources at the expense of individuality, diverting or shaping new hierarchies.

In timbre theory, instruments are perceived as groups through shared timbres (cf. Mcadams and Goodchild 2017). In the tracks analysed here, it is reversed as it is the grouping (through frequency filters and dynamic control) that defines the timbral character of the individual sounds. Grouping trumps individuality. This represents a new type of (radical) layering, both in terms of frequency response and dynamics, that arguably challenges source-bonded, ecological interpretations of musical space.

The three tracks, in various ways, utilize the technique of subtracting or almost completely removing the mid or upper registers in the instrumental backtrack to achieve clarity for the lead vocal. It was done with the sheer reduction of sound sources in ‘The Hills’, with the
pitch shifted and lowpassed voices in ‘bury a friend’, and it was particularly present in the almost extreme division of registers in ‘Hey Hey Hey’.

Arguably, Katy Perry’s track even displays a separation between an upper layer of lucidity and a lower layer of something oneiric. The dark, distant, underwater-like, technology-driven and unruly lower section resembles notions of the subconscious, a Dionysian dissolution or plain eeriness in its absence of the human (cf. Fisher 2016). Conversely, the lucidity of the upper layer suggests precision, clarity, textual meaning and the singer’s persona – in other words, control, intention, meaning, consciousness. It is in the latter layer that musical analysis usually takes place: through intentional, conscious, reflexive interpretations of meaning.

What analysis arguably forgets is the elusiveness of space, as well as of texture, timbre and the manner in which processes unfold. Fidelity and singularity are subject to different kinds of operations. For example, sidechain compression is often used to attain clarity. It can make a kick drum stand out without masking from other sounds, because they are ducked when the kick sounds. In other words, clarity gains an automated temporal character as it becomes dynamic, an ongoing adjustment predicted and controlled by automated volume modulation. Similar to a multiband compressor - that groups and applies different types of compression to different frequency bands - internal distinction in the group is muddled. But it also creates balance and clarity when the whole track’s various frequency-response is balanced dynamically. Many sounds can share the same frequency spectrum, acting as one, or they can take turns when one sound is ducking the other so that they never sound at the same time. Avoiding masking becomes responsive, ongoing, temporal, controlled by setting up semi-autonomous algorithmic processes.

Consequently, sonic space is subject to dynamic processes and the fundamental shaping of an envelope by individual as well as collective sounds. From this perspective, frequency-filters and particularly dynamic compression (and limiter and gate) become the main stagers of space. Arguably, reverb and other traditional spatial stagers can also be seen as both group-makers and algorithmic in that they respond to sound source(s) by set parameters, but they are mostly used as additions. Dynamic processing and particularly compression is a process of changing and shaping by engaging directly with the sound source’s characteristics and other effects such as reverb. In other words, sonic space is defined not by traditional spatial stagers, but by interrelated functions, processes and techniques that were not initially or necessarily created for spatial staging as much as dynamic control.
Beyond the unreal

The three tracks all challenge traditional performance-based notions of proxemic order. The drums (particularly the snares) are so dry that they all seem in front of the lead vocal. This reversal is not unusual in recent programmed pop music. However, it would be a misunderstanding to interpret the three tracks’ spatial staging as merely unreal or surreal. This implies a real, ‘natural’ image, which again rests upon interpretations of mediations of performance-based music. Indeed, many of the sounds do refer to traditional instruments or to the function they fulfill (a snare, bass, vocal, etc.). Yet the production or origin of most of the sound sources in the tracks analysed here will indeed remain elusive for most pop music listeners. Instead, they are based on the negotiation of these functions. They are subject to the organising principles (to use Schloss’ terminology) that define the track. In other words, sound sources do not just refer to a ‘natural’ counterpart, but the processes that shape them. ‘The Hills’ and ‘Hey Hey Hey’ are subject to various levels of essentially algorithmic agencies. These affect, shape and to some extent define the performance gestures. The embodied performance gestures and their source-bonding spatial potentials are supplemented – subject to, if not overtaken by, automated processes. The beat of ‘bury a friend’ also excels in automation, but the intricate tapestry of Eilish’s vocals is arranged, edited and produced by a human hand. Yet the result of the organising principle – the eclectic negotiating and shifts in Eilish’s many dry vocal iterations – challenges or exceeds references to any notions of a ‘natural’ or ‘real’ space.

Listening intentionality in relation to previous experiences therefore has less to do with physical sources and spaces and more to do with the somewhat black-boxed experience of digital processes at work.

