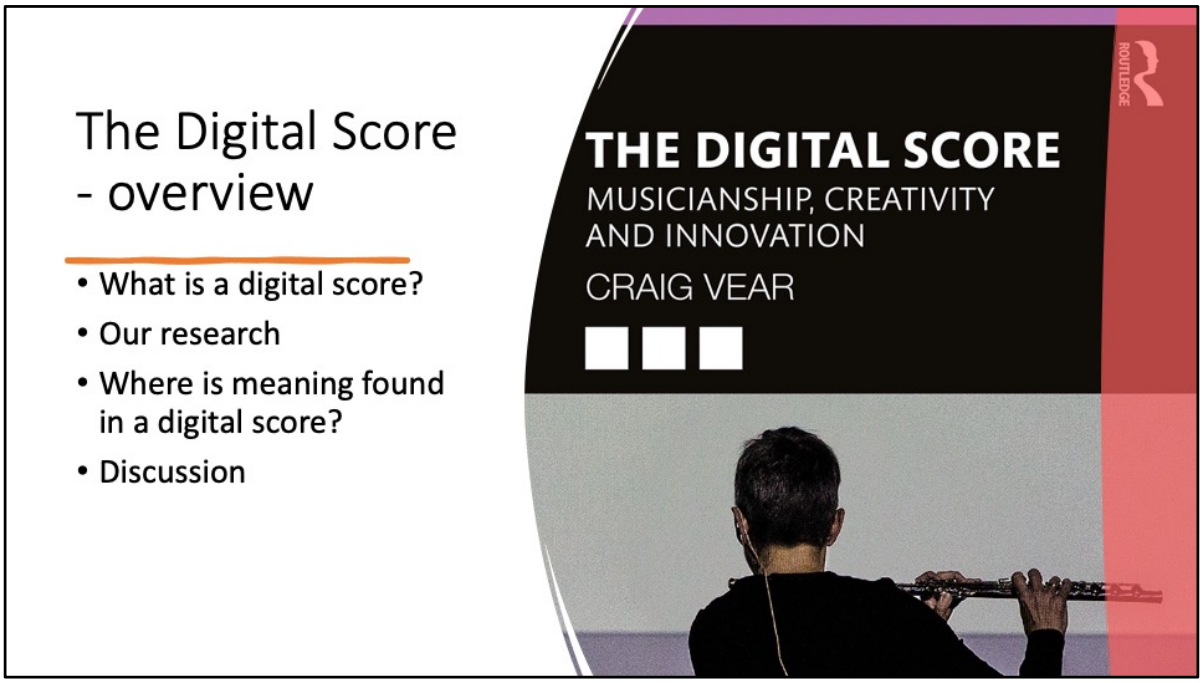
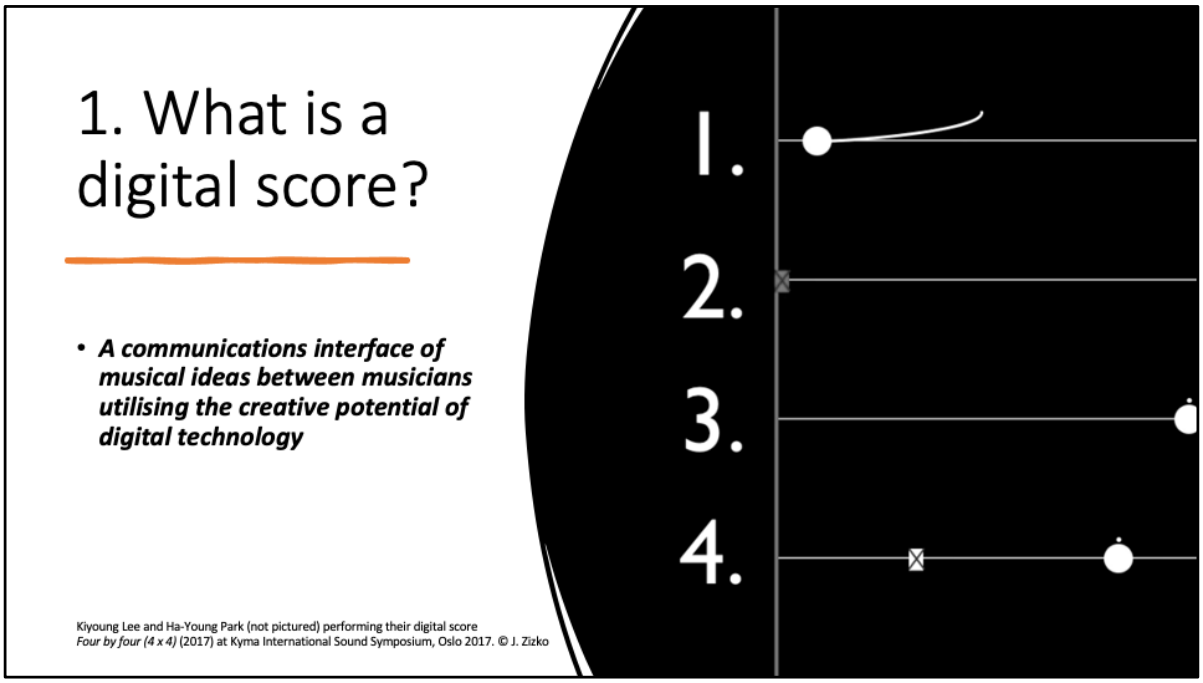
1. Thank you Jonathon and Vincent

2. please engage with us.



Thank you for giving me the opportunity to speak about the digital score project. This talk is basically split into 4 sections:

1) an overview of what a digital score is
2) The ERC research project
3) where we are looking to find meaning in digital score music-making
4) finally, I will give a brief update as to where we are with the project (month 6)



In the simplest terms, a digital score is a ***Communications interface of musical ideas between musicians utilising the creative potential of digital technology***

They are the next evolutionary stage of the music score, and therefore have a lot in common with them. But the use of digital media and computational technology changes our relationships and meaning-making with them, that goes way beyond the scope of the traditional paper-based music score.

Firstly, we need to challenge the perspective that notation (the list of instructions) is the only feature of a music score worth studying (although it can be a big part of it, as I will discuss later),

And second that the carryance medium (the piece of paper, the iPad, the Unity game engine) is NOT a neutral element in a musicians understanding of a score.

Therefore we need to study how the score system as a whole (the technology, the agents, the media, the visuals, the instrumental interfaces, the gestural maps, the screens, the behaviours, the presences etc etc etc and any notation (in the broadest

sense) affect meaning-making in the musicianship of those who create digital scores, and those who realise/ perform/ study/ experience them.

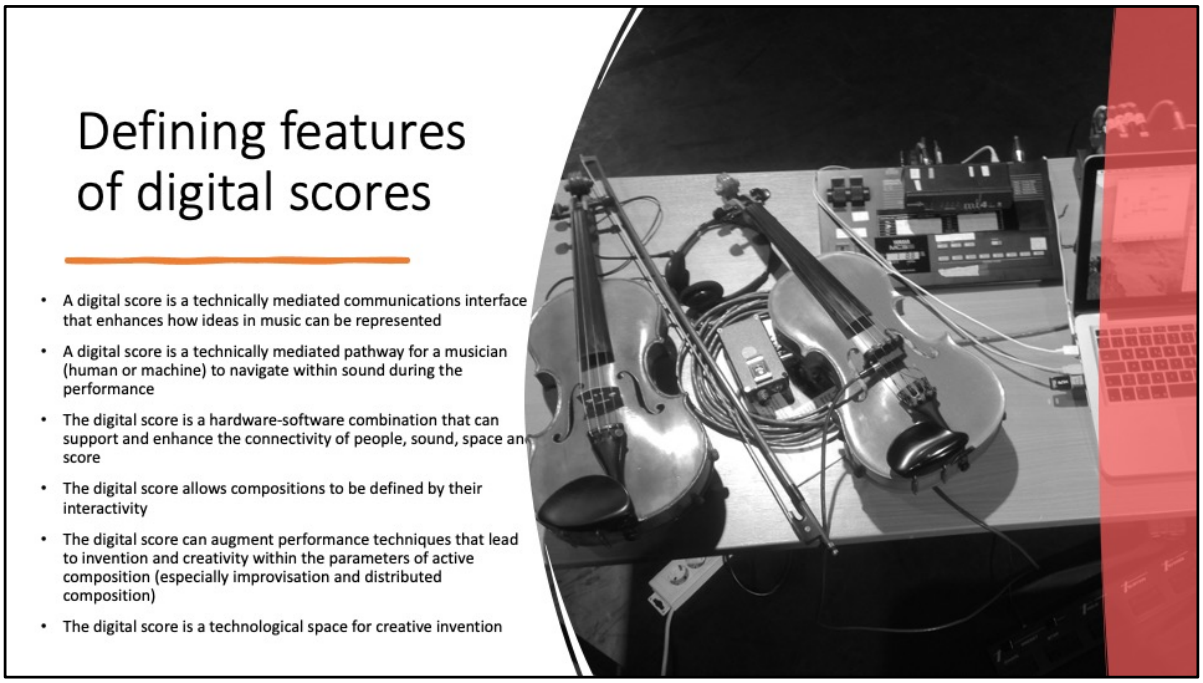
First we must consider the core function and purpose of a digital score

In my book I have argued that:

The core purpose of a digital score is a technically mediated communication interface between the creativity of a musician (say a composer), the creativity of another musician (say a performer), and the creative mind of the listener.

