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On Material Indeterminacy

Scott McLaughlin

‘Material indeterminacy’ is the term I use to discuss how my work since 2010 has explored the consequences of placing materiality, indeterminacy, and responsiveness at the centre of a compositional practice, and what means for the relationships between instrument, player, and score. I propose that the structural consequence of contingency in instrumental performance is an underexplored aspect of experimental composition, which has historically tended to focus on models that either control contingency or obviate its consequences. ‘Material indeterminacy’ is proposed as a third way that folds the emergent consequences of contingency back into meaningful relation with the unfolding structure. This research is framed by theoretical perspectives on materiality: Andrew Pickering’s performative ontology of human and material agencies, specifically his ‘dance of agency’ between human and material; anthropologist Tim Ingold’s phenomenological approach to materiality that valorises the relational ‘working-with’ of human and material. The liveliness of materiality is considered in relation to Lucy Suchman’s work on situatedness and the entwined nature of plans and actions, and then returned to a musical context via listening and the discourse of improvisation as response-to-contingency. Finally, I discuss these ideas via examples of my own work from the Garden of Forking Paths compositional project (2019–2021).

Keywords: *Indeterminacy; Materiality; Agency; Responsiveness; Situatedness; Improvisation*

I bow the C-string of the cello, a full-sounding stable tone that resonates through our body: my body, connected to the body of the cello. After a time, I slow my bowing significantly, lighten the weight of the bow, and move it towards the bridge, but not so close that it becomes glassy sounding and chaotic. The bowing is now so gentle that it almost stalls, but not quite. As it skates along the surface of the string, the bow energy doesn’t excite the fundamental as it normally would. Instead, the energy pools in low harmonics, enacting an acoustic crossfade as the fundamental recedes and a harmonic partial rings out. But not just one partial. As I bow back and forth there is a subtle ebb and flow between the 7th, 8th and 9th partials, never settling on one for long, another always peeking over the

shoulder of whichever is dominant in that moment. I make changes to my bowing to try and exert control, to stabilise the system. The 9th partial stabilises for the duration of an up bow but collapses into noise on the down bow, only to re-emerge on the next up bow. I play a little while longer, allowing this cluster of partials their dance, which I facilitate by maintaining an even bowing (as least, as evenly as I can). I focus my energy on maintaining this balance that lets the cello do its own thing. Gradually I return to the stable tone, sit with it for a minute and then, without stopping the bow, I reach up with my left hand and make a small adjustment to the tuning peg. The string judders momentarily as it slackens and settles into a new regime, a semitone(-ish) flatter than before. The string's timbre is now slightly darker, the response of the string under the bow now marginally looser and heavier. The cello and I are somewhere else, carrying the embodied memory of what came before into a new space. I prepare myself to carry out the same actions as before, on a string that is different-but-the-same, loaded with new potentials that emerge when played on a knife edge.

Based on moments of practice as the one described above, this essay explores the consequences of placing materiality, indeterminacy, and responsiveness at the centre of a compositional practice, and what this can mean for the relationships between instrument, player, and score. What I refer to as 'material indeterminacy' has been central to my compositional practice since 2010. This way of thinking has brought to attention questions that have shifted my understanding of composition and of what it can mean to be a human interacting with sound. I will address several of these questions in what follows, not to arrive at fixed answers or conclusions, but to knit together several fields of inquiry currently playing out in academic discourse around music, materiality, embodiment, performativity, and how these things relate to agency (as a feedback loop). As an example of where this line of thought has led, me these are some of the larger questions that come out of this practice: What does it mean to compose for an instrument that is animate, that is, in a certain sense it exhibits something like agency in performance? What new possibilities arise in the relationship between player and instrument when material indeterminacy in performance is valorised as an embodied and engaged feedback loop (rather than as a source of arbitrary sounds)? What new powers are revealed in the player's training and skills when they no longer conceive of their instrument in terms of 'control' but, instead, when they work with continuously and responsively as a co-producer? What role can notation play when half of the system (or relationship) is an emergent unknown? What can happen compositionally when, as Nicholas Cook puts it, 'instruments [...] "talk back" just as human agents do' (Cook 2018, 10)?

What do I mean by 'material indeterminacy'? A few initial position-statements will help to frame this, each of which I explore more fully below. By 'material' I am referring to the sounding of physical things (that is to say, the physical instrument itself as well, as the physical human playing that instrument), so when I refer to 'material indeterminacy', I mean indeterminacy (especially pitches) that can emerge from this physicality and its processes of interplay.¹ The term 'contingent'—though common in everyday speech, meaning subject to chance, or occurring only if

certain circumstances are the case—is also worth defining in this context. I use ‘contingency’ here to imply two meanings simultaneously: the determinate dependency on other forces (for instance, emergent pitches may be contingent on strong resonances in the instrument body) and the indeterminate subjection to chance and unpredictability (perhaps several strong resonances are audible but the specific emergent pitch is highly contingent and cannot be predicted). ‘Material indeterminacy’ is therefore my umbrella term for both the contingent sounding of physical things, and also the compositional strategy grounded in the productive tensions of this contingency. Composing with material indeterminacy channels the performative response to an instrument’s materiality in repetitive structures that expose its multiplicity.

