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INTRODUCTION

INTER-FACE, the second International Conference on Live Interfaces, was dedicated to problematizing convergences and divergences between different understandings of performance technology. It sought to expose a variety of motivations and approaches, and discuss how specific understandings of 'liveness', 'immediacy', 'timing' or 'flow' manifest in performance with digital media.

Computers are tabula rasa. Software mediates physical action through code, and code embeds theories informed by specific purposes and criteria. For example, interfaces may apply the study of mechanisms through which we naturally perceive the world, because the interface brings a sense of immediate interaction. At the same time, interfaces may require effort, in a way that conveys expression. The problem is, theories embedded in software are too often taken for granted. In everyday life we are used to handling computers as magic black boxes that save us labour. When the black box works, its origins are forgotten; the more science and technology succeed, the more opaque and obscure they become, and the more distant we become of computation as creative material. Furthermore, collaborations between artists, designers, programmers and engineers can become frustrating when individual motivations are unclear.

INTER-FACE gathered paper presentations, performances, interactive installations, poster demonstrations and workshops. It happened in Lisbon, Portugal, at the Fine Arts Faculty of the University Lisbon (FBAUL); the School of Music of the National Conservatorium (EMCN); ZDB; the National Museum for Contemporary Arts (MNAC) and the Institute of Art, Design and Enterprise (IADE).

The Conference is biannual, and these Proceedings are published a year after the conference itself. The authors had the opportunity to strengthen their work after the presentation at the conference, benefitting from the feedback of the other participants and the editorial peer-review.

The Conference included two round-tables, "Problematizing Foundations" and "Further Directions". These moments were extremely useful to outline a common ground of discussion, and we wanted the proceedings to include a general dimension as well. This is the purpose of the following interview, which developed as a collaborative online discussion after the conference itself.

LIVE INTERFACES: SEEDS OF DEBATE

A discussion with:

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ADRIANA SA: Each person in this discussion develops and performs with digital systems, and some also make systems for audience interaction. I'll ask a few questions that I find important to consider, and clarify, when we use terms such performative expression, embodiment, immediacy and liveness, or when we discuss a system's transparency/ opacity to audience.

ADRIANA SA TO JOEL RYAN: You are composer, inventor and scientist; and you pioneered the application of digital signal processing to acoustic instruments. Your contribution to the first roundtable was titled *"Knowing When"*. What sort of knowledge do you mean, and why the quotes?

> **JOEL:** The fact is I know when. Before it happens, I know when a beat should come, I know after, when it didn't. This knowledge is not something you can necessarily explain in words. It is something you demonstrate in playing but also listening, in enjoying music. It is the knowledge of how to make time. The proof is that with practice you get there on time, again and again.
>
> When I first began making music with computers, I tried to make the software do all of the work. The idea at the time was to be able to program a complete work. Though I was already committed to performance, I still self-consciously avoided touching what I had coded as if it were cheating. But, as I kept painfully discovering, my programs never really worked well enough making time, never went far enough. So gradually, discreetly, I began letting my hands fix what was wrong. In the end I realized this wasn't cheating but the solution. Once touch was liberated, I began to understand my relation to time in music.
>
> **Time in music derives from performative knowledge.** Systems of representation are capable of rendering many parts of this, but rendered via rigid symbol systems for discursive thinking, which moves more slowly than music. A performer has to revisit and revise his experiment everyday. More generality (down to logic itself) doesn't help but hinders the moment.
>
> **Local Time.** The time referred to here is not the objective, uniform time inferred by physics or fashioned by technology, but another, local time. It is not a supplement or embellishment nor is it a primitive or schematic time but the time we make, enacted time, dense and polyvalent, the most elaborate aspect of time in music.
>
> **Knowing when implies a sense of Quantity.** We have various perceptions of quantity both discrete and continuous: counts and measures and durations of intensity, quantities of force and weight, of acceleration and deceleration, degrees of speed and slowness in things we do and observe. Riding a bicycle leverages these capacities as does playing an instrument. We make time from the difference reveal in these Knowing when is articulate and arguably more precise and than musical representations of time. The time of performers is perhaps the most sophisticated demonstration of this human sense of *timing*, though it is present in the most everyday movements and gestures.

These are not qualities, but precise repeatable enactments and registrations of quantity. This might seem odd: to feel (sense) quantity like we feel quality, because quantities are supposed to be *calculated*, an aspect of rational mind.