The core function of this communications interface is to represent the ideas that happen inside the mind of the musician using digital technology in such a way that they are capable of being translated into sound during performance through the technique and creative interpretation of another musician (human or machine).

My research aims to discover what IS being communicated, what CAN be communicated and how we form meaning through digital scores.



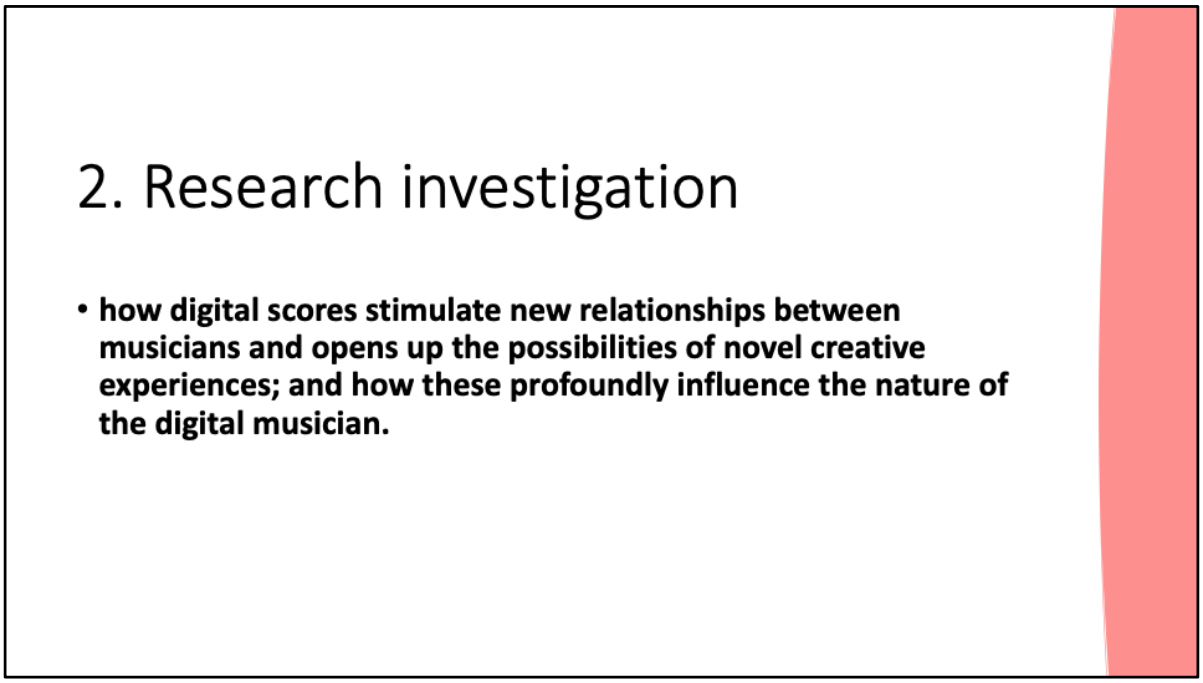
The over-arching features of a digital score are listed here.

There is not a singular, identifiable creation, nor is there an exemplar for what one might be

Nor are they dominated by the single sense of sight (symbols on a page).

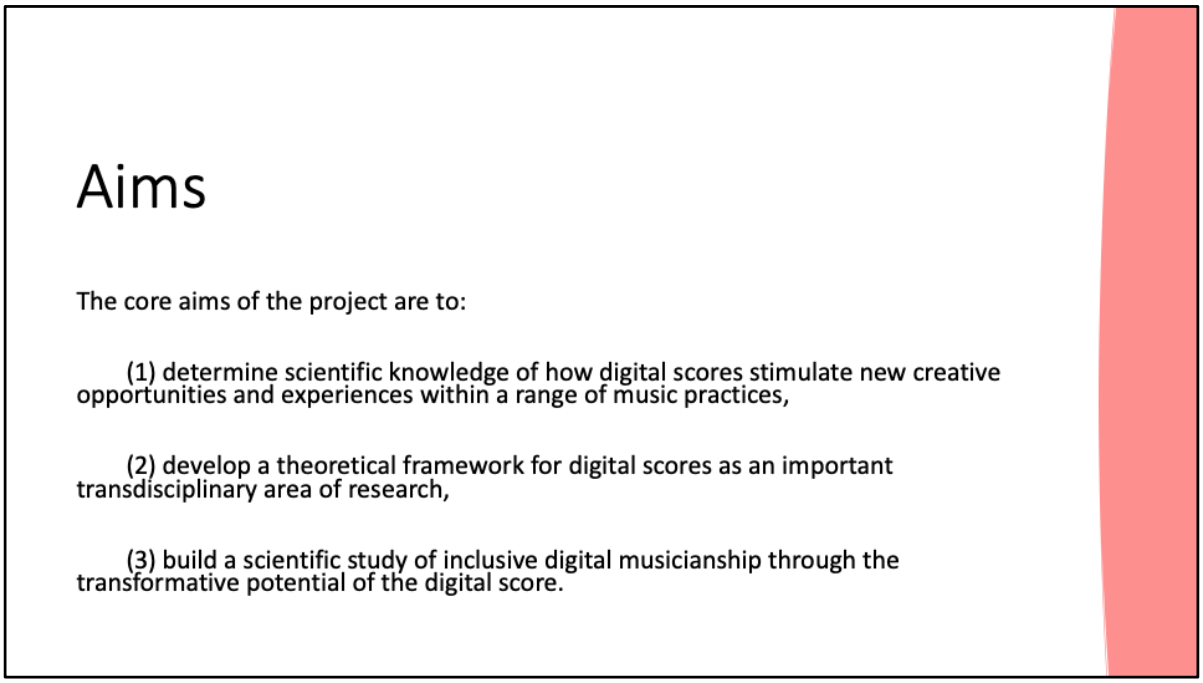
In fact, computation and digital media facilitate the communication of ideas across a range of senses. These could be embedded as visual, acoustic, tactile, robotic, or sonic and involve an equally wide range of materials such as text, movement, sound, code, image, haptic objects, as well as the sense of time, presence, and co-operation.

They communicate contemporary ideas between musicians that would be difficult (if not impossible) to achieve using existing score-systems.



In 2021 I was awarded a €2 Million ERC consolidator grant to expand the research laid out in the Digital Score book. The central research question is:

how digital scores stimulate new relationships between musicians and opens up the possibilities of novel creative experiences; and how these profoundly influence the nature of the digital musician.

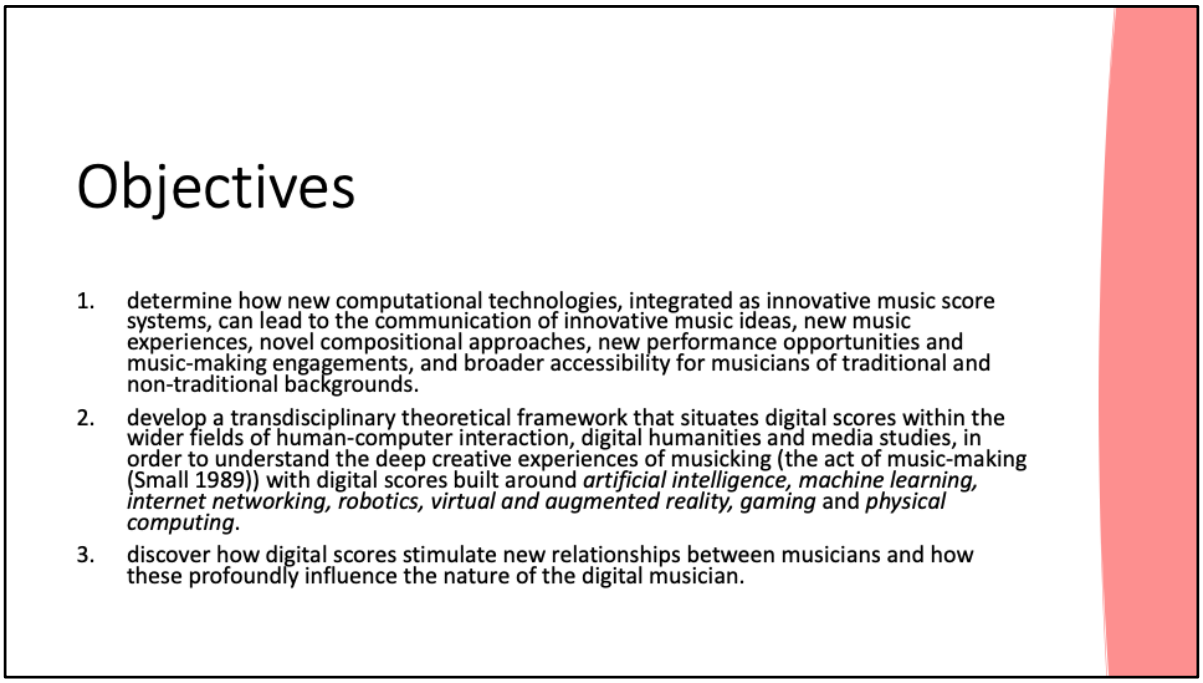


The core aims of the project are to:

(1) determine scientific knowledge of how digital scores stimulate new creative opportunities and experiences within a range of music practices,

(2) develop a theoretical framework for digital scores as an important transdisciplinary area of research,

(3) build a scientific study of inclusive digital musicianship through the transformative potential of the digital score.



