# ANALYSING THE DIGISCORE CORPUS: THE PACMMAN FRAMEWORK

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## ABSTRACT

This research reconceives digital scores through a multidimensional sensory lens: the PACMMAN framework. In doing so, digital scores are positioned as interactive, embodied, and rich medium. The study explores the digital score as a dynamic, co-creative system that reshapes musical meaning through real-time interaction, phenomenological engagement, and multisensory integration. By synthesizing insights from experimental performance contexts, it reveals how digital scores function as responsive, algorithmic entities that foster collaborative meaning-making between musicians and technological systems.

Key themes include the score's transformation into an interactive, sentient collaborator; its phenomenological presence through gestural and spatialized interfaces; and its capacity for multisensory expression, blending visuals, haptics, and sound. The composer's role shifts from authoritative author to system designer, structuring emergent, improvisatory frameworks that balance algorithmic processes with performer agency. Interdisciplinary integration dissolves boundaries between notation, movement, and multimedia, while socio-political and neurodiverse perspectives highlight the score's potential for inclusivity and cultural resonance.

Ultimately, this research proposes an ecological model of musicking, where performers, algorithms, and environments co-create within an entangled network. The digital score becomes an active participant in a fluid, process-oriented practice, challenging hierarchical structures and redefining musical presence as a collective, exploratory act. This PACMMAN framework not only reimagines music scores future but also expands the very conception of digital musicking as a living, evolving dialogue between human and non-human agents.

## 1. INTRODUCTION

The Digital Score is a five-year European Research Council-funded project (2021–2026) exploring the transformation of musical notation through digital and computational technologies. Led by Principal Investigator Prof. Craig Vear (University of Nottingham), the project involves four international partners: Prof. Cat Hope (Australia), Prof. Sandeep Bhagwati (Canada), Prof. Kenneth Fields (USA), and Prof. Li Xiaobing with support from Dr. Zhang Yuan (China).

During a recent project meeting, a key question emerged: *What have we learned about digital scores?*. This paper responds directly to that question by presenting findings from a longitudinal investigation into creativity and meaning-making through the DigiScore corpus, a collection of digital score case studies generated and studies through the project. While the project has also generated insights into digital musicianship and AI's role in new forms of musicking, this paper focuses on the analysis and evaluation of the corpus.

The paper is structured in three parts: first, an overview of the project's aims; second, a detailed account of the methodology, including data capture techniques and the PACMMAN evaluation framework; and third, a discussion on the long-term impact of engaging with digital scores.

### 1.1 Defining a Digital Score - the "message"

Vear [1] [2] defines a digital score as *a communications interface for musical ideas between musicians that utilizes the creative potential of digital technology*. While digital scores encompass diverse approaches and technologies, they share a common purpose: *to communicate musical ideas through technological mediation*.

The Digital Score project (hereafter DigiScore) specifically investigated *how* digital scores communicate musical ideas, *what* mediates this communication, and what musical materials could serve as meta-materials for future digital scores. Taking a phenomenological approach, the project examined these questions from within the creative act of music-making itself. This represents a deliberate shift away from external perspectives that treat music as either textual artifact or performance object. While such perspectives remain valuable, they fail to account for the full spectrum of experiential and meaning-making processes in musical practice.

A core principle of DigiScore is that the technologies constituting a digital score fundamentally shape the communication of musical ideas. While notational language remains important, the project particularly emphasizes how scores extend "tendrils of affordance" [1], drawing musicians into their worlds through networks of connections and possibilities. This perspective aligns with Marshall McLuhan's foundational media theory concept that "the medium is the message" [3]. McLuhan argued that communication media exert greater influence on human perception and behaviour than their specific content - a television program affects us differently than a printed article

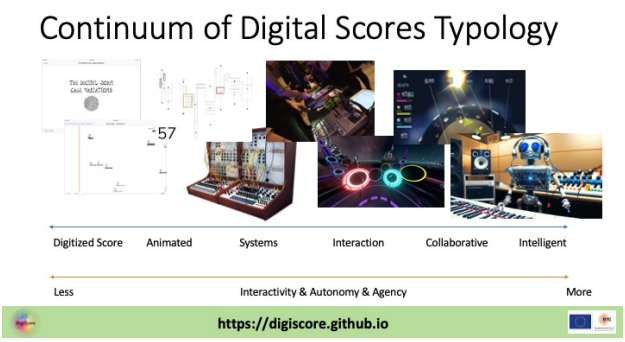


**Figure 1**. Continuum of digital score types

not just through its content, but through its very form as a medium.

Digital scores, as technological media, similarly transform musical meaning-making in ways that transcend their notational content. The project seeks to understand these medium-specific effects, which often operate at subconscious levels, to reveal how digital technologies fundamentally reshape musical communication and creativity.

### 1.2 Continuum of digital score types

When examining digital scores, there is a risk of focusing too narrowly on either the technology or the notational content in isolation, thereby overlooking the deeper connections and meaning-making processes that underlie their surface appearance or semantic language. Vear contends that we should instead assess digital scores through their dynamic networks of connections - how these evolve during both the creation and realization of the work.

This connective perspective reveals digital scores as existing along a continuum, from basic implementations (such as digital screens displaying static or animated notation) to complex systems incorporating AI and intelligent agents. Crucially, at each point along this spectrum, the technological medium fundamentally transforms what can be communicated and how it facilitates creative engagement. These shifting relationships reshape musical creativity itself, ultimately exerting a profound influence on musical ideas and practices.

The continuum of digital score types (see Figure 1) can be classified into three distinct sections based on step-changes in their relationship with musicking: Referential Screen, Interactive Systems, and Co-operative Code.

Part A - Referential Screen includes three types:Augmented Page: Enhances the musician's relationship with the score through screen-based technology, displaying static images of the printed page. Technological Conductor: Uses fixed media elements to guide the musician through a structured, linear timeline of sonic and visual elements. Collaborating Score: Integrates real-time manipulation of sound elements, actively participating in the creation of the music alongside the performer. These digital scores journey alongside the musician, providing direction and influence, but without deep interaction or agency compared to the following types.

Part B - Interactive Systems involves three types that engage more dynamically in the creative process: 4. Animated Score: A visual-based system where the design and signals are dynamic, evolving with the music. 5. System-as-Score: Utilizes hardware and electronics to create tactile environments for interaction. 6. Creative System: Combines pre-defined audio, dynamic visuals, and sound processing, reacting in real-time during performance. These systems are spontaneous and generative, with the full creative potential realized only during performance.

Part C - Co-operative Code consists of four types: 7. Performative Code and Hacked Bodies: Involves physical movements and data streams, with the machine responding interactively. 8. Gesamtkomposition: Coordinates multiple media streams in real-time with autonomous, generative behaviour. 9. Networked Ensembles – Connected Score: Links performers in a network, organizing and distributing compositional materials. 10. Living Score: Uses intelligent computation to actively co-create within the musicking process. These scores are co-operative, with clear shared tasks between the musician and the digital score, offering a creative presence and autonomy in the performance.

With this typology in mind, it should be clear that different types of technologies will mould the way we think, perceive, and interact with the music ideas that are embedded within digital scores. The next section defines the methodology for generating data about such relationships.

## 2. METHOD

The investigation unfolded through three phases designed to examine digital score practices. The first phase focused on capturing the complete creative lifecycle through multi-layered data collection [4]. During the creation stage, we gathered musicians' formal artistic proposals and intention statements as reflective documents, while simultaneously collecting real-time creative process documentation through journals and blogs. The complete digital score artifacts - including all code, media assets, and technical documentation - were preserved as primary research objects. For the performance/ realization stage, we employed video documentation alongside immediate stimulated recall interviews to capture initial reactions, followed by more reflective semi-structured interviews conducted within days of performances. Audience surveys provided external perspectives, while legacy questionnaires administered four weeks later revealed lasting impacts on both performers and creators.

The second phase involved pattern analysis as the dataset grew. We employed grounded theory methodologies, with systematic coding verification using NVivo software and AI summarization tools. Through iterative examination of case studies, distinct patterns began to emerge. This analytical process developed Vear's PACMMAN framework (see below), which synthesized these emergent understandings into a coherent structure for assessing digital score practices.

Currently in the final analytical phase, Vear is conducting a comprehensive evaluation of the complete dataset cor-

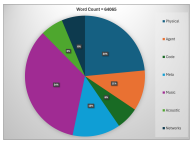

**Figure 2**. Corpus Survey word count.

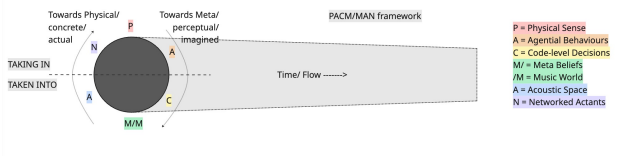


**Figure 3**. The PACMMAN concept

pus - for this paper it amounts to 60 detailed case studies derived from 35 distinct digital scores (composers and performers forming different case studies). This involves aligning key phrases and concepts with the PACMMAN framework's categorical structure, followed by both quantitative and qualitative evaluation. Preliminary findings from the 64,000-word dataset show particular concentration in the "Music" (21,949 words) and "Physical Senses" (15,049 words) categories, as visually represented in Figure 2. This distribution suggests particularly rich engagement with these dimensions throughout our case studies, highlighting their central importance in digital score practice.