First, I look at material indeterminacy in the context of two overarching current compositional trends, proposing it as a third way with respect to normative strategies of performance and composition that largely avoid the structural consequences of contingency. The second section investigates how I see the performer-instrument assemblage, and imports discourses of lively materiality: philosopher of science Andrew Pickering’s performative ontology of human and material agencies, specifically his ‘dance of agency’ between human and material; anthropologist Tim Ingold’s phenomenological approach to materiality that valorises the relational ‘working-with’ of human and material; and, Lucy Suchman’s work on situatedness and the entwined nature of plans and actions. The third section returns to music to situate material indeterminacy in the discourse of improvisation, listening, and responsiveness. The fourth section integrates the investigations of the previous sections by looking at compositions from my Garden of Forking Paths project (2019–2021) for clarinet(s). The conclusion asks further questions arising from this investigation, summarising the endless nomadic mobility of material indeterminacy in the practices of composition and performance.

Composing and Materiality

To begin, it is useful to outline some general practical observations about the indeterminacy of sounding objects in terms of both their physical characteristics and the context of the performer. I remain with the cello as an example for now.

A cello is a resonating box with strings of variable length that vibrate when activated by external energy (typically bowing or plucking/striking) and a cello is also a set of historical practices (both technical and aesthetic) that valorise the production of discrete notes.² My investigation of material indeterminacy departs from the common-practice attention to notes (hereinafter referred to as ‘normative’ training/technique/playing). This departure allows for alternative terminology relating to pitch/resonance and player-intentionality, which in turn lays the framework for an alternative concept of indeterminacy wherein pitch-specificity is emergent and not imposed by external frameworks.³

First, as a general conceptual grounding, I borrow the concept of ‘phase space’ from physics, where it is used to show all of the possible states of a system of interactions.⁴

Thinking about the cello in this way allows me to circumvent thinking about the C-string as a thing-that-makes-the-note-C2, and see it instead as a reservoir of possible sonic behaviours coupled to techniques, a system of inputs and outputs with varying levels of determinateness. The key material characteristics here are the resonant frequencies of the string/wood, and how that interacts with the various possible bow movements (different speeds, pressures and so on). A massively simplified phase-space visualisation of this system might be made by graphing pitch/frequency, noisiness, and bow energy: the pitch C2, for example, would be a very prominent zone in the middle (haloed by a variety of tonal colours across a timbral spectrum from focussed to diffuse), with various C2 harmonics also forming smaller and smaller satellite zones, and a wide range of different non-pitched/noisy timbres stretching to the edge of the graph. The set of sounds produced by this system is a correlate of the set of different ways a player can activate it, some of which are well-understood techniques, and some are contingent sounds on the fringes of technique and accident, ‘unreliable’ sounds.⁵

Second, it is important to include player training and intentionality within this concept of phase space: if the phase space is not simply a set of possible sounds, but rather all of the possible states of a system of interactions, does this mean speaking simply of the interaction of bow and string or of performer and instrument? A player’s agency and free will are constrained to some extent by what Ben Spatz describes as ‘sedimented agency’, or the layers of techniques, embodied practices, and traditions which condition the territory of what is thinkable and playable (Spatz 2015, 50). Technique extends like tendrils into the phase space of the instrument, laying down paths where sounds can be made reliably, and an assortment of less reliable sounds that leak away from these well-trodden paths. The job of notation in the context of material agency is to define the freedoms and constraints which will make the relational network heterogenous and productive as it engages performer technique with contingent materiality in performance.

Third, building on the concept of phase space, I can discuss how a prioritisation of the interactions of that space—rather than a normative prioritisation of controlling stable sounds—can flip the idea of indeterminacy on its head by positioning it in relation to aesthetics of control. Following the C-string example above, a cellist’s training typically valorises the ability to play the pitch C2 reliably and repeatably in a variety of musical contexts. In normative cello playing, unreliability is ‘trained out’ as players learn to avoid unreliable zones of sound production. The aesthetics of control in modernist and experimental composition have acknowledged and utilised unreliable sounds generally by reducing or neutralising the indeterminate as a consequential force. Speaking broadly of composition since the 1930s, the situation can be simplified into two models: a total-control model that specifies as much as possible to the player, and an obviation model that removes consequences for the specific results of indeterminacy. The total-control model is the norm, seen in common-practice musical notation that has been expanded to extend its valorisation of the specific and repeatable areas outside pitch, often making use of ancillary notations to achieve this control. Take, for example, the—near ubiquitous in new music—extended performance instructions with or

without new notational symbols. Conversely, the obviation model describes techniques of working with unreliable sounds that embrace unreliability—often to a significant degree—but do so by removing the need for specific sounding outcomes.⁶

These two models of total control and obviation avoid the specific indeterminacy of sound, either by pinning it down in order to remove it (or, worse, merely represent it), or by removing any consequence of indeterminacy by accepting whatever sound emerges. I argue for material indeterminacy as a third way to reconcile unreliable sounds to engaged performance by allowing the temporal emergence of material specificities to be structural, where emergence explicitly influences path selection in an unfolding performance. Rather than specifying sounds to be played in advance, I specify both a performance technique and also what happens to that sound once it has emerged (that is, once it has become *specific*, and not before). Specificity is moved from the domain of pitches into the domain of actions undertaken by the player (as in tablature), but with the caveat that actions carry a second order of specificity that feeds back into the unfolding of the piece through engagement with the material. For example, when I weakly bow the C-string of the cello and the 5th partial (E4 -14¢) emerges as the predominant pitch, that emergent E4 can now inherit specific relations from the score, perhaps becoming the anchor pitch for a melodic line or as a ‘pitch memory’ to be matched to new material emerging through exploratory playing of a different string. The E4 in its specificity now has consequence and meaning but, until it emerged there, was only a placeholder for material contingency. This means that a sound outcome is not simply a byproduct of playing the instrument, but brings the player into recursive engagement with materiality. In this situation, the player is required to stay *inside* the indeterminacy of the material, listening to what it reveals, and folding these emergences into the piece in specific ways. A general schema of material indeterminacy might therefore look like this:

- A score prescribes specified techniques and methods for engaging with material;
- Actions in the score unfold through—and in response to—materials that have indeterminate specificities. These may be explored (in advance or in the moment) to reveal tendencies, but will never be completely knowable;
- The player responds to emergent specifics according to the score, which usually includes recursive forms where actions become resituated in newly emergent sonic contexts.⁷

An important aspect of material indeterminacy—for me at least—is that it *wholly* involves the skills of the player, but situated in service of supporting material agency rather than in controlling the instrument to achieve a defined sounding outcome.⁸ As such, this compositional strategy revolves around technicalities of the instrument’s sound production and the unstable phenomena at the edges of the phase space. The next section of this writing looks at the conceptual underpinning of how such unstable phenomena can be composed within their agential ‘thinglyness’.⁹ I also discuss the score in relation to the agencies of the player and the instrument.

Materiality, Agency

Dan Fischlin notes, in his discussion with improviser Evan Parker, how the saxophonist's comments 'get at the kind of deep listening and openness to changed circumstance that are at the core of improvisational aesthetics' (Fischlin 2009, n.p.). In Parker's words:

You couple yourself to that instrument and it teaches you as much you tell it what to do. So you're sensitive to ... how it's responding to your efforts to control it. By hearing it, the way it's feeding back to you, you learn to control it better, so it's a very dynamic and very sensitive process ... [But] the instrument at the same time seems to be giving you additional information so that there are things you have under your control, but every so often something will go wrong. You'll lose control. [And] in that moment you are given an opportunity to learn something else that the instrument can do ... the nature of the instrument and its will in relation to its destiny ... [its] set of intentions in its relationship with you, and you start to find it difficult to distinguish yourself and your intentions from the instrument's intentions. (Fischlin 2009, 1)

When I think about the human performer and the instrument working together responsively, I think in terms of agency: rather than a conventional anthropocentric model—where the agential performer controls the passive instrument—I conceive of an interdependent and mutually constitutive interplay between human and material agencies. The philosopher of science Andrew Pickering in his *Mangle of Practice* outlines what he calls a 'dance of agency', a performative ontology of entangled human and material agencies (Pickering 1995, 21). While Pickering's work emerges from science studies, his 'mangling' of the 'machine-human couple' can be applied to the performer-instrument assemblage (Pickering 1995, 158). For Pickering, the dance of agency is an 'open-ended modelling process' (Pickering 1995, 19) between human and material, a continuous process wherein practice is 'interactively stabilised' as agencies are 'reciprocally and emergently defining and sustaining each other' (Pickering 1995, 17). This conceptualisation applies well to contexts where a performer is working within an unstable zone of sound production, continuously balancing their intentionality (as guided by the score) with the material agency of the instrument. As Pickering describes it,

my analysis of practice [...] points to a situatedness and path dependence of knowledge production. [...] As I have emphasized, one needs also to take into account the contingencies of practice, the precise route that practice takes through that space. The contingent tentative fixing of modelling vectors, the contingent resistances that arise, the contingent formulation of strategies of accommodation, the contingent success or failure of these—all of these structure practice and its products. (Pickering 1995, 185)

Knowledge here is with the player, emergent from, and ongoing in, their continuous being-with the instrument in each moment of playing.¹⁰ Tim Ingold echoes

Pickering's dance of agency in his discussion of living with materiality as 'a process of *working with* materials and not just *doing to* them, and of bringing form into being rather than merely translating from the virtual to the actual' [original emphasis] (Ingold 2011, 10). Ingold and Caroline Gatt share Pickering's insistence on a non-representational ontology:

Such creative improvisation calls for both flexibility and foresight. The element of flexibility lies not only in finding the grain of the world's becoming—the way it wants to go—but also in bending it to an evolving purpose. It is not, then, merely a matter of going with the flow, for one can give it direction as well. Designing for life is about giving direction rather than specifying end points. It is in this regard that it also involves foresight. (Gatt and Ingold 2013, 145)