The core objectives align to this but crucially

Extend the foundational work from *The Digital Score* with a particular focus on

A) *Co-operative Code:* digital scores built around *artificial intelligence, machine learning, internet networking, robotics, virtual and augmented reality, gaming* and *physical computing*
B) Inclusivity

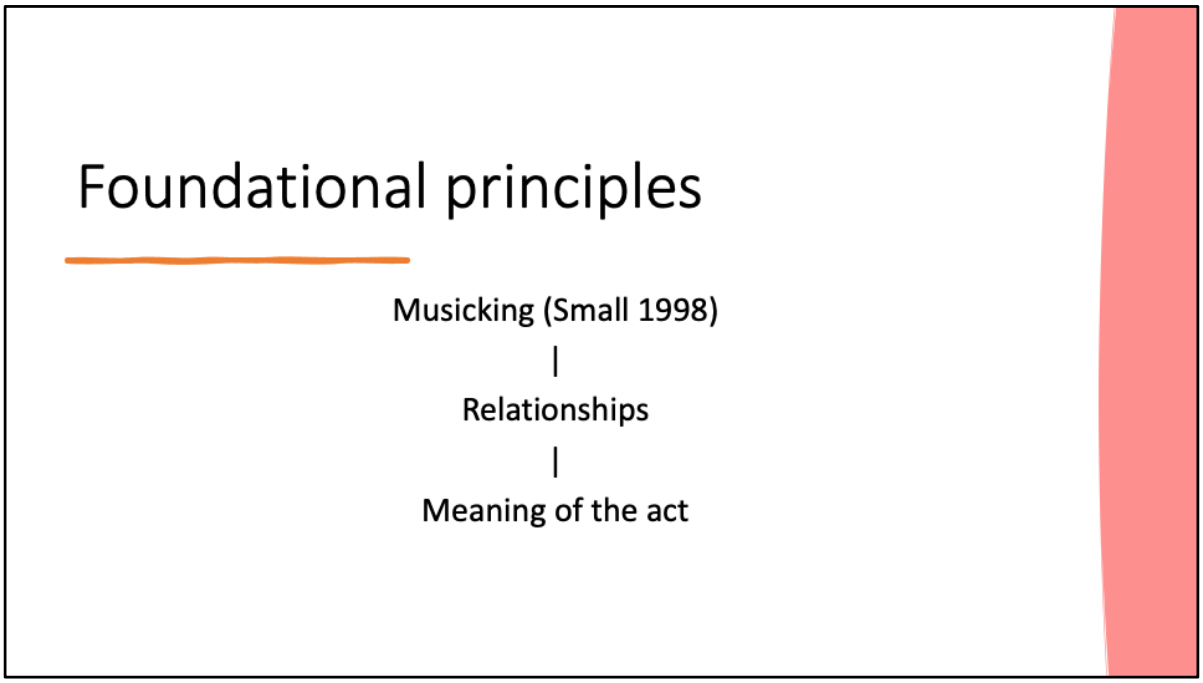
I stated earlier that the use of digital media and computational technology changes our relationships and meaning-making with digital scores

And, that the technology is more than a conveyance mechanism.

And I believe that understanding where meaning is embedded within, and inferred/ invited/ inspired/ evolved/ emerged through a digital score is a critical part of the study of digital scores.

And that the digital technology fundamentally transforms, enhances, expands, extends, shifts and augments the 'taking part' of a score. The primary reason for this is that digital technology operates as more than simply a tool in the creative process.

But how do we go beyond a discourse that explains what the technology does, or how we put it together? What parameters, approaches, principles, values do we construct to understand how these actions and creative constructions form meaning through the creative acts of "composing", " performing" & "listening"?



First and foremost, this research believes that to make music is to take part, whether this be performing, composing, coding, listening, dancing. Christopher Small calls this Musicking (1998).

Second, that 'The act of musicking establishes in the place where it is happening a set of ***relationships***, and it is in those relationships that the ***meaning*** of the act lies' (Small, 1998).

However, meaning should infer the 'what you mean to me' (Emmerson 2007), (this subtle shift circumvents the significant issues of value and who is doing the evaluation of meaning).

Therefore, meaning (or the what-you-mean-to-me) is to be found in the relationships formed between the new creative acts of musicking and the technologies and media of a digital score as a whole, and how they operate/ collaborate, co-create with us through time

Musicking = inside perspective
Implicates the "I" and "self" as the primary perceiver = a phenomenological perspective
Meaning is to be found in the inter-relationships and inter-connections between musician – technologies – media – music.

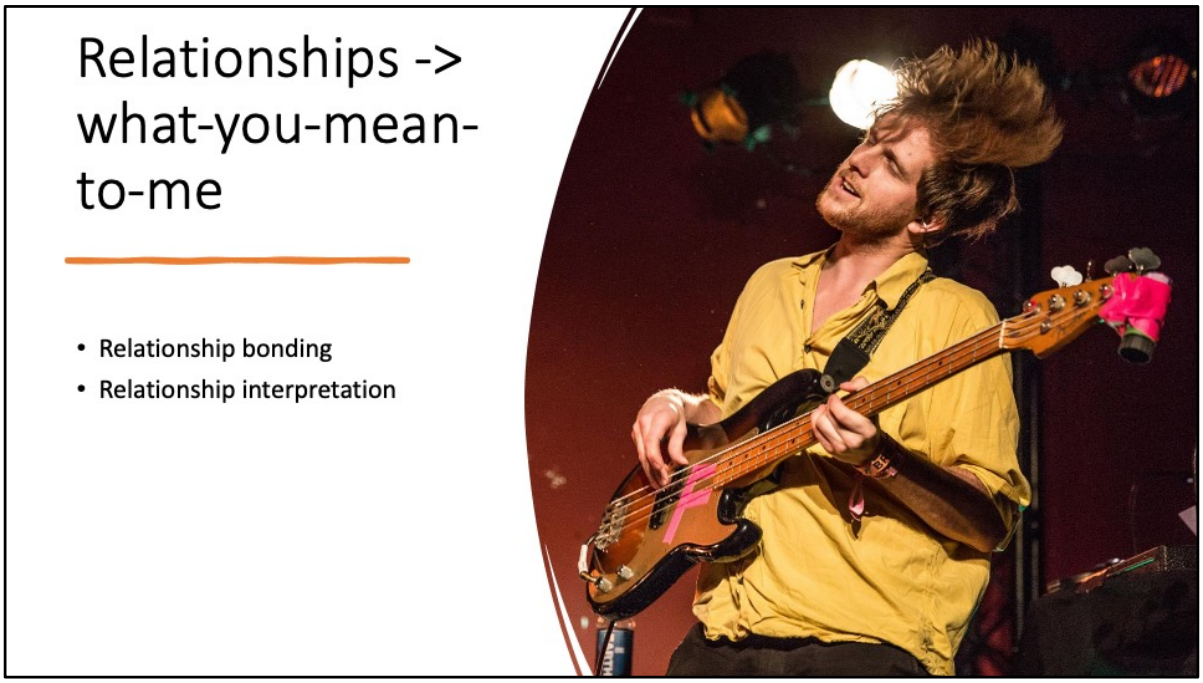
As such, we need to ask more questions about the relationships between say, media, music, space, sound and the presence of human or machine intelligence. Such as:

What is taking part?
What is the music-world setting?
How are representations of self and others manifest in this new setting?
How do these relate as journeys of interwoven connections and relationships?

I want us to think about this problem from two perspectives and in two ways:

The perspectives are that of the making of a digital score (the encoding and intention of relationships (tacit or concrete) built into a digital score by a musician), and the receiving/ realizing of a digital score (the decoding and reception of the embedded relationships by musicians).

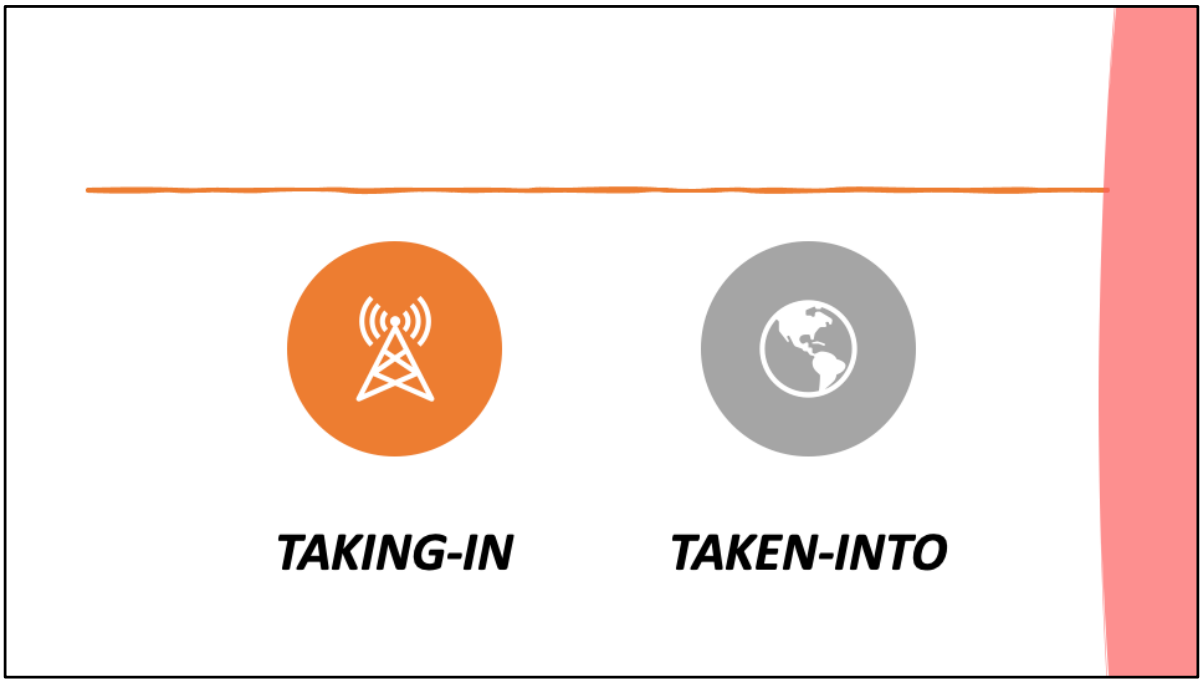
This is not meant to exclude other non-binary ways of digital score musicking, and I intentionally include these modes within this model, even if they are not explicit in my descriptions. Furthermore, I wish to get rid of the terms “composer” and “performer” and purposefully try to ween myself of this unhelpful divide.



