Thinking About Syncing: Examining the impact of 21st century DJ technology on the production and performance of Electronic Dance Music

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Abstract: The introduction of synchronisation (sync) to the professional toolkit of the disc jockey (DJ) in the early 2000s proved to be controversial and divisive. Until that point, DJs had been so focused on beatmatching—the manual process of tempo-setting and alignment of tracks—that many dismissed sync as 'cheating'. Concern over technology-assisted creative output is not unique to electronic dance music (EDM). David Hockney's investigation into the use of optical aids by the Old Masters highlighted similar perspectives in visual art. As sync has simplified some of the mechanical aspects of DJing, DJs have shifted away from building sets by sequencing pre-recorded audio made by other music producers towards an approach that incorporates improvisatory composition and production. Through a process of reflective practice and critical review of technique and repertoire both pre- and post-sync, this paper discusses how technology shapes and informs the realisation of a DJ set, highlighting how sync has catalysed a disconnect between the performer, their gestures, the source material and audiences, necessitating a rethink on how we demonstrate and recognise technical virtuosity in performance. This paper concludes by arguing that virtuosity in modern DJing is primarily a product of instrument configuration and pre-production, an amalgamation of formerly distinct production and performance techniques, and identifies how sync's affordances might inform future views on DJ practice and the presentation of EDM.

1 Introduction

In a packed nightclub, DJ Davvincii appears, arms spread wide as the crowd chants his name. He theatrically lowers a finger to start the music, immediately sending the audience into a frenzy. Members of the audience proclaim, "I love you, Davvincii," "*this* is music" and "he's the king!" while the DJ finds time to fry an egg, play Jenga, draw a self-portrait, swipe credit cards, play computer games, operate a miniature train set and more. When he feigns a heart attack, the tension is palpable, but the DJ miraculously recovers, finally striking the oversize button marked BASS to set forth an apocalyptic response. The performance, part of a Saturday Night Live (SNL) skit from 2014, presents a comic take on a commonly-held mainstream trope about 21st century DJ practice; one in which the craft and skill of DJing can be automated and distilled down to a single button. Andy Samberg's portrayal of DJ Davvincii and the response of his adoring fans highlights the growing disconnect between performer, repertoire and audience caused by disruptive technologies.

Canadian DJ Deadmau5, a notable artist in the *real* world of EDM, sparked controversy by admitting that "we all hit play" (Zimmerman 2012). For Deadmau5, virtuosity is demonstrated in the studio, while beatmatching—tempo-setting and aligning tracks[1]—can be handled by technology. A central

[1] In DJ parlance, 'track' usually refers to an arranged work. Historically these were played from vinyl, then from CDs. The advent of digital audio led to flexibility in the type and shape of tracks that could be played. Here 'track' refers to audio played by DJs, distinct from the track one might find on a Digital Audio Workstation (DAW) – DJs and producers often refer to these discrete audio tracks as 'stems'.

argument in this paper is that beatmatching and its automation through sync therefore sits at the centre of discourse on virtuosity and authenticity in 21st century DJing. In the pre-digital era, that virtuosity was more easily identified: audiences heard and saw DJs playing records and could directly connect performance gestures that caused shifts in timing or pitch—furious backspins, or scratching back and forth. DJs further demonstrated authenticity through "digging" i.e. procuring rare and exclusive records and amassing enormous record collections.

As vinyl gave way to digital audio, first through the introduction of the CD format and then through digital audio files, the process of collecting and handling music was made invisible, replaced by a panoply of knobs, buttons and blinking lights (Butler 2014, p. 1) that might not bear any obvious connection to the music played. By 2008 and armed with sync, Canadian DJ Richie Hawtin had abandoned turntables and beatmatching in pursuit of "something else" (Gholz 2011, p. 59), playing digital audio and loops on four virtual decks using Traktor Pro DJ software. He has since expanded further, incorporating modular synthesizers, sequencers and effects into his DJ sets.

In 2012 Pioneer DJ released the CDJ2000NXS, a standalone but network-connectable digital turntable that appealed to DJ approaches old and new. On one hand offering tactile control of digital files akin to handling records, and on the other offering a button marked SYNC, which put automated beatmatching within arm's reach of all DJs except the vinyl purist. Other affordances, such as quantized looping and immediate file transferability, presented DJs with a compelling case to abandon vinyl.

In 2011, Attias used the term "formatism" to explain a DJ's preference for vinyl over digital audio via CDs, WAV files or MP3s, arguing that "anxiety over formats in DJ culture marked a 'crisis of identity' that was mediated by discourses of *virtuosity* and *authenticity*" (emphasis Attias 2013, p. 17). Attias articulated two areas where these aspirations are accompanied by anxieties that "continue to animate current controversies in DJ culture [...]: a concern that new technologies degrade the fidelity of musical recordings and a concern that they undermine the development of musical technique" (2013, p. 21).

It is no surprise that many vinyl DJs considered sync and digital audio a threat to the craft; product developers pursued a workflow where beatmatching's "cognitive load is heavily reduced" (Andersen 2005), and resistance came from both practitioners and academics. Mills suggested that DJing might become "nothing more than a button any promoter can push" (2013), while van Veen and Attias (2011) lamented that "the role of the DJ as human agent of music selection has been removed completely now."

This correlates to a shift by DJs toward the laptop, an instrument used to produce music, prepare for a set, and to simultaneously play and record a performance, with much of this work invisible to the audience. Accordingly, Montano argued for a revised view on how authenticity and skill was recognised, suggesting that "with the increasing use of CDs, mp3s and computer programs such as Ableton Live, the notion that vinyl and turntables represent the authentic technology of DJ culture seems somewhat redundant" and that "there needs to be a redefinition of the concept of DJing and a reframing of the skills and abilities seen as being essential to DJ practice" (2010, p. 397).