The methodology's phased structure allowed for both depth and breadth of understanding, moving from rich data collection through progressive analysis to comprehensive evaluation, while maintaining flexibility to incorporate emergent insights throughout the research process. Complete dataset can be found https://digiscore.github.io/pages/outputs/

### 2.1 The PACMMAN framework of connections

The PACMMAN framework builds on the *Taking-In/ Taken-Into* concept originally presented in [1]. It also considers several other theoretical frameworks that have provided inspiration over the course of this project, for example Chris Small's notion of *Musicking* [5], Simon Emmerson's *Living Electronic Music* [6], and David Borgo's *Sync or Swarm* [7], amongst others.

In Figure 3, the circle on the left-hand side is split into the 2 realms of the *Taking-In/ Taken-Into* framework with North being affordances and South which is more subjective and imagined. The diagram also suggests a movement between the two, although this is not a linear movement around the fields.

For the purposes of the survey, the seven fields were defined as:

- **Physical Senses**: The stuff we see, touch, read (notation), hear (reduced to physical sound, or harmonic relationships), bio/movement of other agents (human or machine)
- **Agential Presence/ Behaviours**: How we perceive the score behaving, the tangible presence or feel that something is there, the liveness of pre-recorded sound, the behavioural meaning of animation
- **Code-base decisions**: Reasoning presence, a mind in action, how we give meaning to random choices or generative AI, how we rationalise graphical behaviours or on-screen generative images, why something did what it did, or seemingly ignored me
- **Meta belief**s: the contexts embedded within the score:
  - MACRO) the cultural context within which it is positioned. e.g. the digital score is embedded with referential materials such as previous works, styles, identities
  - MICRO) the aesthetic and artistic and cultural beliefs (its world view) that guide the operationality of the score. E.g. the digital score is embedded with specific interactive behaviours and belief governing it's interactivity and/ or responses
- **Music world**: I am somewhere. The imaginary world a score conjures. The meta-physical space created by the score. E.g. in *Nautilus* this is NOT the Unity world (this is part of the Physical senses dimension), but it is the feel of the music, and the imaginary landscape in the musicians mind.
- **Acoustic space**: The actual acoustic space created by the realisation of the score. Using Emmerson's Local/Field-Stage metaphor it has more to do with the physical evocation of space and how that is staged in the music. Additionally, it can describe the actual physical sensation of the acoustic space on the musician, and this might be different depending on performance spaces.
- **Networks/ Participants**: Those participating in the music. Representations of self and others as a complex network of inter-relationships. This could be fellow performers, audience, sounding objects. The focus is on the web of actants in a musicking network and its dynamics over time

## 3. FINDINGS FROM PACMMAN ANALYSIS

This section presents the high-level findings from Phase 3 - survey, analysis and evaluation. It addresses each field of the PACMMAN framework in isolation and does not attempt to draw relationships across the fields.

### 3.1 P – Physical Senses

This field focused on the tangible materials of the DigScore corpus by examining what we see, touch, read, hear, and how we experience the touch and feel of such an object. The analysis focused on these emerging themes:

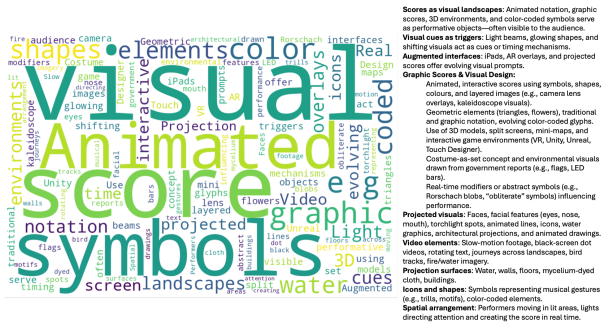


**Figure 4**. Physical field, visual focus word cloud


**Figure 5**. Physical field, materials focus word cloud

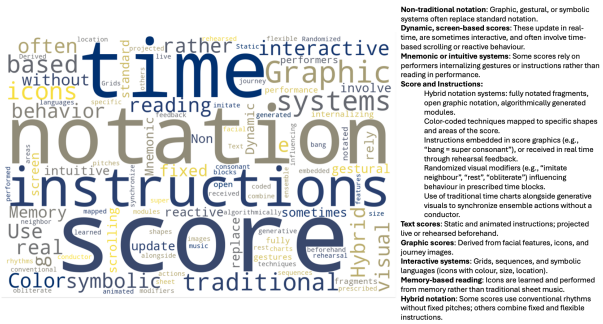


**Figure 6**. Physical field, notation focus word cloud

### *3.1.1 The Stuff We See - Visuals as Meaning*

The analysis revealed that visual elements are not merely decorative but central to how scores are understood and performed. Animated components, colour-coded symbols, 3D visuals, and projections function as both notation and metaphor. For example, projections of water or moving shapes may cue performance actions while simultaneously reflecting deeper narratives such as migration or climate change. Shifting animations and visual symbols provide cues for timing and emotion, while transforming icons - like flowers, triangles, or facial expressions - convey dynamic musical intentions. These scores resemble maps or ritual objects, emphasizing the interplay between perception and meaning.

Visual elements play vital metaphorical, structural, and emotional roles, shaping how performers engage with the works. In pieces like *Speechless* (by Cat Hope), the visual score acts as a kinetic prompt, guiding performers through gesture and intention rather than fixed rhythm or pitch. These components form a symbolic language that invites interpretation and improvisation.

Visual elements and game-like interfaces extend the expressive range of performance beyond traditional notation. Colors, shapes, and symbols (in say *GuitaRPG* by Xavier Davenport) operated as signifiers of musical gestures or moods, offering abstract and layered meanings. Performers stated that they became immersed in visually rich environments - sometimes including virtual or projected spaces - with their own internal logic. Furthermore, projections on surfaces such as water or fabric heightened or distorted meaning, emphasizing ephemerality. Likewise, imagery of journeys, camps, or natural elements carries symbolic weight, evoking shared cultural or emotional narratives such as in *Open Orchestra*. In general, visual elements are not supplemental - they are integral to the composition's structure and message, merging aesthetics, intention, and performance into a unified idea.

### *3.1.2 The Stuff We Touch - Material as Interface*

Some case studies discussed how touch became an active, interpretive gesture in these works. Musicians engage not only with traditional instruments but also with hacked electronics, handheld controllers, and unconventional materials such as fabric, architecture, or wearable technology. These objects are often amplified, allowing motion to directly produce or manipulate sound. Pressure-sensitive surfaces and haptic interfaces turn physical contact into sonic expression, making embodiment both visible and audible.

For audiences, witnessing this tactile interaction creates a tangible connection between performer, space, and material add to a blurring of the boundaries between composer, performer, and environment (a common theme in this research). Pieces like *Exercices d'étrangeté III Mycorrhizia* by Sandeep Bhagwati highlight how drawing, pressing, or manipulating materials generate both structure and sound, collapsing creation and performance into a single expressive act. The materials themselves "push back," offering resistance and feedback that shape the performer's response.

In this domain, meaning emerges through this physical dialogue - touch becomes a language of intention and exchange. Touch is not merely a means of execution - it is a mode of authorship. Performers shape sound and meaning through direct engagement, with environments like water or fabric becoming instruments in themselves. This tactile process reinforces performer agency and creates a shared sensory experience, where body, material, and sound are intimately entwined.

### *3.1.3 The Stuff We Read - Notation as Memory and Suggestion*

As with many (most) scores that are discussed at TENOR, the contemporary notation systems utilised in many DigiScore case studies move away from prescriptive symbols toward suggestive, interpretive forms (for example *Netrono-*

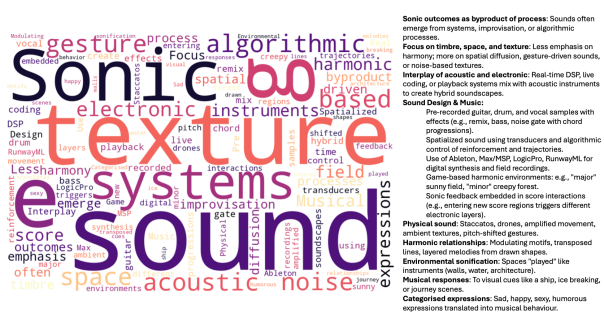


**Figure 7**. Physical field, sonic focus word cloud


**Figure 8**. Physical field, bio/ movement focus word cloud

*mia* by Ken Fields and Ethan Cayko). These may include icons, hybrid scores, or mnemonic graphics that prompt memory rather than dictate specific actions. Often, scores evolve in real time via screens or augmented reality overlays, requiring performers to respond to shifting visuals (for example *Machine à sons* by Jonathan Bell). Instructions may appear as embedded text within animations or as feedback emerging from rehearsal, positioning performers as co-creators who balance structure with freedom.

