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"Directions in Music by Miles Davis": using the ecological approach to perception and embodied cognition to analyse the creative use of recording technology in *Bitches Brew*.

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Introduction

In August 1969 Miles Davis went into Columbia Records' Studio B in New York to record *Bitches Brew*[1]. It was earlier that year on the sleeve of the *Filles De Kilimanjaro* album[2] that Davis started to use the credit "Directions in Music by Miles Davis". Davis is simultaneously alluding to the already firmly established notion of creative leadership of the cinematic industrial production process and the frequently used metaphor of taking music in a new direction. In this article I will examine the ways in which the various musicians, the sound engineer and the record producer engaged with the recording and instrument technology to produce this record and just what Davis may have meant by this unconventional name check. To do this, I will examine the process using ideas taken from the Social Construction of Technology (SCOT),[3] and Actor Network Theory, (ANT)[4]. It may seem reckless for a musicologist with only a recent engagement with Science and Technology Studies to step into this minefield of referencing both paradigms but my approach is based on the ideology that all theoretical models are schematic representations of some aspect of the world 'as if' certain constructs were true. If one simplification of messy reality is more useful in one situation and another works elsewhere then I see no reason for exclusivity. This resonates with Law's questioning of whether there is "a single intellectual and political space to be 'won'"[5]. In that regard, I aim to bring to bear tools from notionally competing paradigms whenever I think they provide useful perspectives. My recent research into record production does this from the

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[1] Davis, *Bitches Brew*.

[2] Davis, *Filles De Kilimanjaro*.

[3] Pinch, Bijker, and Hughes, *The Social Contruction of Technological Systems: New Directions in the Sociology and History of Technology*.

[4] Latour, *Reassembling The Social: And Introduction to Actor Network Theory*.

[5] Law, "Actor Network Theory and Material Semiotics."

starting point of the ecological approach to perception (EAP)[6] and embodied cognition[7]. Of course the notion of affordances has been 'borrowed' from Gibson[8] quite extensively by sociologists[9], but I aim to extend the use of these ideas to provide a psychological and cognitive foundation for SCOT and ANT.

There are two key terms from EAP that need to be introduced: *invariant properties* and *affordances*. Perception is a schematic process and the mechanism by which that schematic nature arises is that particular neural pathways become entrained through frequent firing. Thus, if as an infant I have several experiences of moving towards an object and bumping into it, many of the features of this perceptual experience will be different each time: the color and shape of the object for example. The perceptual features that are the same each time, the invariant properties, become connected with the results, the affordances. Thus, in the bumping example, the movement of lines and shapes across the retina from the centre to the periphery – the visual result of something approaching quickly – become invariant properties that are associated with results such as the inability to move further forward, a particular type of pain and so forth – the affordances. Note that in EAP these are perceptual and interpretive features rather than material properties and, despite what Gibson says about the direct perception of affordances, he is referring to the direct identification of previously experienced pairings of invariant properties with affordances.

This allows us to build schematic representations of objects, environments and processes that Lakoff and Johnson[10] have described as image schemata and event schemata. These are constructed from the required elements or conditions (invariant properties), variable properties, and the potential affordances that will provide our expectations of what is likely to happen next. These schemata are constructed through direct connections with our bodily experience but we also develop metaphorical connections between these basic bodily

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[6] Gibson, *The Ecological Approach to Visual Perception*; Clarke, *Ways of Listening*.

[7] Feldman, *From Molecule to Metaphor*; Lakoff and Johnson, *Metaphors We Live By*.

[8] Gibson, *The Ecological Approach to Visual Perception*.

[9] see, for example, Hutchby, "Technologies, Texts and Affordances"; Latour, *Reassembling The Social: And Introduction to Actor Network Theory*; Bloomfield, Latham, and Vurdubakis, "Bodies, Technologies and Action Possibilities: When Is an Affordance?"

[10] *Metaphors We Live By*.

experiences and schematic representations of the world outside our bodies. To revisit our bumping example, if we come up against a problem in the wider world where our progression towards some solution is blocked, we think of it in terms such as "I've come up against a brick wall." – a connection made between an embodied blockage and a metaphorical one.

Whether we're talking about concepts such as the technological frame in SCOT or the use of the term affordances in ANT, the fine detail of how these social activities are performed can be examined from the perspective of invariant properties, affordances and schemata. Latour's assertion that ANT provides an empirical description of social activity is based on assertions of causality between one or more agents and the actions of others. By inferring a causal relationship assumptions have to be made about the psychology of the participants and this model seeks to make the psychology behind that causality more explicit. An individual builds cognitive models about their current situation and maps them onto the schematic scripts they have learned to utilize in previous circumstances. Of course, these scripts don't exist as discrete entities but are an emergent property of probabilities based on previous experience. There may be many potential variations in the likely outcome of 'running a script' so the 'map' may be somewhat fuzzy. This mapping process results in a plan where the end result of enacting these scripts comprises the achievement of a goal. Collaborative creativity requires that the participants align these types of plans and goals in some way. The collaborators don't have to share the same goals. They don't even have to share the same perception of what is and isn't happening during the process. Indeed, as we shall see, that is one of my principal contentions about the making of *Bitches Brew*. Although the participants didn't share perceptions, goals and schemata about precisely what it was that they were engaging in, they were contracted by a combination of financial and cultural goals and loosely defined, shared schemata about what musicians do to achieve them: play music and make recordings. If the activity that is planned and undertaken stimulates the development by each individual of cognitive models, scripts and plans that achieve their own individual goals then the network can function: even if they each believe something different is happening. Indeed the idea from SCOT that there might be several competing technological frames at play in any given instance of technological development is an example of this. These ideas can also relate to the level of immersion an individual may have in a technological frame, or their capacity for

interpretive flexibility. My aim here is to explore whether ideas such as these from ANT and SCOT can be explored from a fresh perspective using EAP.