Again, it is not a logic of adding effects that creates real or unreal spatialities through spatial contrasts. They display more than a deprivation of depth on the account of dynamic compression and gating. The so-called ‘sonic canvas’ is instead subject to a particular vertical frequency-based rationale where registers and layers rule supreme. Here, sounds are compressed, pushed and distorted onto the textural surface.
Dead space and mediatized massification

Analogue recorded music will traditionally contain some level of noise from the recording media (for instance tape) or the recording environment. This is defined by a signal-to-noise ratio where the objective is to attain as much as possible of the desired signal compared to the background noise. Additionally, traditional instruments produce overtones that resonate in acoustic environments. To some extent, this sound of recorded mediation supplies a textural tapestry or a background and perspective that all sound events relate to and abide by. However, digitally programmed music does not have the same kind of noise, hiss or overtones, and the absence of these sounds creates a different kind of sonic ‘dead space’. It is this complete silence that is again further amplified by the use of gating, which again is amplified by the contrasting potential loudness of compression. Particularly ‘bury a friend’ excels in this dryness, the sound of sound events that reference only their own event with no background, but a void in which even reverb is subject to the same flatness. There is no overtone randomicity, only sounds switched on and off. Background collapses into foreground.

Yet, noise is still integral, albeit in other ways – as filter noise, sweeps, distortion overtones, etc., that can fill out the spaces between the layered, perhaps even segregated sound sources, groups and registers. For example, when ‘The Hills’ and ‘Hey Hey Hey’ reach their last choruses (at 3:02 and 2:48 respectively), the traditional pop form dynamic ‘trick’ of adding something extra to push everything to new climactic levels is in both cases a subtle high-frequency layer of noise. It is most probably only consciously noticed by a few listeners, yet it does have an effect. It arguably finds a place in the space between the dead space of sounds, while also adding perceived loudness due to the perception of something recorded that is turned up because the background noise becomes audible.

54 Dale Chapman (2017) offers similar thoughts in his interpretation of how early hip-hop’s fondness for buzz, crackle and analogue warmth is reversed in 1990s and 2000s productions by (among others) the highly successful producer Timbaland. As Chapman argues how his beats are defined by a flatness, a two-dimensional ‘dead space’. Definitely digital they deny referentiality in their ‘meticulously spare, reverbless sonic environment’ (2017:185).

55 As such, pop’s digital ‘flatness’ begins to resemble minimal music’s lack of hierarchy and proliferation for saturation (see Fink 1999 for a discussion on lack of hierarchy and sonic flatness).
Arguably, this represents a new level or even new kind of sonic materiality (Cox, 2011; Großmann & Hanáček, 2016; Sterne, 2014). It is a sonic massification that is in some ways comparable to Phil Spector’s famous ‘wall of sound’. Contrary to Albin Zak (2001), who argues that Spector sought to capture a live feel and energy, Ulrik Schmidt (2011) argues that the wall of sound demonstrates unity and a massification of sound defined by referencing its own medialized design over instrumental parts. The focus turns to the unfolding of the mediatization rather than the hand of the composer. In contemporary digital production, Spector’s massification is fairly easily attained through a multiplicity of stacked, looped sounds; metadata can be sent to as many virtual instruments and sample-banks as your heart can desire. Furthermore, the mediatized unfolding of ‘the sonic mass’ is temporally and collectively shapable in new ways and at new levels in the digital. The focus turns to the temporal unfolding of the material surface, deferring references outside the sonic texture itself.

Instead, as I will argue in the following section, it becomes topological.

**Topological space**

Denis Smalley (2007) places time at the service of space in electro-acoustic music, and, arguably, the semantic models of recorded space do so too. The processuality of digital pop music reverses this order. The increasing focus on loops, sequences and controlling and adjusting automation, means that the spaces of music are fundamentally subject to these processes. Few philosophers have argued as adamantly for placing time before space as vitalist and process philosopher Henri Bergson (2004, originally 1889). He differentiated between qualitative and quantitative multiplicities of time, which is, in short, the difference between abstract experience of time and mathematical clock-time. Instead of being built on quantitative lines of spatial images, he argued that human experience bends and breaks in abstract flows, and it is defined by this qualitative experience of the constant flux.