In this context, we could suggest that notation was reimagined as a flexible, dynamic tool - less a rigid directive than a framework for creative interpretation. Findings showed how animated, symbolic, or procedural notational systems invite performers to make decisions in the moment, emphasizing improvisation, internalization, and agency. Reading becomes a performative act in itself, where meaning emerges through engagement rather than fixed outcomes. There were also many issues with this too, such as the nature of extreme sight-reading.

In works like *Kaleidescore* by Lauren McCall, notation functioned as behaviour or scenario; it was time-based, interactive, and open-ended. Rather than issuing commands, these scores offer prompts and cues, encouraging performers to navigate ambiguity and construct meaning through interpretation. Symbols, gestures, and visual modifiers carry semiotic weight, forming an evolving language learned through practice and experience.

Visual notation also played an emotional and aesthetic role. It rendered the compositional process visible and treats the score as a performative object. Reading becomes embodied and improvisational, shaped by the performer's response to time, shape, and motion (such as *Shadow Aria* by Jaslyn Robertson). In general, there was a large interest in exploiting the boundary between written and improvised performance. As such, notation became a site of negotiation between structure and spontaneity, memory and invention where meaning is to be created through active interpretation and imagination.

### *3.1.4 The Stuff We Hear - Sound as Relational Information*

In many case studies, sound emerged not from fixed compositions but from processes, whether improvised, gestural, interactive, or contextual (such as *Returns and Simulacra* by Solomiya Moroz). The findings suggested that emphasis shifted from melody and harmony to timbre, space, and texture. Spatialization and real-time digital signal processing contributed to immersive environments (for example *Nautilus* by Craig Vear). While tools like Ableton, Max/MSP, and field recordings generated hybrid, evolving soundscapes. Sonic events often responded to visual or physical triggers such as a performer's movement or a shifting icon, making sound an emotional or spatial echo of visual and gestural elements.

Several musicians suggested that sound was not a finished product but a trace of an action, shaped by physical gesture, algorithmic logic, or environmental input. It reflected behaviour, decision-making, and spatial dynamics, functioning as a narrative voice that heightened relationships between performer, system, and space. Works like *Point Line Piano* by Jarek Kapuscinski and OpenEndedGroup's Paul Kaiser and Marc Downie exemplified this approach as drawing produces sound directly, unifying gesture and audio. Sound in these contexts are spatial, responsive, and feed the emotions. In *Dynamic Landscapes* by Elsa Kitching, harmonic shifts may align with symbolic visuals - such as a "minor" key underscoring a dark forest - creating associative resonance. With both these pieces, performers shaped the sonic environment in real time, becoming active agents within a living soundscape.

Overall, there was a trend for meaning to arise through cause and effect: sound is interpreted in relation to movement, visual elements, or systemic behaviours. Whether reacting to facial expressions, site-specific materials, or animated imagery, sound becomes an audible record of interaction - an echo of gesture that invites both performers and audiences into an active, co-creative experience.

### *3.1.5 Bio/Movement of Agents - Embodiment and Agency*

The movement of others, whether human or machine, was central to meaning-making in case studies such as *Jess+* by Craig Vear. The musicians involved felt that the robotic arm was not merely a tools but a collaborator, where its co-agency created a fluid, reciprocal relationship between humans and machine. In this case, musicians responded to each other and to machines with intention and improvisation, producing expressive, relational meaning. The boundaries between performer, audience, and system begin to blur, transforming performance into a collaborative field of interaction.

Embodied AI were treated as co-performers, such as in *Solaris* by Craig Vear. Their autonomous behaviours where read as expressive acts, prompting human performers to engage in a responsive dialogue. In *KC+* by Craig Vear and Kerry Francksen, the manipulation of visual forms becomes a kind of choreography, visible to both audience and fellow performers, shaping the piece's unfolding in real time.

In these digital scores, gesture and motion serve as primary conveyors of narrative and emotion, whether enacted by human bodies or algorithmic systems. Movement communicates struggle, coordination, surprise, creating meaning through visible intent and response. As such, meaning emerged through inter-agency: the interplay between human and non-human bodies, between movement, memory, and interpretation. The performer's physical presence (human, machine or AI) became part of the score, and motion became a shared language of intention, culture, and embodied understanding.

### *3.1.6 Discussion of the Physical Senses Field*

Understanding a digital score from this multidimensional approach to the senses transformed our understanding of digital scores into an interactive, embodied, and visually rich perspective. An aspect of the digital score approach that needs serious consideration from a compositional, performative, or experiential perspective. Each sense - sight, touch, sound, motion, and notation - offered not a fixed meaning, but a platform for exploration. The result was a living, evolving form of music-making, where interpretation is communal and meaning emerges through action, presence, and interplay.

Collectively, these case studies can be seen to redefine musical meaning as a dynamic, co-created process rooted in interaction, embodiment, and perception. The score is no longer treated as a static composition to be played or heard, but as a multisensory experience; something to be seen, touched, read, felt, and negotiated in real time. With meaning arising not from a single element such as sound or score, but from the interplay between gesture, material, system, and the musicking mind. Both performers and audiences are invited to engage actively, shaping and interpreting the work through their perceptions and responses.

What emerges is a pluralistic, participatory form of meaning-making. In most cases, notation becomes suggestive rather than prescriptive, visuals function as expressive environments, and sound becomes a trace of action and intent. Interaction, interpretation, embodiment, and perception contribute to an evolving narrative shaped by presence and performance. Rather than delivering a fixed message, these works cultivate meaning as a living, emergent process, co-created across sensory and conceptual domains. Perhaps this is something for our music educators to be mindful of.

## 3.2 A - Agential Presence/ Behaviours

This field focused on how we perceive the score behaving, i.e. the tangible presence or feeling that something is there. The analysis focused on these emerging themes:

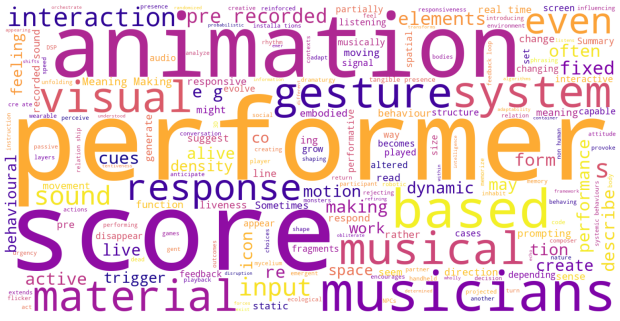


**Figure 9**. Agential field word cloud

### *3.2.1 How We Perceive the Score Behaving*

In these works, the score transcends its traditional role as a static container of information, instead functioning as an intelligent, responsive system that actively shapes the performance. Performers frequently describe the score as exhibiting quasi-cognitive behaviours - listening, adapting, and transforming musical material in real-time based on their input. Through algorithmic functions like "echo" or "obliterate," familiar motifs are dynamically reorchestrated, creating an emergent dramaturgy where memory and innovation interact as generative forces.

The architecture of these scores exists in a deliberate tension between fixed and fluid elements. While composers establish fundamental temporal structures and visual triggers, probabilistic algorithms introduce controlled variability. It was mentioned that this hybrid approach demands a new mode of musicianship - one that privileges adaptive responsiveness over rote execution, as performers navigate a musical landscape that evolves through interaction.

A particularly compelling aspect is the score's perceived agency even those without AI. Performers often report the system functioning as a critical collaborator - capable of refining, rejecting, or redirecting musical input. This creates a creative feedback loop where each gesture is met with algorithmic response, prompting continuous reassessment of musical strategies. Some advanced systems employ recursive processing, analyzing previous input to generate subsequent notation through transformation chains that may decay, mutate, or evolve.

Three key characteristics define this paradigm:

1. Co-creative agency: The score actively participates in shaping musical outcomes through responsive algorithms
2. Structural hybridity: Fixed compositional elements coexist with probabilistic, emergent behaviours
3. Negotiated dramaturgy: Meaning arises through real-time interaction between performer decisions, system responses, and the work's memory of previous states

This framework redefines musical interpretation as a dynamic conversation rather than prescribed execution, where the most compelling performances emerge from the tension between compositional intention, algorithmic behavior, and performer creativity.

### *3.2.2 The Tangible Presence or Feel That Something Is There*

Musicians readily described their encounters with digital scores as something far more profound than interacting with mere notation - they report experiencing what can only be called a presence. These scores seem to listen attentively through real-time audio analysis, respond thoughtfully via adaptive visual transformations, and make decisions through sophisticated algorithmic processing. What makes this experience particularly striking is how it transcends the boundaries of the screen - through motion sensors that track gestures, robotic arms that mirror human movement, and spatialized sound systems that respond to a performer's position in the room, the score becomes an embodied participant in the performance space.

This sense of presence manifests in several distinct yet interconnected ways. The score's agency extends physically into the performance environment through responsive technologies - robotic limbs that move in counterpoint to musicians, lighting systems that react to musical phrasing, or kinetic sculptures that transform according to algorithmic decisions. Even ostensibly static visual elements develop what performers perceive as intentionality; graphical symbols that expand with crescendos or dissolve during silences become interpreted as meaningful responses rather than mere visual feedback. Many musicians described developing what feels like genuine dialogue with these systems, testing boundaries and interpreting reactions much like they would with human collaborators - one musician characterized her digital score as "a duet partner with strong opinions."