Regardless of the DJ's choice to beatmatch by hand or by sync, from an outsider's perspective, the set—the culmination of DJ curation and programming—has barely changed since the 1970s. The audio remains a collection of tracks, summed and arranged in long form with the intention of minimising distinctions and maintaining continuity. Many patrons cannot detect whether they are experiencing the nuances of manual, human beatmatching or the precision of automated sync, and SNL's representation of adoring EDM fans suggests that plenty do not care.

Sync presents an opportunity to move the DJ craft beyond its two-deck conventions: more precise mixing; more channels, and new instruments brought together in ways that were previously impossible. In so doing, adding these new layers of control and automation can "obfuscate and distend the moment of creation, making it more difficult for audiences to connect what they see on stage with what they hear" (McAlpine 2019, pp. 189-190). The risk is that by characterising DJ performance as did the SNL sketch, the craft of the DJ is reduced to the press of a magic button; EDM audiences are considered gullible, and DJs are considered cheats.

Hawtin hardly seeks a reduced cognitive load, however; his setup incorporates new instruments

and techniques across the six-channel[2] Model 1 mixer that he helped to design. Before 2001, DJs could not have imagined a performance on six channels, but with the cognitive load historically devoted to beatmatching now freed up, modern DJs can move beyond connecting the "intro" and "outro" sections of existing tracks to be more creative with the underlying materials. This continues a tradition established in the early 1970s by DJs like Nicky Siano, who in 1973 began playing on three turntables instead of two (Shapiro 2005, pp. 37-38). Siano made drastic temporal changes to records to make them fit into his sets and used duplicate records to piece together new arrangements. He was "not so much playing records as making music" (Lawrence 2003, p. 107). Nevertheless, until the turn of the century, the DJ's standard "two-deck" performance configuration had barely changed, and as a result, neither had the form and structure of the DJ set. Much of the craft of DJing was devoted to cueing up and handling the transitions between vinyl records, and virtuosity was measured by the number of simultaneous tracks a DJ could handle; by the late 1990s, "three deck wizards" like Mills were considered virtuosi (Butler 2006, p. 52; Reynolds 1998, pp. 272-273). Overall, it was the introduction of new digital technologies—primarily MP3 files, digital controllers and sync—that enabled DJs to overcome the tactile and cognitive limitations of traditional DJ performance and to routinely play and manipulate multiple tracks in real-time. As a consequence, the practice and the output of DJing, and the notion of what constitutes virtuosic DJ technique has changed.

This paper argues that sync continues the tradition of digital disruption and extends it to consider the impact not only on music performance, but on notions of authenticity and virtuosity. Investigating the work of DJs such as Hawtin and Mills and the author's own practice pre- and post-sync, it draws parallels between the DJ-centric discourse on sync and David Hockney's enquiry into the use of optics by the Old Masters of painting and drawing. Hockney's practice-led research methodology allowed him to chart historical trends in technology-assisted technique, and then to identify where artists rejected precision and departed from that trend. Similar insights emerged through the author's own performance design for a sync-driven work entitled *Real Time, Online* (2020).

This paper concludes that rather than reducing the cognitive load of DJ work, sync represents an opportunity to expand the DJ craft to incorporate new instruments and new techniques—including those previously viewed as the domain of producers (studio *makers* rather than *performers)*—for combining pre-recorded audio with real-time composition.

2 A Selected History of Disruption

When the Beatles released *Sgt. Pepper's Lonely Hearts Club Band* in 1967, the pop world realised that "performances and records were not necessarily linked" (Moorefield 2010, p. 55). The album was the product of 700 studio hours of "almost continuous" technological experimentation (Tingen 2017). The production's final touches involved "the taping of nonsense gibberish that they had decided to cut into pieces, stick together at random and play backwards before putting it in the concentric run-out groove of side two"[3] (Julien 2008, p. 7). Pierre Schaeffer was the first to exploit disc-based audio looping and performance on multiple turntables—using shellac records to create what he called "closed grooves" (Schaeffer 1952, pp. 32-36)—an approach that would be revisited by Techno producers playing vinyl in the 1990s.

In the 1980s, the UK Musicians' Union expressed concern that Gary Numan's synthesizer music was "putting proper musicians out of work" (Whalley 2009, 41:30), echoing the sentiment that radio DJs in 1920s USA were putting live musicians out of work (Brewster & Broughton 2006, p. 33). Simon Frith's commentary on disruptions caused by drum machines succinctly articulated the problem of human-machine interfacing more broadly: "It reflects [the] belief that the drummer is a musician in a way that the drum-machine programmer is not" (1986, p. 265). Other electronic instruments, such as the Fairlight CMI, "[gave] rise to the new types of practitioner, such as the 'programmer' " (Marrington

[2]Since then, Hawtin has moved to performing on a modified ten-channel desk designed by his father, an Allen & Heath PLAYdifferently MODEL 1 "EX" with additional direct output modifications on the extended rear panel.

[3]The run-out groove prevents the needle from reaching the record's inner label by trapping it in a loop.

2020, p. 718).

In Detroit in 1992, Mills asked his record cutting engineer, Ron Murphy, to cut circular grooves on one side of a double-LP release (Mills, Banks & Hood 1992) to look like The Rings of Saturn. Where The Beatles had added looped, layered, and reversed outtake chatter from the band's studio sessions (Lewisohn 1989, p. 109), Mills at first sought a visual effect. Murphy experimented further to add audio to the grooves (Zlatopolsky 2015). At a fixed tempo, 133.33 beats per minute (BPM), and with the record spinning at 33.33 revolutions per minute (RPM), he discovered a workable method for creating endless musical loops of 1.8 seconds duration, where the downbeat of one musical bar synchronised perfectly with each revolution of the record. In DJ circles these concentric loops became known as locked grooves (LG).