- Relationship bonding is the identification, connection or attachment of some-thing from within the digital score into our musicking world
- Relationship interpretation is the ways in which we decode the signals, behaviors, materials, qualities or journeys into what-you-mean-to-me

- This latter point is relatively easy to deal with, and most of us do this naturally: we see a music note moving around on a screen, or a sweep of a coloured line, and we interpret that using the rules and symbolic representations of whatever formal structures are placed around that particular score.

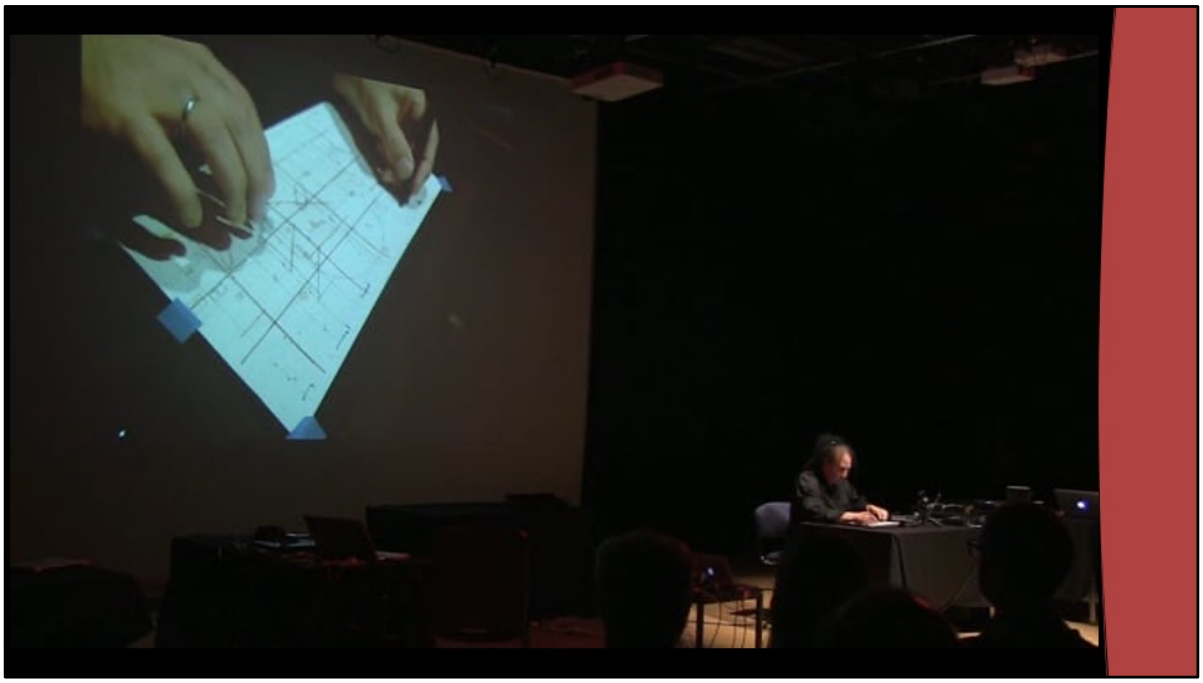
- But it's Relationship Bonding that I feel needs more time today, as this not so clear, and is certainly side-stepped with music education (because it's a very difficult problem).



To simplify this process of bonding I developed a double dimensionality that exist simultaneously within a digital score

Taking-in*:* – how the perceived affect of the technology and media of a digital score reaching out, suggesting, offering and shifting through the tendrils of affordance and experience make connections with the musician(s) (affect)

Taken-into: how the digital score can establish a world of creative possibilities through embodiment and the flow



Before I dig a little deeper into this double dimensionality, I'd like to illustrate it with a case study: Between the Words, for Wacom tablet & Kyma, Jeffrey Stolet

First lets watch a bit (up to 4')

https://vimeo.com/193205022

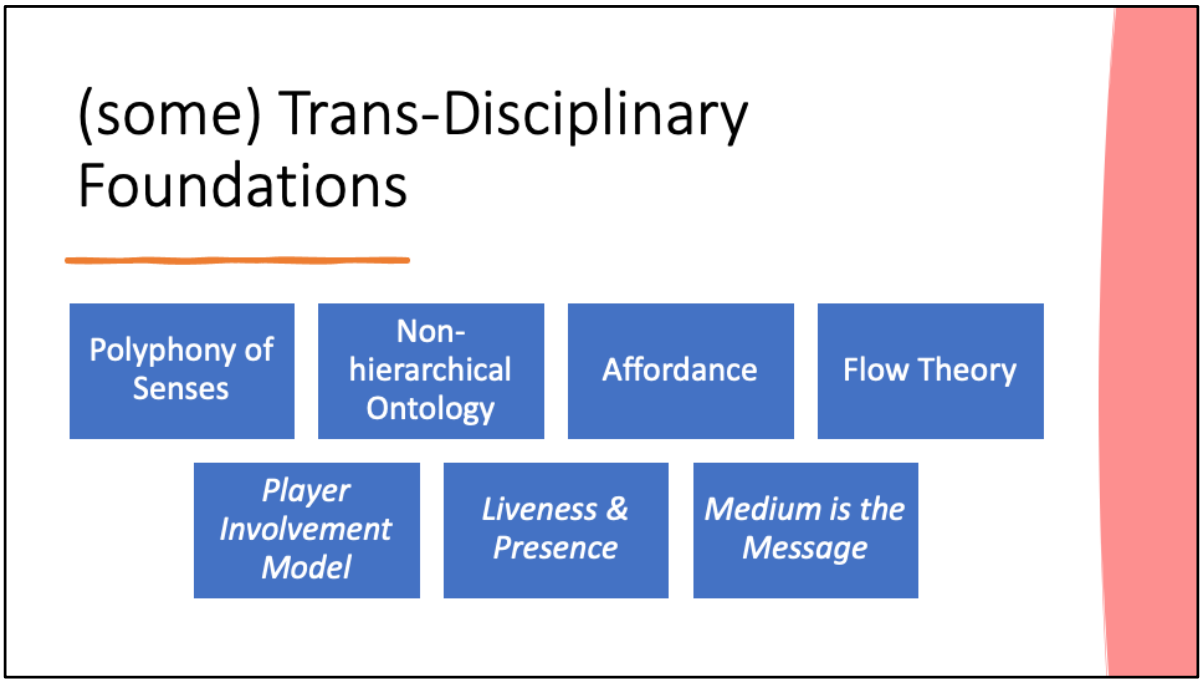
In this video we can see Stolet sat at a table performing. His immediate technological interface is a laptop screen and a piece of paper with markings on it taped onto a Wacom Tablet. The paper page is projected onto a large screen behind him. Stolet is using the stylus of the tablet to trace the pre-defined markings on the paper, from which sound emerges. The laptop screen gives him some indication of the flow of time and the type of sound processing in operation at each section of the piece, but it is also programmed to wait for certain signals and gestures that Stolet defines and renegotiates in real-time.

In performance, Stolet traces out these mapped gestures on the paper with the stylus

and the sound processing system responds accordingly by making music. It is reactive to the type of pressure and the dynamic speed of the stylus movement. The stylus is more than an instrument because of the embedded tactile sensation as it dances over the pencil lines and their direct response to sound production. The paper goes beyond notions of traditional scoring because it is simultaneously an aide memoire, a direct interface to the sound, and a scenographic/ performance space for the audience to gaze upon whilst immersed in the music. The pencil marks are offering traces of pre-composed memories and gestures; these are more than encoded symbols as they as implicitly bound to the process of pre-selecting the sounds and how they are manipulated through the touch and the gesture of the stylus. The whole system is fusing an augmented instrument and a hyper-score in which all these elements combine into a single experience with a core aesthetic imperative: the music.