This transformation from passive notation to active participant fundamentally changes the nature of musical interpretation. Performers find themselves engaged not in decoding instructions but in negotiating with what feels like an intelligent counterpart - one that communicates through multiple sensory channels simultaneously and demands the same kind of real-time adaptability required in ensemble playing with human musicians. The resulting performance exists in a unique creative space where meaning emerges continuously from this embodied negotiation between human creativity and algorithmic behavior, challenging traditional distinctions between interpreter and score, between execution and collaboration.

### *3.2.3 The Liveness of Pre-Recorded Sound*

In these performances, pre-recorded sound undergoes a fundamental transformation - shedding its static nature to become a dynamic, responsive partner in the musical dialogue. Through real-time digital signal processing and interactive triggering systems, fixed audio layers gained a sense vitality, modulating their texture in response to performer activity, shifting density according to musical phrasing, or moving spatially in reaction to physical gestures. Some musicians described these elements not as passive playback but as active collaborators that appeared to remember previous phrases and respond accordingly, creating an evolving musical discourse.

These systems fostered a form of musical relationship where even structurally fixed material develops phenomenological liveness. Performers reported developing a rapport with the audio, learning through repeated interaction how certain gestures will provoke specific sonic responses. This knowledge becomes embodied, transforming the performance into a ritualized exchange where musicians anticipate and react to the system's behaviours. In game-like scenarios or installations, pre-recorded NPC cues function similarly, their apparent simplicity belying the rich, improvised responses they inspire from human performers.

What emerged were instances of liveness in electronic performance. The "aliveness" of these pre-recorded elements stems not from their internal variability but from their relational role within the performance ecosystem. Through interactive modulation, anticipatory relationships, and ritualized interaction, structurally fixed audio gains performative vitality. Some systems remembered, the performer anticipates, and together they created a musical present that seemed to be always becoming - where even "dead" recordings could be said to pulse with life through their dialogic relationship with the performer.

### *3.2.4 The Behavioural Meaning of Animation*

Far from serving as mere visual decoration, animation in some digital scores operated as a dynamic performative language. These moving elements communicated through a vocabulary of behaviour rather than static symbols; for example, a thickening line might suggest intensification, accelerating icons suggest rhythmic urgency, while flickering or floating visuals could imply ambiguity or invitation. Performers become adept at reading these animations not just for their literal content but for their expressive intent, responding to the score's visual gestures much as they would to a conductor's nuanced motions.

The relationship between animation and sound often flows both ways. Some systems transform drawn lines in three-dimensional space directly into evolving musical material - notes, rhythms, and harmonies that develop their own algorithmic life. Others create feedback loops where animations dynamically adjust their speed or density in response to live audio analysis, fostering a genuine dialogue between visual movement and sonic response. This reciprocity transforms the score from an instructional document into an active participant in the musical conversation.

Certain animations constructed entire environments to be inhabited rather than simply read. Mycelium-like tendrils might weave between performers' positions, or ephemeral "monsters" appeared fleetingly, challenging musicians to capture them sonically before they vanish. These temporal and spatial behaviours created a sense of ecological interplay, where open and willing musicians must engage with urgency and presence within the score's living system.

The spatial distribution of these animations further enhances their behavioural impact. Whether projected across walls, displayed on wearable surfaces, or cast from handheld devices, the placement of visual elements turns physical space into an active score component. Performers navigate these environments through full-body awareness, where proprioception and gestural response become as crucial to

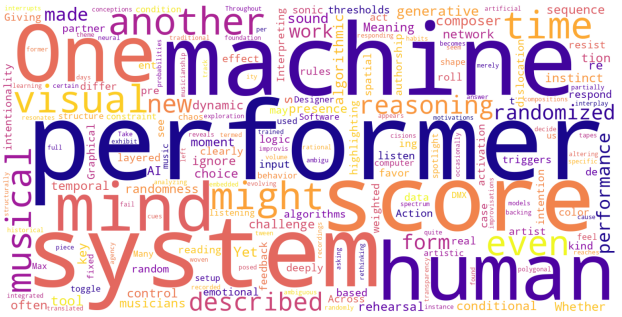


**Figure 10**. Code field word cloud

the musical outcome as traditional instrumental technique. The animated score thus becomes what one cellist described as "a landscape we move through together" - a shared space of visual, physical, and sonic negotiation where meaning emerges through embodied interaction.

### 3.3 C - Code-base decisions

This field focused on how we perceive reasoning presence, a mind in action, how we give meaning to random choices or generative AI. The analysis focused on these emerging themes:

#### *3.3.1 A Mind in Action: Interpreting Human and Machine Intentions*

Throughout the exploration of AI-integrated musical works, one theme emerged: the *presence* of a mind at work - even when that mind is partially artificial. Across a spectrum of compositions and performance systems, decisions were made that challenge traditional conceptions of authorship, agency, and intention. Whether through neural networks analysing rehearsal tapes, generative algorithms altering scores, or conditional triggers responding to performer cues, each piece revealed an evolving interplay between human musicianship and algorithmic reasoning. For example, *Nautilus* (by Craig Vear) or *DigiTabla* (created by tabla performer and composer Shawn Mativetsky), are systems where a backing track is composed of pre-recorded improvisations that randomly trigger sounds but interrupts itself if a performer reaches a certain level of behaviour. To the musicians the machine appears to *listen*, to *decide*, and occasionally to *ignore*. It becomes not merely a tool but an improvising partner, with ambiguous motivations. This ambiguity - this not-quite-human reasoning - forms a foundation for rethinking performance itself.

#### *3.3.2 Reasoning Presence: Why Did It Do That?*

Several musicians noted that when the digital scores seem to respond - or fail to respond - they were left asking: *why did it do that?* Often, the answer is found not in rational cause-effect sequences, but in layered probabilities, thresholds, or embedded rules. Algorithms might favour specific choices based on historical data, as in Iran Sanadzadeh's *502 Days of self* where machine learning models trained on 502 days of rehearsal recordings translated a performer's habits into visual elements. These systems exhibit what might be termed a "reasoning presence": an intentionality that resists full transparency. When randomness is structurally woven into a score (for example, using weighted probability distributions), the system doesn't simply act arbitrarily; it executes a different kind of logic. These logics, while opaque, are not unintelligible - they just resist the intuitiveness we apply to human collaborators.

#### *3.3.3 Giving Meaning to Generative AI: Interpreting Randomness*

Musicians often found themselves attributing intentionality to machines, reading significance into outcomes that may be statistically random. One artist described feeling "like a machine, like an instrument", highlighting the dissociation between input and perceived output. In another case, performers of *Jess+* expressed scepticism about whether a score was truly reactive, only to be convinced later by emotional resonance and feedback. From the data we can infer that meaning here was constructed retroactively. When a digital score lands on an uncanny moment of synchronicity, it feels "meant." Yet in truth, it might have been the result of an algorithmic coin toss. What is of interest here is how the human mind insisted on interpretation - we generate narrative and causality even when facing stochastic structures. A few musicians even discussed how the unpredictability of rest sequences caused them to sit silently, awaiting their next activation; a moment that felt both deeply musical and deeply disempowering.

#### *3.3.4 Graphical Behaviours and On-Screen Imagery: Rationalising the Interface*

The graphical representations of some digital scores appeared to bring a new semiotic challenge to existing knowledge and taught patterns. In some cases, colour represented amplitude or panning; line curvature denotes frequency modulation. Yet these visuals are not mere ornamentation - as in Cat Hope's *Speechless* - they serve as proxies for sonic behaviours, demanding real-time interpretation. In *GuitaRPG* (by Xavier Davenport) and *Kaleidescore* by Lauren McCall visual elements encoded musical, algorithmic, and spatial data. At one instance a musician described navigating a map with a single key, the direction randomized each time. This dislocation from linearity pushed the musician to reinterpret how movement and sound are linked. Another performer noted how text spirals spun at different speeds, a simple but profound temporal mapping that transformed reading into a form of listening.

#### *3.3.5 Why Did It Ignore Me? Algorithmic Indifference*

Having outlined the above positive attributes, there were some negative feelings. There was a sense that the machines do not prioritize us, nor do they favour our feelings, fatigue, or artistic instincts (unless explicitly programmed to). One performer described their discomfort when their sound was shaped by another's input, their autonomy subsumed by the system. Another recounted how triggering visuals or sonic events required a sequence of precise key

presses and script activations - a procedural hurdle that separated musical instinct from execution. Musicians spoke about the anxiety of not being in control, about being ignored by systems that only responded within narrow thresholds or temporal windows, for example, a Max patch might suppress overtones once a pitch gets too loud; a spotlight might never illuminate a performer despite their readiness. These moments of silence or inaction underscored an essential "other-ness" of some generative systems.

#### *3.3.6 A Network of Conditions: Systemic Interactions and Constraints*

The computational/ code-based behavioural systems described in these digital scores were often layered and conditional; and formed a significant part of the compositional process and concept. The general intention here was to create a dynamic condition network that reflected a musicking-mind in *flux*. The response to this was the need for realising musicians to toggle between control and surrender. This is something that is not readily taught in academia, yet appears to be a condition across many innovative scores.