Historically, DJs played commercial releases that were first arranged and mixed in the studio, then mastered and manufactured before being played live. The DJ's pursuit of a continuous mix in these settings informed the structure of the tracks: producers made "DJ friendly" arrangements that would build gradually with an "intro" and then end with an "outro" (Rietveld 2011, pp. 6-7) to combine "the functions of textural decrescendo and closing within a single section" (Butler 2006, p. 224). Conventions for arranging intersected with conventions for two-deck DJ performance, where DJs moved back and forth between records on Deck A and Deck B, waiting patiently until "safe" points in an arrangement to execute transitions without incident. The risk of superimposed tracks playing out of time (a "trainwreck") imparts a degree of risk upon any extended overlay, making a two-turntable performance configuration enough for most DJs working un-synced. In pursuing continuity most DJs *do* seek convenience, an observation that emboldened Deadmau5 in asserting that "beatmatching isn't even a skill" (Zimmerman 2012).

With audio materials reduced to short loops running at a fixed tempo, DJs such as Mills and Hawtin used new performance approaches and formats such as the LG to challenge the form of EDM. Assembling loops in real-time facilitated a more fluid and flexible movement between tracks (or *less-than-tracks* – shorter loops created with the intent of bridging transitions, creating breaks or providing textural layers[4]) played simultaneously. Mills' live recording from a Japanese nightclub *Live At The Liquid Room – Tokyo* (1996) distributes excerpts of his three-deck performance across a CD release in segments. "Segment 2" includes thirteen tracks[5] in just under twenty-four minutes, including the Mills original "Loop 3," a locked groove hardly distinguishable from the other loop-based arrangements played in Mills' set. Although LGs are also necessarily mastered and cut to vinyl, this short format brought Mills a step closer to merging his production and performance practices by deferring any arranging until the moment of performance.

Despite his prior challenge to EDM form through looping LGs and loop-based studio arrangements, Mills did not seize the opportunity to merge production and performance through the exploitation of sync. Rather, he rejected it with the boldest of statements: *Exhibitionist* (2004), a DVD mix compilation that celebrated the manual technique—and the potential for error—of the Techno DJ. Amidst a market of carefully curated DJ mix CDs assembled with precision, this was a bold statement of "warts and all" DJing (Finlayson 2015). Within the first two minutes, Mills arguably makes enough "mistakes" to convince any novice to stop the mix and start over. The result of Mills' rhythmic drifting and shifting is reminiscent of Steve Reich's *Piano Phase* (1967), a work that was itself inspired by experiments with tape: *It's Gonna Rain* (1965); and *Come Out* (1966). Mills' rejection of the affordances of 21st century performance technologies echoes that of Paul Cézanne's response to the photographic technologies that emerged in the 1870s and the optical aids that preceded them, as discussed in the next section.

Once Hawtin began using software in performance, his works transformed completely. This is evident between his mix CDs *Decks EFX & 909* (1999) and *DE9 Transitions* (2005): software-based synchronisation replaced manual beatmatching, arranged tracks no longer represented the building blocks of a set. Hawtin either reduced these blocks to short loops in advance, or he applied EQ and filters

[4]In fairness to records arranged according to the sections form outlined in the previous paragraph, it is worth making a distinction between a 1.8-second audio loop and a complete track.

[5]Mills played thirteen separate pieces of audio from vinyl. These were presented as a single CD track, in this case labelled a 'segment'.

to strip tracks down to their rhythmic skeleton, not unlike the work of a Dub producer extracting a rhythm from a reggae song (Veal 2007, p. 48).

The loops and stems created as a product of this process were woven back together in a tapestry of "six, seven, even 10 primary sources" (Loftus 2005). Effectively Hawtin created *remixes* of works by other artists, then assembled these new productions in a DJ mix. By the time *DE9: Transitions* was released in 2005, his blends were so elaborate that each of the twenty-eight tracks was attributed to Hawtin as the original artist, though not without credit to the artists from whom he sampled. That this process might be characterised as *sampling* rather than simply *playing tracks* shows how the work relied on studio processes as much as performance techniques, facilitated by a common instrument deployed to both pursuits: the laptop.

For the 21st century DJ, technology has eased the mechanical burden of creating new works, and though some practitioners and observers might consider this "cheating," this affords the adopters of such technologies an opportunity to incorporate new elements of performance into their craft. Technology does not equate to a shortcut, but a facilitator and redistributor of effort. This has direct parallels in other areas of creative practice.

3 David Hockney's Secret Knowledge

After visiting an exhibition of nineteenth century portraits by Ingres at London's National Gallery in 1999, David Hockney began drawing with an optical device called the camera lucida (Hockney 2006, p. 12), eventually leading him to pursue a visual argument that "from the early fifteenth century Western artists had not just been aware of, but had relied on optics to create"living projections"" (Bolt 2010, p. 28). His theory was met with resistance by colleagues and contemporaries: "their main complaint was that for an artist to use optical aids would be 'cheating'; that somehow [Hockney] was attacking the idea of innate artistic genius" (Hockney 2006, p. 14).

Hockney's research enquiry was itself assisted by technology: affordable colour photocopying. After creating a wall of reproduced images that was "seventy feet long and covered five hundred years more or less chronologically" (Hockney 2006, p. 16), he could not only view the works side by side, but could arrange a timeline to view the history of visual art as it intersected with technologies that emerged to challenge or assist it. This included lenses used by the Old Masters since 1430, and "the invention that fixes the lens image with chemicals (photography) doing away with the need for the artist's hand altogether" in 1839 (Hockney 2006, pp. 184-185).