In this large-scale industrial sector of the recording industry during the 1950s and 1960s engineers and producers were trained in a very formalized and modular way[11] - the 'correct' ways to use various pieces of equipment. Developments in the technology, which were largely undertaken by a research and development department that was part of the record company, were influenced by suggestions from these users (not the musicians directly) but were also driven by a positivist agenda of quality[12]. Sound engineers were often also electrical engineers and there are numerous examples of them making and modifying the equipment themselves. Thus the main driver for changes to both the technology and the working methods within these networks came from this dialogue between sound engineers and R&D departments[13]. It was only just before the production of *Bitches Brew* in 1969 that musicians started to exert an influence on the working practices in these networks. Up until that time musicians with economic 'muscle' were more interested in exerting influence on choices relating to arrangers, musicians and song writers[14]. The influence of producers and engineers such as Mitch Miller, Phil Ramone and Bill Putnam[15] had helped to raise the profile of creative control over the 'sound' of records to the extent that artists felt that they should also get involved.

Background To Bitches Brew

If we consider the process of making this album as an example of actor network activity, then we need to establish the scope of this network: both in terms of people and technology. On the one hand we have the direct participants: Don Alias (percussion), Harvey Brooks (bass),

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[11] Kealy, "From Craft To Art: The Case Of Sound Mixers And Popular Music"; Schmidt-Horning, *Chasing Sound: Technology, Culture, and the Art of Studio Recording From Edison to the LP*.

[12] This was framed mostly in terms of frequency and dynamic range but was also driven by a more subjective ideology built on the narrative of 'high fidelity' See, for example, Taylor, *Strange Sounds*, 78–81; Zagorski-Thomas, *The Musicology of Record Production*, 49–69.

[13] Ryan and Kehew, *Recording The Beatles*; Schmidt-Horning, *Chasing Sound: Technology, Culture, and the Art of Studio Recording From Edison to the LP*.

[14] Zak, *I Don't Sound Like Nobody: Remaking Music in 1950s America*.

[15] Schmidt-Horning, *Chasing Sound: Technology, Culture, and the Art of Studio Recording From Edison to the LP*; Zak, *I Don't Sound Like Nobody: Remaking Music in 1950s America*.

Chick Corea (keyboards), Miles Davis (trumpet), Jack DeJohnette (drums), Herbie Hancock (keyboards), Dave Holland (bass), Teo Macero (Producer), Bennie Maupin (bass clarinet), John McLaughlin (guitar), Jim "Jumma Santos" Riley (percussion), Wayne Shorter (saxophone) Stan Tonkel (sound engineer), Lenny White (drums), Tony Williams (drums), Larry Young (keyboards) and Joe Zawinul (keyboards). We also have several musicians and sound engineers who worked on previous recordings for Miles Davis which helped to shape the working practices employed on this album. Some, like Teo Macero and Wayne Shorter also worked on Bitches Brew whereas others, like Joe Beck (guitar on 'Circle in the Round'; Davis 1979[16]) and John Guerriere (sound engineer on *In A Silent Way*; Davis 1969b) didn't.

Then there is the studio and instrument technology that was available to them at that time. Columbia's Studio B in New York in 1969 had a 1" eight track tape machine and a twenty channel mixing console[17]. Despite the fact that eight-track recording had been developed by Ampex in 1957-8[18], it hadn't developed as a commercially viable technology until around 1968. There was an echo chamber in the building[19], an EMT plate reverb and there were plenty of mono and stereo tape machines with which to create tape delay and these were technologies that had been used extensively in the recording industry for quite a while. Teo Macero also had a device made by the Columbia R&D department called the 'teo 1'[20]. This was a tape loop audio delay device much like an Echoplex Tape Delay except that it had multiple record heads instead of single moveable one. These multiple delays are audible on Macero's mixes (for example at 08.40 on Pharaoh's Dance). On the instrument side, both Fender Rhodes and Wurlitzer had both released newer models of electric pianos in the second half of the 1960s that were popular with pop and rock musicians (rather than jazz players). Direct Injection (DI) boxes started to appear commercially in the mid 1960s and were also built by the in-house engineers at many studios[21]. A DI box allows a signal from an

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[16] Although "circle In The Round' was recorded in 1967, it wasn't released until 1979.

[17] Simons, *Studio Stories*, 124–35; Clark and Cogan, *Temples of Sound*, 181–92.

[18] Zagorski-Thomas, *The Musicology of Record Production*, 101–7.

[19] This was usually a highly reflective, irregularly shaped room into which a signal was played through a speaker and relayed back to the mixing desk via another microphone. This allowed smooth, bright reverberation to be added to vocals or other instruments.

[20] Tingen, "The Making of 'The Complete Bitches Brew Sessions.'"

[21] Moss, "Ed Wolfrum - Detroit Sound: Interview with Dr. Edward Wolfrum."

electric instrument such as an electric piano, guitar or, most commonly, a bass guitar to be inputted directly into the mixing console (and thence to tape) without being played through an amplifier into a room and recorded through a microphone.

These human and non-human elements in the actor network determined the forms of activity that took place. Davis' direct interaction with recording technology was mostly mediated through Teo Macero but he was also influenced by his perception of other, more distantly connected actors in the network. Latour has used the term oligopticon[22] to describe generalized groupings of actors such as popular musicians or the musical establishment. However, to extend my use of ecological perception and embodied cognition, I think it makes more sense to represent this 'ghostly presence' in terms of Davis' perception and interpretation of some disembodied external agents rather than to include them explicitly in the network. The advantage that this has is that I can, for example, include two different interpretations of the same group of actors that Davis and Macero might have. The potential problem for ANT is that this seems to go against the notion of grounding studies in materiality: in 'stuff' rather than 'the social'[23]. However there is material evidence of Davis' perception and interpretation – and, of course, a longer and more detailed study could attempt to piece together the material trail of activity, the translations,[24] that influenced these perceptions and interpretations. This method of attempting to represent the wider influence of human and non-human actors in terms of the image and event schemata of the participants, works better for me as it avoids what I consider to be problematic constructions such as oligopticons and panoramas. It also avoids problems of determinism and essentialism by making concepts such as affordances, translations and inscription individual rather than universal i.e. that they are ascribed by agents rather than inscribed in agents. Thus Macero, Davis and the other musicians can all have different perceptions about the possible affordances of recording technology and the desirability of the potential outcomes. They can also all have different goals. The functioning of the network doesn't require them to share these perceptions,

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[22] Latour, *Reassembling The Social: And Introduction to Actor Network Theory*, 181.

[23] Law, "Actor Network Theory and Material Semiotics."

[24] Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay."

schemata and goals, only that they can synchronise them sufficiently well for the production to be completed.

