INTRODUCTION

This exposition discusses the entwining of 'technique' across compositional and performance domains in two compositions by Scott McLaughlin, developed in collaboration with violinist Mira Benjamin and pianist Zubin Kanga respectively.

[There are two ways to read this exposition.
1) Click the links below to first listen to performances of the two pieces (with accompanying commentaries on technique and realisation), and then come back to the 'Introduction' to read our contextual discussion around ideas that inform these pieces

2) Read-on to begin with the ideas, then listen to the pieces in the next section alongside their commentaries.]

> *The endless mobility of listening* (for violin and live electronics, 2015)
>
> *In the unknown there is already a script for transcendence* (for prepared piano, E-bows and magnetic resonator, 2018)
>
> Additionally, we point towards a new work for violin and piano currently in development.

This Practice Research treats the indeterminacy of instruments as 'material agency' (Pickering) which becomes entwined with the human agency of the musician, what Pickering calls a 'dance of agency'. Here, performance techniques are not simply an aspect of musical material used in the piece, but are fundamental to the compositional technique; techniques of performance and composition emerge from each other via a fulcrum of indeterminacy as a material-epistemic object (Knorr Cetina). The case-study compositions take different approaches to this idea, each casting it in a different light. In *endless mobility…* the violinist uses extremes of bow technique to afford material agency from the string in the form of indeterminate spectral 'revealings', while *In the unknown…* explores indeterminate sounding states of prepared piano strings continuously excited by resonators.

This project is influenced by some pieces where material agency is 'tuned' in the process of setting-up and then left to run by itself: Nicolas Collins' *Pea Soup* (1974); many of Alvin Lucier's installation pieces, such as *I am sitting in a Room* (1969) and *Music on a Long Thin Wire* (1977). These piece foreground material indeterminacy but do not require the interaction of a performer; the dance of agency happens entirely in tuning the setup. Of more interest to this project are those pieces that include an ongoing tuning of the human and material agencies in performance. For example, Lucier's *Music for Cello with One or More Amplified Vases* (1993) requires the cellist to interact with the material agency of the vases by very slowly sliding up the cello's register to reveal vase resonances. The acoustic compositions of Éliane Radigue are written as a very close collaborative process between composer and performer to develop the sounds and structure that allow emergent

phenomena. As Radigue describes it, 'as if the sound had an autonomous life which must be respected.'

Notation too is important here as an actor (in the sense of Actor Network Theory), a force that can have both enabling and constraining effects in a complex field of play. Radigue's pieces rely on the performer to memorise the specific instrument techniques and structure, but the pieces in this exposition use a score to direct and constrain the performance. In this project—as is common in experimental music—the scores are mostly text and graphic notations. This is partly because the things and relationships used are not well-represented by common-practice notation, but also (similar to Radigue and Lucier) because the work relies on the performer's understanding of the agentic relationships which are performative and not representational. While this approach can yield many different kinds of notational-constraint—from levels of open-ness akin to free improvisation, to the ultra-literal interpretation of text as 'prescription for action'—this project is influenced most by what Thomas DeLio describes as 'circumscribing the open universe', that is, allowing an infinite possibility of movement within specifically bounded constraints. Pauline Oliveros' music also achieves the same open-ness but through (mostly) a purely textual approach, and relies even more on listening to tune into environment and response. Most importantly, in this project the life of the piece demands that the performers are continuously open—via listening and sensing—to the possibilities that change and bifurcate in performance, held in an incomplete state during (and after) the process of performance unfolds them. These pieces are epistemic objects as Karin Knorr Cetina describes it; '[o]nly incomplete objects pose further questions, and only in considering objects as incomplete do [researchers] move forward with their work'.

The case studies for this exposition both differently develop from the same compositional approach which McLaughlin calls 'material indeterminacy'; the inherent indeterminacy of materials in unstable states. While much contemporary composition makes frequent use of indeterminate sounds from instruments, our research here is not in the technique of playing or deploying these sounds, but in devising compositional strategies to use this indeterminacy as a generative force within the performance such that the techniques of composition and performance in the piece are mutually entangled and extend each other openly. In this way, the research is only minimally concerned with the aesthetics of such sounds, focussing instead on the relationship between player, instrument and compositional framework, as Tim Ingold might put it, as *technique-in-formation*. That is: (1) the mechanisms by which the instrument destabilises, and the behavioural topology of its instability; (2) the musician's techniques for working 'with' the instrument (Ingold) and following its material agency (Pickering); and (3) the notational and structural strategies that can productively constrain the musician's agency such that an appropriate feedback loop is fostered.

The theoretical weave to this research is in thinking about composition and performance cybernetically, invoking a black-box model described by David Borgo as 'something that does something, that one does something to, and that does something back.' Such a feedback-loop of score and performance requires 'a

fundamentally performative engagement' according to Borgo, which is presented here in terms of a non-representative approach to musical composition that valorises a generative and lively assemblage of the human and the material: the co-constitutional manifold of physical materials in flux with the embodied technique [BUBBLE] of the musician. Andrew Pickering describes such performative entanglements between human and material agencies as a 'dance of agency'; 'the reciprocal tuning of human and material agency, tuning that can itself reconfigure human intentions'. What possibilities emerge when human intentions are reconfigured in performance by the response of the instrument?