In his broad overview, Hockney charts artists and their output with a green line that runs parallel to a red line representing technology (2006, pp. 184-185). Where the green line shows the work of Michelangelo, for example, he is seen to depart from the red line (electing not to use optics), but remains relatively close, due to the influence of other practitioners and works. In the 1870s, once photography had become more widespread and people had become more exposed to its realism, artists such as Cézanne departed much further, and after four centuries of realism, "awkwardness" returned (2006, p. 185). Hockney demonstrates this awkwardness by displaying Caravaggio's 1597 work, *Basket of Fruit* next to Cézanne's 1878-79 painting, *Apples* (2006, pp. 188-189). It is no surprise that Caravaggio's position on the green line touches the red line that represents technology; the precise detail in his fruit is almost photographic, especially next to Cézanne's awkward apples that appeared after photographic perfection could be achieved with a camera. Hockney's argument was not that one work is more skilled than the other, but that our understanding of how each work was created can be advanced through more focused research—why didn't Cézanne use optics?

This kind of enquiry allows us to better understand why artists deploy different techniques and media: Cézanne's decision to "eyeball" a subject asserts an artistic view that transcends realism. To draw this back to DJ practice, consider Mills' approach to beatmatching:

> *I'll let it fall off a little bit before you hear it, so you can feel it coming together. Because, you know, we're dealing with people, and people are not machines. Perfection is not always the*

Figure 1: Caravaggio's *Basket of Fruit* 1597/1600. Source: Google Arts & Culture, reproduced under a creative commons license.

Figure 2: Cézanne's *Apples* 1878-79. Source: Google Arts & Culture, reproduced under a creative commons license.

> *point [...] If you never let the audience hear that, then they might believe that you're perfect, and that you mix like a computer, like software* (2019).

Even when DJs elect not to utilise sync, they operate amongst a field of practitioners for whom it is widely available, just as the Old Masters "would have seen paintings and drawings made with [optics], and maybe even some projections themselves (to see optical projections is to use them); and as apprentices they probably copied works with optical effects" (Hockney 2006, p. 17). In EDM, where precise, sync-driven transitions have become increasingly commonplace, the audience might expect precision from performers who choose not to use the technology. Still, just as Cézanne did not seek high resolution perfection in his execution of *Apples*, performers such as Mills favour the imperfection of manual assembly—micro-timing between discrete rhythms, alignments pursued in real-time and by feel—over the precision of sync.

Despite its precision, there are limitations and skills inherent in using sync, many of which are yet to be fully investigated. Consider Hockney's comment on the use of optical aids: "let me say here that optics do not make marks, only the artist's hand can do that, and it requires great skill. And optics don't make drawing any easier, either, far from it – I know, I've used them" (2006, p. 14). Bolt reviewed Hockney's drawings with and without optics: "the line was much surer and more confident than the 'groping lines' of a drawer struggling to 'see' and record freehand. However, in this confidence it lacked the struggle, the variation in line quality and indeterminacy of the eyeballed drawing" (2010, p. 28).

In DJ performance, the difference between the sure hand of sync and the groping lines of manual assembly is worth exploring. Mills must work harder for every alignment between tracks, and in so doing generates a sonic outcome characterised by variation and indeterminacy that is, for many listeners, more appealing than the rigidity and confidence of a sync-driven Hawtin set.

4 Analysis of pre- and post-sync technique and repertoire

The differences between a synced Hawtin and an un-synced Mills, and between Caravaggio and Cézanne—utilising technology for precision in creative practice or rejecting it—are evident in a side-by-side viewing of two performance works by the author. The first is *Honkytonks: The Last Dance* (2006) (*TLD*), a vinyl-only set performed with two Technics SL1210 turntables and a two-channel Pioneer DJ mixer. This was released globally as a DJ mix CD, a format since superseded by online radio streaming and podcasting. The second is *Real Time Online* (2020) (*RTO*), an audio-visual (AV) performance using Ableton Live on an Apple MacBook Pro and a six-channel Model 1 mixer. This was transmitted via Facebook Live during the Covid-19 pandemic. The following section describes pre-production, performance design, and examples of DJ mix transitions in *The Last Dance* and *Real Time Online*, then discusses how they each embody different facets of virtuosity and authenticity.

4.1 The Last Dance

Full Set (1)

TLD paid homage to traditional DJ practice. Comprising fourteen tracks by other producers, the continuous set was live-mixed by the author.

4.2 Pre-Production

The work of curating and then performing this mix was punctuated by months spent in front of spreadsheets and emails: licensing deals were negotiated with producers and labels, permissions granted, and a shortlist approved. This represented a commitment to digging that moved beyond finding records to securing the rights to combine and re-record them. Once opening and closing tracks were selected, the planned transitions between tracks were rehearsed in an effort to map out a musical trajectory for the set. In the years after digital DJ devices emerged, authenticity was front of mind for both audiences and performers, and so the decision to perform the set using vinyl, and to record the mix in a single take