In a context of musical indeterminacy, both 'foresight' and 'designing'—which I read as co-extensive with 'planning' in this context—are partly situated in Spatz's 'sedimented agency', discussed above, but also partly in the domain of musical scores, plans that guide the players' intention across a musical structure (which may be open or closed to varying degrees). Here I am concerned less with traditional scores, and more to the type of scores prevalent in experimental music that are based on actions and instructions. Christopher Ballantine draws a line between traditional notated music and experimental music because, rather than relying on convention, in the latter 'the horizons of the musical language are established anew with each piece, or at any rate each performance' (Ballantine [1984] 2013, 119). Even as a sweeping generalisation there is a truth to this that is relevant when trying to establish a music that radically explores materiality by separating musical/instrumental technique from its performance practices and contexts. I am not claiming that experimental music is a blank slate with no sedimented performance practices and histories. If anything, I mean the opposite, that a prominent—and deeply sedimented—characteristic of experimental music is that some pieces absolutely require a *tabula rasa* approach. In pieces like Christian Wolff's *Edges* (1968), Lucier's *Music for Cello with One or More Amplified Vases* (1993), or Ben Patterson's *Paper Piece* (1960), the first step must be to put aside any preconceptions and start with the instructions. Text scores are sometimes purely interpretational (equivalent to graphic scores, but in words) but most are a set of instructions, the outcome of which is a performance.¹¹ Following Cage's approach to performance as 'disciplined action', such instructional scores are focussed on the matter of doing, the how and when of carrying out actions (Piekut 2013, 145). This sometimes requires the development of entirely new technique, but often relies on traditional techniques being resituated. Of course, where instrumental technique is concerned, preconceptions and sedimented agency cannot be ignored or completely put aside but, by holding them at bay initially, the score is empowered to re-situate the imperative of avoiding convention in order to prioritise the focal idea of the piece and allow traditional techniques to take their place as required. The first thing the score has to do is explain how it is to be read. As Philip Thomas points out,

[e]ngaging performers in an exploratory, investigative mode of music-making requires composers to be clear about the parameters of any indeterminate score [...] performers respond to the demands of the score, without reference to any external stylistic code, and focus upon the production of sound within the parameters of the score. (Thomas 2009, 90–91)

Working with materiality requires the material to take the lead, so the score must find a way to grant the material priority, and make clear the role of the player to make exploratory co-production possible.

Scores can be technologies for exploration, both in a macro-level sense of priming the user with specific tasks or principles of exploration and the micro-level sense of outlining specific techniques. Echoing Gatt and Ingold above, scores can give direction rather than specifying end-points, and the determinateness of that direction can be open or closed to different degrees. Lucy Suchman's conceptualisation of 'situated actions' is useful here to support a compositional strategy that foregrounds the situatedness of indeterminacy in performance:

That term [situated actions] underscores the view that every course of action depends in essential ways on its material and social circumstances. Rather than attempt to abstract action away from its circumstances and represent it as a rational plan, the approach is to study how people use their circumstances to achieve intelligent action. Rather than build a theory of action out of a theory of plans, the aim is to investigate how people produce and find evidence for plans in the course of situated action. More generally, rather than subsume the details of action under the study of plans, plans are subsumed by the larger problem of situated action. (Suchman 2007, 70)

Plans, for Suchman, are 'resources for people's practical deliberations about action'. Instruction scores are plans for the situated action of performance that often exploit and rely on that very situatedness.¹² In the context of material indeterminacy, instructions for actions that arise through contingency prime the player with techniques to assess and respond to that contingency. As the player explores the materiality of their instrument, what the instrument reveals is connected back to the plan of the score. For Suchman, the

efficacy of plans, instructions, and the like [...] relies precisely on the ability of those who make use of them to find the relation of these general prescriptions to the particular occasion that faces [them]. It is in this respect that instructions do not precede the work of their enactment but rather that their sense is found in and through, and only in and through, that work (Suchman 2007, 15)

In order to engage with the contingent materiality of instruments, paying attention to the situatedness of performance is critical, because this is how players find the relation of the general technique to the specific material situation. The compositional strategy is to map technique to instrument phase space via contingency. The meta-technique of working with contingency is the performer's active awareness, as Tim Ingold puts it: 'I experience a heightened sense of awareness, but that awareness is not *of* my playing, it *is* my playing' (Ingold, cited in Suchman 2007, xi).

Suchman's *Human-Machine Reconfigurations* begins with the above quotation from Ingold about his cello playing. Ingold speaks to the connection between knowledge and performance in all fields of activity. His discussion of technique centres around performative awareness as a hallmark of fluency and experience, 'an intimate coupling of perception and action' (Ingold 2011, 58) where the practitioner's activity is 'sustaining [them] both perceptually and materially through a continual engagement with the field of practice' (Ingold 2011, 59). Ingold's model is fundamentally holistic, echoing Suchman and Pickering's insistence that agencies and environments are reflexive, 'a mutually constitutive relation' (Pickering 1995, 159) requiring the practitioner to be attuned and 'responsive to the task as it unfolds' (Ingold 2011, 6). Ingold follows Gibson's ecological model of perception as embodied and 'fundamentally about movement' (Ingold 2011, 12).¹³ Ingold notes:

Gibson insisted that perception is the achievement not of a mind in a body, but of the whole organism as it moves about in its environment, and that what it perceives are not things as such but what they afford for the pursuance of its current activity. It is in the very process of attending and responding to these 'affordances', in the course of their engagements with them, that skilled practitioners—human or non-human—get to know them. (Ingold 2011, 11)

In exploratory performances that involve material indeterminacy, the phase-space of the instrument is the environment and the score instructions are constraints that create affordances to drive the performance in ways that focus the player on immanent specifics; not those externally imposed by abstract musical systems. The player's awareness is focussed by the score on actions contingent on emergent of particular sounds or behaviours, 'affordances' that drive the player's perception, feeding the embodiment of techniques. Techniques are grounded in sedimented agencies but are continuously attuned in the service of the score-defined affordances. The drone-bowing of a string or the long notes of a clarinet keep the player focussed on unfolding sound rather than discrete events. Setting up structures of repetitive and looping actions deliberately to cover the same ground over and over—rather than simply exploring and responding—make these affordances more acute, developing attunement and sharpening affordance-driven perception. The awareness of the player is not on the score as fixed instructions but 'with' the instrument as an Ingoldian 'wayfaring', a 'framework that is itself suspended in movement, in an environment where nothing is quite the same from moment to moment' (Ingold 2011, 60).