The formation and functioning of the network flows from the image and event schemata that the participants developed in relation to this activity, and from their perception of the affordances provided by the technological and other non-human actors that were available to them. In particular I will draw upon four aspects of these schemata that relate to the technological production process of recording that helped to shape this album:

1. The emerging idea that live and recorded music were different forms of artistic expression.
2. The creative possibilities of improvised performance in the recording studio.
3. The notion of tape editing as a creative tool.
4. The notion of sound mixing as a creative tool.

Miles Davis

Davis' *Birth Of The Cool* [25] project in 1948 can be seen as an important model for his future work. This nonet recorded twelve tracks for six 78rpm records in 1949 and 1950 and this was subsequently released as a vinyl LP in 1956 once that format had become established. In 1957, Columbia Records' George Avakian suggested he should make some large ensemble recordings with an arranger and Davis chose Gil Evans who had written some of the arrangements for *Birth Of The Cool*. *Miles Ahead*[26], *Porgy And Bess*[27] and *Sketches of Spain*[28] are examples of recording sessions where the ensembles were put together specifically for a project. While, for the most part in the 1950s and 1960s, Davis went into the studio and recorded with his current touring band, these kinds of project opened his mind to the concept of recording projects that broke with this mold. Firstly, and perhaps most importantly, it fostered a perception in himself and others that he was a special figure, not just in terms of his importance as an improvising soloist but also that he was leading the general move towards jazz as art music rather than entertainment. Throughout his autobiography

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[25] Davis, *Birth Of The Cool*.

[26] Davis, *Miles Ahead*.

[27] Davis, *Porgy And Bess*.

[28] Davis, *Sketches Of Spain*.

Technology and Culture

Davis is at pains to emphasise his skills and abilities as they might be judged within the European classical tradition[29]. Although this is constantly balanced by his indignation at having to prove himself to white gatekeepers, it is a strong motivation in the 1960s for him to develop his artistic practice in ways that reflect both his affiliation with the Afro-centric aesthetic of the Black Power movement and his parallel desire to be lauded and accepted by the predominantly white musical establishment.

During this period, Davis developed a new relationship with the notion of improvisation. Up until 1948, like most jazz musicians, he was improvising within the structure of composed song forms. Roles tended to be stylized and compartmentalized: composers wrote a tune that was stated at the start and the end and the chord sequence for that tune served as the vehicle for the performers to improvise solos between those two thematic statements. The main adjustments to their performance practice that they made in the recording studio was to restrict the length of pieces to fit the three minutes or so of the 78 rpm record. The *Birth Of The Cool* sessions and Gil Evans' subsequent work with Davis explored how written arrangements could be interwoven with improvisation. Davis started to incorporate these ideas into his other recording projects in 1959 with *Kind Of Blue*[30] which involved taking basic sketches into the studio and getting the musicians to create improvised compositions without any prior rehearsal. Davis was thus using his position as a band leader to impose new working methods on the other musicians. The more general network of jazz musical activity had always had quite a macho approach to musicianship: soloists were very competitive and players were expected to be able to respond to anything that was thrown at them. Davis had a particular response to these types of event schemata which was to deliberately force players out of their comfort zone. This was a strategy that he developed throughout the 1960s:

> "I had been experimenting with writing a few simple chord changes for three pianos…in 1968… It went on into the sessions we had for *In A Silent Way*… I told the musicians that they could do anything they wanted… but that I had to have this as a chord… so that's what they did. Played off that chord.

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[29] Davis, *Miles*.

[30] Davis, *Kind of Blue*.

> I told them that at rehearsals and then I brought in these musical sketches that nobody
> had seen, just like what I did on *Kind Of Blue* and *In A Silent Way*. [31]

These evolving event schemata, the way that Davis conceptualized the processes of composition, improvisation and performance in the studio, and image schemata, his notion of the sound that music created in these ways might produce, changed quite profoundly in the two decades between 1949 and 1969. By 1968 he was taking more conventional compositions and deconstructing them with the specific intent of stripping them down to their bare bones and using them as vehicles for this form of creative development. Joe Zawinul's composition 'In A Silent Way'[32] is a case in point. Davis used the composition as the title track of the album but it was a much simplified version of Zawinul's compositional idea.

Smith[33] and Svorinich[34] both cite several interview sources which suggest that Miles Davis "understood the studio to be a different creative environment from a live concert, and he maintained distinct ideas about what was musically appropriate in each setting"[35]. There was also a substantial shift in the notion of the recording as an artwork that was taking place in 1966 and 1967 in the world of popular music. The Beatles' *Revolver*[36], followed by The Beach Boys' *Pet Sounds*[37] and The Beatles' *Sgt Pepper's Lonely Hearts Club Band*[38] ushered in the idea of the recording as an exploration of the possibilities of studio technology rather than as a reproduction of a group's live sound[39]. This was followed by Sly & The Family Stone's *Dance To The Music*[40], Jimi Hendrix's *Electric Ladyland*[41] and Isaac Hayes' *Hot Buttered*

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[31] Davis, *Miles*, 288–89.

[32] Davis, *In A Silent Way*.

[33] "Sound, Mediation and Meaning in Miles Davis' 'a Tribute to Jack Johnson.'"

[34] "Listen To This: A Musical Analysis of Miles Davis' Bitches Brew."

[35] Smith, "Sound, Mediation and Meaning in Miles Davis' 'a Tribute to Jack Johnson,'" 50.

[36] *Revolver*.

[37] *Pet Sounds*.

[38] *Sgt. Pepper's Lonely Hearts Club Band*.

[39] Ryan and Kehew, *Recording The Beatles*; Zak, *The Poetics of Rock*; Butler, "The Beach Boys' Pet Sounds and The Musicology of Record Production."

[40] *Dance To The Music*.

[41] *Electric Ladyland*.

Soul[42] which made the point that this wasn't just a white rock musician's trend [43][44]. Davis was also influenced by the growth of an African facing aesthetic that was looking more to blues, funk and soul rather than jazz for its soundtrack[45]. In December 1967 Davis recorded 'Circle In The Round' (not released until 1979)[46] which marks the start of his experiments with recording in separate segments intended for editing together in post-production. In this case 35 short recordings were edited together to create a 26 minute piece of music.