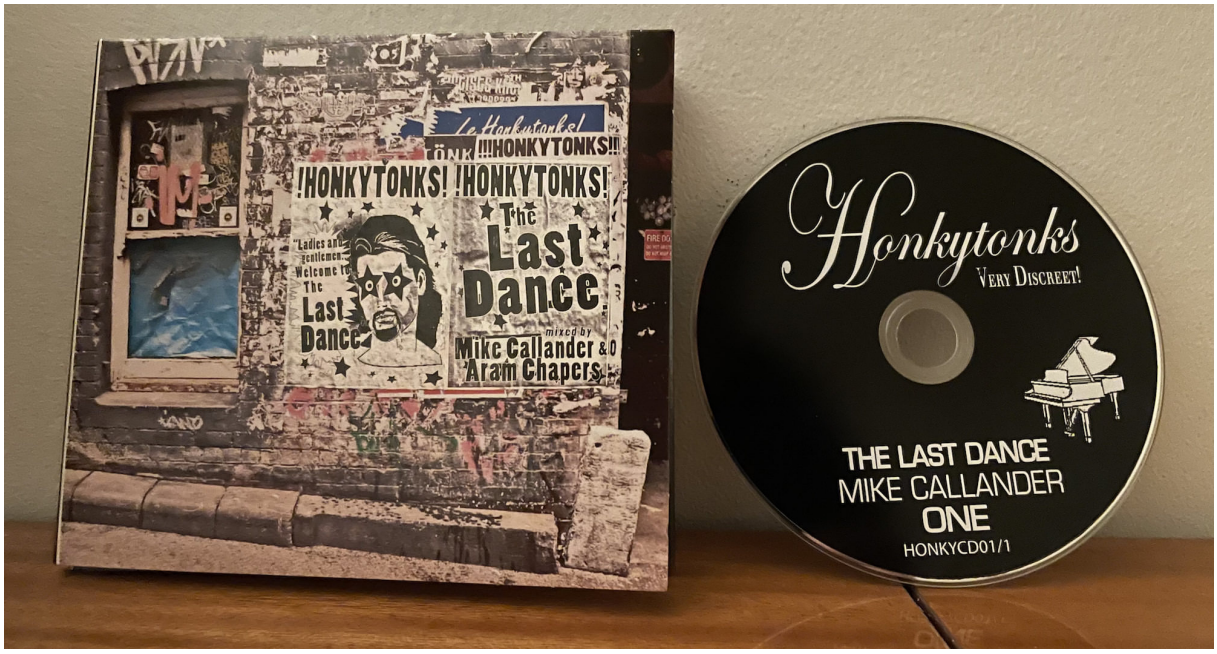

Figure 3: Mike Callander mix for *Honkytonks: The Last Dance* (2006)

without further editing was a commitment to the history of the DJ craft. The CD liner notes for *TLD* proudly announced: "these are real turntable mixes, using vinyl, two Technics SL1210s and a mixer" (Callander & Chabdjian 2006). This echoed the sentiment of rock bands that explicitly asserted their authenticity: Queen plastered a statement on their 1970s albums that read "no synthesizers!" (Milburn 2013, 112); and Rage Against The Machine proclaimed that "no samples, keyboards or synthesizers [were] used in the making of this record" (de La Rocha, Morello, Comerford & Wilk 1992).

4.3 Execution

In *TLD*, a cautious approach to live DJ performance is evident from the outset. After four minutes of the first track, Jackmate's *80SC7SEQ* (Baumann 2003), Hervé AK's *Serial X* (Hervé 2006) blends in smoothly (Transition 1A). The sparse outro of the former allowed for the alignment of the two without the need to adjust the mixer's equalisation and volume. When the first track entered its sparser outro phase, the transition became a matter of maintaining alignment. Within a minute, only *Serial X* was audible—not a quick mix à la Mills, but a safe one. The set progresses in a similar vein, the DJ barely intervening in the arrangements as they had been cut to vinyl, instead focusing his attention on the transitions between tracks. With two records spinning, the tempo had to be set by ear; analogue turntables lack the precise tempo readings that are presented by digital decks in decimal increments. Every suspended overlay represented a risk to the performance and required continual adjustment.

As the set continues, the mixing becomes more cautious as the DJ aims for safe transitions to avoid an audible trainwreck from derailing the recorded performance to that point. The boldest interruptions amount to little more than early exits from tracks, the DJ preferring the performative safety of leaving a single track in play without creating an audible chasm of frequency, rhythm or volume (Transition 1B). Occasionally an opportunity presented to exit a track earlier than at the outro. During a short break around halfway into *No Matter Whether* (Scasacia 2005), the mix switched quickly to the beatless intro section of *Bildeburg Group* by Konrad Black and David Brown (2006) (Transition 1C). This transition capitalised upon energetic shifts happening on an intra-track basis: the ambient introduction to *Bildeburg Group* provided a sense of drama in an otherwise continuous flow of forward-moving, minimalist Techno; the short break in *No Matter Whether* represented an opportune moment to switch between two beatless sections.

The DJ's part in the process really *was* that of a disc *jockey—riding* the forward motion of these

records and switching from one to the other, but without generating energy that was distinct from the tracks as they had been produced. Aside from deciding which track to play when, at what pace and for how long, the DJ technique had little impact on the sound or shape of each record. The DJ selected, presented, and blended works by other producers, but did not produce or compose.

4.4 Authenticity and virtuosity before sync

TLD prioritised mixing *live* to capture the recording in a single take and on *vinyl only* as a matter of artistic choice. Though the setup was not dissimilar to that used by Mills in 2004 (two turntables rather than three, plus a mixer), the digital precision that emerged in other performances around that time, especially from Hawtin, had evidently influenced the set. To achieve Hawtin's digital precision at the frequency of Mills' vinyl execution is beyond the reach of most DJs. Accordingly, the performance was executed with caution, seeking a comparable precision but without using the technologies that could guarantee it. Though this approach resisted emerging digital technologies, it lacked the confidence of Mills or Cézanne in celebrating the awkwardness inherent in that choice; virtuosity was a matter of minimising mistakes in the pursuit of flawless technical execution.

In recording *TLD*, virtuosity was further displayed through curatorship and programming: tracks were selected carefully, arranged in order, and then assembled without technical incident. In spruiking the releases, the matter of authenticity was addressed by emphasising that the mix had been recorded without any post-performance editing. As the set was executed without any studio tricks, it was *real* DJing, an honest representation of how the set would be performed live. This approach is embedded with nostalgia, more like a direct-to-disc recording of Frank Sinatra and his orchestra in the 1940s-1950s (Granata 2004, pp. 37-38) than *Sgt. Pepper*'s 700 hours of production using multi-track tape.