So knowing when is innate, and performative i.e. not inferred via symbolic calculation. It consists of immediate enactments *now!, again like that, more than that, faster, enough*. Our time "sense" is neurological. It derives from the bodily capacities to make things happen "on time", originally locomotion etc, but now greatly elaborated in all aspects of action and perception. These begin in our actions but seem also to be the basis of how we register quantity outside our control as in listening to music and watching a dancer. In the past such sources of time have been deprecated in favor of descriptive/ symbolic theories.

Is this innate Q sense abstract? In playing music we digest and respond to relations among many simultaneous expressions of time both our own and others that we hear. Can we digest any posited relation of quantity or are the specifics of human experience and bodies folded in to music? E.g. is a drummer somehow a complex metronome capable of being *set to any tempo?* Or a heterogeneous entangled system of distinct temporal resonances both embodied and melded with those of his drums, tunable certainly, but not abstract like system of computation.

Building from representations alone loses the open empiricism of play, and its desire to go beyond itself. To universalize, representations make reductions. In music this is the *loss of detail*. Local knowledge, the local experiment, deprecated. (the specific character of materials, of human bodies and their histories).

The Problem: Computer music inclines towards pure representation. In the digital domain we can generate music via representation alone (code, calculation, scores, scripts) without further need of human intervention: "look ma no hands". This is unparalleled in music history: underestimating the contribution of musicians with their musically specific innate knowledge.

Music differs from science in that personal knowledge trumps the general. The idiomatic turns of a poet/musician create language not the other way around. Classical languages decay without the renewal of (local) dialects.

It would take too long to clarify here, but this isn't a rant against formal speculations in music. It is more a campaign to enlarge musical empiricism, an attempt to remind us of the many tacit ways we know when and to claim that this is an essential source of form in music of any kind.

ADRIANA TO JOEL: Your contribution to the second roundtable was titled *The Role of Effort in Music*. Would you say that some interfaces require that particular type of knowledge, and other interfaces do not? Must the interface be effortful for such knowledge to substantiate in music?

JOEL: When Michel Waisvisz and I were discussing the ideas that went into *Effort and Expression* it was not only resistance to the uncritical enthusiasm for effortlessness in computerland but shorthand for deeper

questions about how music gets its form. Michel had run into big problems trying to carry over his discovery of electronic touch into the digital domain. In order to assimilate touch in a virtual world we had to discover what touch conducted, its intelligence. Effort became a reminder that in the material world, some notes are easy some are very rough (ask Tina Turner). The landscape of effort runs through human bodies, our habits and our history banging up against instruments and acoustic materials. To delete effort for some idea of convenience (making it easier to make music, or for the simplicity of representation, poverty of theory) is a way to remove context from music.

Effort is then a marker for the feedback between the world and our desire.

ADRIANA TO ANDREW MCPHERSON: On your webpage you explain that you integrate high-resolution sensors into acoustic instruments, so that performance gestures can be analysed in detail and correlations drawn with expressive intent. Can you tell us more about your notion of expression? Does your use of high-resolution sensors aim to maximize the performer's control over all the input variables, or are you more concerned with producing complex sonic behaviours? Do you seek to rule out unpredictability, or does it play a role in expression?

ANDREW: "Expression" is a difficult term to pin down, especially as it relates to designing instruments. To me, anyway, the term implies that there is a performer who seeks to express or communicate something using the instrument. As a designer, my job is to let the performer express their own ideas in their own way, without forcing them to conform to my artistic outlook. In other words, each performer playing on the instrument should sound like themselves; they shouldn't all sound alike because the technology has dictated what they can do. This is what we expect from familiar instruments: different guitarists may play similar instruments, but every player can craft a personal identity.

As for how that relates to sensor design, I'm much more interested in capturing subtlety than in trying to control as many simultaneous dimensions as possible. Timing precision seems to be a very important consideration here, as does being able to control slight variations in volume, pitch or timbre. The sensitivity to small changes may be at least as important as the overall range for any given control, provided the interaction is learnable and repeatable.

Complex sonic behaviours absolutely have a role in digital instruments, as they do in acoustic instruments (e.g. woodwind multiphonics, certain string articulations). I'm very interested in unexpected effects or playing techniques which the performer can discover and develop for themselves. On the other hand, I try to avoid overt large-scale randomness in my designs, as I think it moves control away from the performer and into the technology.