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56 Albin Zak (2001) describes it as ‘one thick textural mass, many of whose constituent parts are indistinct to the ear’ and says that ‘the fabric itself assumes authority’ (2001:88). No individual sounds except for the drums are discernible in its ‘high infidelity’ (Milner, 2010, p. 153).
The same can be said of the auto-generative character of algorithmic music. Processes precede notions of individual spatial entities. The new kind of space reflects not only the mediatized processes of the computer-based DAWs that create algorithm-based music, but on a more general level, the ubicomp culture of which music production is a part. Just as our lives are directly and indirectly defined by the ubiquity of computing, music production exists as a logoed thumbnail on the networked interface-logic of laptops, tablets and smartphones. In other words, to think digital music production and its aesthetical potentialities as a closed environment outside digital culture seems increasingly problematic. Ubicomp challenges interpretations that rely on static spatialities and puts the emphasis on mediatization and, instead, understands the media itself as a spatialized environment. In other words, it is perhaps not surprising that the spatialities of contemporary pop music begins to resonate with that of digital culture.

The screen’s two-dimensional frame controls the operations, yet it is also subject to change in accordance with its ability to open into other coexisting spatialities with which it is constantly connected (Manovich, 2001, p. 95). The flat interface controls an archive that is not defined, stable or grounded in fixed space or locations. It is a set of potential indexical processes, a continuously changing surface of searchability that makes space relative, plastic and open-ended. To this end, pop music space begins to resemble ubicoms’ ambiguous relationship between, on the one hand, the endlessly potential, mutually dependant spatialities of indexed, abstract, networked databases, and, one the other, the two-dimensional, flattened screen that controls them.

This propensity for shifting lists, models, networks, clouds and fractals is essentially the emergence of a topological rationality that entails a loss of fixity, distance and perspectival horizon (Lury et al., 2012). The result is a particular kind of surface defined by a process-based negotiation of materiality. Celia Lury argues that processual relations produce ‘a surfacing of the contemporary mass ornament’ (Lury, 2017, p. 32). It is a logic in which figures, forms and patterns emerge and disappear, making proximity into a moving ratio, constantly producing changing relations of nearness in ‘a surface, never fixed, always surfacing’ (Lury, 2017, p. 31).

The analysed tracks too displayed a shift from recorded performances to data itself becoming ‘live’ through operations of iterative and automatic processing systems. In the de-hierarchized reduction of ‘The Hills’, the algorithmic wall of sound of ‘Hey Hey Hey’, and the constantly shifting sonic mass of ‘bury a friend’, one can hear the negotiation of layers, textures and timbres – an ornamentation of the ever-changing surface.
Conclusion

In this article, I have argued for a departure from overt performance-based, essentially ocularcentric interpretations of sonic space that directly or indirectly refer to notions of ‘real’ or ‘natural’ spatialities. Instead, I have argued that the electronic practices of hip-hop and EDM represent different approaches to sonic space that are based on a processual layering of textures. Furthermore, I have argued that this processuality has found new levels of actualization in the loop-based, algorithmic processes of DAW-based pop production. This means that traditional spatial staging is less centred on effects such as reverb, and more on the interrelational control and shaping of envelope, mainly through various types dynamic processing (compression, gating, limiting). These challenge traditional notions of sound source individuality, hierarchies and fidelity. The result is a sonic materiality that is subject to distinctively digital process agencies and logics, creating a particular topological surface. This can still hold semantic references, but these are subject to a spatiality that refers less to any notion of a ‘natural’ environment and more to the sonic materiality of the digital mediatized design itself.
Outro

Mediatized space

As I discuss in the article, the tracks analyzed can be heard as a new kind of sonic massification akin to Phil Spector’s “wall of sound”, but with the emphasis on the mediatized topology. This increased lack of fidelity connects with our cognitive capacity to single out auditory information – or what, in relation to conversation in noisy environments, is called the “cocktail party effect/problem” that allows us to navigate competing sounds (Getzmann & Näätänen, 2015; Narayan et al., 2007; Zion-Golumbic & Schroeder, 2012). When sound sources in music are grouped and (com)pressed together, it increases masking, decreases segregation and comprehension, and can thus produce perceived loudness. Since it takes an increased cognitive effort to produce the cocktail party effect, it can also result in a cognitive overload and thereby listening fatigue (Vickers, 2010).