4.5 Real Time, Online

Full Set (2)

Real Time, Online deployed a modern approach to DJing that was inspired by the LG format discussed earlier: un-arranged, loop-based tracks were assembled in real-time. Performed across six channels and held together by sync, records and turntables were replaced by three channels of pre-recorded audio and accompanied by three more channels of electronic instruments. In June 2020, with support from the City of Melbourne's *Covid-19 Quick Response Arts Grants*,[6] the set premiered via Facebook Live. The funding proposal demonstrated how ideas for the craft had changed: "real time audio and video synthesis merges with the artist's own form in a multimedia broadcast that cannot be replicated and will exist only online." Authenticity in this performance was not connected to format or curatorship, but to time and place: the combined sum of pre-recorded audio and improvised accompaniment would be unique to the moment of assembly. The intent for *RTO* was to push the boundaries of DJing as far as possible, as Hawtin inferred, allowing the DJ to do "something else" (Gholz 2011, p. 59).

4.6 Pre-Production

Most of the audio used in *RTO* was recorded at Melbourne Electronic Sound Studio (MESS), in front of unfamiliar instruments such as Moog's System 55 or Buchla's 200 modular system, with their audio output routed into Ableton Live. With recording enabled, sampling, re-sampling, and programming began immediately. Passages of audio were duplicated, edited, looped, and layered alongside subsequent overdubs. The new ideas that emerged through that process were saved as versions, leaving the previous session intact and creating a new virtual sketch. The best of these were rendered as audio and distributed across three tracks in a new Live set, and then routed into respective stereo channels of the Model 1 mixer.

[6]Detail on CoM Covid-19 grants https://www.melbourne.vic.gov.au/arts-and-culture/strategies-support/funding/Pages/assistance-creatives-covid-19.aspx

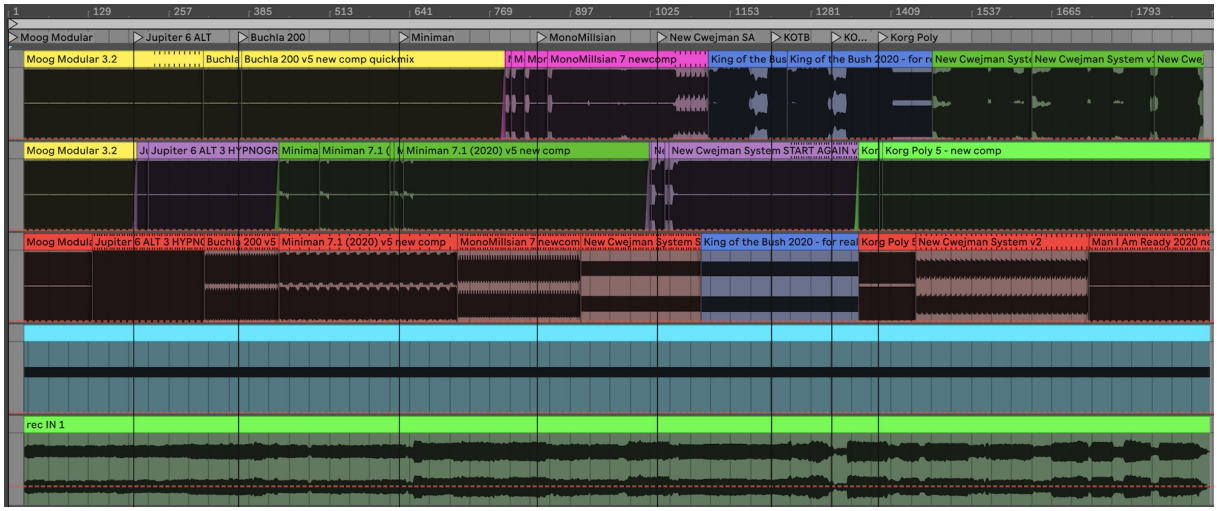

Figure 4: *RTO* timeline from Ableton Live. Clips from Live's Session View were recorded into the Arrangement View. The fourth layer (light blue) shows MIDI notation from Native Instruments Maschine 2. The fifth layer (green) is summed audio from the Model 1.

Working in threes facilitated a performance approach somewhere between "we all press play" and a more fluid improvised assembly. It enabled moving from one piece of recorded audio to the next as any traditional DJ might, but it also enabled the exploitation of opportunities afforded to DJs through powerful DAWs in the 21st century—duplicated audio signals, looping, and an expanded track count. Through this workflow, the un-arranged studio-made track was treated as a flexible building block for mixing in multiple directions, rather than a destination reached via typical mix transitions from one track to another.

4.7 Execution and analysis

Ableton Live was used to track the playback of audio clips alongside summed audio that had been routed back into Live's Arrangement View, while a video camera documented the performance. This enabled review of the set's inputs and outputs simultaneously on a shared timeline, and correlation between performance gestures and sonic outcomes. The visual timeline below shows which tracks were introduced, when, and for how long.

The CD liner for Hawtin's *Decks EFX & 909* (1999) presented a similar view of DJing that departs from typical Deck A to Deck B programming; this demonstrates Hawtin's early interest in sync-enabled multi-channel performance. Rather than one complete track transitioning to another, this was a more elaborate deconstruction and reassembly of tracks, with a less obvious delineation between one and the next, and less adherence to the outro-intro conventions of DJing with commercial releases.