Popular music, personified particularly by artists like The Beatles, The Beach Boys and Bob Dylan, was receiving the attention as alternative art music that jazz had been afforded in the 1950s and that was a position to which Davis aspired. The perception of the recorded album as a new art form that was different to live performance was obviously on Davis' mind at this point and that encouraged him to engage in the networks of recording activity in different ways: not just changing what he asked the musicians to do but also challenging the sound engineer/producer.

By 1968 the 'second great quintet'[47] was starting to disintegrate and, as this happened in a relatively piecemeal fashion, Davis started to experiment even more than previously with using players more like session musicians on recordings: putting people together specifically for one or two tracks on an album. It was on the album cover for the quintet's last recording, *Filles De Kilimanjaro* [48] that Davis first used the credit 'Directions in Music by Miles Davis' and said in an interview "It means I tell everybody what to do …it's my date, y'understand? …I got tired of seeing 'Produced by this person or that person'. When I'm on a date, I'm usually supervising everything"[49]. Normally the decisions about session players were made by

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[42] *Hot Buttered Soul*.

[43] Bowman, *Soulsville, U.S.A.: The Story of Stax Records*, 181–85.

[44] See Davis *Miles*, 281–83. for an account of how Betty Mabry introduced Davis to Jimi Hendrix and how Davis was interested in popular music at the time.

[45] Ibid., 280–83; Tingen, *Miles Beyond: The Electric Explorations of Miles Davis, 1967-1991*, 48–61.

[46] Davis, *Circle In The Round*.

[47] The 'second great quintet' is the term used in jazz circles to describe the Davis' quintet from 1964 to 1968 which comprised Ron Carter (bass), Miles Davis (tpt), Herbie Hancock (piano), Wayne Shorter (sax) and Tony Williams (drums).

[48] Davis, *Filles De Kilimanjaro*.

[49] Tingen, *Miles Beyond: The Electric Explorations of Miles Davis, 1967-1991*, 43.

producers but the idea of artists taking control of that aspect of the network activity can be seen in popular music at the time with artists like The Beach Boys[50] and Marvin Gaye[51].

Davis was also aware that the methods he developed for working with the musicians on *Bitches Brew* were innovative and, at the same time, born out of the moment:

> "I wish I had thought of video taping that whole session because it must have been something and I would have liked to have been able to see just what went down, like a football or basketball instant replay."[52]

The 'directions' that Davis was supplying can be characterized as arising from notions of creativity and authorship that he considered to be African in nature[53]. Gates[54] has identified the notion of *signifyin(g)* as an African-American performative tradition whereby pre-existing repertoire is seen as communal property which should be embroidered. Jazz is thus seen as music that grew out of an oral tradition rather than a written one: the precise detail of the retelling is never the same. Therefore the leadership of the interpretation process is where the authorship and authority reside. The invariant properties of this type of working practice lie in the variation of simple, pre-existing materials rather than the European tradition of complex composition. Davis, who was well versed in both traditions, had by the late 1960s moved away from orchestral works such as *Sketches of Spain*[55] and was focused on celebrating African influences through the lens of jazz, funk and soul. He was also, as evidenced by the use of 'Directions in Music by Miles Davis' on his album covers, looking for ways in which this authorship and authority could be incorporated into this communally creative network activity.

These kinds of invariant properties were the basis for the deep-seated habitus of jazz: the schemata associated with musicians' creative practice. In Davis' case this was accompanied by an enjoyment of control and leadership, and success as a jazz musician was also deeply rooted in the hierarchies of band leadership. As Davis developed his creative persona

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[50] Butler, "The Beach Boys' Pet Sounds and The Musicology of Record Production."

[51] Edmonds, *What's Going On? Marvin Gaye And The Last Days Of The Motown Sound*.

[52] Davis, *Miles*, 289.

[53] Ibid., 395.

[54] *The Signifying Monkey*.

[55] Davis, *Sketches Of Spain*.

increasingly through the way he put musicians together and encouraged them to play, he also began to explore the same possibilities for creative leadership in the recording studio.

As part of this, he also wanted producer Teo Macero to be part of this process: to be stimulated by his unorthodox methods. Of course, this stimulation was a reciprocal process despite Davis' leadership role. Davis speaks in his biography about the challenge that Tony Williams' musicianship posed to him and how he benefitted from the stimulus[56]. He was, however, very resistant to admitting a similar benefit from being exposed to Macero's working practices. Presumably this stems from his oft-stated resentment of 'white folk' taking credit for his work[57]. It seems unlikely, though, that he would have developed his radical approach to the improvised creation of recorded music if he hadn't been exposed to and influenced by Macero's creative enthusiasm for editing.

Teo Macero

Macero, as a record producer, had a similar gripe about authorship: that his contribution to musical life was largely ignored or considered to be administrative and financial rather than creative. Similarly, on the technical side, the creative aspect of editing was also dismissed (or more often not known about). Macero was certainly stimulated by Davis' flexible mindset when it came to recording technology and he was someone, like the other musicians in Davis' recording circle, who responded to Davis' stimulus.

As an editor and then subsequently as an in-house record producer for Columbia Records, Macero had also been developing this notion of the recording as a different form of artwork. A theme that runs through many of his interviews[58] is that his creative input is not sufficiently recognised by either the artists or the record companies. Macero was working in the pop world as well as the jazz and classical and would have been at least as aware as Davis was of the shift towards the notion of the album as an artwork in itself. He was very aware of the technical possibilities that the rapidly changing recording technology of the time was offering. The affordances of eight track recording, dynamic processing with limiters and compressors,

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[56] Davis, *Miles*, 267.

[57] See for example: Ibid., 290.

[58] ArtistsHouseMusic, *Teo Macero on Working With Dave Brubeck And Miles Davis*.

spatial effects from echo chambers and tape delay and other technologies were all part of Macero's event schemata at this point in his career. The usage of all of this technology, however, was often constrained by record companies', musicians' and potential audience members' notion of what was appropriate or authentic for a particular style of music[59]. Davis gave him a rare opportunity to explore them in a relatively unfettered manner.

The Technology

Anthony Meynell[60] has pointed to the importance of reverse engineering in the development of recording practice in the late 1960s: engineers hearing effects on other released records and developing their own techniques to emulate them. Working backwards from a knowledge of the affordances of particular technologies and practices they hypothesized a process that would make 'that sound'. Macero and Davis were immersed in a musical culture and, unlike others in the jazz community at the time, they were both keenly interested in the developments in popular music. The sounds of popular music that interested them both would have involved particular avenues of reverse engineering by suggesting forms of activity (and forms of technology) that afforded those sounds.