But an effect need not be random to be chaotic, where the slightest change in the input will produce a significant change in the output. These situations can be artistically rewarding, and the performer can

learn to control them more precisely with practice, or to embrace the uncertainty on their own terms (rather than on my terms as the designer). I think it can be quite useful for an instrument to have regions of stable, straightforward sonic output punctuated by smaller regions of more complex or chaotic behaviour.

ADRIANA TO THOR MAGNUSSON: You do live coding performances, creating drones with microtonal textures, often in collaboration with acoustic musicians. Potentially, live coding allows for human-computer interaction to happen at low level in the digital architecture, less mediated than if the software encapsulated a large amount of musical theory. But code typing also brings constraints with respect to timing. Does that lead you to dispense with a low level approach? Or would you say that live coders have a characteristic understanding of musical timing, different from that of acoustic musicians, who interact with their instruments in more immediate ways?

THOR: There are many layers to this question; perhaps these can be mapped to the layers in which code is structured. Indeed, one could say that there is a direct relationship between the level of code and the potential for expression. The more low-level the language is, the more control you have over the hardware; the higher you get in this stratification, the more constrained you are by the abstractions defined by the system. But you gain speed: for a musician or an artist working with computers, the key question is at what level they want their constraints to be. We should note that time is always an important constraint as well.

Now, some software defines your music, some defines your work processes, and there is software that's so open you need to build your own systems to think and to express yourself. Different tools serve different people and purposes. Personally I am interested in coding at a high musical level – above synth building, signal routing, or pattern composition – and I have created two live coding systems: ixi lang and Threnoscope. Both of these are built on top of SuperCollider, and although they define their own methods and rules to the degree that they look very different from SuperCollider itself, the user is still able to code in the SuperCollider language. The aim with ixi lang was to be able to code quickly, to communicate the code to the audience through a simple notation system, but also to make the coding easy as I found nightclubs at two in the morning not exactly the right place to be debugging code.

It seems like musical performance and coding require two different types of focus and your points about immediacy and mediation are interesting in this context. There is almost a lived time and algorithmic time, the latter of which is so abstract that it has no duration. And to me these are two different experiences of flow. The live coder is constantly switching between the two, but the issues with timing you point to is the slowness of coding, the anticipation and lack of immediacy. Typing the code is of course an embodied and time-based action, but it is not a gesture that has one-to-one relationship with the sonic results, like we are

accustomed to with acoustic instruments, so we can't talk about immediate gestures as we find with acoustic instruments.

Regarding timing in acoustic instruments, we could talk about the issue of latency (where some acoustic instruments have quite some latency, such as the church organ or bells). If we look at the live coder's actions and observe what they result in, we might say that live coding has almost no latency: the letters appear on the code document immediately after the key on the keyboard is hit! This is not a joke. Live coding is not just about the sound, it's a performance that's equally about the live composition. It doesn't make sense to separate the two words of performance and composition. So the issues of timing in live coding performances depend of course on the person who is playing, the music being performed and the system used. It is here that we can start to look at immediacy and mediation. Both of these words can differ in meaning depending on context, but in acoustic instruments we might say that immediacy is one of gestural immediacy, whilst in live coding we might refer to the time it takes from getting an idea to executing it. Same with mediation, where musical instruments mediate certain gestures into sound, whilst in live coding we might talk about mediation at many levels, for example how methods mediate through encapsulating complexity, how the language itself mediates through its semantics and syntax, or how live coders mediate their intentions. The live coding language is equally designed for talking to the computer as talking to audience members, and in this sense immediacy and mediation are highly relevant to the live coding performance.

ADRIANA TO THOR: You speak of Threnoscope as a graphic notation system, where sound and image represent each other. However, the cause-effect relationships may be not fully understandable, even for those who know SuperCollider very well – as you say, your code looks very different. To which extent is the understanding of the audio-visual relationship important to you?

THOR: There are many aspects of notation in the Threnoscope system: the code, the code score, the representational score (the visual system), and then you can write scores in linear or non-linear formats using timed arrays. I agree that the causal effects might not be understandable immediately, but that's fine: if people are interested they investigate, I think, and arrive at some conclusions, because it's all there. I don't think musical instruments should be necessarily easy to play or understand. We're not designing buttons in an elevator or a coffee machine where the affordances responding to the thing's function should be understood immediately.