4.8 Deconstructing a modern mix

At the beginning of *RTO* it took more than nine minutes before the first track, "Moog Modular 3.2," was audibly removed from the mix, though any listener could be forgiven for missing the point where it dissolved over time. "Jupiter 6 ALT 3 Hypnogroove" was introduced at 00:04:07, but it was not until 00:09:34 that the first track had disappeared completely (Transition 2A). Fluidity was the objective, as it was for Hawtin's *DE9* trilogy (1999; 2001; 2005). Across three channels, and with various clips representing partial deconstructions of two original works, the summed audio transformed gradually over time. This approach to assembling tracks was continued throughout the hour-long performance.

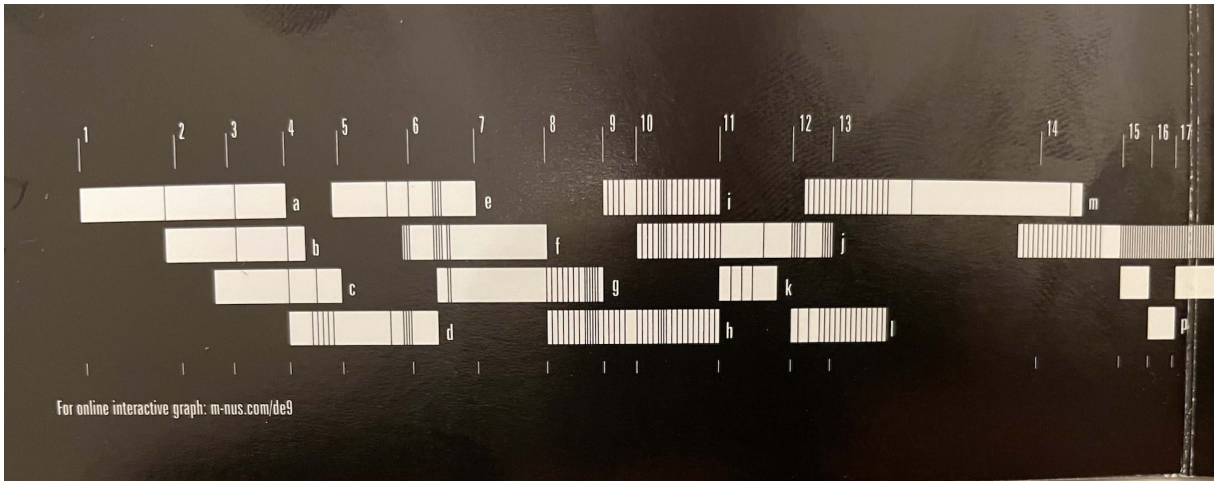

Figure 5: Arrangement detail from Hawtin's *Decks EFX & 909* (1999).

Table 1: Timestamps for tracks played in *RTO*. Bold rows (8, 10, 12, 14, 16) indicate where clips from three separate tracks played simultaneously. At other times the set represented blended duplicates or triplicates from the same source audio.

ITEM	TIME	TRACK 1	TRACK 2	TRACK 3
1	0:44 - 4:07	Moog Modular 3.2	Moog Modular 3.2	Moog Modular 3.2
2	4:07 - 6:18	Moog Modular 3.2	Moog Modular 3.2	Jupiter 6 ALT 3 Hypnogroove
3	6:18 - 9:34	Moog Modular 3.2	Jupiter 6 ALT 3 Hypnogroove	Jupiter 6 ALT 3 Hypnogroove
4	9:34 - 9:38*	Buchla 200 v5 new comp quickmix	Jupiter 6 ALT 3 Hypnogroove	Jupiter 6 ALT 3 Hypnogroove
5	9:38 - 13:15	Buchla 200 v5 new comp quickmix	Jupiter 6 ALT 3 Hypnogroove	Buchla 200 v5 new comp quickmix
6	13:15 - 13:17*	Buchla 200 v5 new comp quickmix	Miniman 7.1 (2020) v5 new comp	Buchla 200 v5 new comp quickmix
7	13:17 - 22:03	Buchla 200 v5 new comp quickmix	Miniman 7.1 (2020) v5 new comp	Miniman 7.1 (2020) v5 new comp
8	**22:03 - 24:24**	**Buchla 200 v5 new comp quickmix**	**Miniman 7.1 (2020) v5 new comp**	**Monomillsian 7 newcomp**
9	24:24 - 28:05	Monomillsian 7 newcomp	Miniman 7.1 (2020) v5 new comp	Monomillsian 7 newcomp
10	**28:05 - 31:26**	**Monomillsian 7 newcomp**	**Miniman 7.1 (2020) v5 new comp**	**New Cwejman System START AGAIN v2**

ITEM	TIME	TRACK 1	TRACK 2	TRACK 3
11	31:26 - 34:00	Monomillsian 7 newcomp	New Cwejman System START AGAIN v2	New Cwejman System START AGAIN v2
12	**34:00 - 34:22***	**Monomillsian 7 newcomp**	**New Cwejman System START AGAIN v2**	**King of the Bush 2020 - for real time online**
13	34:22 - 41:43	King of the Bush 2020 - for real time online	New Cwejman System START AGAIN v2	King of the Bush 2020 - for real time online
14	**41:43 - 41:45***	**King of the Bush 2020 - for real time online**	**New Cwejman System START AGAIN v2**	**Korg Poly 5 - new comp**
15	41:45 - 44:33	King of the Bush 2020 - for real time online	Korg Poly 5 - new comp	Korg Poly 5 - new comp
16	**44:33 - 45:19**	**King of the Bush 2020 - for real time online**	**Korg Poly 5 - new comp**	**New Cwejman System v2**
17	45:19 - 53:00	New Cwejman System v2	Korg Poly 5 - new comp	New Cwejman System v2
18	53:00 - end	New Cwejman System v2	Korg Poly 5 - new comp	**Man I Am Ready 2020 new comp this track was not made audible.**

The process of moving from one track to the next represented a kind of homogenisation between works. If part of one track stood out from the other, it was equalised or filtered, or its volume was lowered, until at the mixer it became difficult to determine the origin of each sound. With sync mitigating the risk of a trainwreck, the DJ's cognitive function could be directed towards the blend of frequencies and amplitudes, rather than towards rhythmic alignment. While a blend between tracks was pursued in both the pre- and post-sync performances, in this performance the blends were more gradual, more layered, and more precise (Transition 2B).