#### *3.3.7 Scoring the Unscored: Software as a Creative Partner*

*Decibel ScorePlayer* software can be used to reconfigure notation into something more participatory, even democratic. This system, and other scroll-based case studies, allowed large-scale adjustments post-rehearsal, immediate visual feedback, and dynamic highlighting of individual parts. This flexible infrastructure let musicians "see" their own voice and place in the ensemble clearly - a new way of making sense of sound in time. A performer described how easily scores were adapted mid-process, emphasizing the overlooked practicalities of technological tools in artistic contexts. These tools are not passive; they shape what kind of music can be made, rehearsed, and performed.

#### *3.3.8 Discussion: The Composer as Designer of Chance*

Within the DigiScore corpus we found that in general, the composer's role shifted from author to a kind of musicking-system designer. Many works described switching between predetermined and randomized forms, making "structuring randomness" a compositional act. One system began with a fixed timeline but then slowly randomized its form. Another used "Time Out" hand gestures to allow human override. Yet another used score projections and live DMX lighting to choreograph space and time. This is not necessarily an abdication of authorship, but could be considered a redefinition. By curating randomness through weighted algorithms, conditional rules, or generative visuals, musicians can shape a meta-performance: not just *what* is played, but *how* choice itself is enacted.

Across many of the case studies, what emerged was not a singular approach to AI or interactivity, but a shared fascination with machine behaviour as both constraint and co-creator. Whether the digital score, or the machine, listens, mishears, ignores, or surprises, it challenged musicians to think beyond their own trained musical instincts and to engage with a reasoning presence that is foreign, partial, and


**Figure 11**. Meta Beliefs field word cloud

provocatively inhuman. Yet we found that in that ambiguity lies potential for new interpretations, new forms of attention, and new stories made from random choices. It would appear that we, as human musicians, fill in the gaps and assign meaning where the machine leaves room.

### 3.4 M - Meta beliefs

This field focused on the macro and micro contexts embedded within the digital score. The analysis focused on these emerging themes:

#### *3.4.1 Meta Beliefs, World-views, and Artistic Frameworks*

Several of the works in the corpus framed their artistic creation as a metaphorical journey or exploration. *Pathways* by Dejana Sekulic, and *Nautilus* by Craig Vear drew on symbolism of journey, for example, transcontinental voyages of refugee's, or those of the nautilus, a deep-sea mollusc whose spiral shell represents layered, immersive navigation through complex environments. These journeys extended beyond physical realms into abstract soundscapes and interactive spaces, reflecting an aesthetic world-view that valued exploration, discovery, and movement through intricate and multi-dimensional contexts. The connection to ancient symbols ("nautilus" as "sailor") tied traditional cultural mythologies to digital score creativity, blending historic and modern perspectives into a unified aesthetic vision.

Another batch of works focused on immersive environments as co-creators. These works (such as *Point Line Piano* or *Dynamic Landscapes*) situated immersive visual and sonic environments as active participants in performance rather than passive backgrounds. Other works (such as *Queer Temporal* by Solomiya Moroz) used large-scale projections, multisensory stimuli, and spatial atmospheres to shape both performers' and audiences' perceptions, emotions, and interactions. In a poetic sense, they underscore a belief in environment as a co-creator of meaning and experience, emphasizing embodiment and dynamic engagement with space. In this context immersion is both physical and conceptual, fostering deep sensory connection and emotional resonance.

Some works used organic, natural patterns as creative models for the digital scores. Fractal geometries, natural soundscapes, and biological processes served as inspirations and structural models for works such as *The Forecast*

by Kate Milligan. This reflected a world-view that creativity is intertwined with nature's complexity, self-similarity, and organic growth. In this context, artistic form and musical structure mirrored natural phenomena (such as mycorrhizal networks or cellular automata in Sandeep Bhagwati's *Exercices d'étrangeté III* Mycorrhizia), positioning art as an extension of natural systems and cycles. As such, nature's patterns become metaphors for interconnection, emergence, and evolution within the creative aesthetic of a digital score.

An abundant theme in the DigiScore corpus was the role of improvisation as a core concept, and finding a balanced with structure. The ideas described were generally heterophonic and fluid, emphasizing improvisation within defined frameworks. This balance between freedom and constraint suggests a cultural ethos that values open-endedness moderated by form, enabling coherence and emergent order from apparent freedom. This dynamic interplay rejected rigid authoritarian control of "the composer" in favour of emergent, collaborative creation between musicians.

Many of the case studies transcended traditional disciplinary boundaries, integrating graphic scores, interactive visuals, movement, and sound into unified, multimedia experience where artistic media were porous and interdependent. In these works, this hybridity fostered richer modes of storytelling and engagement, breaking down silos between visual, auditory, and performative art forms.

Themes of censorship, marginalization, and socio-political resistance permeated as a central narrative in some works. For example, in *Shadow Play* by Jaslyn Robertson, improvisers' responded to "censoring lights" metaphorically embodying struggles against suppression, echoing broader concerns around power, control, and voice within society. This reflected a critical cultural consciousness that foregrounds marginalized perspectives - particularly of refugees, women, and neurodiverse individuals - highlighting digital score creation as a site of resistance and empowerment.

*Digital Syzygy* by Andrew Hugill embraced neurodiverse ways of experiencing and creating music, including autistic and d/Deaf perspectives. The concept of "digital syzygy" signified new modes of cognitive and sensory alignment enabled by digital tools, challenging normative models of musical cognition. This inclusivity broadened definitions of creativity and highlighted technology's potential to facilitate novel forms of connection and expression beyond conventional sensory or neurotypical boundaries.

The motif of migration - both avian and human in *Pathways* by Dejana Sekulic- and the tensions between open and closed borders reflect larger socio-political and ecological concerns about displacement, belonging, and movement. This awareness situated this work within contemporary dialogues on refugee experiences, community, and environmental systems. It suggests an interconnected world-view that considers life trajectories as shaped by fluid yet constrained pathways within social and natural ecologies.

The adoption of RPG metaphors (for example in *GuitaRPG*) framed performers as explorers in richly detailed, dynamic worlds, embodying values of play, learning, adaptation, and identity negotiation. It was felt that this resonates with contemporary digital cultures that foreground agency, multiplicity, and iterative discovery. The RPG model emphasizes exploration and experimentation over fixed outcomes, aligning with the work's fluid and emergent artistic ethos.

#### *3.4.2 Broader Cultural Contexts (MACRO)*

There were several broader cultural contexts (macro) embedded in several of the digital scores. For example:

- **Social and Political Engagement**. Some works engaged deeply with social issues such as refugee trauma, displacement, identity, and belonging. Themes of speechlessness and ineffability reflect experiences of trauma and marginalization. The inclusion of diverse cultural backgrounds and histories - particularly of refugees and women - foregrounds social solidarity and community-building as central to these realisations.
- **Technological Integration and Post-Human Perspectives**. In several works in the corpus, AI, robotics, and virtual reality were regarded as not mere tools but integral to the creative ecosystem, challenging traditional human-centred notions of music-making. This openness to non-human "performers" (algorithms, robots) reflects a post-humanist world-view, expanding artistic agency beyond human actors and embracing hybrid creative processes.
- **Queer Theory and Nonlinear Temporality**. Theses works disrupt normative temporalities and social conventions by exploring queer concepts of time - non-linear, cyclical, and fluid. This challenges traditional narratives of progress and climax, instead privileging repetition, cycles, and openness. In this sense, space and time become sites of subversion and re-imagination, aligning with broader queer theoretical frameworks.
- **Inclusivity and Democratic Access**. Many works consciously attempted to break down barriers between professional and amateur, disabled and non-disabled musicians, as well as embracing broad stylistic pluralism and multicultural participation. Democratic creative processes ensure accessibility and shared ownership of artistic outcomes, reflecting progressive cultural values of equity and diversity.

#### *3.4.3 Artistic, Aesthetic, and Cultural Beliefs (MICRO)*

On a micro level, digital scores were embedded with identifiable artistic, aesthetics and cultural beliefs, values, principles and themes. For example:

- **Fluidity, Flexibility, and Performer Agency.** Some digital scores were designed as mutable, modular frameworks that emphasize performer agency and improvisation. In others, algorithmic elements introduced unpredictability, ensuring performances remain fresh and responsive. The performer was seen

as co-creator rather than mere executor of pre-defined material.

- **Human Imperfection and Gesture**. Human gestures, imperfection, and expressive flexibility were valued over mechanistic precision in some digital scores. Conducting gestures and bodily expression become essential components of musical communication, allowing space for silence and interpretation, fostering shared rhythmic and emotional pulses.
- **Interactivity and Embodiment**. In many digital scores, multimedia integration - video, virtual environments, graphic notation - expanded sensory engagement and embodiment. Performers' identities and bodily expressions were integral to meaning - making, with virtual reality and animation fostering new forms of agency and discovery.
- **Community and Collective Identity**. Some of the digital scores functioned as a framework for collective identity, emphasizing collaboration, pluralistic interpretations, and social interconnectedness (such as *Villanelles de Voyelles* by Sandeep Bhagwati). The boundary between composer, performer, and audience were blurred, reinforcing the communal nature of the musical experience.
- **Non-linear, Queered Temporality**. Some digital scores emphasized repetition without sameness, and cycles without closure, these works embraced toporhythm (spatial-temporal offsets) and process over fixed goals. This fostered aesthetic experiences that prioritize journey and transformation over destination or resolution.
- **Multistylism and Cultural Pluralism**. In some digital score multiple musical traditions and contemporary techniques were combined to create hybrid forms that respect and transcend cultural boundaries. These score's openness to diverse interpretations reflects a pluralistic worldview, valuing difference and hybridity as strengths.