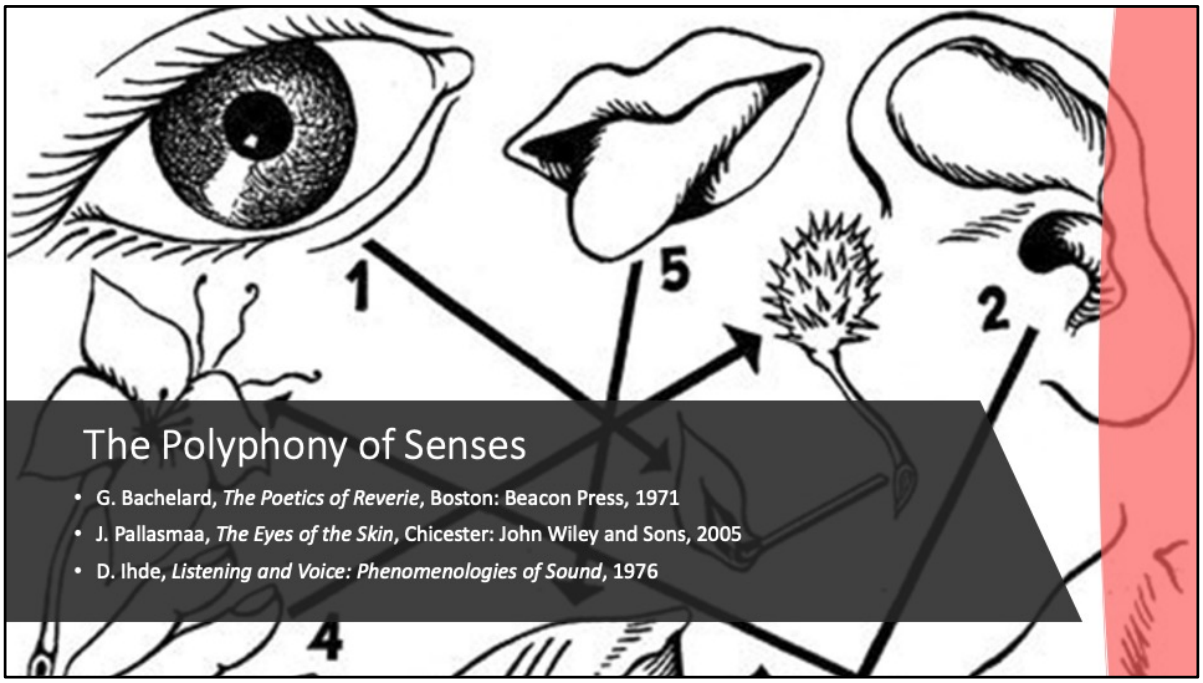
This complex inter-relationship is the digital score: it is not enough to describe it as just the tablet, nor the paper map, nor the sound processing timeline, it is the interaction between these and simultaneously how they communicate with him. The whole system is speaking out to him, and simultaneously drawing him into a mediated, technological world. All these components are compounding together in a very unique system that takes it beyond concepts of hyper-instrument. These all reach out to Stolet and afford instructions that are not symbols of common-notation, but are symbolic of sensorial affect: a touch here, a gesture there, and a sound emerges. The media is reaching out to him, and he is also reaching back into the system through its interactivity. In a techno-poetic sense, the digital score is also reading him.

The interface between the musician and the technology changes through the various stages of creativity. At one point in the creation of this piece Stolet was interfacing with the sound processing hardware as he designed the technological system for future exploration. At another time, he was freely exploring the soundworlds through musicking, sensing what they felt like and the aesthetic limits in their malleable characteristics. Later these were marked as gestures on paper, preserved memories as pencil marks and as coordinates between the stylus and the tablet. Finally, Stolet becomes embodied in the digital score through performance within a triple presence of himself, the close-up image of his hand on the large screen, and as sound. In this he sculpts the sound in relation with the performance space and time, and into the minds of the audience. Stolet is immersed in a system that is tactile; he is listening to the sound and experiencing the score through his body. Like a game this digital score is immersive in a very different way to a traditional score because of these extra-parameters.



To dig deeper into meaning-making (what you mean to me), I wish to briefly introduce these these main theoretical areas that are informing this research. They are some of the ways meaning through relationships in musicking can be understood, examined and evaluated. But they are not the entirety of the solution. And I'm not including key psychological foundations such as Mirror-neurons.

For the rest of the keynote I'm going to briefly explain each one in turn. And use them to illustrate the case-study



One of the foundational principles here is that we do not experience music/ life through a single sense. Nor can we separate out experience into individual senses – they are implicitly bound together into a wholeness of experience.

This implies that meaning-making in musicking with digital scores is a whole-body experience, and therefore to reduce it down to a single sense (say sight or hearing) only serves to reduce our understanding of such experiences.

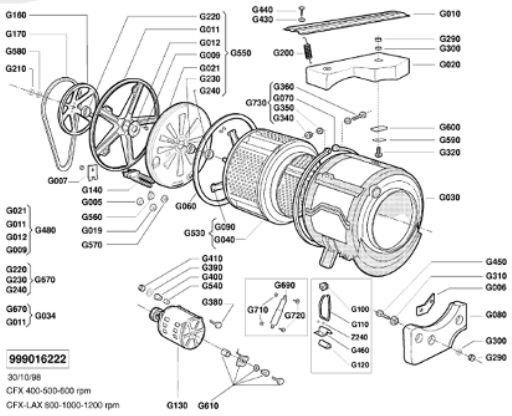
This principle is based on an aesthetic awareness in the experience of an environment as felt through the senses. This refers not only to the eyes and the ears, but also to the full body interaction within the music-world that the digital score establishes inside musicking. This requires an understanding of the multi-sensorial experience of being in these music-worlds, and is underpinned by Bachelard's notion of "the polyphony of sense".

Going back to the case study, although Stolet is focussing his sensory instruments to attend to the hand-eye-ear coordination in the way he realises his score, his experience of musicking is also taking-in the presence of the screen and the audience, aswell as his seated position, the feel of the stylus, the quality of the paper.

Furthermore, experience is not just limited to the sensorial instrument input, memory and imagination also work into the mix. All of which presents opportunities for relationships bonding, and then the interpretation of such relationships into the what-you-mean-to-me

Non-hierarchical Ontology

- Harman, G (2005). *Guerrilla Metaphysics: Phenomenology and the Carpentry of Things*. Peru, Illinois: Open Court
- Harman, Graham (2002). *Tool-Being: Heidegger and the Metaphysics of Objects*. Peru, IL: Open Court.
- Bryant, Levi; Harman, Graham; Srnicek, Nick (2011). *The Speculative Turn: Continental Materialism and Realism*. Melbourne, Australia: re.press
- Bogost, Ian (2012). *Alien Phenomenology*. Ann Arbor, MI: Open Humanities Press
- Morton, Timothy (2010). *The Ecological Thought*. Cambridge, MA: Harvard University Press.

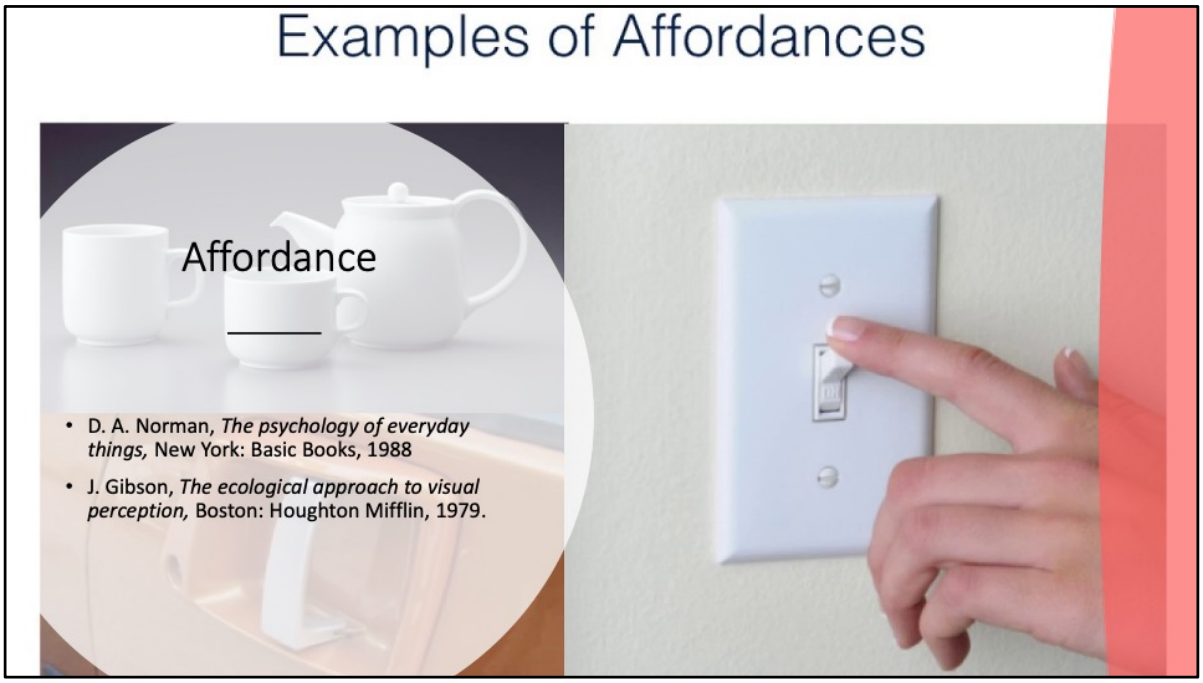


A second foundational principle for this research is to consider each element in the [digital score] + [human musician(s)] relationship system in a non-hierarchical way. By that I mean that I purposefully reject the privileging of human existence over the existence of nonhuman objects.

Although this has elements in common with trendy 21st Century philosophies especially Object-Oriented Ontologies of Bogast, Harman and Bryant, it's purpose is to allow into the conversation about meaning how these objects exist independently of human perception and have a life of their own, and in the case of AI generated agent/ actors, or connectionist interactivity, exist in the same music-world as the human musician(s) and are not necessarily spawned only for the consumption of the human when they are encountered in the digital score, they are always present.