4.9 Authenticity and virtuosity after sync

Virtuosity in *RTO* was not displayed through tactile handling, but through performance configuration and pre-production; as Deadmau5 explained: "my 'skills' and other PRODUCER'S skills shine where it *[sic]* needs to shine: in the goddamned studio" (2012. Emphasis Zimmerman).

Skill in *RTO* was demonstrated through the design of a custom instrument that was configured to play exclusive music—routing discrete audio outputs from Ableton Live through a Model 1 mixer departs significantly from two-deck conventions—and because the DJ's handling of the music was unique to that performance. It was not necessary to demonstrate visible tactile control over the alignment of tracks, instead tracks that had never been heard were composed on the fly. DJ performance and studio production were amalgamated.

Armed with a suite of original and exclusive audio and engaged in a newly-combined practice between studio and stage, the DJ did not need to dig for records, nor seek permission to use them. From start to finish, this set belonged to the DJ; authenticity was demonstrated through the scope of the work and an expansion of technical skills. Authenticity and virtuosity were intertwined, but in a manner different to that advanced by Attias (2013, p. 17): the performance was realised entirely through

the work of a solo practitioner using new tools, such as Ableton Live instead of turntables, distinct from the fourteen studio producers and one performing DJ involved in the execution of *TLD*.

5 Conclusion

This paper began by highlighting the disruptive effects of sync. Automating the work of beatmatching led to a conceptual divide between those who view DJing as being inextricably linked to the tactile craft of playing records, and those who see the DJ as a practitioner that works on producing, arranging and instrument configuration before presenting music in a live setting.

In the tradition of technology-assisted performance and production, sync and digital audio do present a challenge to the DJ craft. It is the assertion of this paper that the challenge should result in the evolution and growth, rather than the death, of DJing. While digital audio removes some of the difficulties in sourcing and handling records, and sync automates some of the DJ's work in connecting tracks, practitioner concerns over technology-assisted practice are only valid where it is assumed that making a task easier necessarily results in a loss of skill. If deployed in a two-turntable setup, where DJs simply continue the work of connecting tracks made by other producers, sync would certainly reduce the DJ's cognitive load, but should that matter to our ideas for quality in performance?

This paper presents an expanded view of the scope of DJing, where the work of production and performance can be amalgamated. The modern practice amounts to more than finding and connecting ready-made records; it involves making new works and executing more elaborate real-time combinations. Evidently, the DJ's embodiment of authenticity and virtuosity can also be amalgamated; the modern DJ can be a producer of recorded musical works *and* a producer of live performance works. Comparisons between *RTO* and *TLD* showed that virtuosity and authenticity did not disappear as a result of sync, they were demonstrated at different stages and in different ways.

RTO demonstrated, and Hawtin continues to demonstrate, that DJs can use sync as an opportunity to do *something else* and *something more* in performance. New ways of DJing that explore techniques and configurations previously impracticable are emerging as more DJs redeploy the headspace and dexterity that is freed up by utilising sync. When paired with a desire to pursue improvisatory assemblage in a more fluid and immediate manner, the reduced cognitive load offered by sync is offset by an increased cognitive capacity during performance, and a front-loading of the work required to realise a more elaborate set.

RTO exemplified a modern approach to DJing that departs from its historical conventions. At a technical level, utilising sync enabled longer blends between less developed tracks that were distributed and manipulated across an expanded track count. More broadly, and considering how the performer combines technique and repertoire, sync facilitated a greater degree of improvisation, and enabled deferral of arranging and mixing—the realisation of a track—until the execution of a set.

Through critical review of technique and repertoire both pre- and post-sync, this paper outlines a series of technology-mediated transitions. Set preparation shifted from record digging to production and pre-production: new works were made to play, rather than made for record store shelves. The new shape of materials necessitated a reconfiguration of performance instruments. Matters of authenticity and virtuosity were disconnected from the vinyl format, and the historical methods for handling it, to an all-in-one offering: production and performance merged. This correlates to a shift toward the laptop, an instrument used to produce music, prepare for a set, and to simultaneously play and record a performance. *RTO* also made use of that same device to review the performance on a more analytical level. As laptops become more powerful and their interfaces more interactive, it is likely they will be used even more extensively in DJ practice.

For those of us deciding how to align and assemble audio, and for anyone watching and listening, these discoveries should inform future views of DJ practice and the presentation of Electronic Dance Music. With the SYNC button in front of most new DJs, many will learn to perform with that technology enabled. A few might seek more of a challenge, or some connection to the past, and will learn to play records as a point of distinction. This choice between convenience and manual control is reminiscent

of driving a car, where features such as automatic transmission, power steering and cruise control are optional.

With sync enabled, DJs will be gig-ready in a shorter time. With more DJs in the field, there will be more competition and more innovation. The relentless emergence of new beat-making machines, sequencers and groove boxes will encourage them to improvise with new compositions: to loop, re-arrange, edit and effect works in real-time. This trend is already evident amongst next wave Techno DJs such as Amelie Lens and Charlotte de Witte, each of whom "takes a totally new direction" with the Pioneer RMX-1000 DJ effector and sampler ("RMX-1000 Professional DJ effector & sampler (black) - Pioneer DJ", n.d.). The difference between existing works and exclusive performance works will blur further, and just as a young Nicky Siano experimented on three turntables in 1973, these modern DJs will be not so much *playing records* as *making music*.

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