This lack of fidelity and clarity also can also be understood from a timbral perspective. Timbre theory often defines timbre in relation to a sound’s ability to carry information about its source and location (e.g. Butler, 1973; McAdams, 2013). However, paradoxically, as Cornelia Fales (2002) argues, we have no language for timbre, but a sort of amnesia that relegates timbral qualities to metaphors. Instead, Fales reasons that the dimension of timbre is preattentive. For her, timbre is not just about sound-source and location, it is also about “the environment through which the sound has travelled” (2002, p. 57). This means that timbre is forged invisibly by the listener in relation to expectations based on sounds identified in the past. As previously

57 Perceived loudness and the “louder is better”-paradigm have been fundamental parameters in popular music since the 1950s (Milner, 2010; Taylor, 2017; Vickers, 2010). Since then, changes in format (particularly the industry shift to the CD), new music technology and the race for loudness has made compression of music’s dynamic range more and more extreme. Even though some have tried to call off the loudness war (Reierson, 2011; Robjohns, 2014), the use of so-called hyper-compression in mastering still prevails. With more resent production techniques that integrate not only specific techniques, but also the master perspective of the producer, the quest for perceived loudness has become an integral part of compositional practice.

58 Isabella van Elferen (2017) argues that timbre is both material and immaterial. This paradox engenders a sublime aesthetic experience of being drawn towards something seemingly real and material, yet beyond comprehension.
discussed, electronic sound sources suggest a somewhat elusive idea of origin. Previous experiences arguably mainly refer to electronic music, rather than natural acoustic phenomena. I also briefly mention Dale Chapman’s analysis of Timbaland’s virtual, two-dimensional sonic spatiality in a footnote, but, interestingly, Chapman turns to Paul Virilio’s (1997) concept “telepresence”. This involves “a peculiar short-circuiting of conventional space and time” and situates the present “within a ‘no-place;’ an ‘atopia’ separate from our spatial-temporal coordinates” (Chapman, 2017, p. 188). Perhaps this no-place is exactly in the processual mediation – the environment through which sound travels?

New media researcher Stephan Günzel (2012) proposes three types of space: mediated space (the space which is mediated), the space of the mediation (where the mediation takes place), and the space of the sensation (the space where the mediated is experienced and decoded). Transferring these categories to music production, we could call them the space of the sound sources, the space of the mediatization (in most cases the DAW, or, from a broader perspective, cloud-based music production), and the space of the listener when listening. The initial point that I am trying to make here is that the distinction between the two first spaces – the mediated space and the space of mediation – blur. The mediatization becomes the space itself. The distinction between individual sounds, groups or notions of an overall environment is replaced by a sonic mediatized massification.

Ulrik Schmidt describes what he calls “big data aesthetics” (Schmidt, 2016, p. 28), which is based on a “‘performative’ staging of big data”. Schmidt describes how this massification of data begins to echo ambient aesthetics in its lack of differentiation between foreground and background (Morton, 2009). The proxemic “flatness” that I describe in this article and its lack of hierarchy instead points toward what could be understood as a datafication of space, in which the listening practice – akin to ambient aesthetics – is more about inhabitation than interpretation.

*Bergson’s qualitative spatialities*

The fundamentally grounding adherence to sound in the natural world or source-bonded music production, from a Bergsonian perspective, distorts and conceals the real structures of consciousness. For Bergson, it is our philosophical task to engage with qualitative spatialities to reveal the true and ordinarily hidden nature of consciousness. This is particularly interesting in
relation to pop music’s increasing departure from instrumental and traditional gestural recognition and traditional source-bonding. When pop music increasingly consists of spatialities and sources that are beyond listener’s comprehensions (how does one envision a side-chained wall of synthesizers?) the link to spatial forms in the external world is diluted. Digitally macro-synthesized music is, for most people, a black-box of processes that are understood subconsciously rather than through deliberate interpretation.

On the one hand, in the sequencer-paradigm of contemporary pop music production, clock time rules in the digital grid, where all sounds either directly or indirectly adhere to the exact quantized repetitions. On the other hand, the tracks’ unruly morphing challenges the same gridded clock-time. In other words, to build on Bergson’s distinction, digital culture has spawned a highly heterogenous temporality of both excessive macro clock-time, and abstract, qualitative juxtaposition of past and present in interdependent processes.

Towards pop’s sonic materiality
The processual layering of contemporary pop music is in essence a turn to “sonic matter”. The notion of sonic materiality has often been explored in sound art theory, frequently in light of (post)-Schaefferian notions of the acousmatic (Cox, 2011; Kane, 2014; Kim-Cohen, 2009; Steintrager & Chow, 2018; Voegelin, 2019). Similarly, sound studies explores materialities of various parts of sound culture (e.g. Gopinath & Stanyek, 2014; Großmann & Hanáček, 2016; Schulze, 2018; Scrimshaw, 2013; Thompson, 2017). However, twenty-first century pop music is not acousmatic in the same way that sound art is. Yet the layering and topological spatialities of recent pop do present a turn from representation to abstraction, and perhaps more generally toward a different kind of causality rooted in the macro-synthesis of compositional practices.

