Pop Materialising: Layers and topological space in digital pop music

ANDERS REUTER

Independent researcher and writer. Email: andersreuter@gmail.com

This article argues that pop music's increasing assimilation of hip-hop and EDM (electronic dance music) practices combine with computational automation and this has substantial consequences for musical space. Traditional 'space-makers' such as 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 mediatised topological materiality.

1. INTRODUCTION

Two interrelated transformations are changing sonic space in contemporary pop music. First, hip-hop and electronic dance music (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, synthesisers and sequencers. Less dependent on recording or faithfulness to source-bonding or physical gesture, they suggest different approaches to the staging of space. Second, the practices of hip-hop and EDM are increasingly hosted by a new generation of digital audio workstations (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, 2015) and Allan Moore's *sound-box* (Moore 1993, 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).[1] 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 and 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.[2] They represent a particular mediatisation practice 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. Synthesised 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, music such as EDM is increasingly based on a negotiation of texture (Butler 2006: 93).

I therefore begin this article by discussing how the practices and techniques of hip-hop and EDM

[1]They are directly or indirectly indebted to ecological conceptualisation of visual perception (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).

[2]I discuss the logic and practices of newer DAWs as opposed to the recording studio paradigm in more detail in the article 'Who let the DAWs Out? The Digital in a New Generation of the Digital Audio Workstation' (Reuter 2022).

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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 (ubicomp) (Lury, Parisi and Terranova 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.

2. LAYERING OF PROCESSES

2.1. 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.) (ibid.: 20–1). 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 share specific frequencies in the lower register. This is resolved with mirrored equalisation 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 (Krims 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' (ibid.: 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).[3] 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).[4] 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 not only amplifying the effect on the sound but also adding filter noise and even distortion.

In EDM, it is not uncommon for producers to mix their own material (Devine and Hodgson 2017). In pop, mixing and mastering are still done separately by highly specialised engineers, but EDM techniques have increasingly become part of pop music's compositional practices. 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.[5]

This also affects interpretations of proximity. High-frequency content and detail suggests greater proximity (Zagorski-Thomas 2010: 202). In other words, the

[3]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 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).

[4]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 not only to identify and predict parts, but also to control and shape them (Grote 2016: 195).

[5]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 means to portability (like the MP3 format) (Kassabian 2016), where the goal is fidelity (Softky 2019), but rather a compositional technique and artistic expression.

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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 turned 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 2012). In other words, it enabled him to achieve loudness at the expense of fidelity. Akin to what Tricia Rose 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.

2.2. Envelope, compression and the master perspective

In electronic music production, the temporal stages of a sound are defined as the envelope. The main parameters are attack, decay, sustain and 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 also the creation of sounds.

Often, the manipulation of the 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 and knee. Since the volume peaks thereby can be controlled, it allows for an overall volume gain, which adds to the coveted perceived loudness.[6] 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 control or a guard against signal clipping. It becomes 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 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.[7] 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 synthesised sounds, waveforms, samples, envelopes, pitches, modulations, filters and effects in polyphonic manipulations. DAWs such as Ableton 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 mixing-desk's aligned channel-strips representing each sound, and the step-by-step process of recording.[8] 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.

[6]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 and 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; Vickers 2010; Taylor 2017).

[7]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 the synthesisers and/or the bass.

[8]I discuss the processual character of recent pop music and its consequences in the article 'Pop as Process: The Digitalization of Groove, Form and Time' (Reuter 2021).

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3. 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 sidechained connectivity to the kick drum, and it demonstrates both an ambiguous reduction of sound sources and an inversion of traditional hierarchies between sound sources. 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.

3.1. 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 desubjectivising 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 not only across registers and groups, but also across any divide between the recorded and the synthesised, the human and the machine.

The programmed drums sit dry[9] 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 machine's 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 overall 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 dehierarchised, compressed surface underlining the track's expressive ambiguity.

3.2. 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 emphasised 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

[9]Dry and wet refer to the absence or presence of reverb, respectively.

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syncopated, making the dips and swells uneven. This unpredictable nature is emphasised 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 a 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 contrast in the drums and the vocals. The snare sound is fairly dry, thin, almost like a rim click (except for the larger snare in the pre-chorus). 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 with 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 the 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. On the other hand, there is also the underlying, almost 'low-passed' layer of the unruly, abstract, algorithmic agency in the bouncing wall of bass and synths.

3.3. Unstable space and intimate materiality: Billie Eilish's 'bury a friend'

Billie Eilish's '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 negotiating 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 that 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 and so on. Instead, the shuffled beat pumps and pauses unpredictably between and inside its many different formal units. Furthermore, 'bury a friend''s many non-diegetic sound effects (that often reflect lyrical content, e.g., glass breaking, a dentist drill, a bell ringing) add to song's sense of disorientation.

The track excels in the low-pass 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 augment 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.[10] Yet the unnatural amplification of sounds

[10]This is not unlike the sonic intimacy of ASMR–videos on YouTube, where extreme proximity can produce very direct physical responses (Sterne 2015: 119; Poerio, Blakey, Hostler and Veltri, 2018; Harten 2020).

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in a vocal can also create an acousmatic, dehumanising 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 destabilise 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.

4. NEW SPACE, NEW MATERIALITY

4.1. 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, in terms of both frequency response and dynamics, that arguably challenges source-bonded, ecological interpretations of musical space.

The three tracks, in various ways, utilise 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 low-passed 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 and 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 necessarily created for spatial staging as much as dynamic control.

4.2. Beyond the unreal

The three tracks all challenge traditional performance-based notions of proxemic order. The drums

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(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 fulfil (e.g., snare, bass, vocal). 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's terminology) that define the track. In other words, sound sources do not just refer to a 'natural' counterpart, but also 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 account of the 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.

5. DEAD SPACE AND MEDIATISED 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 with 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. In particular, '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.[11] There is no overtone randomicity, only sounds switched on and off. The background collapses into the foreground.[12]

Yet, noise is still integral, albeit in other ways – as filter noise, sweeps, distortion overtones and so on 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.

Arguably, this represents a new level or even new kind of sonic materiality (see Cox, 2011; Sterne, 2014; Großmann and Hanáček, 2016). It is a sonic massification that is in some ways comparable to Phil Spector's famous 'wall of sound'.[13] 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 medialised design over instrumental parts. The focus turns to the unfolding of the mediatisation rather than the hand of the composer. In

[11]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. Chapman argues that 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).

[12]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).

[13]Albin Zak 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' (Zak 2001: 88). No individual sounds except for the drums are discernible in its 'high infidelity' (Milner 2010: 153).

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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 mediatised 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.

6. TOPOLOGICAL SPACE

Denis Smalley (2007) places time at the service of space in electroacoustic 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 ([1889] 2004). 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.

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 mediatised processes of the computer-based DAWs that create algorithm-based music, but also, 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 mediatisation and, instead, realises the media itself as a spatialised 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: 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 ubicomps' 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: 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' (ibid.: 31).

The analysed tracks too displayed a shift from recorded performances to data becoming 'live' through operations of iterative and automatic processing systems. In the dehierarchised 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.

7. 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 actualisation 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 the 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

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any notion of a 'natural' environment and more to the sonic materiality of the digital mediatised design itself.

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