Material indeterminacy as a compositional technique is fundamentally performative and emergent in its foregrounding of material phenomena that are continuously lively. Scores situate players in an unfolding dance of agency as they 'get to know' material and its forces in relation to techniques within the phase space of the instrument. In these situations, all elements of the performative assemblage are emergent, interdependent and mutually co-constitutive from moment to moment.

Improvisation, Awareness, Responsiveness.

James Kendra and Tricia Wachtendorf's assertion that '[w]hile planning encompasses the normative "what ought to be done", improvisation encompasses the emergent and actual "what needs to be done"', transposes Suchman's plans and situated actions into musical performance (Lewis and Piekut 2016, 17). A broad reading of improvisation outside specifically musical contexts is ultimately fruitful in relation to a model of material indeterminacy that expects the player to work, in Ingold's sense, 'with' the contingencies of the material. An example of such a broad reading is Benjamin Piekut and George Lewis's expansion of improvisation to 'non-artistic theorists assert[ing] an understanding of indeterminacy as an aspect of everyday life that is addressed improvisatively' (Lewis and Piekut 2016, 17).¹⁴ Similarly, Dan DiPiero argues for 'thinking improvisation through a contingentist framework [...] whether in music or social life' as a way to interrogating the relationships between contingency and practice (DiPiero 2018, 1). Additionally, Piekut and Lewis—as well as DiPiero—note how such non-artistic contexts avoid the 'oppositional' binary of freedom and structure in improvisation, noting instead that 'freedom and structure—as well as power, agency, and constraint—become emergent in improvisative interaction' (Lewis and Piekut 2016, 17) This is wholly in line with Pickering's 'open-ended modelling' of agency as emergent and performative, and is enacted in the compositional strategies of material indeterminacy as providing a heterogeneous field of generative paths for exploring the field of power, agency, and constraint. To repurpose Donna Haraway's paraphrasing of Anna Tsing's mushroom ethnography, material indeterminacy 'proposes a commitment to living and dying with response-ability in unexpected company. Such living and dying have the best chance of cultivating conditions for ongoingness' (Haraway 2016, 38).

Pickering's open-ended modelling and Haraway's 'ongoingness' both prioritise a subject in continuous reciprocal awareness of action and environment in feedback: ongoingness negotiates through perceptual affordance. Daniel Belgrad's model of improvisation orients contingent musical practice along lines that resonate with this:

emphasising awareness and interaction rather than interior psychological contents. It is realised in the creation of an autopoietic system, a decentralised 'society' ordered by feedback processes. (Belgrad 2016, 300)

Similarly, David Borgo casts this in an ecological frame, as shifting 'from storing and recalling information to detecting it, in the form of ecological invariants and affordances' (Borgo 2017, 1025). In material indeterminacy, the human player has clear agency and intentionality but they volunteer themselves in a performance where their agency is redirected to accommodate a material agency that is continuously an unknown-becoming-familiar but always retaining an alien quality of unpredictability, of not-quite-knowableness. This also aligns well with the cybernetic, which, as Pickering describes it, 'envisaged a world that was in the end unknowable, but to which we can indeed adapt performatively' (Pickering 2010, 157; see also Borgo

2016, 4). Material indeterminacy valorises the unstable zones of instrumental sound production as black-box situations of actions and responses mediated by not-quite-knowable processes. There are only the player's inputs and the consequent outputs of the instrument, which must be parsed through a player's auditory-tactile awareness—or listening—to offer potential paths forward.

For a player to follow the material of sustained sound, they need to listen to the leading edges of resonance in the material. Long sounds and drones invite spectral listening where the inner structure of the sound reveals single pitches to be multiples, strata of harmonic partials reaching out across a frequency horizon where pitch bleeds into timbre. In a drone, the flickering movement of inner partials comes easily into focus when the nominal percept of the sound, the fundamental, is unchanging. The inharmonicity of sounds such as multiphonics makes this even easier since the sound is already palpably multiple. As Alex De Little puts it: 'this approach to playing necessitates deeper listening, not listening correctively, but listening past the image of the note into the flows and complexities produced by the sounding assemblage or "apparatus"'.¹⁵ Spectral listening becomes a kind of haptic feedback, where the instrumental technique is entwined with listening in a manner analogous to a spider's use of the web as an extension of bodily sensing (Japyassú and Laland 2017).

As Davide Sparti puts it, 'improvisation is "attention" over "intention"'. While some improvisers may argue that this perspective reduces or caricatures their agency, in the case of material indeterminacy, Sparti's epithet productively emphasises the need for human agency to make space for the material. Supporting material agency requires directing focused listening attention to the forces in the instrument as the basis for accommodating them (through instrumental technique). Attention, for Sparti, is 'the ability to expose oneself to music in such a way as to respond creatively to the musical situation as it unfolds'. Echoing Evan Parker, and paraphrasing Gibson's model of affordance, performative awareness points both ways, to the material and to the player, being both aware of the paths offered by the material and the techniques that allow movement 'with' the instrument to follow those paths.