So, how can this move, this sonic materiality of pop, be understood in light of developments in listening practices? In digital music, as well as digital culture, human agency is not erased but supplemented, supported and increasingly defined by nonhuman agencies. The departure from human to distributive agency and the move towards topological space aligns pop with a renewed ontological interest in materiality. A broad range of contemporary perspectives across the arts, humanities and social sciences have spawned theorizations of various new materialisms, and I have mentioned some as part of this dissertation. New materialism rejects identity, biography and what Hayden Lorimer calls the postmodern obsession with
deconstructing textual meaning (Lorimer, 2005). Instead, it emphasizes “the power of the precognitive as a performative technology for adaptive living, as an instrument of sensation, play, and imagination, and a life force fueling the excesses and the rituals of everyday living” (Vannini, 2015, p. 6). Echoing Alfred North Whitehead’s process philosophy and what he called the “fallacy of simple location” (Whitehead, 1978, p. 137), things are not to be studied in isolation, but rather in the processes through which they take place. Non-representational theory aligns with perspective of affect theory in its privileging of corporeal sensations at the expense of (subject-intentional) perception (Massumi, 2002; Thrift, 2007). Sonic materiality and the acousmatic do indeed resonate with new materialism and non-representational theory, and so do the topological spatialities of the tracks analyzed.

Yet pop music, despite its radical changes, still abides by a pop format and traditions. A snare is perhaps not a snare, but it functions as a snare (Eshun, 1999, p. 78). There is no need, yet, to dismiss signification, representation and meaning. However, twenty-first century pop music’s more recent production practices intersect with computational culture’s shift towards new materialities that bend and mold space in new ways that increasingly emphasize less referential sonic layers; in this music, causality is based more on processes than individual sound sources.

From this perspective, pop tracks’ abstract, topological spatiality affords a listening dualism perhaps best exemplified in ‘Hey Hey Hey’ by Katy Perry. One way to listen is innately based on extracting communicative potential, meaning and semantic content.59 The other is more akin to a Schaefferian reduced listening that ignores sound’s referential possibilities, stripping it of suggestions of sources or significations (Schaeffer, 2017). The challenge here is obviously that no two listening practices are alike, and, as I have argued, listening might shift between the two. My point here, then, is mainly that pop music theory and analysis tend to prioritize the former way of listening, while approaches to various (and often very different) types of electronic music and sound art tend to prioritize the latter. What is surprising and novel is that

59 As previously mentioned, Luis-Manuel Garcia (2005) argues that the abstract layers of EDM instill a particular processual navigation in the listener. On a similar note, Mark Fisher analyses Brian Eno’s ‘Ambient 4: On Land’ (1982) and concludes that the acousmatic character of the sounds encourages us to think and wonder about the source of the sounds (Fisher, 2016)
the pop music format, in its increasingly intrinsic digitality, entails very particular, original aesthetical potentialities. I’m not arguing for a pop monism that does away with semantics, meaning or narratives. As Grossman and Hanáček (2016) duly point out, sonic materialism can tend towards preconscious essentialisms that tend to delete cultural reflection (2016:61). I’m arguing for a place for pop music where its value is not contingent on cultural interpretations because listening and production practices have spawned a new pop music sensibility based on a particular algorithmic processual materiality.
Conclusions and perspectives

Conclusions

In this dissertation, I have argued that the digitalization of hip-hop and EDM’s practices represents a new type of pop production. This has been brought about by what I call the DAW 2.0, which is defined by a change from a recording logic to a control of automated interrelational processes such as loops and signal processing. This represents a shift towards negotiating metadata at the expense of inscriptive value. I have further discussed this shift to process in the second article.

Here, I challenged the anthropocentric and phenomenological interpretations of the relationship between difference, groove and teleology. Instead, I argued that technology holds particular temporal characteristics and that these can essentially be understood as heterogenous and ambiguous. They are characterized by distributed agencies that, through processual algorithmic automation, create complexity and detail via digital precision, synchronization and hints of stochasticity. In terms of teleology, this results in seemingly contrasting dynamic structures between flux and circularity. I have argued that groove in electronic music must be interpreted less in relation to an individual sound’s accuracy or discrepancy, and more according to what type of process and technology it signifies. Furthermore, the processual and often interrelational character of pop music suggests new understandings of the mutually affective character of entities. Yet these manifest less according to cognitive reflection and more as tacit knowledge. In the second article’s conclusion, I argued that the innately digital temporal character of recent pop represents a new kind of relationship between music and time that both reflects and challenges the irreversibility of time as well as ubicomp’s temporal flux.