There are two key invariant properties of multi-track tape recording: the separation of recorded sound on a tape into a larger number of signal streams than would be required by the playback system and the development of the selective synchronous (Sel-Sync) recording head. If you record a larger number of signal streams than speakers, you need to mix them down during a separate post-production process into a mono or stereo master. As the number of channels increased so too did the creative potential of the mixing process, reworking the balance of the various instruments, but also there was the potential to entirely re-work an arrangement by bringing instruments in and out of the mix. In addition, the Sel-Sync system affords the recording of selected channels on the multi-track tape at different points in the production process. Thus it was possible to record instruments on channels 1 and 2 from one performance and then select those tracks as playback only and others, 3 and 4 say, as record. Two new performers could then listen to tracks 1 and 2 while their

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[59] Zagorski-Thomas, *The Musicology of Record Production*, 203–23.

[60] "Capturing the Sound of Revolution: Differences in Recording Techniques between British and American Recording Studios in the Late 1960s."

synchronized performances were recorded on tracks 3 and 4. It was the Sel-Sync system and the affordance of overdubbing new material on existing recordings that produced the demand for multiple tape tracks[61]. The creative possibilities of mixing were, therefore, more of an unforeseen by-product of a desire to sculpt recordings out of layered performances. Indeed, the creative recording milestones of this period, such as those by The Beatles and The Beach Boys, focus much more on the production process of creative layering than on the post-production process of mixing[62]. Davis recorded 'Circle In The Round' [63], *In A Silent Way* [64] and *Bitches Brew* [65] in multiple sections that were edited together, but it is likely that the ensemble was recorded together without overdubs[66]: the interaction of performers being an integral part of Davis' event schema for jazz performance. From Davis' perspective, the editing he wanted control over was linear – an affordance of all tape recording systems - but for Macero separation was important because it afforded the creative potential of working on the mix. Even if Davis did use the affordance of overdubbing, it seems it would have been a tool of relatively minor importance.

The affordance of separation was further produced and refined by a number of parallel developments which have their roots in the technologies of radio, film and even music education. Radio and film required technologies for mixing multiple signals early in their development: combining music with spoken dialogue and sound effects or, specifically in radio, jumping between advertising announcements and program content. This initially involved the mixing of multiple microphone signals but subsequently led to more directional

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[61] Although it did take a decade for the usage of eight track to catch on after its development in the 1950s.

[62] Ryan and Kehew, *Recording The Beatles*; Butler, "The Beach Boys' Pet Sounds and The Musicology of Record Production."

[63] *Circle In The Round*.

[64] *In A Silent Way*.

[65] *Bitches Brew*.

[66] I haven't been able to establish this definitively but email communications with Bennie Maupin who played bass clarinet on *Bitches Brew* suggested there wasn't and, on the other hand, Mark Wilder, who remixed the original 8 track tapes for the box set Davis, *The Complete Bitches Brew Sessions.*, said "it is hard for me to say if there were overdubs on the tape. I'm not saying there aren't, but I did those mixes in the late 90's (?) and haven't touched the tapes since. It's not something that dawned on me at the time. There are tracks with multiple instruments on them, so it is very plausible" (email communication 15th Apr 2014)

microphones, acoustic screens between sound sources and, later still, to isolation booths and Direct Injection (DI) boxes. DI boxes allowed signals from electric instruments, such as guitars, bass guitars and various types of electric keyboard instruments, to be played directly into a mixing console rather than through an amplifier that is then captured with a microphone. Recording bass and guitar through a DI box was one of the keys to the development of the Motown sound as it allowed for greater clarity and for a stronger and more defined low frequency content [67]. Although electric pianos were originally targeted at the education market, to allow multiple students to practice with headphones in the same room [68], they also started to gain favor with popular musicians, particularly those from the gospel tradition such as Ray Charles. Instruments such as the electric piano, the electric guitar and the electric bass guitar therefore, enhanced the potential for separation on multi-track tapes. These signals could be recorded to separate tracks without the spillage from other sounds in the room that came with microphones. In addition, the use of directional microphones and acoustic screens between players afforded improved separation of a similar sort even between acoustic instruments.

These technologies all provided greater separation, an important affordance for the development of the post-production process of mixing. In turn, this development of the concept of mixing as a creative activity that happened separate to and after the recording process encouraged recording practitioners to change their schemata about the nature of recorded music: to start thinking of the piece as a collage where elements can be brought in and out. Once the affordance of being able to mix a piece in a number of different ways becomes part of the mental representation of recorded music for recording network participants, it is only a short step to the developments that helped shape popular music styles in the 1970s: complex performed mixes, the creative revolution of dub in Jamaica and editing together the same section of a recorded piece with each section mixed differently to create the extended dance mixes of disco. Mark Wilder (email communication 15th Apr 2014)

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[67] Moss, "Ed Wolfrum - Detroit Sound: Interview with Dr. Edward Wolfrum."

[68] Vail, *Keyboard Magazine Presents Vintage Synthesizers: Pioneering Designers, Groundbreaking Instruments, Collecting Tips, Mutants of Technology*, 263–67.

makes the point that it was Macero's mixing that created the enhanced bass frequencies that Davis was after because "he always pushed it to '11'"[69]

The possibilities of linear editing had been utilized by Jack Mullin from the first moments he worked with Bing Crosby on his recorded radio shows in 1948. Once the process was split between two tape machines, the multi-track master of the recorded performances and the final mixed master, there were two opportunities for linear editing:

1. creating a continuous piece from multiple short takes or sections from different takes before the mixing process takes place.
2. creating new arrangements by, for example, mixing the same section of the multi-track tape in more than one way and then editing them together.

Davis and Macero had changed their working practices to take advantage of these perceived affordances and, in addition, Davis used the process of recording multiple directed short improvisations to create an energy and sense of experimentation among the other musicians in the network.