Pickering is writing as a Philosopher of Science, using the image of the 'mangle' to describe how scientists' goal-oriented interactions with materials are central to how they 'do' Science. As such, Pickering's dance of agency is not a technique in itself but rather an agent-focussed reading that could be applied equally to any human-material interaction; from the electromagnetic manipulation of subatomic particles, to the eating of a sandwich. Translating Pickering's performative ontology of science into the performance of music provides a novel perspective on the general interaction of human/musician and material/instrument, and usefully describes the embodied techniques required for the realisation of the rich musical traditions across all cultures. Historical trends in instrument design and performance technique have honed the 'capture' of material agency that affords 'mastery' of the instrument via countless hours of learning to negotiate their agential interaction.

Pickering notes that within the mangle, goals are 'temporally emergent', situated as they are in a 'dialectic of resistance and accommodation' with material agency, becoming a 'goal-revising' practice. Generally speaking, the Western concert music tradition reproduces the goal-directedness of Pickering's scientists; arguably even more acutely. However, when Pickering's model is considered in an experimental music [BUBBLE]context it exposes fascinating possibilities for the dance of agency to be applied generatively as a form-giving process. Where Pickering's scientists dance to a single temporally-emergent goal, experimental music provides a rich context for open-ended structures that afford directed-ness and revision as multiplicities that can be realised concurrently or as ever-branching paths. In the compositional research outlined here, Pickering's dance is explicitly enacted in a heightened manner via a score where the performer's role is actively shifted between *controlling* the instrument (by imposing human agency on it) and redirecting human agency to *facilitate* and *support* the material agency of the instrument. The material agent is foregrounded as the force of the piece, constrained by varying open-ness of structure at local and global levels. In the case studies, the violin becomes agent as the player alters bowing into a non-standard zone of sound production. Here, the violin string can choose between several metastable states where a single overtone suppresses the string fundamental and emerges as the foreground tone in its own right with no specific choice from the player other than to support the string's agency.

Pickering's concept of 'tuning' becomes key here since it describes how the generative possibilities of interaction are both initialised and maintained by reciprocal interaction between agencies. Common-practice-era approaches to the musical

instrument 'tune out' indeterminacy via 'craft', the management of instrumental technique to maximise efficient production. Equally, 20th Century avant-garde musics of many stripes have actively tuned against this to destabilise instrumental sound. While it is certainly the case that these practices often ossify into production-friendly objects (so-called 'extended techniques', a representational idiom where sounds evoking chaos and instability are made reproducible precisely upon request—what anthropologist Tim Ingold would describe as 'the reduction of things to objects and of their consequent "falling out" from the processes of life.')—the door is always open for these techniques to be un-tamed. Such radically unruly sounds fit readily into Ingold's anti-hylomorphic 'ontology that assigns primacy to processes of formation as against their final products, and to flows and transformations of materials as against states of matter.' The historic tendency in composition has been to activate these sounds and let them roam free, untethered from their embodiment and environment. Ingold's conception of materiality is important here because of its Deleuzian focus on materials in flux, underpinning a move away from unstable-sounds as fixed and knowable 'objects', and towards a lively 'thingliness' that is not simply pinned down and instead must be engaged with. The 'thing' Ingold says 'is a "going on", or better, a place where several goings on become entwined. To observe a thing is not to be locked out but to be invited in to the gathering. We participate, as Heidegger rather enigmatically put it, in the thing thinging in a worlding world.'

This continuous engagement with the sound thing relates back to Pickering's tuning and dancing. The dance of human and material agency is the interaction of the musician and instrument intertwined in an unstable zone of sound production [BUBBLE], making moment-by-moment actions to tune into the 'thinging' to balance and sustain the ongoing sound: Pickering describes material and human agencies as 'mutually and emergently productive of one another'. This tuning happens both in the compositional process of building an appropriate environment for things to flourish, but also in performance through the active engagement with sensing, listening, feeling, and to a certain extent anticipating: as Ingold describes it, 'an improvisatory joining in with formative processes'. Thus the compositional impetus here is to investigate objects in their thingliness, and design a set of open-ended interactions that braid the musician's technique and the instrument's more distant affordances in a feedback loop. In the case studies, *In the unknown…* exemplifies Ingold's 'joining in' as the primary activity of the piece where the player manoeuvres continuously-sounding electromagnetic resonators to explore tipping points in the resonance of the prepared piano. In both case studies the 'joining in' is an embodied technique that essentially IS the piece, with the score acting secondarily as a structuring device for different techniques of 'joining in' (*In the unknown…*) or different positions on the material topology (*endless mobility…*)

To put these ideas in a wider musical context (and expanding the references to Lucier etc above), the most similar research is in new approaches to electronic music incorporating concepts from cybernetics, and interactivity with extended-instruments (see Overholt *et al*). The cybernetic approach builds on ideas from Norbert Wiener and Gregory Bateson, most notably in the 1960s with David Tudor's *Rainforest* pieces where large feedback ecosystems of electronic sounds (some electronically generated, some acoustic sounds amplified and filtered) interacting with human operators aiming for levels of autopoesis through the careful

balancing of inputs and outputs to ensure a foregrounding of the system's own sonic workings (material agency). Daren Pickles quotes Tudor and colleague Gordon Mumma:

> With respect to *Rainforest IV*, Tudor said: 'the object was to make the sculptures sound in the space themselves. Part of that process is that you are actually creating an environment. […]' Furthermore, Gordon Mumma reiterates the ecological nature of the piece: 'the entire electro-acoustic apparatus [was] an ecologically balanced sound system.'