#### *3.4.4 Discussion: Cultural Identity and Storytelling*

Through both a macro and micro intermingling, the following themes were embedded into some of the digital scores highlighting the versatility of the digital score concept and technological enmeshment to convey larger cultural identities and new avenues for storytelling through music:

- **Connection to Place and Heritage**. These works used local historical texts and Indigenous cultural symbolism (journeys, spirits, bird tracks) to root itself in cultural heritage and place. These digital scores become narrative tools expressing community stories, ancestral journeys, and belonging.
- **Temporality and Memory**. Some digital scores focused on non-linear time through cyclical structures and metaphorical devices like wishing wells, reflecting impermanence and memory layering. Ephemeral visual elements like water graphics underscored themes of transience and flux, deepening the sense of historical and place-based identity.
- **Collaboration and Shared Agency**. A common theme across many works was how traditional roles of "composer, performer, conductor, and audience" overlapped, encouraging collective interpretation and mutual listening. Inspired by natural metaphors such as tree networks and mycelium, these works promoted democratic participation and interdependence.
- **Technology as Integrated Meaning**. Digital environments and immersive media served as metaphors for natural interconnectedness, not as superficial effects. Many of the digital scores used technology to enhance multisensory experience, enabling new modes of discovery and spatial musical interaction.
- **Improvisation and Embracing Imperfection**. Flexible score structures encourage exploration within frameworks that merge traditional forms (e.g., Indian raga) with experimental practices. "Errors" and failures are embraced as creative opportunities, reflecting a learning process.
- **Narrative Metaphors and Ambiguity**. The journey motif organized movements around arrival, tension, struggle, and homecoming, while remaining open-ended. Natural and cultural metaphors framed musical interactivity and growth, allowing emotional engagement beyond literal storytelling.
- **Embodiment and Interactivity.** Performances emphasize bodily awareness and facial communication, enhanced by VR and immersive media that grant agency and blur spectator roles. These scores invited playful navigation between fixed cues and fluid improvisation.
- **Plurality and Hybridity**. Multiple musical styles and cultural traditions coexisted and blended, creating a hybrid artistic language. Many works embraced ambiguity and multiplicity as core aesthetic and epistemological principles, supporting a constructivist approach where meaning evolved collaboratively.
- **Multiplicity, Fluidity, and Process-Oriented Art**. The music and performance practices encourage multiple, radically different interpretations, reflecting postmodern values of plurality, process, and flux. The rejection of a "definitive" artistic product underscored art as a living, evolving experience co-created by performers, audiences, and environments. This epistemological stance privileged openness, ambiguity, and ongoing transformation over closure or finality.

The digital score in this corpus could be said to embody a rich constellation of meta beliefs and world-views that position their embedded musical ideas as a dynamic journey through immersive, organic, and interactive environments. In general, creativity was framed as a balance of

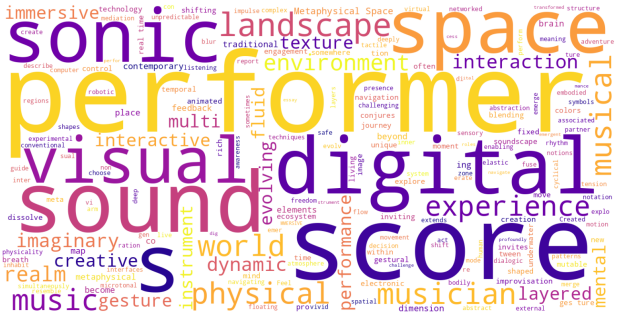


**Figure 12**. Music field word cloud

freedom and structure, deeply informed by natural patterns and cultural narratives. Social and political consciousness - especially regarding marginalization, neurodiversity, migration, and queer temporality - intertwined with technological innovation and collaborative processes. The result could be seen as a fluid, pluralistic, and process-oriented artistic practice that celebrates multiplicity, hybridity, and the interdependence of human, natural, and digital worlds.

### 3.5 M - Music world

This field focused on the imaginary landscape/ music-world created by the score. The analysis focused on these emerging themes:

#### *3.5.1 Immersive Musical Environments: The Performer's Journey Through Metaphysical Spaces and Dynamic Scores*

Musicians suggested that they felt like some of the digital scores in the corpus allowed them to inhabit fluid, immersive environments that were shaped by interactive agents, multi-sensory feedback, and emergent sound worlds. These spaces challenge fixed notions of musical structure and place, inviting a dynamic, co-creative process where sound, visuals, technology, and embodied gesture fuse into a complex ecosystem (such as *Open Orchestra* by Ben Hopkinson). The musicians mentioned how they explored a layered experience as they navigated these richly animated musical realms, and the imaginary worlds conjured by scores (in this case to Antarctica). Other musicians discussed the metaphysical spaces that arise from the interplay of performer and digital elements (such as in *GuitaRPG* by Xavier Davenport), and the fluid mental landscapes that underpin musical creativity.

#### *3.5.2 "I Am Somewhere": The Performer's Immersive Experience*

At the core of many reflections upon performance and intention towards composition, is the sense of performer's experience of "being somewhere". Due to the unique homogenisation of rich media and interactive technology prevalent in many digital score, it generated unique, often shifting, and deeply immersive environments. Unlike conventional performance settings grounded in physical instruments and static scores, these new spaces are dynamic, multisensory realms. Performers frequently described sensations akin to floating underwater, swimming through an otherworldly soundscape, or navigating a metaphysical space that is simultaneously safe and challenging. Performers reported entering a "flow state" or "zone" [8] where their awareness expanded and contracted, merging their internal and external worlds. This flow is underpinned by complex feedback systems - brain-computer interfaces, electronic sensors, digital displays - that both guide and disrupt traditional control mechanisms (such as *Jess+* by Craig Vear). This embodied engagement extended beyond solo exploration to include collaboration with human and robotic partners, networked setups, and real-time electronic mediation. The musical "place" therefore exist not only in physical space and objects, but in temporal, cognitive, and digital dimensions, fostering a heightened sense of presence, immersion, and responsive interaction.

#### *3.5.3 The Imaginary World a Music Score Conjures*

As has been previously documented and argued in [1], the digital score itself becomes a dynamic, multi-layered environment constructed for, say, animated landscape of shapes, colours, symbols, and sounds that through the affordance of the media and technologies involved can constantly evolve. The embedded motifs can function as navigational aids, creative prompts, and expressive gestures, guiding performers through an interactive, "choose your own adventure" narrative, yet guided by the overarching musical idea. The evolving nature of many digital scores invites continuous interpretation, improvisation, and co-creation. It encouraged playful engagements where patterns emerge and dissolve unpredictably, challenging performers to balance control with surrender. Musicians described this as dialogic, a partnership with the score and virtual elements (e.g., a digital bass flute (*Nautilus*) or robot arm (*Jess+*) where mutual adaptation and responsiveness are essential. Through these hybrid digital-physical scores, musicians move beyond traditional instrumental vocabulary into new realms of sound and movement. The score mediates between the performer's inner ear, bodily gestures, and the external sound world, becoming a meta-instrument that could reshape notions of composition and performance in the digital age.

#### *3.5.4 The Metaphysical Space Created by the Score*

Beyond tangible sounds and visuals, the interaction generates a metaphysical dimension - a non-physical space of temporal dilation, abstraction, and layered interaction. In a digital score such as *The Forecast* by Kate Milligan, its meta-space transcends conventional time and rhythm, creating elastic, non-linear experiences that require improvisational freedom balanced with responsibility. In this metaphysical realm, distinctions between performer and observer, live and electronic, will and involuntary response dissolve. Other digital scores have integrated brain-computer interfaces, random lighting cues, and networked interactions to create a "zone" charged with tension between control and chance, human and machine, intention and emergence. Musicians described inhabiting this liminal space as a form of shared consciousness or secondary awareness, where their actions negotiate through overlapping layers of live sound, visuals, and digital feedback loops. These

interactions generate unpredictable sonic textures and gestural behaviours, blurring physical distance and temporal constraints. As such, these spaces are a "playing field" where meaning emerges through the evolving game of interaction, where the performer's decisions and the score's responses weave a unique, ephemeral sonic architecture.