The beginnings of separation of signals in the 1940s and 1950s had also seen the development of signal processing. While this began with devices that, for example, limited the amplitude of a signal to prevent electrical overloading or increased the high frequency content of an audio signal to compensate for its loss elsewhere in a recording system, these soon developed from 'error correction' to creative manipulation[70]. Alongside more sophisticated frequency and dynamic processing that helped to produce greater clarity and the psychoacoustic illusion of greater loudness, this period also saw the development of artificial spatial processing. In the 1940s this started with echo chambers in studios but this also developed into electrical and electronic artificial reverberation and tape delays[71]. As mentioned, just before the making of Bitches Brew, Teo Macero asked the Columbia Records

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[69] A reference to the joke in the movie This Is Spinal Tap Reiner, *This Is Spinal Tap*. in which a guitarist praises an amplifier because the volume level goes up to eleven "which is one more than ten".

[70] see, for example, Chanan, *Repeated Takes: A Short History of Recording and Its Effects on Music*; Zak, *The Poetics of Rock*; *I Don't Sound Like Nobody: Remaking Music in 1950s America*.

[71] Doyle, *Echo And Reverb: Fabricating Space In Popular Music Recording, 1900 - 1960*.

research and development department to create him a customised tape delay unit that afforded variable delay times and multiple simultaneous delays [72].

The Working Practice Of Production

The most unusual aspect of the *Bitches Brew* sessions was Davis' decision to record the album in multiple short sections with a view to editing them together afterwards using very vague sketches of ideas as cues for creating composition through a process of group improvisation:

> So I would direct, like a conductor, once we started to play, and I would either write down some music for somebody or I would tell him to play different things I was hearing, as the music was growing… While the music was developing I would hear something that I thought could be extended or cut back. So that recording was a development of the creative process, a living composition… Sometimes, instead of just letting the tape run, I would tell Teo to back it up so I could hear what we had done. If I wanted something else on a certain spot, I would just bring the musician in, and we would just do it." [73]

Several of the musicians playing on the album found Davis' approach disorienting and uncomfortable and yet they continued to engage in the process and loved the album when they heard the released version. Joe Zawinul:

> had been so baffled by the *Bitches Brew* sessions that he didn't even recognize the resulting music when he heard it later in another context. "I didn't really like the sessions at the time, "Zawinul reminisced. "I didn't think they were exciting enough. But a short while later I was at the CBS offices, and a secretary was playing this incredible music. It was really smoking. So I asked her, 'Who the hell is this?' And she replied, 'It's that *Bitches Brew* thing.' I thought, Damn, that's great." [74]

If their bemusement at Davis' working practices and their occasional inability to recognise their own playing on the records is sufficient indication, the performers were not as deeply

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[72] Tingen, "The Making of 'The Complete Bitches Brew Sessions.'"

[73] Davis, *Miles*, 288–90.

[74] Tingen, "Miles Davis and the Making of Bitches Brew: Sorcerer's Brew."

invested in these revised ideas about recording as Davis and Macero were. They were, of course, exposed to the changes occurring in popular music in the same way that the rest of society was and they would have been aware of the changing status and nature of the album in that genre. They also, for the most part, looked to Davis as someone always at the vanguard of jazz and someone whose judgment was, therefore, to be trusted. However, the image and event schemata that these musicians retained in relation to their core identity as jazz performers and improvisers didn't change.

Davis, in parallel with his musical change of direction towards rock, funk and soul and the emerging styles of jazz-rock and jazz-funk, was changing his image schemata relating both to the nature of a recorded album and to the processes that might be used in its creation. In relation to the SCOT this can be seen as an alteration of the technological frame away from capturing a performance that has the same basic characteristics as a live concert but with greater clarity and less background noise. In Davis' newly emerging schema the problem is framed in terms of constructing an artwork that allows him to use improvisation to produce the raw materials for a composition. But this is a composition of recorded sound, not a traditional score based composition and shaping the sound in the production process also became part of the composition. In this regard Davis was coming around to the perspective of Lieber and Stoller who were quoted in the late 1950s as saying 'we don't write songs, we write records'[75]. Davis, though, was looking for ways in which the stimulation of creative practice in others, not only in terms of instrumental improvisation but also through recording and editing, could become the basis of his recorded art.

Macero and Davis have both given very different accounts of the creative process and the narrative of production – in particular relating to the extent and importance of Macero's contribution. Once Davis had an idea of the creative possibilities – from working with Macero on 'Circle in the Round'[76] in 1967 – he then started to think more radically about creating performed 'collages' that could be edited together. Indeed, when they worked together on the post-production for *In A Silent Way* in 1969, he pushed Macero beyond his current schema by editing the material down to 27 minutes (much too short to fill two sides of an album). Macero

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[75] Palmer, *Dancing In The Street: A Rock And Roll History*, 35.

[76] Davis, *Circle In The Round*.

and John Guerriere, the engineer on the album, then re-edited it with some repeats from Davis' version to 38 minutes. The commercial and physical necessity of creating something that fitted the time constraints of the vinyl LP format, along with his perception of the affordances of linear editing, gave Macero the idea of editing copies of the start sections of two of the pieces onto the end. Even though, these were improvised pieces, the technique gives the impression of a musical recapitulation: the restatement of thematic material. Davis obviously picks up on this idea and uses the technique on the track 'Bitches Brew'. With *In A Silent Way* and *Bitches Brew*, as we have seen, Davis asserted that he was deliberately working in a new way and Macero has frequently asserted that he was left to clean up the mess and turn Davis' fragmented activities into finished products. The two men had very different perceptions and interpretations of what was happening.

The main way in which Davis adapted his practice to accommodate tape editing was by working in shorter sections. Michael Cuscuna pointed out in an interview[77] that because Davis was doing this with improvised sections, the usual practice of recording overlapping sections that allowed a range of options about the position of the edit point wasn't available. Indeed Davis possibly exacerbated this issue by making no attempt to create overlaps: generally recording exactly from the proposed start of the segment and stopping sharply at the ends.

All of this demonstrates that the musicians, technicians and other actors engaged in the networks that produced these works were engaged in a continuing process of translation: constantly revising their event schemata for the process of recording. Mol[78], in her study of atherosclerosis, examines how this one particular disease is perceived as having multiple forms by the way network participants engage with it in different contexts: in short, she challenges the notion that "successful translation generates a single co-ordinated network and a single coherent reality"[79]. In our example, the musicians and other actors are continually re-shaping their event schemata creating a precarious and unstable process of translation much like the one identified by Mol. For me, one of the most interesting aspects of this network is the emergent nature of the process: Davis is not only deliberately pushing

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[77] Svorinich, "Listen To This: A Musical Analysis of Miles Davis' Bitches Brew," 46–47.