To take this model of material indeterminacy to an extreme engages with a materialist animism that treats the dance of agency between human and material as a duet between actants that can never fully know each other, but who nonetheless have a sympathetic and sympoetic relationship in ongoingness. The player's response to the liveliness of the instrument-environment calls to mind Donna Haraway's imagined 'Terrapolis', which she describes (partially) as

mak[ing] space for unexpected companions [... a] web of always-too-much connection, where response-ability must be cobbled together [...] passing patterns back and forth, giving and receiving, patterning, holding the unasked-for pattern in one's hands [...] Becoming-with, not becoming, is the name of the game; becoming-with is how partners are, in Vinciane Despret's terms, rendered capable. (Haraway 2016, 11)

For the player to be ‘rendered capable’ in a contingent performance is an expression of the player-instrument assemblage, the rendering of a path forward through the combination of a player’s embodied skills and the ‘unasked-for patterns’ of sound thrown into the world by the instrument and ‘detected’ (in Borgo’s terms) by the player. It is a conscious act of the player to be in that mode of being, an intentional becoming-with the instrument. In the final section, I will present this becoming-with through a case study of works for clarinet solo from the Garden of Forking Paths project (2019–2021).

The Garden of Forking Paths

My compositional project, *The Garden of Forking Paths*, explored the contingent threads that lie between the known points in the phase space of the clarinet. This is a model of composition where pitch is an emergent property of performative stabilisation of the instrument across routes through its phase-space. The emergence of pitch, and corollary structures of pitch, are also tied to compositional techniques of recursion and looping, repeating the same actions in a flexible and contingent material space to afford variation.

As a starting point, any given fingering configuration on the clarinet is assumed to have several strong resonances across the instrument’s three registers which can be accessed (with varying levels of resistance) through a combination of standard techniques (normal playing and harmonics/overblowing) as well as more esoteric techniques such as underblowing and other non-standard configurations of breath and embouchure. Equally, the project assumes (contrary to received wisdom on this point) that every fingering affords multiphonic sound of varying types, simultaneous sounding of some of these resonances with varying degrees of stability and spectral-fusion. What is key here is that performing indeterminacy can engage with and extend the standard techniques of the instrument and that performer agency is not undermined by arbitrary indeterminacies but further focussed by the need to work ‘with’ the instrument and follow the paths it opens. Pickering’s dialectic of resistance and accommodation is key to indeterminacy as a performative ontology and (for me, at least) compositional systems are richer for building this in from the start.

The speculative approach to composing with this model is to write pieces that completely avoid specifying which fingerings are used—much less what specific pitches are expected—and deal instead in behaviours and topologies. Any given fingering is assumed to conform to an ideal/Platonic set of behaviours. This assumption is a deliberate move that sets up the ideal so that performative exploration of that ideal reveals the real by letting the (non-Platonic) material world in. The crux of such compositions lies in the ways they reinforce certain elements of the clarinet’s phase space in order to expose fault lines, emergent opportunities for the musician to follow. The contingent reality of any particular fingering’s specific non-idealness, in that ongoing performative moment, can then point to forking paths which are possible directions forward in the unfolding composition. Where the haecceity—the ‘this-ness’—of each

new facet of this fingering-instrument-performer assemblage is leveraged in the moment to exercise material agency in the decision-structure of the piece, then composition becomes the design of temporal strategies for the onward flow of the piece along forking paths.

Figure 1 shows an early attempt at notation that could facilitate this. The title *Puzzle Canon no.1* references the Renaissance musical form where players would have to work out the appropriate canonic voice to make a licit harmonic realisation. This notation focusses on phenomenal pitch: not specific quantifiable pitches, but rather the phenomena of pitch itself as a periodic standing wave emergent from activation of resonances of the vibrating air column, and expressed across a continuum from stable pitch percepts to ambiguous complexes of pitch and timbre.¹⁶ While the basis of the notation is the player's engagement with phenomena (as opposed to notes), the framing is in terms of standard clarinet technique, while also attempting to decentre those techniques so they can be treated as flexible (and explorable) continua rather than reified and sedimented, which is to say that multiphonics and single pitches can be seen as different points on the same phenomenal continuum rather than discrete sound-objects.

The notation in Figure 1 assumes the Platonic ideal of a fingering that can play single pitches in all three of the clarinet's registers (the three-line staff) and also that any of these registers can be played simultaneously as a multiphonic (vertical line connectors): horizontal connectors are essentially phrasing slurs.¹⁷ The player