Having established this process paradigm, I looked to musical space in the third article. I argued that hip-hop and EDM represent different approaches to space that are focused less on notions of a natural image (of performed music) or source-bonding, and more on manipulation of textural layers through various production practices, including signal processing such as frequency filtering and dynamic processing (mainly compression). From this perspective, these techniques become the main spatial stagers. This also distinctly places space at the service
of time, or, more specifically, digital process. Space becomes topological as proximity can be subject to a moving ratio, unfixed, always surfacing. This creates a particular sonic massification where the mediatized processes can be interpreted as the spatial environment and qualitative unfolding of space and texture become the harbors of aesthetical potentialities.

This dissertation has been based on bridging practices from hip-hop/EDM, new media studies and music production theory with the intention to inform the latter. I have challenged some of the paradigms in music production theory that rely heavily on perspectives from recording, performance and anthropocentrism. As I wrote in the introduction, it has not been my ambition to convey any kind of exhaustive new directions for either popular musicology or music production theory, but to heuristically offer new understandings to a field and an art form in rapid development. It is not a matter of replacement. But to state the obvious, it does not look as if digitalization or the assimilation of hip-hop/EDM practices are in decline in pop music production. The shift to digital process control as the main compositional factor and its consequences presents a fundamental challenge for current popular musicology.

New media theory has here proved to offer constructive theoretical input that has added substantial new perspectives. These have not only countered or challenged previous musicological understandings, but positively offered new insights and interpretations. As such, my initial basis for this dissertation was to approach pop music not purely as a musical entity, but as a digital entity. Perhaps surprisingly, this approach has not taken anything away from the appreciation of its “aesthetic value” as an art form. On the contrary, without reviving a whole dualistic high/low debate about pop authenticity, it seems that some of the perspectives offered here actually add to the understandings of the aesthetic potentialities of pop. This includes the temporal heterogeneities, the distributive agencies, the layering of textures in topological space and its sonic massification. To put it crudely, I believe that the appreciation of pop’s value and aesthetics are to be found here more than, for example, in overt interpretations of lyrics, human performance, meaning, expressivity, biographies or persona. Nevertheless, it is arguably these

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60 Persona is something that I have discussed fairly little. Interpretations of persona are obviously a very subjective matter, but I will still argue that, in digital pop, they are subject to processes. The tracks I have analyzed all display ambiguous negotiations of, on one hand, the singer’s persona, and on the other the practices that negotiate this with
perspectives that dominate pop music research as well as discourse outside academia. They rest upon hermeneutic models that are admittedly easier to approach than some of the more abstract, black-boxed processes and perspectives that I try to bring attention to. However, I do hope that I paved a tentative way for a new language and understandings of pop music.

**Perspectives**

Unanswered questions and concerns have manifested. New trajectories take shape. To follow up upon them thoroughly will have to be reserved for another occasion outside this dissertation, but I would like to open some of the issues that the dissertation’s discussions and findings have raised for further research.

I have focused on the digitalization of pop music’s production practices, but listening practices have also changed substantially in digital culture. For instance, Spotify CEO Daniel Ek has stated: “We’re not in the music space – we’re in the moment space” (quoted in Seabrook, 2014, n.p.). Interestingly, this echoes Ableton CEO Gerhard Behles, who in the same year said: “The whole vertical session view doesn’t know beginnings and ends, it just knows now. That is what we wanted to bring in, the notion of now and the absence of a song that simply begins and ends” (quoted in Cardiner 2014, italics in original). In other words, the “moment space” of streaming and the compositional “now” begin to align on two of the most significant digital platforms for music. Essentially, algorithmic agency shapes the music from inception to selection to reception. Accordingly, when Robert Prey (2016) discusses the algorithmic processing of data on streaming services – or what he calls the “datafication of listening” – it begins to resemble some of my discussions regarding mediatized space and data becoming “live” as sonic materiality.

Furthermore, Prey (2019) argues that streaming encourages inattentive listening. The argument is admittedly fairly easy to follow as it aligns the ubiquity of listening (Kassabian, 2013) with the ubiquity of computing - as the latter’s growing inherence or “immanence in our various (either human-led or algorithmic) processes that essentially construct a de-hierarchized sonic massification that dilutes human presence (for more on persona, see e.g. Auslander, 2006; Frith, 1996; Moore, 2012)
life form, its technological platforms sink deeper into the skin of human agency—often, if not always, receding from conscious perception and sensation into a peripheral background” (Díaz & Ekman, 2011, p. 127). From this perspective, the ubiquity of streaming places music in the background (Hesmondhalgh & Meier, 2018).