### *3.5.5 The Feel of the Music and the Imaginary Landscape in the Musician's Mind*

Musicians reported experiencing the music as an evolving terrain - a sensory and emotional landscape rich with textures, colours, and gestures. They discussed their connections to sound-worlds that oscillate between pitched and unpitched elements, microtonal nuances, and extended techniques, blending organic and synthetic timbres into fluid, atmospheric soundscapes. They mentioned how the music felt like a dialogue between control and surrender, and how they had the options to selectively engage with visual and sonic elements, navigating a mutable landscape. In certain cases they visualized the digital score as a map populated with shifting regions, symbols, and colours associated with specific techniques and sonic qualities (for example, *GuitaRPG* and *Shadow Play*. Other mental maps were dynamic and non-linear, blending fragments of memory, perception, and creative impulse (such as *Returns and Simulacra*. This phenomenon supported the navigation from literal reading to abstract improvisation, enabling a deeply personal yet interconnected musical experience. These inner landscapes were sometimes described as tactile and embodied, where small agential and media shifts, breath, and gesture have profound sonic consequences. Some musicians imagined dancing with invisible partners - other performers, robotic arms, or gestural videos - in a fluid choreography of sound and movement. Others discussed slow-motion details and cyclical structures enabling them to experience different layers of rhythm and texture. This created dreamlike atmospheres where sonic molecules float and interact, inviting exploration, discovery, and playful experimentation.

### *3.5.6 Discussion: The Coalescence of the Performer, the Score, and the Metaphysical Space*

Findings from this field suggested that musicians created and realised works through a dynamic space shaped by their physical interaction with instruments, responsive digital visuals, and real-time sonic feedback. Their journeys were both tangible and imaginative, guided by, say, gestures, brain activity, and technological mediation. In this sense the score, no longer a static set of instructions, becomes a living, evolving landscape—part spatial map, part improvisational playground—that invited musicians to co-create within its unfolding sonic universe.

This ecology transcends traditional disciplines, merging music, visual art, digital media, philosophy, gaming and neuroscience, to name but a few, into a single expressive medium. The result is a musical space where time and perception stretch and warp, allowing meaning to emerge organically. Within this environment, the performer's mind constructs its own vivid, tactile world—an internal compass that navigates the interplay between intuition, sound, and machine. At its core, this paradigm redefines musical presence, shifting from rigid interpretation to immersive exploration. It's no longer just about playing notes but inhabiting a living, responsive ecosystem—one where deep listening, spontaneity, and collaboration that can reshape what it means to be inside the music.

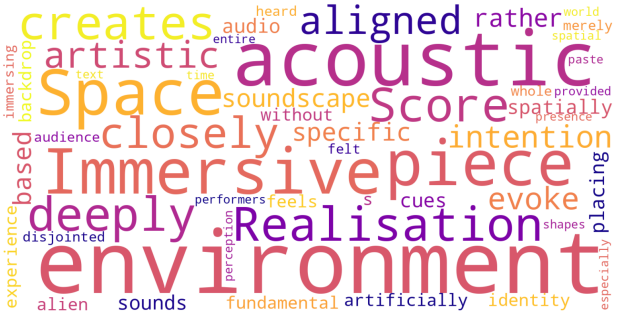


**Figure 13**. Acoustic field word cloud

## 3.6 A - Acoustic space

This field focused on the acoustic spaces created by the realisation of the score. The analysis focused on these emerging themes:

### *3.6.1 Immersive Acoustic Space and the Realisation of the Score*

Many works in the corpus were discussed as creating deeply immersive acoustic environments that were closely aligned with their original artistic intention by evoking soundscapes based on a specific environment, rather than just spatially placing sounds or audio cues artificially (e.g. as a backing track). These environments were more than a backdrop, they were fundamental to the piece's identities. The acoustic space was not merely heard but felt as a whole environment, immersing both audience and performers in a world that shapes perception, especially of time and spatial presence. From an Emmersonian perspective, this relates strongly to the "Field" [6] component of the Local/Field-Stage metaphor, where the field refers to the physical and acoustic space that surrounds and envelops performers and listeners. The acoustic space is not a neutral container but an active, lived space that shapes the sound itself and how it is perceived.

### *3.6.2 Physical and Sensory Immersion for Performers*

Several musicians emphasized the sensory and physical experience of being immersed in this space. The musicians mentioned how they felt they were physically immersed in the audiovisual environment, often having to orient themselves spatially - such as having their backs to the audience to focus on a large screen that is central to the performance. This immersion led to some musicians mentioning how it affected their sense of time and agency, fostering a loss of peripheral awareness, focusing attention inward on the sounds, their sensations, and the environment as a whole. For some musicians they described this as embodied and poetic, something difficult to convey in technical

terms but deeply felt as a “floating atmosphere” or “space to immerse into.” The acoustic space thus functioned as a physical and psychological environment, influencing both interpretive freedom and the bodily experience of sound production and reception.

### *3.6.3 Balancing Live and Electronic Elements in Acoustic Space*

The acoustic space generated by many digital scores also involved a complex balancing act between live instruments, live-electronics, synthesizers, and the room’s natural acoustics. In some works the performers collaborated closely with sound engineers who adapt spatialization and electronic sound balance in real-time according to the room’s acoustic response, where the musician’s immediate physical environment is shaped and reshaped by real-time interaction with technology and space, and inviting the sound engineer into the co-operative play of musicking.

### *3.6.4 Acoustic Space and Performer Experience*

The acoustic effect varies strongly with the performers’ physical positioning in the space. Some performers felt more immersed in particular positions (e.g., standing at the back), where they could better hear spatialized elements of the fixed media track, affecting their musical response. This shows that the physical layout of the space and performer positioning are crucial in staging the acoustic environment, emphasizing the embodied nature of the music-making process within a particular acoustic field.

In case studies where the audience were polled, they mentioned their experiences of the acoustic space as an immersive audiovisual environment, enhanced by large screens and multi-channel speaker arrays. The sense of being “inside” the music is a deliberate compositional and staging strategy, fostering a shared spatial experience despite the complexity of spatialized sound. Meanwhile, the performer’s acoustic space tended to be a more intimate and physical experience, shaped by their position, embodied movement, and interaction with technology.

### *3.6.5 Discussion*

In summary, the acoustic space is a complex, immersive environment created through the interplay of, say, electronic spatialization, live acoustic performance, technological mediation, and the physical performance space itself. The acoustic space is not static but dynamic, site-specific, and performer-dependent, shaping perception, time, and bodily engagement with the music. The performers’ physical sensations vary widely with different venues and positions, emphasizing the deeply embodied nature of acoustic staging in digital score musicking.

## 3.7 N - Networks/ Participants

This field focused on those agents perceived to be participating in the music; representations of self and others as a complex network of inter-relationships. The analysis focused on these emerging themes:

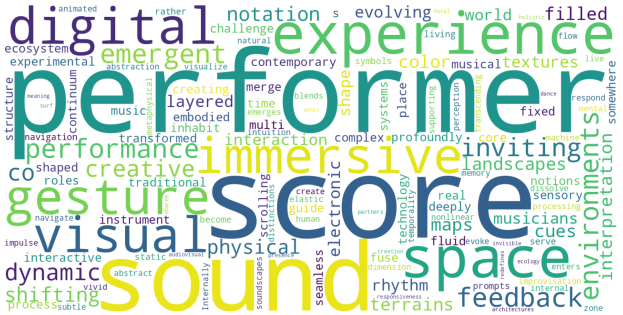


**Figure 14**. Networks field word cloud

### *3.7.1 Musicking as a Network of Relationships*

At the heart of many digital scores in the corpus lies a dynamic and shifting web of relationships between human and non-human agents, including performers, scores, sounds, visuals, technologies, environments, and audiences. These actants co-create a musicking network that continually evolves through interaction. Musicking in these contexts is never solitary; even when alone, the performer is entangled with pre-recorded tracks, algorithms, scores, or responsive technologies.

This relational field is not only a backdrop but the essence of these artistic works. Musicians frequently mentioned how they were being drawn *into* environments - digital, sonic, or visual - within which they encountered agents like pre-recorded materials, visual stimuli, remote collaborators, and artificial intelligences. These agents were not passive; they provoked, suggested, and shaped the performers’ choices. For example, one performer described how the digital score acted like a game, pulling them into a world populated with non-player characters (NPCs) and sonic behaviors derived from game environments. This sense of being “dragged in” highlights the agency of the score as an actant within the musicking network.

### *3.7.2 Self and Other in Constant Reconfiguration*

The boundary between self and other was porous in some scores. Musicians often referred to their relationship with their instruments or sound-producing entities as one of *dialogue*, *co-creation*, or *alignment*. Similarly, musicians mentioned how background tracks were not just reference points but as companions or structures that afford security, within which they can still navigate freely. Overall, the network of participants mentioned included fellow musicians (sometimes remote), the audience, electronics, and environmental factors such as room acoustics or even costume design. These elements were not merely supporting features - they influenced timing, interpretation, and emotional connection. In one instance, the performer felt fundamentally different when positioned closer to speakers, noting that the spatial arrangement dictated which sounds were perceptible and, therefore, which musical relationships could emerge.

### 3.7.3 Cooperative Agency and Mutual Responsiveness

A central theme is that musicians felt they were not the sole authors of musical meaning within a network characterized by fluid agency. In some examples, musicians mentioned live electronic, spatialization systems, and algorithmic scores often responded to the input of the performer and then provided new material in return. In these systems, such as *Solaris* by Craig Vear and Fabrizio Poltronieri, causality is recursive: the performer influences the sound, which in turn affects the next action of the score. One participant described this as being 'immersed in the situation', where freedom and responsibility coexist. Another reflected on a synthesizer response that altered their playing, noting the feeling of a "trialogue" between themselves, another musician, and the system. This triadic (and sometimes more complex) web of relationships often leads to nonlinear communication. Musicians felt they were constantly balancing between self-listening, listening to others, and being attuned to technological feedback. As such, the act of musicking becomes a networked cognition where each element pushes and pulls on others, reconfiguring identity and role in real-time.