While much excellent work has been done in designing digital systems with inter-agential qualities (see for example Magnusson 2010, Bowers 2002, Chadabe 1997, Carey 2016, Pickles 2016, Blackwell and Young 2004, Di Scipio 2003), this project is more concerned with physically interactive systems; whether this means purely acoustic instruments, or electronic sound centred on a physical component (feedback is the most common example). This area of practice is more sparse than the digital, but has a strong history emerging from the same cybernetic concerns that were in the air when electronic music and experimental music were much closer communities.

The following sections of this exposition will explain how the two pieces function, exposing the research of composing technique and performing technique in relation to the ideas outlined above.

→ Techniques I: *The endless mobility of listening* (violin and live electronics)
→ Techniques II: *In the unknown there is already a script for transcendence* (prepared piano and resonators)
→ Composing and Performing Technique

Introduction

Techniques I: *The endless mobility of listening* (violin and live electronics)

[go back to the context chapter]

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The endless mobility of listening (for violin and live electronics) was written for Mira Benjamin in 2015: the title is taken from Salome Voegelin's *Listening to Noise and Silence*. As an overview, with details expanded and exemplified below, the key research in this piece is a formalising of performance technique around material indeterminacy and listening, and using the score as both a description of this technique and as an external structure that bounds the piece. Material indeterminacy here is achieved through 'drone-bowing' [BUBBLE] which allows indeterminate harmonic partials to emerge prominently in the sound of a bowed open string. Listening is vital here in ways that are different to the normal listening of the performer, to the extent that listening becomes a technique in itself. The entwining of player and instrument via material indeterminacy and listening is 'the piece'; amplified by a structural process of repetition moving through iteratively altered materiality.

Drone Bowing

The 'drone bowing' technique is a method of generating indeterminacy in the harmonic spectrum of an open string through changes in bow pressure, angle and position. The bowing technique causes the spectrum's fundamental to collapse and other partials to become prominent, but it is not predictable when the spectrum will change and which partial(s) will emerge. While the technique is not novel in itself—it is used by many improvisers to play their instrument timbrally—its use here is novel as a source of indeterminacy within a form of improvisation constrained by compositionally defined forces and listening behaviours.

While these bowing techniques are a primary technical focus for the violinist, the broader mechanism of the piece is to use them as part of a responsive *listening strategy* where the player must be in sympathy with the string. Rather than trying to 'dig' or 'mine' sounds from the string, the player is a facilitator who provides energy to the string, and a *supporter* who enables the string's material agency to be foregrounded. By continuously playing on the edge of timbre like this, Benjamin invites material agency to the foreground as something she simultaneously supports and responds to, an embodied process of becoming. As Tim Ingold describes similar processes in the flux of forces and materials:

> [...] movement along these [paths of form-generation] is creative: this is to read creativity 'forwards', as an improvisatory joining in with formative processes, rather than 'backwards', as an abduction from a finished object to an intention in the mind of an agent.

Ingold invokes the improvisatory, which is highly appropriate here not in the context of musical free improvisation specifically, but rather in the larger understanding of

improvisation as a creative response to shifting circumstances, and also in the implication of applying the knowledge and experience of those that live in that environment. Material agency in the unstable string is not simple randomness—the string exhibits a hierarchy of preferred partials in its spectrum. In any given performance, the string will tend towards certain partials, but always with the possibility that highly-unlikely partials may also emerge. The instrument's agency is further entrenched by the fact that these preferences shift from day to day due to changes in environment and material (humidity, temperature, string tension, etc.). Nonetheless, the player's listening and response become more honed over time, as they develop technique witin the phase-space of behaviours. As such, the player's listening and supportive approach are the core of the piece, curating the indeterminacy that affords a rich interaction and 'mangling'.

Form / Procedural Elements

While material agency plays-out on a local, moment-to-moment level, the indeterminate harmonic partials that emerge from this process are captured electronically to be sustained indefinitely as an ever-growing 'carpet' of electronic harmony (see Fig.2). A directed but knowable harmony contingent on the dance of agencies. The piece's structure acts as an iterative process to undermine the player's knowing of the material agency, revealing further novelty as the player adapts anew in each cycle.