[78] *The Body Multiple: Ontology in Medical Practice*.

[79] Law, "Actor Network Theory and Material Semiotics," 13.

other actors out of their comfort zone but is taking a leap into the dark himself. In Columbia Studio B's control room we have Macero, Stan Tonkel and whichever assistant engineers and tape operators were present on these three days. They have set up the studio so that there is relatively good separation between the instruments on the eight tracks. Although the set up varied, they kept the two drum kits, the two electric pianos, the electric guitar and the electric bass on separate tracks so that Macero could process them to achieve what Tingen[80] has characterized as Davis' "search for a heavy bottom end" during this period. Macero, as producer, is attempting to ensure that Tonkel and he will be able to edit the eight track multi-track tape master together in a way that will create order out of the seeming chaos that Davis is producing. Their notion of what constitutes 'good practice' in the studio is being deliberately challenged by Davis who is partly driven by purely musical ideas and partly by his desire to create energy in the studio by breaking away from the norms. Some of the comments made by the musicians demonstrate this sense of unease and instability: "Often I didn't know if we were rehearsing or recording"[81] "[Miles] had a way of pulling things out of [musicians] that they were unaware of. He certainly did it to me"[82]. Davis himself, is working from very basic sketches and directing the improvisations to follow up ideas that seem useful and to give up on those that don't. In short, everyone working within the network has different goals, different assessments of what would be a good outcome and different ideas about how this sort of situation should progress. The key delimiting factors are technical and organizational: that whatever happens in the studio will be recorded on tape and that the session has relatively fixed start and end points. Indeed, the majority of the players have no idea whether they have had a successful day or not. The usual criteria by which they judge this are not available: they didn't complete anything that felt like a finished piece of music.

The Working Practice Of Post-Production

Macero describes:

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[80] *Miles Beyond: The Electric Explorations of Miles Davis, 1967-1991*, 41–62.

[81] Dave Holland quoted in ibid., 65.

[82] John McLaughlin quoted in ibid., 61.

> I had carte blanche to work with the material, I could move anything around and what I would do is record everything, right from beginning to end, mix it all down and then take all those tapes to the editing room… and then add in all the effects – the electronics, the delays and overlays… I was a madman in the engineering room. Right after I'd put it together I'd send it to Miles and ask 'How do you like it?' And he used to say, 'That's fine,' or 'That's OK,' or 'I thought you'd do that.'… He never saw the work that had to be done on those tapes. I'd have to work on those tapes for four or five weeks to make them sound right." [83]

In A Silent Way and *Bitches Brew* were the first Davis albums recorded on eight track. This innovation gave Macero the affordance of keeping more of the instruments separate in the recording process and, therefore, provided more creative affordances to him when it came to mixing. Macero's recollections about the extent of the editing on Bitches Brew seem to be at odds with some of the other evidence and this may be the result of his eliding several album projects into a single 'blur'.

> Miles would say, "Do you remember that little thing that we did yesterday?... I want that to be part of the record."… There were times that we used cassettes into
>
> masters! He'd send me up a cassette and I'd say, "Look it. You're out of your mind! You know we're in the 20th century! Everything has to be stereo."
>
> I said, "Okay, I'll do it!... And he would send me the tape and this is how I made all of *Bitches Brew*…
>
> … We might have recorded for five months and I'd say, "Oh, I need a piece there." I might go back in one of his tracks and take something out and put it in *Bitches Brew*.
>
> I'd do that with a lot of his stuff. When I didn't have something and I wanted it, I'd go back one or two sessions before or five sessions before because I remembered a couple of good tracks. I used to have stacks of tapes in the editing room. Stacks! [84]

As Bob Belden, Mark Wilder and Michael Cuscuna were able in 1998 to reconstruct all but four seconds of the mix from the original eight track master tapes, it seems impossible that

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[83] Ibid., 67.

[84] ArtistsHouseMusic, *Teo Macero on Creating "Bitches Brew" With Miles Davis*.

Macero could have been including material from other masters – other than a 'mysterious' four second long keyboard passage in Pharaoh's Dance. It may well be that Macero is confusing this job with the many recordings that Davis and Macero made between February 1969 and June 1970 at Columbia Studios.

It's also not as clear that Davis gave Macero quite as much of a carte blanche to edit the pieces together as he has suggested. The following comes from a letter that Davis wrote to Macero after the *Bitches Brew* recording sessions and while Macero was working on the edits:

> "Take the last two takes, which are the same thing, and stick the first take on the beginning (the slow part in C minor with the C pedal) The second take -- put on the end with the C pedal in the C minor and all the drum noise which ends the side. Now we have the beginning and an ending. [further technical instructions]
>
> Don't break any of the sections. Have them run into each other whether they are high in volume or low in volume.
>
> This is one side that I want you to work on. If you are not sure you have the right take, phone me in California.
>
> Extend the bass clarinet introduction and let it play twice before the trumpet comes in – just repeat it over.[85]

This letter that Davis wrote to Macero at the time gives very specific instructions - certainly leaving him room for creative interpretation - but nonetheless it doesn't chime with Macero's accounts of the process. It also makes it clear that Davis had received and listened to rough mixes of the various reels of recording that were done on the day – still in some kind of fragmented form as he gives these detailed instructions about the takes. However, it also seems that various stops and starts in the recording of the sections may have already been edited together. On the one hand he had laid out a number of sections that appear in Macero session notes as takes of sections[86] – such as Bitches Brew Part 1, take 1; Part 2, takes 1 &

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[85] Letter from Miles Davis to Teo Macero headed "Job 53069, Part II, Recorded 8/19/69 quoted in Svorinich, "Listen To This: A Musical Analysis of Miles Davis' Bitches Brew," 172.

[86] Ibid., 170–71.

2 etc. These are the sections mentioned in Davis' letter to Macero above. However, it also seems as if many of these sections were recorded in fragments[87], probably with verbal comments and instructions from Davis to Macero in between them, and it makes sense that Macero may have already edited these fragments together in the copy sent to Davis.