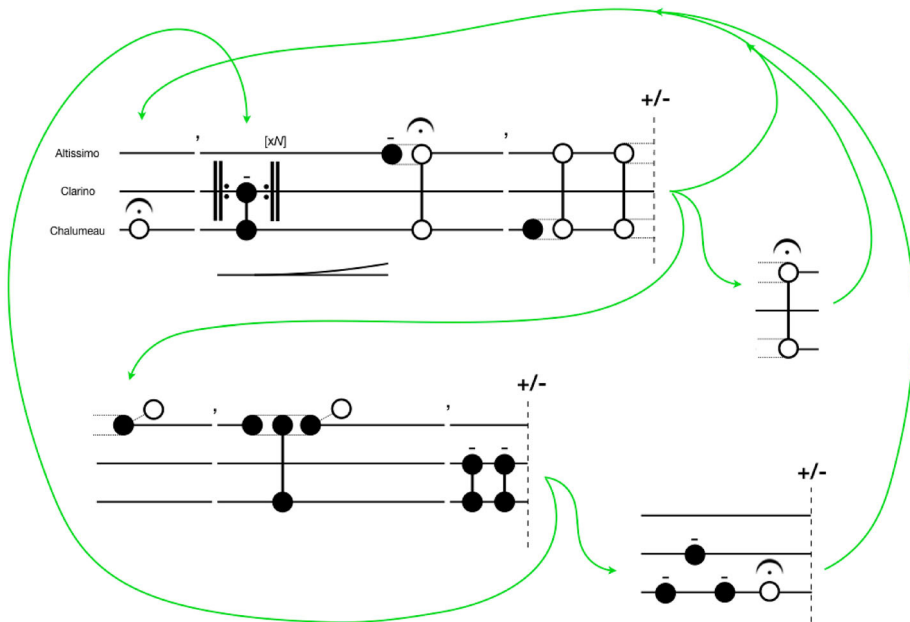


Figure 1. Notating for material indeterminacy in clarinets.

can approach this with any fingering to try to match the contours of behaviour indicated by the notation, which mostly consists of a vertical dimension (movement through registers) and horizontal (change of fingerings, change of harmonic environment and resonant topology). This notation foregrounds the cracks across registers and between fingerings. It makes explicit the physical reality of the clarinet and the effort required to make connections across this heterogenous network of resonances: the clarinet is already three superimposed instruments (the registers) with subtly different physics, but each fingering configuration is also a different instrument with its own resonances. This notational strategy should not be taken as being of a kind with tablature-like approaches that specify actions and deprioritise sound: instead the notation points to directional configurations of action which, through the effort of realisation, produce contingent paths to follow in sound. The key part of this notation is not so much the vertical. Rather, it is the way that contingency and opportunity are fostered by the horizontal motion which constrains and disrupts.

This horizontal motion is reliant on continuous sound, with its attendant vulnerabilities and tension generating contingency. Standard musical notation is largely predicated on the event model where a discrete physical action leads to a sound. In the context of the piano, key-press X leads to sound-action Y, with no feedback; once the key is pressed the player has (in most cases) no further influence on the sound. This model is applied also to instruments that make sound continuously, such as wind instrument and bowed strings, but the discrete actions of X-leads-to-Y is too simplistic for the possibilities of continuous instruments. With continuous sound, action cannot be separated from sound because the two are entangled. The player acts on the continuous sound and must respond to the reaction of the material. Philip Thomas describes experimental music notation as a 'prescription for action' (Thomas 2009, 77), but here I skew this to mean that notation acts upon the player-instrument assemblage as a cybernetic 'steer' in response to which the assemblage must stabilise. By 'stabilise', I mean it must carry out the mutual work of ongoingness, of keeping the composition-performance on track, which may or may not involve a stabilisation of sound in itself. Like a bicycle and rider responding to the curve of the road and the flow of traffic, they act separately but together. The notation provides intention and goals, in the knowledge that the music is then emergent from ensuing negotiation with the material instrument. In the clarinet, this notational strategy shifts the emphasis from fingers to embouchure and breath, foregrounding techniques which tend to be opaque to non-clarinetists.

While the basic notation is a continuous push-pull of stabilisation, there are also discrete events that alter the environment, requiring some level of embodied learning to re-situate, adjusting to the new parameters. In the notation of [Figure 1](#), the clarinet maintains the same fingering configuration until instructed to change by the '+/-' symbol. The notational principle is simply that there is a disruptive change, the specifics of that change (and any constraints on possible responses) are different from piece to piece: in this piece the symbol means remove or add one finger, but of course, there are many other possibilities. Material indeterminacy is a process of

learning the material affordances in situ, but also deliberately altering that situation both to discover new knowledge in performance and to transform existing knowledge in the light of the new. Change here is not to keep the player ‘on their toes’, but to use repetition as exploration, to know the space by continually altering the point of view in tiny ways. All of this echoes Lucier’s technique of scanning by focussing on the interaction between instrumental technique, listening, and materiality: Lucier’s pieces scan around phenomena to reveal them, sometimes leaving open the possibility of further exploration. The case study discussed here uses scanning alongside repetition to dig further into the phenomena until the phenomena is the model in a very dynamic sense. Contingency is the model and knowledge emerges from responses to contingency, accreting across performance. Structure emerges as the knots in accreted knowledge, and the compositional challenge is to allow the foregrounding of these knots without predetermining them.

Conclusion

Material indeterminacy decentres the external authority of western music theory, replacing it with a world of emergent pitches and relationships, re-purposing the score away from hermeneutics and into play, as an overarching set of principles to constrain and focus. Compositionally, the fascination here lies not simply in wallowing in arbitrary emergence, but in setting up a performative ontology for the player-instrument assemblage, in nudging Haraway’s ‘always-too-much-connection’ into momentary cynosure and becoming. Material indeterminacy is a compositional principle that tries to not abandon technique or direction but instead retool them for Haraway’s response-ability and contingency. Yves Citton presents Anthony Braxton’s relationship of score and improvisation as ‘diagrammatic’, an artificial and regulating space to ‘channel and organize [...] potency [...] without generating positions of power’, allowing players to ‘generate their own local language, which spontaneously carries the participants into non-idiomatic territories’ (Citton 2016, 171–172). While here Citton is discussing the political context of ‘multitudes’ through Braxton, I think that the same argument holds here in the assemblage of human and material agencies as a heterogenous coming-together situated by the score. The score here sets up an artificial space in a contingent environment, and the performance of that space is to maintain the conditions for living and ongoingness by following material flows.