### 3.7.4 Score as Environment and Actor

Across all the corpus the digital score operated as more than instruction, and in many cases it was often felt as a participant or even a world in which the performer operates. Some scores loaded random elements or contained algorithmic variability, making each iteration slightly different. This gives the performer a sense of navigating through a landscape, rather than executing fixed instructions. The visual aspects of some digital scores - dual colour schemes, animated symbols, or environmental imagery - often served as a active and agential stimuli for emotional and musical responses, while also coordinating interactions between players. In ensemble contexts, communal coherence frequently superseded individual virtuosity. Whether through holding hands during choral sections, echoing each other's phrasing, or adapting to subtle changes in the environment, performers consistently prioritized relational sound-making. They reflected on the emotional depth of being "with" each other - even when not physically present - as when remote performers contributed via video or audio streams, creating a poignant sense of distributed presence.

### 3.7.5 Non-Human and Hybrid Agents

Some systems involved artificial intelligence, robotic arms, or generative animated environments. These were not just tools - they were treated as co-performers. A robotic arm that responded through motion and notation was said to foster connection and even camaraderie. One participant remarked, "We never felt we were playing alone... we were playing with it." This extension of agency to non-human actors redefines the performance space as post-human, where emotional resonance and co-creativity extend beyond the human participants. Furthermore, the materiality of instruments and objects also played a role. Tactile transducers, contact microphones, and altered acoustic properties became actants in the musicking web. These objects carried affordances - suggestions for how they might be played or heard - shaping the performer's engagement.

### 3.7.6 Discussion: Musicking as Entangled Practice

What emerged from these accounts is a vision of musicking not as solitary expression or hierarchical ensemble, but as entangled, relational, and ecological. The performer is situated within a mesh of influences - visual, sonic, emotional, spatial, technological - and becomes both a respondent and a provocateur. Each note played, each action taken, shifts the shape of the network. This entangled network includes not only the performers and their tools, but also audiences, spaces, scores, and non-human agents. It is this web - dynamic, unstable, and rich in potential - that could be seen to define the artistic practice. Through navigating this complexity, performers do more than make music - they participate in an evolving system of co-existence, where the boundaries between self, other, and environment blur into one collective act of musicking.

The individual nature of these connections and actants form the material of the other fields in the PACMMAN framework. For example, a shape, colour, sound can have a response through the physical sense, or emit behaviours as an agential actant, or contain a meta narrative.

## 4. EVALUATION

The digital score corpus, examined through a multidimensional sensory lens, transforms our understanding of musical notation into an interactive, embodied, and visually rich experience. This perspective challenges traditional notions of the score as a static, prescriptive document, instead positioning it as a living, evolving form of music-making where meaning emerges through communal interpretation, action, and interplay. The following discussion synthesizes the key insights from this exploration through the PACMMAN framework, expanding upon the central themes that redefine musical meaning in digital and experimental performance contexts.

The key Aspects of the digital score corpus as a dynamic, co-creative system are:

**1. The Score as an Interactive, Responsive System** The digital score is no longer a fixed set of instructions but a dynamic, algorithmic entity that reacts to performers' input, reshaping itself through processes such as echoing, altering, or rejecting musical material. Performers engage in a feedback loop with the score, interpreting its signals while simultaneously influencing its behaviour, fostering a collaborative meaning-making process. The score's perceived "intelligence" (through generative algorithms or interactive visuals) creates a sense of co-presence, where the system acts as a sentient collaborator rather than inert notation.

**2. Embodiment and Phenomenological Engagement** Performers experience the digital score not just visually or sonically but phenomenologically - as an active, responsive presence in the performance space. Gestural interaction, motion tracking, and robotic extensions integrate the score into the physical domain, blurring the boundaries between performer and system. Spatialized projections (on

bodies, instruments, or environments) enhance proprioceptive awareness, making gesture and movement central to musical decision-making.

**3. Multisensory Meaning-Making** The digital score engages multiple senses - sight, touch, sound, motion, and notation - each offering a platform for exploration rather than a fixed meaning. Visual elements (animations, graphics) function as performative languages, conveying behavioural cues that shape musical responses. Haptic feedback and interactive interfaces deepen the performer's tactile relationship with the score, reinforcing its materiality.

**4. Liveness and the Reanimation of Fixed Media** Prerecorded sound is recontextualized as interactive material, modulated in real-time through digital signal processing or performer gestures. Fixed audio becomes dynamic, responding to live input and fostering a sense of dialogue between the performer and the system. Performers develop an embodied familiarity with these sonic responses, anticipating and reacting to them as if engaging with an improvisational partner.

**5. The Composer as System Designer** The composer's role shifts from an authoritative author to a curator of interactive systems, structuring randomness through algorithms, conditional rules, or generative processes. Works may incorporate human override mechanisms (e.g., "Time Out" gestures) or probabilistic structures, allowing for emergent, performer-driven outcomes. The compositional focus expands beyond *what* is played to *how* choices are enacted, emphasizing meta-performance and emergent dramaturgy.

**6. Improvisation Within Structured Frameworks** The music thrives on heterophonic fluidity, balancing improvisational freedom with pre-set structural elements. Performers navigate mutable score structures, responding intuitively while maintaining coherence within an open-ended framework. This approach rejects rigid control in favour of collaborative, emergent creation, reflecting a cultural ethos that values adaptability and collective interpretation.

**7. Interdisciplinary and Multimedia Integration** Digital scores dissolve traditional disciplinary boundaries, merging graphic notation, interactive visuals, movement, and sound into unified multimedia experiences. Technology, body, image, and sound intermingle, fostering richer modes of storytelling and engagement. This hybridity reflects a world-view where artistic media are porous and interdependent, enabling new forms of sensory and cognitive alignment.

**8. Socio-Political and Cultural Resonances** Themes of censorship, marginalization, and resistance emerge metaphorically in interactive systems (e.g., performers reacting to "censoring lights"). The work amplifies marginalized voices - refugees, women, neurodiverse individuals - positioning artistic creation as a site of empowerment. Larger sociopolitical concerns such as, migration (human and avian) and ecological awareness inform the music's conceptual framework, reflecting contemporary concerns about displacement and belonging.

**9. Neurodiversity and Inclusivity** The digital score accommodates neurodiverse modes of musical experience, including autistic and d/Deaf perspectives. "Digital Syzygy" describes new forms of cognitive and sensory alignment facilitated by technology, challenging normative models of musical cognition. The digital score can break down barriers of access to musicking such as *JoyInst* and *Jess+*. This inclusivity expands definitions of creativity, demonstrating how digital tools can foster novel expressive possibilities beyond conventional sensory boundaries.

**10. Role-Playing Games (RPGs) as a Structural Metaphor** Performers are framed as explorers in dynamic, rule-bound worlds, emphasizing play, adaptation, and identity negotiation. The RPG model aligns with contemporary digital cultures that value agency, multiplicity, and iterative discovery. This approach encourages experimentation over fixed outcomes, reinforcing the fluid and emergent nature of the music.

**11. Multiplicity, Fluidity, and Process-Oriented Art** The music embraces radically different interpretations, reflecting postmodern values of plurality and flux. There is no "definitive" version of a work; meaning is co-created in real time by performers, audiences, and environments. Art is treated as a living, evolving process rather than a finalized product, privileging openness and transformation.

**12. The Acoustic Space as a Dynamic, Embodied Environment** The performance space is not static but shaped by electronic spatialization, venue acoustics, and performer interaction. The Local/Field-Stage metaphor [9] applies, where the physical environment of the performers merges with the theatrical experience of the audience. Performers' bodily sensations vary with different venues, emphasizing the deeply embodied nature of digital score musicking.

## 5. CONCLUSION: TOWARD AN ENTANGLED, ECOLOGICAL MODEL OF MUSICKING

What emerged from these case studies is a vision of digital score musicking as an entangled, relational, and ecological practice. The musicians exist within a dynamic network of influences - visual, sonic, technological, spatial - acting as both respondent and provocateur. Each musical gesture shifts the system's trajectory, reinforcing the idea that music-making is a collective act of negotiation rather than individual expression.

This model extends beyond human musicians to include non-human agents (algorithms, interactive systems, spatial acoustics), creating a web of co-creation where boundaries between performer, audience, and environment dissolve. The digital score, in this context, is not merely a tool but an active participant in an evolving musical ecosystem.

Ultimately, this paradigm fosters a new mode of musical presence - one defined by exploration, deep listening, and co-creative engagement. It challenges conventional hierarchies and pedagogies, embraces multiplicity, and redefines what it means to "be" in music (extending Small's notion of musicking into a digital musicking realm). As digital and experimental practices continue to evolve, this multidimensional, interactive approach offers a transformative framework for reimagining the future of musical notation, performance, meaning-making, and music education.

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