The structure is a cycle of three procedural elements repeating throughout, determining the duration, pacing and form of each realisation:

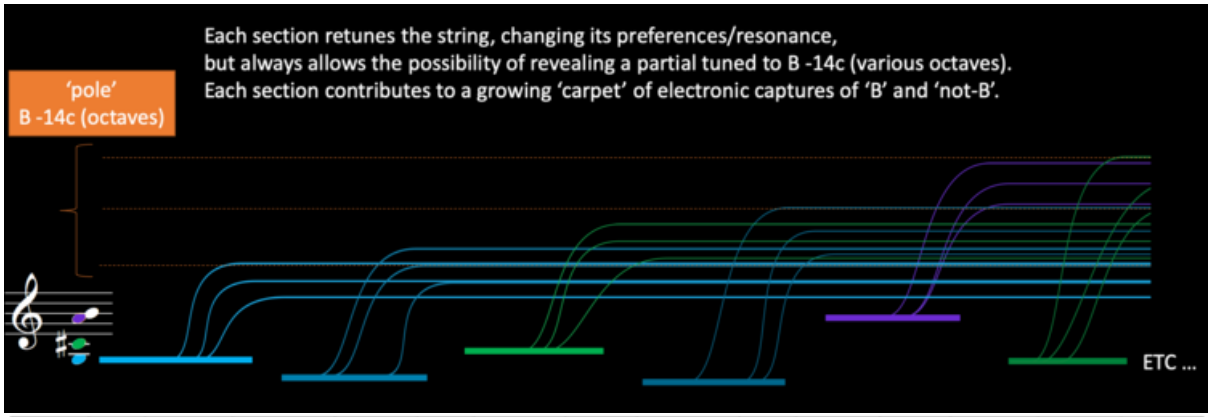
1. (re)Tuning
2. Seeking/Capturing
3. Chorale

Each cycle takes a different open-string *scordatura* (see Fig 1), requiring a retuning of the string at the start of each cycle; the retuning slackens the string and 'resets' its hierarchy of preferred harmonic partials. Fig.1 shows how the tuning schema of each string relates to a common anchor pitch—B5 (-14¢). Initially this is the fifth partial of G, with each subsequent retuning chosen so that B5 or B6 is present as a low-order partial. In each section, this B will be potentially present, but whether it emerges as an available partial is contingent on various material or environmental factors. At this point it is useful to understand the anchor pitch as an entwined agential nexus that focusses the dance of human and material agencies. The anchor pitch is both a 'beacon' to direct human agency (rather than a required sonic element) and a variable potentiality of each string configuration.

The piece's duration can be altered according to the performance context: it has been performed live many times in short versions with two or three cycles (c.15 minutes). The long structure shown in fig.1 has not been performed live to date, but a 78-minute studio recording can be heard here. Even longer versions are also possible, limited only by the viability of increasingly slack strings producing stable isolated partials.

Of the piece's three procedural elements ((re)Tuning, Seeking/Capturing, and Chorales), the listening/capturing phase is the longest in each cycle, lasting usually between 5–10 minutes as the player explores the string's material agency. Benjamin here exercises agency in choosing which emergent partials she finds interesting, guided by the beacon of the potential B -14¢. The chorale is a short recurring structural device that foregrounds the violin, and explicitly connects the harmonic identities of adjacent fundamentals (i.e., the next open string to be bowed). The chorale is flexible, changing each time due to the de-tunings; the score provides a set of basic models to work from (see score for models). In live realisations, strings are re-tuned in real time at the end of each section as a discrete but performative act: this process is omitted in the studio recording.

To summarise, *The endless mobility of listening* uses an iterative process to apply the embodied technique of drone bowing to an instrumental environment where the material agency shifts from section to section. Benjamin renegotiates her technique in each section in relation to both the issue of changing string tension and also the consequent changes of material agency. The 'piece' is the interaction of material agency in the unstable 'drone-bowing' and the embodied technique of the violinist. The external structure is like a pinhole camera caturing an extended long-exposure audio trace of these agencies playing out.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Str. II					A 9°				G 5°			F+36 11°		E-16 3°
III			C#+23 7°				C-2 15°			B-14 2°				
IV	G 5°	F+36 11°		E-16 3°		D+45 13°		C#+23 7°			C-2 15°		B-14 2°	

Fig.1: The structure of *Endless mobility of listening* as a series of cycles of re-tunings of the violin strings II–IV. Each tuning contains the pitch B(-14¢) in the first 16 partials of its harmonic series.

Fig.2: The build-up of captured/sustained partials in *Endless mobility of listening.*

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The Endless Mobility of Listening
Violin and live electronics
Scott McLaughlin 2016

For Mira Benjamin

Duration: variable, 15 minutes to more-or-less an hour.
Preparation: detune E-string to B-16c. Attach microphone to bridge.

Tuning:
The piece is structured as a series of re-tunings of open strings to a new interval in which B-16c is a different natural harmonic each time. See score page for table showing the order, with each section showing (i) tuning, and (ii) the target harmonic of that string resulting in B-16c (in various octaves). Detuning during performance should be reasonably unobtrusive. A digital tuner may be useful, or not.

Seeking/Revealing:
Continuous bowing to create a drone. Listen inside the drone to the partials. After 30-60 seconds, allow partials to emerge from the string sound. Use subtle changes to bow position/angle/speed/pressure/etc. to coax — but don't force — partials out into prominence: the right hand should not be needed. Seek the B-16c partial, but allow any others to come out. Be generous, afford resolution.
3-6 times in each section, capture strongly emergent partials with the footswitch: except the opening section which should be quite long (8–12 mins) with many captures (1–2 per minute) to build up the recorded texture.