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Notes on Contributor

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Notes

- [1] Of course ‘material indeterminacy’ could also be applied to non-sounding things, but this essay is concerned only with the compositional context of sounding. The rhetorical point here is to valorise the physical and material as primary, supplanting external frameworks (such as abstract pitch systems imposed on the instrument—e.g. 12TET) that don’t emerge directly from the material of the instrument. As such, the concept also imports ideas of materiality, responsiveness, and improvisation from other arts and non-art contexts (see below), but for me this always comes back to sound (especially pitch). Pitch can be found everywhere, and it often emerges from non-musical contexts in indeterminate ways, this is the beauty I try to find in my works. Others may well have other concerns for which material indeterminacy is an apposite tool.
- [2] My concern here is with the ‘discrete’. That technique in common-practice playing is rooted in sequencing sounds of discrete (and determinate) pitch and duration (notwithstanding interpretive wiggle-room).
- [3] It’s also important to note the bias of my own practice on this research. I focus on the spectrum of pitch-to-noise (that is, what sounds are perceived as pitched to varying degrees of confidence, and pitch/timbre ambiguity), so the discussion about indeterminacy and materiality here will also focus on this spectrum, rather than other parameters such as rhythm. Additionally, this essay only discusses solo pieces, recasting them as duets for one player and one instrument. I continue with the cello as my example, but the research applies reasonably well across the range of acoustic musical instruments, as will be seen in the case studies below.
- [4] Specifically, the term is mostly used in dynamical systems theory (or chaos theory), the study of the behaviours of systems over time, especially complex and non-linear systems such as weather or stock markets. A key aspect is the identification of features (steady states, oscillation patterns, chaotic states and so on) and their mechanisms.
- [5] I use the term ‘correlate’ here to emphasise that the two sets are like points on two planes, connected in a heterogenous network (variably dense and sparse) that has an explorable topology.
- [6] For two very different examples where the specific result of indeterminacy is obviated, see the tablature-like notations of Aaron Cassidy, where the player’s movement *is* the composition material, and also the general field of graphic notations, with their tendency to create visual metaphors for sound which can then be interpreted freely. I should stress here, I don’t mean that in these musics *any* contingent result will do, but that musical structuring is not usually a consequence of emergent sounds, or at least not contingent on the specificity of what emerges.
- [7] For simplicity, I stick here to the model of the score, but this could also be a generalised performance practice that augments a score by providing an overarching context for technical and interpretive planning and decisions, as happens in all forms of music.
- [8] As an example, on the cello, ‘support’ might mean bowing very close to the bridge and supporting the first emergent pitch for as long as possible, rather than trying to exert control to elicit a specific pitch.

- [9] ‘Thingliness’ (or ‘thingness’) refers to Heidegger’s discussion of materiality in art, on its centrality;

But even the much-vaunted aesthetic experience (*Erlebnis*) [liveliness?] cannot get around the thingly aspect of the artwork. There is some-thing stony in a work of architecture, wooden in a carving, colored in a painting, spoken in a linguistic work, sonorous in a musical composition. The thingly element is so irremovably present in the artwork [...]. (Heidegger [1956] 1993, 145)

- [10] And perhaps knowledge is with the material too, but this is not an interpretation I want to stress. Since it is unknowable what or where the instrument ‘knows’, this interpretation is far outside the scope of this essay. This responsiveness points towards the discourse within improvisation (broadly conceived) as a useful bridge between Pickering’s dance of agency and the musical context of material indeterminacy. The model of improvisation discussed later in the text complements Pickering’s dialectic of resistance and accommodation by foregrounding the assemblage of the human and material, heterogenous but dependent.
- [11] See, for instance, Manfred Werder’s scores from the late 2000s such as *2009/1* (2009).
- [12] Musical notation—both common-practice and its modern extensions—is also a plan for the situated action of performance, but it differs by actively playing down the situatedness. This does not mean that these notations remove situatedness (as Suchman is quick to point out, plans and situations are not exclusive categories) but they do work towards neutralising the contingency of the situation, as noted above with reference to ‘total-control’ notations.
- [13] Though it is worth noting that Ingold also has reservations about Gibson’s theory, they are not especially relevant here (see Ingold 2011, 78).
- [14] For example, their book includes essays that read improvisation in nominally non-artistic fields such as management, law, ethics, politics, and community farming.
- [15] Alex De Little, personal correspondence, 5 May 2020. For more on the application of Karen Barad’s ‘apparatus’ to music, see Sergeant (2018).
- [16] Note that rhythm is completely absent from this version of the notation, partly because rhythm is not very present as a compositional concern of mine (other than to indicate short/long sounds as black/white noteheads), and partly because the emergent and exploratory nature of the technique makes specific rhythm as difficult to prescribe as specific pitch. For similar reasons, dynamics are not used in the traditional way here, because many resonances of the instrument are inflexible in their dynamics, especially when multiphonic connections are required. Dynamics, like most things in this notation, are materially situated.
- [17] Sometimes the clarinet is described as having four registers, by including the ‘throat’ notes between G4 and Bb4 as a register. In my technique I treat the throat register as part of the *chalumeau*, since these pitches are fundamentals of the tube, which is to say that they are not overblown.

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