I have argued for a prereflexive listening embedded in the processuality of pop music. However, I am hesitant to overtly align the prereflexive directly with inattention or background (it could be a question of framing, since notions of ambient aesthetics sound more appealing than background music). I claimed that the processual character of pop music encourages a prereflexive tacit knowledge of the underlying system and that pop’s sonic materiality relies less on active interpretation of sound-sources, narratives, syntax, semantics or discursivity. Instead, it is non-representational timbre unfolding that connects with affectual sensation of mediatized processes. The point that I am trying to make, also in regard to tacit knowledge, is that musical value manifests preattentively. It does so instinctively, but this is not the same as a strictly passive engagement. It is spontaneous and proactive, yet still before reflection, beyond interpretation or meaning and thus in tandem with Whitehead who criticizes clear and distinct conscious perceptions of what he calls “presentational immediacy”. As such it can be understood slightly differently compared to notions of dynamic listening or dynamic attention, since it is arguably less a negotiation between attentiveness and inattentiveness\(^{61}\), but more one of affectual immersion.\(^{62}\)

Interestingly, almost every theoretical branch I have discussed in this dissertation is grounded in some kind of corporeality – from the sound-systems, block parties and raves of hip-hop and EDM’s dance cultures, to process philosophy (including Whitehead who believes that perception is always already grounded in our bodies), to (most) new materialisms and affect

\(^{61}\) Notions of dynamic attention and listening have been researched from various angles (particular in the growing body of research on the intersection of neuroscience with music, see e.g. Bauer et al., 2015; Jones and Boltz, 1989; Jones and Large, 1999; Fitzroy, 2015). Joanna Demers (2010) suggests something similar in relation to electronic music. She calls it “aesthetic listening”, in which the listener’s attention constantly and arbitrarily mutates, intensifies, or recedes (Demers, 2010, pp. 151–161).

\(^{62}\) In this regard other (arguably post-phenomenological) trajectories such as Hans Ulrich Gumbrecht’s concept of “Presence” (Gumbrecht, 2004) or Gernot Böhme’s “Atmospheres” (Böhme, 1995, 2017) could present interesting avenues for further research.
theory. And pop music is undoubtedly predicated on some sort of physical contact with sound waves and not least the bass register. Bass is a formative part of the listening practices of a long line of popular music cultures that put resonant bodies and corporeal affect at the center.63

However, it can sometimes seem as if what Jonathan Sterne (2003) criticized as “the audiovisual litany” (Sterne, 2003, p. 15) or the general disposition for ocularcentricism in music theory has been replaced with a body essentialism that leaves very little room for variation. Pop music listening has been supplemented with a plethora of new conditions and possibilities in terms of, for example, the number and type of playback devices and sheer level of connectivity. Understanding recorded music as made only for speakers (Reyes, 2010) or positing that we live in a “speaker culture” (Sterne, 2015) seems increasingly problematic. The assimilation of hip-hop and EDM into pop also means that their bass-oriented sounds now have to fit both the format compression algorithms of YouTube and Spotify playlists, and quarter inch big smartphone speakers. Bass music is listened to without bass, and dance music is listened to without dancing. Instead, “sodcasting” (playing music in public on a mobile phone or other portable device) has spawned what has been called a treble culture (Marshall, 2014; Weheliye, 2017).

In other words, listening to popular music in the streaming age – publicly or privately – takes many forms. Listening to pop can be resonate and vibrate in the whole body, while it can also just resonate inside the ears – for example as headphone-based mediatized environments that the individual listener exclusively inhabits. The textural layering of a topological space that I have described perhaps makes it easier for the tracks to adapt across playback devices, formats and situations. Interestingly, in treble culture, it will mainly be the upper frequencies that can be heard. The bass is missing, but the dry and clicky beats of trap adapt well to smartphone

63 Bass culture has been explored in various types of research between – and often intersecting with - sonic materialism (Cox, 2011; Grossmann & Hanacek, 2016; Schulze, 2016, 2018), Afrodiasporic perspectives (Henriques, 2011; Jasen, 2016), societal or political analyses (Goodman, 2010; Straw, 2011) or the materialities of electronic music production and reproduction (Constantinou, 2019; Papenburg, 2016; Wong, 2013). Robert Fink (2018) duly critiques overtly physical and haptic interpretations of sounds below 100 Hz and inscriptions of the subwoofer as fetish object: “Vibrational materialism tends to sonic extremes” (2018, p. 89), he writes, and warns against a sonic materialism that resembles acoustic fundamentalism (2018: 112).
speakers. Conversely, large speakers or boomboxes, car stereos and sound systems can play back the bass-heavy lower layer allowing it to function as “body music.”