With this in mind, they can be considered to be existing within an ecology of symbiotic relationships between a network of actors and agents, some of whom happen to be human, but all of which are important parts of a meaning-making system. The presence of each of these actors, their behaviours, journeys, properties, sensual qualities, gravities and mass can create binding relationships with the human-musicians, and in turn the human-musicians can create relationships for these actors.

With Stolet's digital score it is important to acknowledge and consider all the operational aspects that are combined in its construction. The stylus that he holds, has a significant presence in his music-making, the quality of sound processing from his KYMA PacaRana system is also a significant factor. The list goes on, but the important principle here is that their presence and involvement are as important to the music as Jeff's , and because of this he will form bonds that can lead to meaning.



The next foundational principle is that of affordance. The theory of affordance from Human-Computer Interface (HCI) can help explain the processes that form relationships. In Donald Norman's book The Psychology of Everyday Things he introduced the (then) new concept of affordance into the HCI vocabulary. Norman theorised that 'an affordance is the design aspect of an object which suggests how the object should be used' . This concept specific to HCI was an extension of the work of James J Gibson's research into ecological approaches to visual perception. Within his body of work Gibson suggested an affordance to mean 'an action possibility available in the environment to an individual, independent of the individual's ability to perceive the possibility' . In short, Norman's affordances reach into us and shift from within, Gibson's affordances shift through changing the world around us. These can be encapsulated as a two-way relationship of:

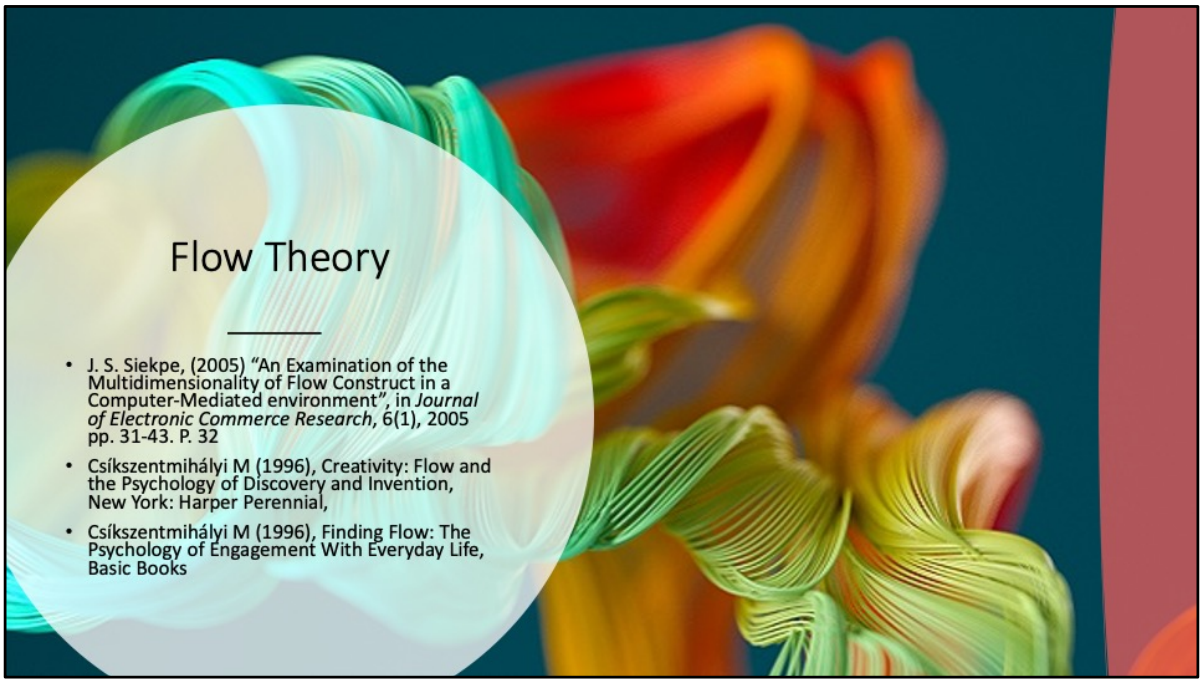
- Emanation - the 'perceived properties that may or may not actually exist' with 'suggestions or clues as to how to use the properties' (Norman), (the coffee cup tells me to hold it) and

- Stimulus - through 'offerings and action possibilities' as environmental shifts that are 'independent of the actor's experience, knowledge, culture, or ability

to perceive' (the presence of the coffee cup sets up the possibilty for dinking)(Gibson)

With Stolet's piece these two properties are very clear: the pencil marks offer clear properties about what needs to be done and where, the stylus needs to be held, the visual timeline of his sound processing needs to be followed. But also, the quality of the lines can indicate or stimulate a response through its design (e.g. thick or thin marks). Likewise the quality, shape, density, feel of the sound processing and samples also offers clues to hum about how to process it in real-time. And the weight of the stylus, the coarseness of the paper all shift how Jeff is to perceive the digital score and his interactions with it/ through it.

Among many other facets of this digital score.

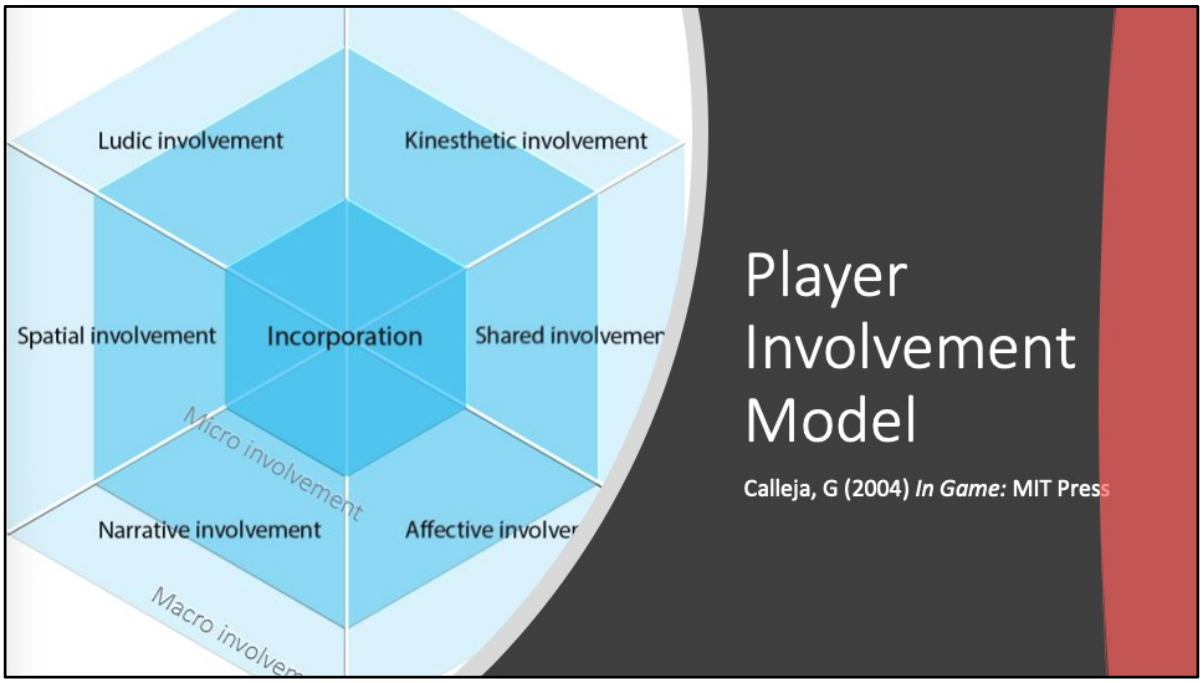


Flow is the experience of musicking from the perspective of being inside the activity. It defines the 'state in which people are so involved in an activity that nothing else seems to matter'. In musicking this sensation can be called *in-the-zone,* or *lost-in-music* and is generally used to describe the sensation when a musician is variably immersed in the ongoing making of music. Within this there is an energised feeling of focus and enjoyment, and a loss in one's sense of normal day-to-day wakefulness. It discusses above all, the journey of musicking through time.

With this in mind, the flow of musicking with the digital score explains how musicians become absorbed in the music through a sense of incorporation within their environment (the soundworld), a shared effort (with digital and human agents), and a loss of awareness of their day-to-day wakefulness and bodily self-consciousness (embodiment with their instrument and into their music).

This, in Stolet's piece, is articulated by the timeline, and the gestural patterns marked on the paper. But it is his ongoing building of music-meaning through his connections and bonding with a variety of relationships he encounters through the course of the performance. These will have been critically considered to offer a balance between boredom, arousal, anxiety, skill definition, challenge, control, apathy and relaxation.

And these are to be found across the whole system of the score in various combinations.



Calleja's Player Involvement Model is an analytical model for understanding player involvement in games, and in my opinion should be fundamental reading for anyone wishing to understand involvement in music. He discusses involvement from the 6 dimensions of Kinesthetic, Shared, Affective, Narrative, Spatial, Ludic, and from a micro & macro perspective.

To me they articulate the enacted areas of music cognition, and are rather self-explanatory in what it is that we can focus on in digital score analysis, composition, performance and appreciation.

Within the flow-state musicians make connections with the digital score many of these connections are formed with things that are present in the music or have liveness.