Chorales:
Each section ends with a chorale of double-stopped harmonics. Use the string currently in play and either adjacent string. The score gives several modules, any or all may be used in any order, and repetitions are allowed. The modules are notated as though in standard tuning, and should be treated as tablature. Timing is loose, giving only long notes and short notes. Chorale section should be less than a minute long. In chorales, the live violin moves into to the foreground. No electronics/footswitch capture during chorales.

Electronics:
Each sound captured with the footswitch will be added to the continuous looping electronics. The loop will be the duration that the switch is held down: minus 500ms each end for fade-in/fade-out. The live violin sound should be immersed in the electronics, with a gentle ebb and flow of foreground and immersion: except chorale sections, where the live violin should mostly emerge from the electronics.

Performance (video)
Score (PDF)

Technique II: in the unknown there is already a script for transcendence

[go back to the context chapter]

In the unknown there is already a script for transcendence was written for pianist Zubin Kanga in 2018. The title is taken from a line in Liza Lim's essay Patterns of Ecstasy.

This piece applies the same core idea of material indeterminacy to the prepared piano, which differs primarily from the violin because the preparations make the strings inharmonic, radically altering their pitch/timbre content, and providing a different material behaviour. The piano is also not a sustaining instrument like the violin: once struck by the keys/hammers, the piano sound instantly begins to decay to nothing. Material indeterminacy in the form used previously requires a continuously sustaining instrument because a continuous input of energy to the material-instrument is required to maintain the specific zone of sound production that affords metastable states. In this piece, the technique is transposed to the piano using EBows and a mains-powered electromagnetic resonator to continuously excite the strings in the similar way to the violin bow in *Endless Mobility.*

Although there is now a significant body of composition using EBows in the piano, this work uses EBows that are designed and modified specifically for the larger (and multiple) strings of the piano. The EBows in this new work are modified with a 3D-printed case to fit onto the piano's triple-strings (see fig.3), and supercharged (using two batteries) to provide a slightly louder output. Even with the extra power, the EBows are only effective in the piano's middle register, but the mains-powered resonator is significantly more powerful and works well across the whole registers, making it a much more versatile and powerful tool.

Each of these tools have their own particular characteristics. Despite the extra power, these EBows still take a while to reach stable sounding due to the relatively low energy. The mains-powered resonator elicits response faster, and can be directed at more specific points of the string to seek out partials and multiphonics. However, because the resonator is handheld rather than placed on the string, it is more difficult to focus energy on a specific point on the string for extended periods: the resonator is also somewhat unwieldy, adding further indeterminacy.

As in *Endless Mobility,* the point here is to allow the pianist the explore the indeterminate materiality of the instrument. The pianist supports the agency of the piano, allowing isolated partials of the strings to emerge according to Pickering's dialectic of resistance and accommodation between the player's actions and the materiality of the piano. The piano strings can be explored in several ways. EBows are generally left in one position to allow the string vibration to settle into a stable pattern, then they can be moved to different positions of the string to allow other partials to emerge. The score directs the player to seek out metastable multiphonics, but allowing other sounds to emerge along the way. Multiphonics can be found by searching different positions on the strings and moving to a point in between different partials; this sometimes also results in the slow transition from one partial to another, or may even reveal a new partial.