To summarise my arguments, streaming pop encourages not only background listening, but an immersion in processual unfolding of sonic materiality that bends time and space just as the data that created it. Few musical forms – or for that sake art forms in general – have been or are being produced and experienced in relation to new media as much as pop. The production and distribution of pop has been directly shaped by developments in digitalization since the 1980s. From that perspective, the new media logic and digital character of music production is perhaps less of a revolution. Music is unique as an art form in its qualitative unfolding of time and space. However, digital pop music exposes this unfolding. It imitates it and negates it. It materializes it. As digital process.
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Abstract:

This dissertation explores two related advances in the production of twenty-first century pop music: first, the assimilation of practices and aesthetics from hip-hop and EDM (electronic dance music); second, the new generation of the digital audio workstation (DAW). This new type of DAW is increasingly part of global computational culture characterized by being ubiquitous, networked and device agnostic. Hip-hop and EDM practices are being integrated and revitalized in light of this digital logic. This has consequences for the production of pop.

The dissertation combines theory on hip-hop and EDM practices, music production theory and new media studies. A main theme in the latter is how ubiquitous computing (ubicomp) culture affects interpretations of time and space; therefore, these theoretical inquiries are the main concerns of the two last articles of this article-based dissertation.

In the first article, “Who Let the DAWs Out? The Digital in a New Generation of the Digital Audio Workstation”, I criticize music production theory’s focus on the physical recording studio and its band or rock-oriented approach, in which the digital is interpreted as a continuation of analog practices. Instead, I discuss how hip-hop and EDM practices can be found in the newer DAWs such as FL Studio and Ableton’s Live. These DAWs are characterized by offering control of interconnected loops and effects. Essentially, this can be interpreted as a shift from working with sound with embedded meaning to an ongoing negotiation of metadata that mutually affect each other in a processual macro-synthesis.

In the second article, “Pop as Process: The Digitalization of Groove, Form and Time”, I further discuss the consequences of this fundamental shift to process. I criticize anthropocentric and phenomenological approaches to the connections between groove, form and time. I analyze Martin Garrix and Dua Lipa’s “Scared to be Lonely”, Post Malone’s “rockstar” and Katy Perry’s “Chained to the Rhythm.” The tracks display very different types of groove, form, teleology and heterogenous temporalities in their algorithmic processes. I also discuss new media studies’ approach to process philosophy, and particularly to Alfred North Whitehead. I conclude that the interpretations of these different types of processes are closely connected to timing characteristics that signify specific types of music technology. Digital pop displays new and
often ambiguous relations between music and time, and these manifest prereflexively as so-called tacit knowledge.

The third article, “Pop Materializing: Layers and Topological Space in Digital Pop Music”, argues that space in pop can be understood less as source-bonded orientational listening, and more as textural layers, where frequency-filters and compression increasingly become stagers of space compared to more traditional effects such as reverb or delay. I analyze this in The Weeknd’s ”The Hills”, Katy Perry’s ”Hey Hey Hey” and Billie Eilish’s “bury a friend”. I further discuss how pop can be interpreted as a mediatized materiality that, at the expense of proximity and intimacy, entails a topological unfolding of musical space and texture.

I conclude that pop music production is increasingly defined by digital processes, and that this has fundamental implications for such essential musical parameters as time and space. This represents a challenge for the field of music production and more generally for popular music studies. New media studies have proved to be a constructive theoretical path. I further conclude that instead of traditional interpretations of lyrics, instrumental performance or biographies, the aesthetic value of pop music can perhaps be found in its digital unfolding and bending of time, space and sonic materiality.
Resumé:


Afhandlingen kombinerer teori om hiphop- og EDM-praksisser, musikproduktionsteori og new media studies. Et hovedtema i sidstnævnte er, hvordan den alletidsnærværende computerkultur (ubicomp culture) påvirker opfattelsen af tid og rum. Disse er derfor udgangspunktet i de to sidste artikler af den artikelbaserede afhandling.


nye og ofte tvetydige relationer mellem musik og tid, og opfattelsen af disse manifesterer sig præreflektivt som stiltende viden (tacit knowledge).