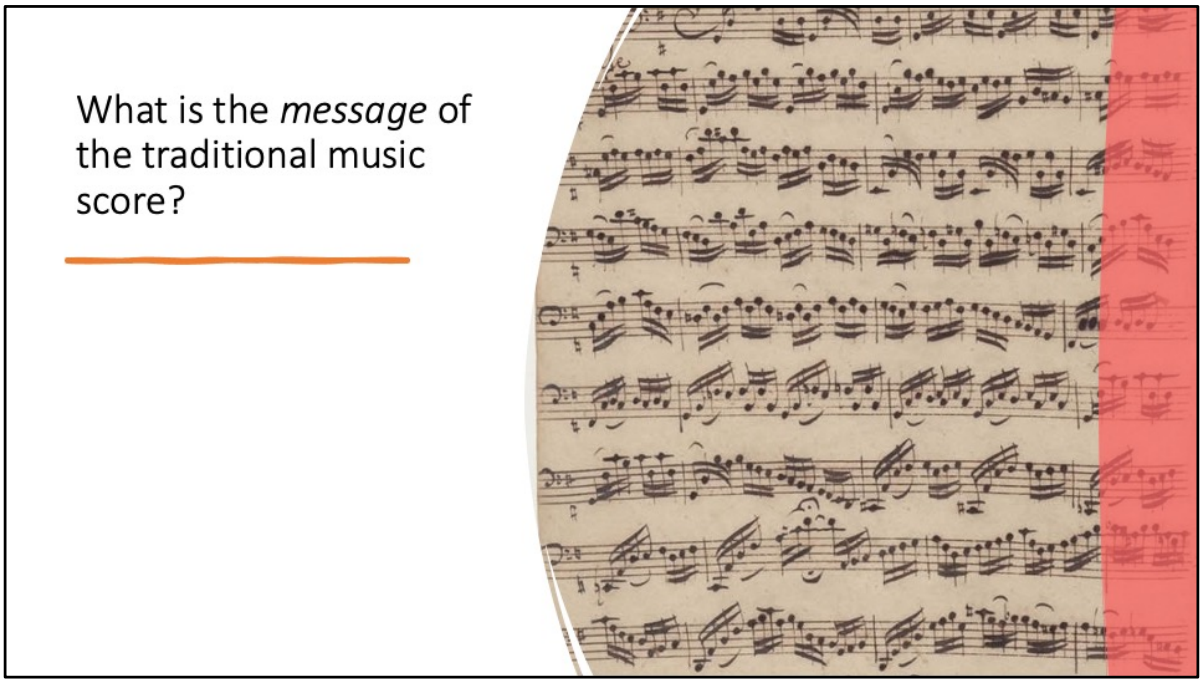
Liveness is the sensation that some element is cooperating in the real-time flow of musicking. Crucially, liveness in the digital score has less to do with corporeality (the living fleshy-ness of human form) or the virtuality of subjective impression (the sound of a pre-recorded image of a human performer). Instead 'Liveness is first and foremost a temporal relationship, a relationship of simultaneity' . In Stolet's piece, the autonomy of the sound processing has liveness. It gives off a sensation that it is working with you in real-time. It may respond to a gesture or join in with a collective task. It possesses liveness as it co-operates in the here-and-now in the co-creation of the music. The processing does not feel like a responding machine, but offers Stolet the feeling of a creative companion journeying through their shared flow. It could be said to be *alive* in the context of the flow, by the way that it stimulates a real co-creative relationship within musicking through its affect of simultaneity. The crucial point of liveness is that it affects creatively in the now, through a sharing of enterprise and focus on achieving an end result. This is accomplished by embedding the

aesthetics of the co-creative act into the algorithms of the digital score, and setting up parameters of behaviour that support a sensation of liveness. The fact that it is a machine does not matter: it is the context within which such behaviour is perceived that determines its liveness.

Presence is an experience that some*thing* is there in the flow, or I am there inside some music-world. By that I mean that the digital score is evoking a sense of an autonomous other in the flow and that this might be manifest as a collaborating performer, a decision-making process, a musical agent, or a sense of a music-reality being generated in the flow that can be willingly entered into and explored. Presence extends the theory of liveness, but it is not necessarily connected to it, as the sensation that something is there does not necessarily equate to it possessing liveness, and can therefore be an inert presence that nonetheless reaches out and affects the musician.
Simon Emmerson's book opens with the chapter *Living Presence*, thus signalling the significance of this subject to 'Living Electronic Music' studies. Emmerson argues that presence implies something more than simply a sound is there, or human agency is there, rather we should consider our 'experience of it' as the primary connection in defining the relationship to this presences. In this sense, the context of presence can be defined as the meaningful engagement in which the 'perceiving body' is 'part of that environment and not a detached observer'.

Marshall McLuhan's *Understanding Media* and his "Medium is the Message" which proposes we view media as it shapes and controls "the scale and form of human association and action" (the message) – rather than studying its *content*

With this in mind, I'd like to analyse a couple of scores in order that we can understand the difference between the *message* and *content* and how they shape and control "the scale and form of human association and action"

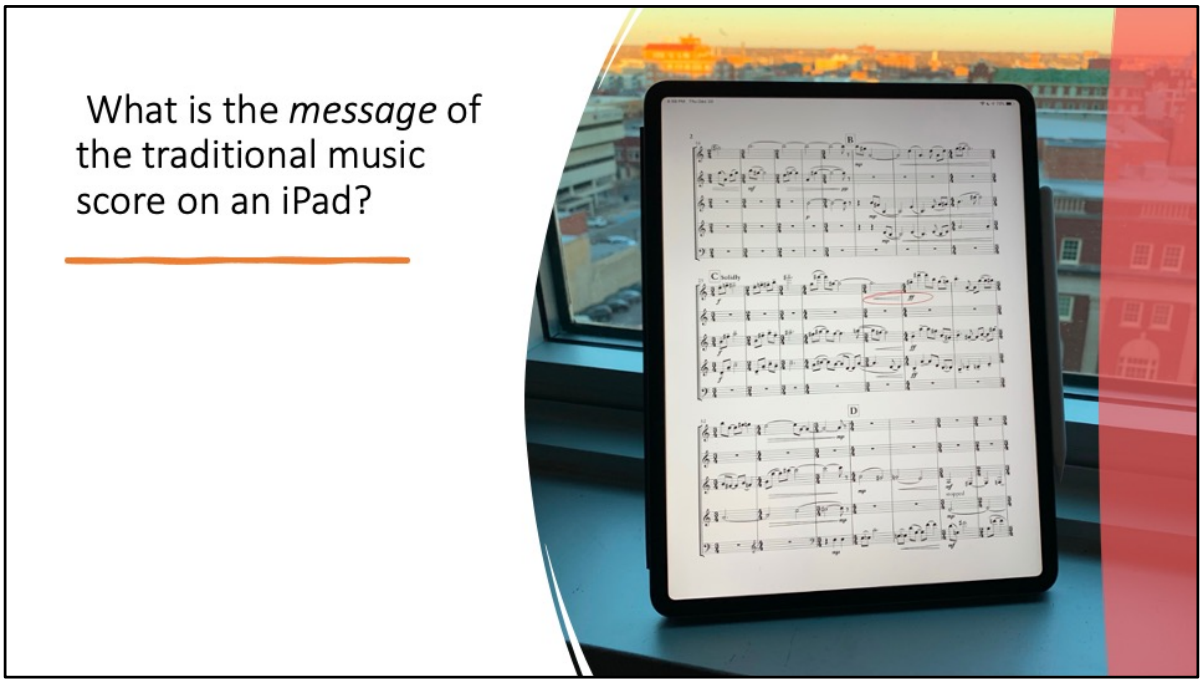


The material page populated with its lines and dots (as opposed to a different type of page such as a newspaper) can signal to the musician a way of behaving, a way of thinking, an attitude; it can raise memories of previous experience, of professional approaches, of fear and nerves, of potentials, journeys explorations, musical experiences.

In this example of Bach, the fact that it is a copy of his actual handwriting communicates something more than a simple sequence of notes.

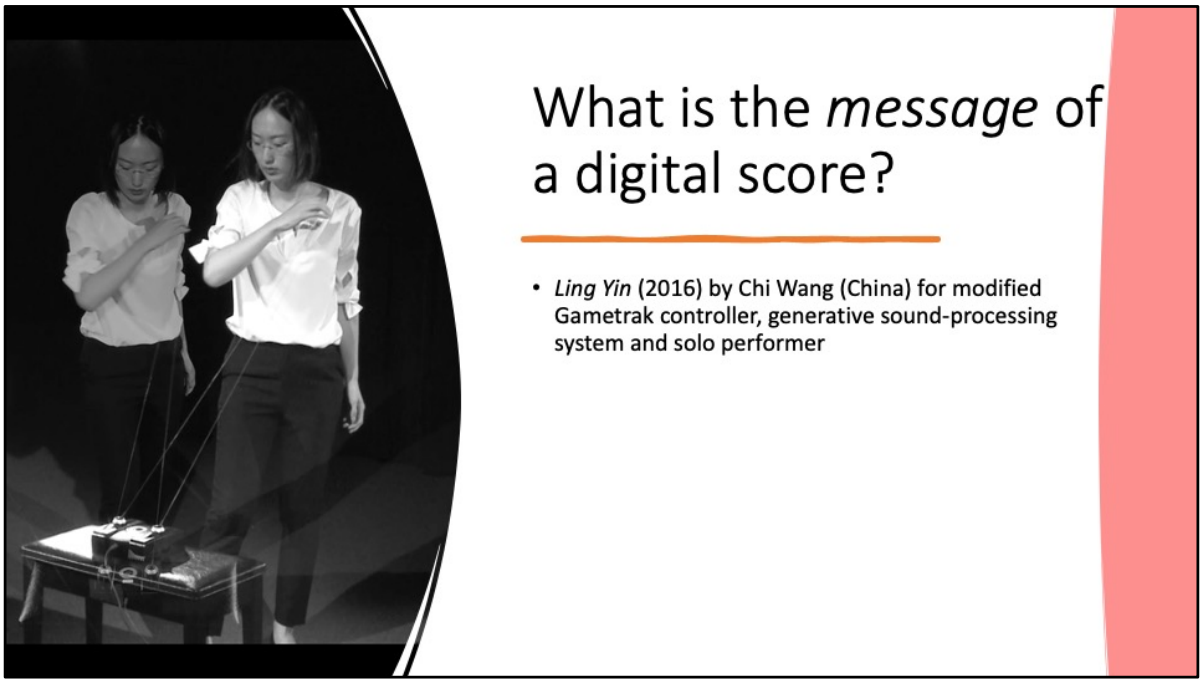
In short, the presence of the score shapes and controls “the scale and form of human association and action”.