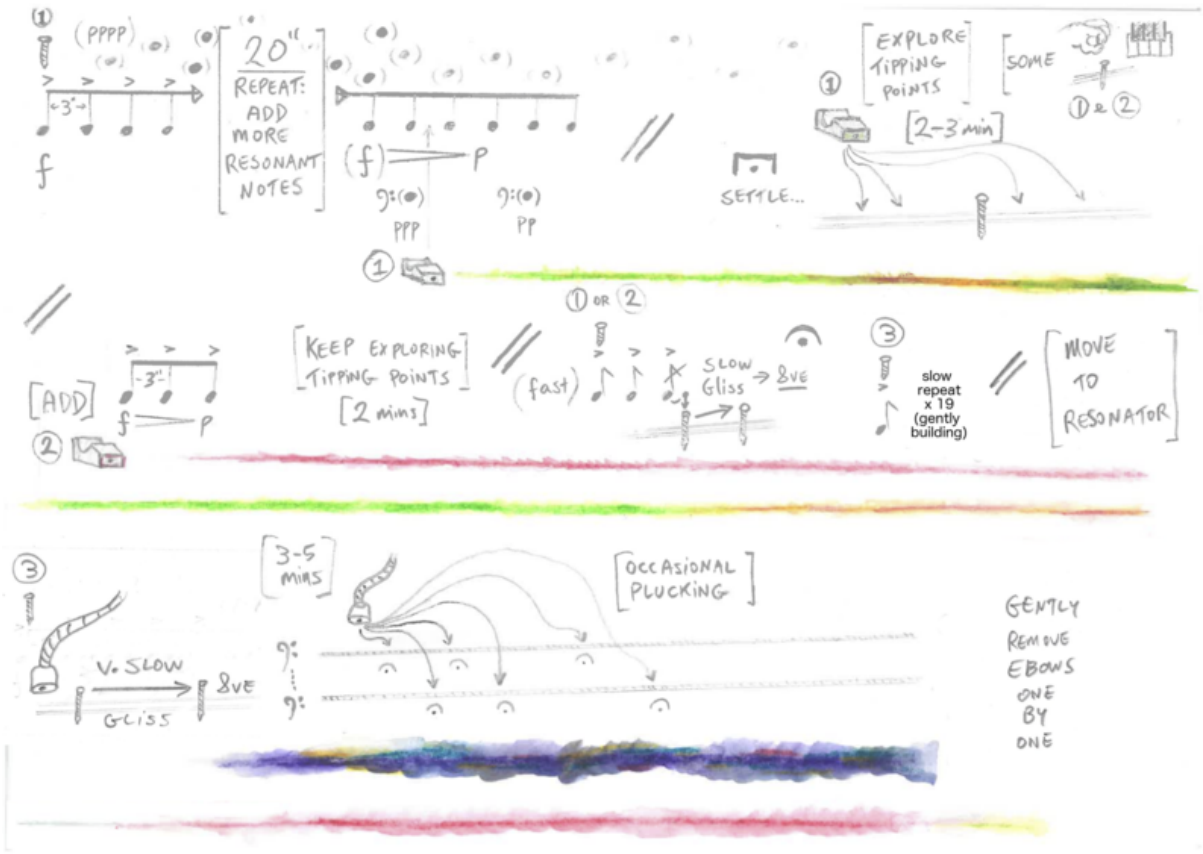
Exploring the strings is a continuous process of the piece, where the player balances several explorations across simultaneous soundings of two or three EBows and the resonator. The exploration is structured around changes of environment (i.e. altered harmonic spectra) by moving the piano preparations (a long screw or bolt) to alter harmonic spectra and available partials: this is comparable to the process in *Endless Mobility* where strings are retuned in each cycle, altering their material behaviour and agency. Movements are carried out both discretely and continuously. Discrete actions are carried out on a muted string by silently moving a preparation to an arbitrary new position: usually while other EBows are droning. Continuous actions can be carried out, if conditions are favourable, by carefully grasping the preparation between fingertips and gently pulling it along the string while still sounding. Since the preparation is coupled to the sounding string this can result in immediately silencing the whole string, but if the vibrational node of the preparation is grasped then the screw will continue to vibrate while being moved. Moving a sounding preparation is used sometimes as a fast gesture with structural/phrasing implications, while a very slow glissando can be used to search for resonant points of the string; which, once the preparation is in the new position, can be further explored by moving the EBow or resonator.

In contrast to *Endless Mobility*, there is no fixed anchor pitch to structure this piece around. Instead of this, the piece uses relative pitch-matching to create moments of coherence at structural points. The player can choose to move sounding preparations to a target position that makes an octave or unison harmony with another drone. The player can also choose to interrupt the glissando at a point where there is a strong resonance, regardless of the sounding pitch at that position. In this way the structural points of the piece can be moved around to suit the material response of the instrument. Conversely, the agency of the piano can interrupt the human structuring by offering an irresistible resonance.

The piece exists as an epistemic object, a set of relationships and practices that elicit Pickering's dance of agency, but also in various relatively fixed (notated) versions. The initial trace of the object was a text score (see PDF on right), with clear instructions based on the processes we had refined in the workshops. Each main process was divided into modules. Originally, a multi-branched structure was devised, so that the modules could be played and repeated in different ways for performances of different lengths.

An excerpt of this score is shown below (see right for PDF of full score):

But the pathway decided on for the Huddersfield premiere was the one that stuck, and this was later concretised into a graphical score.



This score shows the piece's three sections. An introduction, playing the prepared notes and keys that approximate the resonances of the prepared string. The central section using the two EBows and the preparation to performatively explore the strings. A transition section (a note repeated 19 times to build up resonance) and the final section with the resonator, which is governed by searching for partials on two bass strings that match the dominant EBow pitch. The structure concretises a sequence of 'set pieces' to suit a 10–12 minute concert performance, but within these set pieces the performance is highly indeterminate and contingent on the dance of agency. There are plans for future performative-installation versions where these agencies are left free to roam and develop across several hours.

To summarise, *In the unknown there is a script for transcendence* uses an open process to apply the embodied techniques of listening and working with the different magnetic resonators to an instrumental environment where the material agency is continually explored and re-set by the player.

‘Entangled Technique’

The title above should be read not as the technique of composing or of performing, but rather as a situatedness of the entanglement of technique across composition and embodied performance. Both of the pieces discussed here are fundamentally driven by the interaction of material indeterminacy and embodied performance technique, with the score and rehearsal process as *aides memoire*, guides, and structuring devices. Tim Ingold's 'Lines' describes the performative ontology of the flux of materials and forces in these pieces:

> [T]he pathways or trajectories along which improvisatory practice unfolds are not connections, nor do they describe relations *between* one thing and another. They are rather lines *along* which things continually come into being. Thus when I speak of the *entanglement* of things I mean this literally and precisely: not a network of connections but a meshwork of interwoven lines of growth and movement. (Ingold)

The lines of growth in these pieces do not begin with the score or the instrument or the performer, but rather emerge from their meshing and movement. The scores and instrument and performance techniques all have their hard edges, but are designed to yield to each other, flowing around each other and becoming lines both in performance and across performances. The following section outlines how similar approaches to technique arise from the dance of human and material agencies of these particular instrumental configurations, in relation to embodied technique.