It's a fact that many working within a process of complex technological mediation will recognize that the better they do their job, the more invisible their contribution becomes. Editing audio is a case in point. If the job is done well, then the work becomes inperceptible, even to those that know it must have happened. Davis asked Macero to "Extend the bass clarinet introduction and let it play twice before the trumpet comes in – just repeat it over". In fact, that simple request required at least five edits to make it work 'believably'. So, at this point, when the production network temporarily narrows down to two main human actors (Davis and Macero) and two or three blackbox organisations of non-human actors (a mixing room, a tape edit room and Davis' personal playback system), it is easy to see why Davis might underestimate Macero's contribution and why Macero might underestimate Davis'. Both are engaged in long periods of activity which the other doesn't witness (Macero's mixing and editing activities and Davis' close listening to the various edited versions) and providing simplified summaries of their work as feedback (Davis in written form and Macero in the form of audio mixes and edits).

There's no doubt that Davis gave Macero considerable freedom to both edit and mix the album and Macero rose to this challenge in a highly creative manner. Davis' working practice was focused on manipulating the musicians' understanding of their creative process and what they are trying to create - challenging their normal event schemata of the process of making an album. He did exactly the same thing with Macero on some of the tracks - giving him loose thematic directions and telling him to improvise.

> Pharaoh's Dance" contains an astonishing seventeen edits. Its famous stop-start opening theme was entirely constructed during postproduction. [88]

Just before these 'micro-edits' we can hear Macero's addition of tape delay to create different

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[87] Tingen, *Miles Beyond: The Electric Explorations of Miles Davis, 1967-1991*, 310–12.

[88] Tingen, "Miles Davis and the Making of Bitches Brew: Sorcerer's Brew."

textures and he uses a one-second drum and keyboard loop to create a new musical element. These were very radical techniques in the 1960s and even more so when we consider they were happening in the performance focused world of jazz. Davis would have recognized the large structural edits but it is very unlikely that he would have noticed the detail and the amount of precise editing and musical sophistication that went into it.

Discussion And Conclusions

The late 1960s was a period of great change in the history of recording: both in terms of the technology and of what musicians and producers considered a recording to be. This interpretive flexibility therefore developed some sixty to eighty years after the invention of audio recording rather than at its outset and, from the 1940s onwards but particularly in the 1960s, the notion of the recording as an art form that was fundamentally different to the concert hall started to take root. The examples of The Beach Boys' *Pet Sounds* and The Beatles' *Sgt Pepper* have been well documented and analysed in this regard[89] but *Bitches Brew* provides another highly important milestone.

This type of industrial-scale recording (as opposed to the 'cottage industry' style of the small entrepreneurial studios) had been dominated until this period by networks that maintained a strict division between composition, performance and recording. As the techniques of recording and processing, the 'sculpting' of sound, become perceived as part of the creative process, the artists begin to want to take control over that aspect as well. Initially, as in this case and The Beatles, we see artists forging creative relationships with technicians or more rarely, as in the case of the Beach Boys, learning how act as 'producer' themselves. As the 20th century progresses we begin to see technology being redesigned to allow them, i.e. users without long term technical training, to take more control of the process directly. This period, from the mid 1960s to the mid 1970s, is one where we can see artists and producers slowly developing their ideas about how they might be able to control the sonic characteristics of a recording.

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[89] Ryan and Kehew, *Recording The Beatles*; Butler, "The Beach Boys' Pet Sounds and The Musicology of Record Production."

Bitches Brew is interesting in that it comprises a temporary cul de sac. Macero is exceptional in his willingness and ability to engage in techniques that, while possible with these new technologies, were time consuming and monotonous. Fifteen years later, with the development of timecode synchronised digital tape copying, and, a further fifteen to twenty years on, with the advent of the digital audio workstation running on a personal computer, these techniques become much easier and faster. There are very few albums in the popular music or jazz worlds, though, that have used this technique. Paul Simon's work with engineer Roy Halee on *Graceland* [90] is one example but the majority of this type of detailed editing of multi-track recordings takes place in classical music. Macero and Davis, during the production of several albums in this period, developed a working method that few, if any, others adopted. Indeed, the overwhelming majority of musicians, if they considered it all, found this approach to be alienating and counter-intuitive as we've seen with the responses from other musicians involved in the *Bitches Brew* actor network. Davis' notion of authorship through the control and manipulation of other players' improvised and semi-improvised performances can be found elsewhere with producers and artists such as Joe Meek, Phil Spector and James Brown. It was these specific network connections and Davis' resulting experience with Macero that enabled them to perceive affordances in the technology that allowed them to create event schemata for this unusual way of working.

If we look at this activity in the broader context of media that allow the representation of performing arts, i.e. audio-visual recordings, there are two principal types of activity that the changes in technology have afforded: staging and editing. Staging technologies can seek to influence our perception of spatial characteristics (environmental or relational) or the character / nature of the actors or environment. Editing technologies can simply be about removing errors or unwanted features (e.g. noise) or about creating a new structural narrative. In general, the audio-visual industries have seen the development of workflows that requires the performers to work in a highly fragmented way so that editors can construct the narrative in post-production. In audio recordings of music, the vast majority of workflows, particularly popular music, aim to create a complete narrative structure from the outset. Individual or groups of performers then add their parts to this skeletal or guide narrative. In

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[90] Simon, *Graceland*.

1948, Alfred Hitchcock filmed *Rope* [91] in a series of long takes (the length of film cartridges at the time was 10 minutes) as an experiment in creating a different kind of narrative experience in the cinema: a single 'eye' following the action rather than multiple camera angles and edits. It required a hugely complex set design with moving walls, prop men moving furniture in and out of the way of cameras and the actors working to an intricate choreography. Both Hitchcock with his complex technical network and Davis with his, had developed event schemata that played with the creative construction of narrative. Both were wanting to work, for creative reasons, in ways that were both more expensive and more difficult than the industry norms and which inverted the normal workflow. It was only, however, because of their immersion in the networks of professional activity in their respective industries that this was possible. As we've seen, Davis had to develop particular schemata about the nature of recording and recorded music. He also had to develop an authority within these networks through musical and financial success that would persuade the musicians and the record company to allow him to overturn some of the conventions of musical and recording practice. However, that authority and his ability to persuade others was also determined by and reliant on their musical and technical skill: if the musicians and Macero hadn't used their skill and enthusiasm to engage with the novel circumstances that Davis presented them with, the network would have collapsed.

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