The content – the lines and dots – convey a different set of operational meanings, link to encoded symbols of music language.



But if that image of a paper score happens to be on an iPad, then the *message* of the score has changed: an iPad communicates to me notions, feelings, memories and potentials of gaming, computation, photos of my family, relaxed times, eBay shopping. And intellugence through Siri and its bionic chip.

It's *content* is a high def image of sheet of paper, which has its own *message* and crucially another set of *content*.



The *message* in Chi Wang's digital score for modified Gametrak controller, generative sound-processing system and solo performer, conjures a sense of gaming, and physical immersion in a computational system.

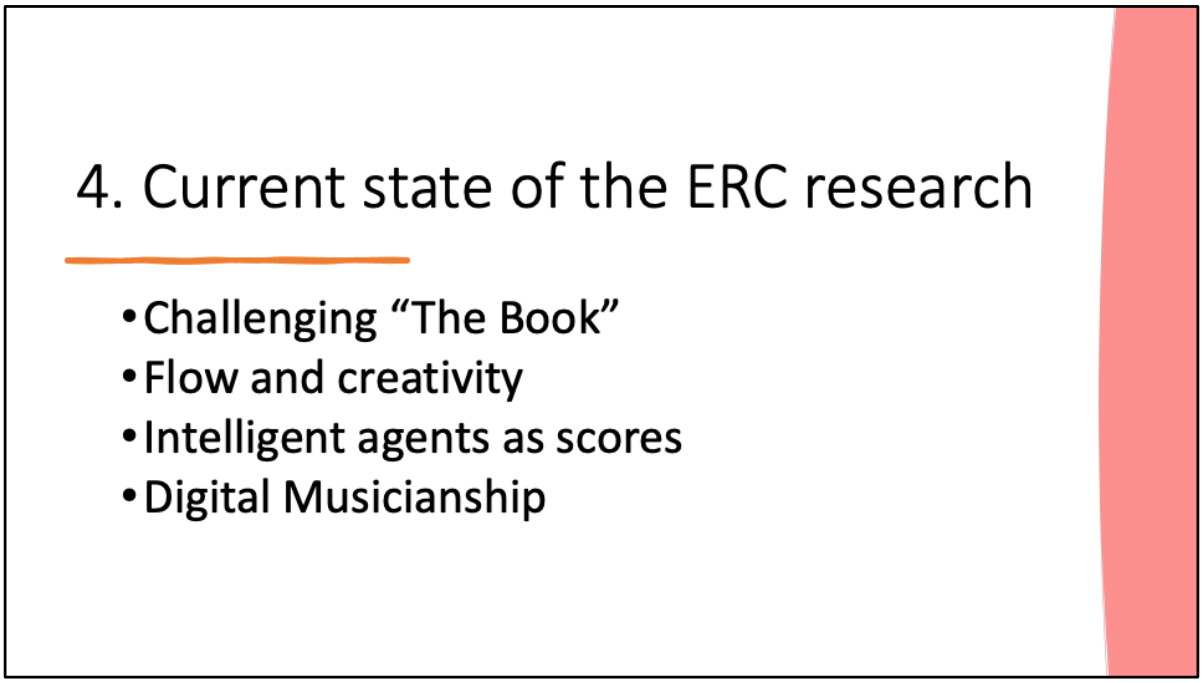
The actions are gestural through the whole body in a hybrid musical instrument and Nintendo Wii way – this makes it feel like a fun game. The generative sound processing, works in realtime with the movement and feels collaborative, and visual feedback systems assist and offer guidance like a map. No common-notation is used.

The *content* of this digital score is the realtime-generation of the soundworld, which itself *contains* semantic meaning, presence, liveness and worlds.

And to get back to Jeff Stolet's piece the *message* of his piece is the intermedial and transmedia relationships that this construction of all the technological aspects form. The video screen, the paper, the stylus with the sound processing potentials and the table and chair and stage, all contribute to a wholeness that shapes and controls "the scale and form of human association and action.

And the message here is that we need to consider this wholeness if we are to give

our understanding of meaning-making in digital scores a fighting chance of depth from the perspective of inside musicking.

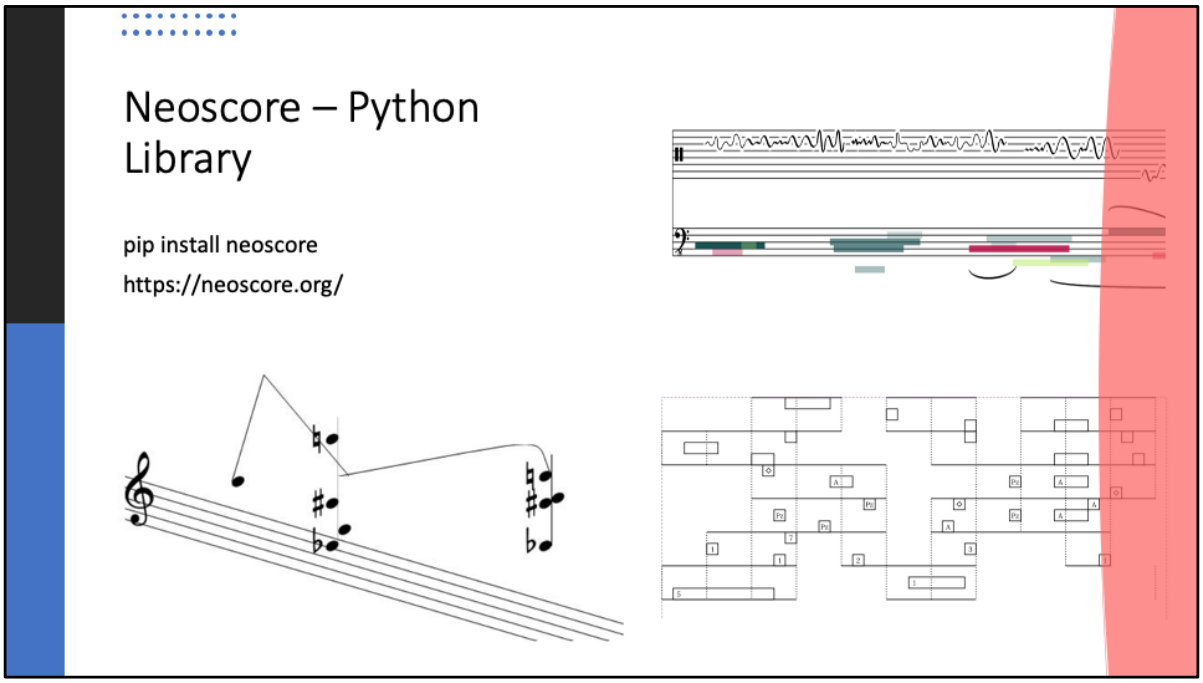


Back to the research project ….

So far we have challenged and expanded the core theoretical proposition proposed by the book (*taking-in ~ taken into*) and really leaning into these three areas.

We are keeping the *taking-in ~ taken into* proposition but realise that it suffers from a freeze-frame issue and doesn't account for the shifting continuum of experience while in the flow of musicking.

Flow is based on the theory developed by Mihaly Csikszentmihalyi in which he outlines the state of mind and being that happens when musicians, athletes, sportspeople, gamers etc are 'in the zone' of their activities. Flow is the experience of musicking – that is while on the inside.



Neoscore is a Python library for notating music in a graphics-first paradigm built on QT. It uses a layered architecture allowing users to work with low-level graphics primitives and higher-level notation constructs according to their needs. Users can build sophisticated scores using the substantial built-in primitives, or they can treat the library as a framework on which to build complex new notation systems. Experimentally it also supports an interactive runtime allowing users to live code on scores and even animate them.

We also need to expand on current thinking about the craft of musicianship in the contemporary context.

To this end musicianship is understood as 'a person's ability to perceive, understand and create sonic experiences' (Brown 2012). Digital musicianship will need to express how digital musicians are aware of musical features with digital scores, their facility to articulate and interpret their features and their affects, and the musician's capacity to demonstrate understanding through active analysis and the generation of music. A starting point for this project is these four dimensions, but this is just the start of this research thread, and I would love to get your input here.

Also, how does this effect music tuition in HE?

Thank you

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