Many conversations between Benjamin and McLaughlin during the research and creation phase of their collaboration centred around the relationship between Benjamin’s exercising of her own enactive bodily agency (technique) over the instrument, and the violin as itself a resonant body with its own material agency. As the violin's material behaviour shifts from cycle to cycle within the piece, this changing environment is in flux with Benjamin's responsive process of listening and bowing as situated by the rules of the score; a higher-level conscious decision matrix that inflects her playing. The following flowchart attempts to summarise this decision matrix.

As Kanga prepared *In the unknown…*, he was able to make closer predictions about a number of key factors: the distance an EBow needs to move to find a new harmonic; the range and strength of harmonics available at different points on the string; and the minute adjustments to EBow angle and pressure to help it to ‘jump’ to another harmonic on the spectrum. These techniques were further adjusted and refined when using the magnetic resonator, which had entirely different properties to the EBow, creating huge jumps in harmonics from a change of a few millimetres in length along the string or height above it. Thus, techniques that at first seemed to Kanga to be passive were developed into active and precise techniques, a virtuosity of a kind that requires a deep knowledge of the piano but mostly unrelated to

conventional piano techniques. And although the consequence of each technical interaction and decision was not 'captured' as in *Endless mobility,* the entire structure of the work is dependent on these techniques. In the HCMF premiere, and subsequent performances, the text score was largely abandoned and the graphic score used as an *aide memoire:* the work is less related to the score than it is to the tools, techniques and aesthetic choices, forming a new epistemic object that is unfolded anew with each performance. Ingold's concept of 'wayfaring' to knowledge is useful here, as he explains; 'the process is rather like that of following trails through a landscape: each story will take you so far, until you come across another that will take you further. It is through wayfaring, not transmission, that knowledge is carried on'. With each subsequent performance, new performance materials (including pianos) and performance durations alter the landscape of the work, allowing new pathways to be explored, new knowledge of the materials revealed, and new possibilities for the piece are created with each iteration

The importance of embodied and memorised technique in these works cannot be understated. The two scores—both the text score, and to a greater extent the extremely compact graphic version of the score—are not self-sufficient. The pieces are contingent upon a huge body of knowledge, of work-specific performance practice, concretised as technique, in order to use them. This technique is the core of the composition, and the scores exemplify two different approaches to supporting this and structuring the piece in different ways. Across the two pieces in this exposition, *Endless mobility*'s score provides the rules for the technique (a set of agential cues and constraints), and a structural diagram for performance, while *In the unknown* uses a score for structure and to provide graphic and textual *aides memoire* that are also descriptions of relationships/behaviours. Technique is explicitly inscribed in the score for *Endless Mobility* because the drone-bowing is not a standard violin method: note that the 'technique' is not solely the drone-bowing, which simply sets up the possibility of the piece's core technique, but the whole embodied and performative adaptation to the material indeterminacy of the string. *In the unknown* assumes that EBow technique is known to the player, and uses description to focus the player on the same embodied technique as the violin piece.

In *Endless Mobility* the seeking and capturing of pitches are to some degree exercises of *choice*, and at the same time these choices are not entirely within the player's control. At any point in any of these above processes, the instrument may behave unpredictably, placing the player in a position of negotiating contingency—whether to continue with an active process, or allow herself to be diverted toward a new process, suggested by the material preferences of the violin. McLaughlin reflects that this persistent sense of contingency in *Endless Mobility* sets the practice 'against a paradigm of control', noting that

> [...] rather than trying to 'get' anything, your job is to support what the instrument wants to do. This creates a levelling of agencies… you bow, hear something trying to emerge, adapt technique to accommodate that, let it come out, support it in coming out. (McLaughlin)

In the same vein, Benjamin can push back against the instrument's material agency and decide, for example, that she is tired of hearing certain strong partials and instead support *other* possibilties to emerge. Such a choice remains rooted in a fundamentally *supportive* perspective toward the instrument; in seeking something other than what Benjamin is currently hearing, she is acknowledging that there are components in the sound that she is *not* hearing, and choosing to support them over what is sounding. The seeking/capturing process leaves in its wake an emergent topology of this dynamic, between her choices (how she responded, what she prioritised, what she sought) and the material agency of the instrument: as before, this process can be likened to a 'long-exposure image'.

As Ben Spatz describes (in the context of Marcel Mauss):

> Technique, here, involves a detailed and context-dependent negotiation between socially defined or symbolic meaning and the concrete possibilities offered by the material world. In this thick relationality, humanity attunes itself to its world. Technique for Mauss is not the domination or instrumental usage of the world but rather, in Deleuze's terms, a kind of becoming-world.

The 'becoming-world' is the combined technique of composition and performance. Not a world-building-composition passed to an accomodating-performance-practice, but a technique that co-constructs the piece from potentials. Where *The Endless Mobility of Listening* houses its virtualities as a cyclic structure that differentially activates lines of flight as agencies-in-formation intersect, *In the unknown there is already a script for transcendence* affords a more open-ended unfolding of possibilities, bounded by fixed structures.

The research and creation of *In the unknown* was similarly based around workshopping techniques of composition and performance together. But whereas *Endless Mobility* drew from the core of Benjamin's embodied knowledge of the violin, *In the unknown…* is only tangentially connected to conventional piano technique. Although Kanga had played a number of works with EBows, the focus here on delicate EBow movement, the somewhat fragile movement of preparations, and the unpredictability of the relationship between the two, required an extension and refinement of these techniques, to form a new corpus of embodied knowledge and knowledge of the instrument. Even more so than the violin work, *In the unknown* demonstrates Helmut Lachnenmann's thesis that composition is a process of 'building an instrument'.

In workshopping the central EBow section of the work, McLaughlin was less focused on procedural strictness than on an attitude to listening and responding to this new 'instrument', which functioned much more in practice like Tudor's electronic environments than a piano (in its traditional conception). He used the metaphor of a water engineer, opening up channels to allow water to flow across to different reservoirs, to explain the role of the performer to Kanga.

> Those little moments where you catch your transition from something to something else. I almost visualise it like water all in one place, then something opens and it flows to a different place. You get these moments of turbulence as the two things are happening. (McLaughlin)

The unfolding structure of this section of the piece would emerge as a result of this method of engineering change, reacting to each result in turn. This shepherding of the sound required a recalibration of Kanga's training (and natural inclination) to be an active agent in the performance, where complex music is matched by corresponding physical strength and agility. In this work, waiting for the EBow, the preparation, and the piano to interact after even a slight adjustment, and actively listening to these slow and minute changes, without touching the instrument, was a crucial technique. This illustrates a very particular version of Pickering's mangle metaphor—rather than a constant 'dance of agency', the interactivity between agencies is brief and crucial, punctuating longer periods of observation of the material's autonomous activity, a dance with minimal contact.

McLaughlin and Kanga also discussed the aesthetic decisions that would dictate each interaction with the 'instrument'. McLaughlin at one point sketched a hierarchy of consonances to be aimed-for between the two EBow/prepared strings: as a structural device to afford some audible consistancy of musical-material across the piece:

> Unisons and octaves are most desirable, fifths are fine, thirds are okay. The further you go in the harmonic series, the less desirable it is. (McLaughlin)

However, many variations of these were found to be more appealing. A micro-interval between a unison and a semitone was a particular favourite of both McLaughlin and Kanga, with McLaughlin stating 'It looks like it's a semitone different now but the beatings aren't the same which means it's not. It's intense!'. McLaughlin's eventual instruction for the 'goal' intervals was much more open than his earlier one 'Rather than judging it by a set of intervals, you're going by feel' (McLaughlin). The more open approach was appropriate for a short (12–15min) performance where there were fixed structural elements to the piece, but in a longer performance where structure becomes emergent (rather than marked by set pieces) the intervals play a more important role in marking structure: longer installation-type performances are planned for 2020–21.

The final flow of decisions in the most free (central) section was not dissimilar to Benjamin's, with a similar variety of branching pathways, repeated but with new conditions each time. Kanga's flow of decisions can be represented as follows (where the strong black line at the start indicates the route preferred by McLaughlin to generate more play and ambiguity at the section start).

Conclusion

Looking forward, it is worth briefly discussing an as-yet-untitled new work for Benjamin and Kanga to be developed in 2021. This new work will take the overlapping human and material agencies and multiply them by building a system where the violin feeds into the resonator to influence and interfere with the piano. The resonator will receive signals from both the piano and from the violin, while an onstage mixer (under Kanga's control) will allow dynamic and performative attenuation of the resonator by mixing more or less of the violin. As such, the two human agencies join to become that strange kind of team where both members are working to the same goal but can only communicate through their actions; and their actions are only experienced as a single continuous sonic amalgam, filtered through the resonant-material topology of the instruments. The point here is that the material agency is not in opposition to the human team, but rather it keeps its place as the mix of force and environment in a constant 'dance' with the players' mutualised agency. Both players navigate the dynamic space of possibilities supporting each other and also the material agency of their 'apparatus' (Barad).

Like *Endless Mobility* and *In the unknown,* this piece will unfold as the players participate in a relational dynamic through a sustained rigorous practice of listening and responding. This nexus of interaction can result in 'ruptures' from which new epistemic objects and pathways emerge. The practice of such a work is thus carried from what Knorr Cetina calls 'habitual' into 'objectual' practice—in which 'objects of knowledge appear to have the capacity to unfold indefinitely'. Such a practice is 'always in the process of being materially defined' and thus its epistemic objects 'continually acquire new properties and change the ones they have'.

In the spirit of Philip Agre's 'critical technical practice', this exposition has outlined an artistic practice developed across three artists inhabiting an entanglement of technique across perceived domains of composition and performance by 'embrac[ing] the impossibility of foundations'. Across these pieces, the compositional constraints and forces drive the indeterminacy to be generative, creating vibrant structures within the work where the human agency is bound to the material rather than simply producing sound as a by-product of indeterminacy. The generative structuring of the indeterminacy both arises from and further pushes the player's embodied technique. The composition and performance techniques exist in a knowledge feedback loop around the fulcrum of material indeterminacy.