If you're asking whether I think it's important that the audience understand the audio-visual relationship, the answer is no. I don't care whether they do or not, some people might even enjoy the music less if they understood everything. People are so different in this regard. However, I think the possibility for understanding should be there, and in

addition I often answer questions afterwards or people can read a paper I wrote about the Threnoscope.

I have sometimes been asked to explain the instrument before I start playing. I've come to the conclusion that this focusses too much on the tool, and draws attention away from the music. How would you have listened to Miles in a concert if he'd started every gig explaining his trumpet and wah-wah pedal? So I don't do that unless playing for a room full of technophiles who really enjoy that kind of approach.

ADRIANA TO ATAU TANAKA: When we met in 1995 you already performed with a system that captures neuron impulses resulting from muscle tension (EMG). You updated that earlier version, but the mode of interaction is the same. The biosignal is captured when you initiate physical gesture; we can say that actuation happens faster than with any acoustic instrument. Do semi-conscious muscle contractions bring certain unpredictability? Is that desirable in your sonic constructions, or do you endeavour to maximise deliberate control?

ATAU: I think that there is a huge spectrum of possibility between unpredictability and control and that neither is interesting by itself. The neuron impulses that cause muscle tension are a stochastic pulse train. So it is not a periodic signal as most musical signals. But this does not mean the EMG signal is random or unpredictable. The stochastic signal does represent the number of muscle fibres firing to cause tension, and this is at some level related directly to the intensity of musical gesture.
At the beginning, in the 1990's, we were in a MIDI controller paradigm, and interested in the idea of "bio-control", as distinct from biofeedback. Biofeedback implied reading a signal that reflected the state of the body, where bio-control implied a form of volitional action. But control is, I think, a dangerous word. To control everything deterministically is not very interesting, and wouldn't give life in music. Ultimately, the muscle electromyogram signal is a very live, living signal that is organic and much more dynamic than any MIDI controller could produce.

Rather than control, I think the volitional aspect is interesting, and this is why I use the system on the forearms – these are the limbs we use for most musical instrument performance, and they are the limbs that are free from other duties of having to hold the body upright, so available to tense and relax freely. Volitional action implies reproducible. So this addresses to some extent the unpredictability issue. But the body is not a machine, the signal is a living signal. We can do the same gesture twice, but we can do it differently. Perhaps never the same way twice. The body can get energised depending on the situation, it can get tired with too much exertion. This is beyond our "control." So this gives a richness in the reproduction of gesture that creates variation – so ultimately more interesting than either unpredictable or totally predictable.

Volitional acts are intentional acts, and I think the EMG is the fastest sensor, closest to the body. Whereas other sensors report on the result of a movement, the biosignal is the signal the body is generating in order to

produce a movement – so thought in this way, it is intention. Alongside this comes effort, and the restraint one needs to exercise not to over-extend. So intention, effort, and restraint, are three key qualities the EMG allows us to use musically.

ADRIANA TO EDWIN VAN DER HEIDE: Your contribution to the first roundtable was titled *Audience and Space as Performers*. Nowadays you create installations, yet you used to perform on stage when we met in the 1990s. Joel spoke of performative skills, which the performer needs time to develop. That is obviously not what you mean in your title. So what does 'performing' mean here? Can we still think of performing in terms of 'expression'? What would that notion of expression entail?

EDWIN: During my study at the conservatory I started focusing on controlling real-time generated sound with sensors in order to create a form of live, physical, control over the digitally computed sound. For most acoustic instruments physical control means a bidirectional form of control consisting of physical actions and physical reactions that are often inseparable (i.e. you touch a string and you feel it move). This means you do not only hear what you're doing but you also sense what you're doing in, for example, a tactile way. Furthermore with most acoustic instruments your body forms an intrinsic part of the sound generation system. However, the sensor-based interfaces that I was using were used to control parameters of algorithms in software but the sensors were not giving any physical feedback regarding what was going on within the algorithms. Another form of feedback that was there nevertheless was of course the live generated sound itself.

This brought two things to me as a performer:

I developed another awareness of my body. I learned to develop and memorize movements and gestures that are based more on the sense of proprioception instead of direct physical (i.e. tactile) feedback from the sound generation.

Because of the 'missing' physical feedback I focused even more on the generated sound.

Working with sensor-based instruments made me not only focus on the generated sound itself but also on the acoustic performance space. I realized that the space can form an intrinsic part of the resulting sound. I became interested in the following questions: How is the sound addressing the space and how is the space responding? And since the audience is inside and part of the space: how is the sound addressing audience and how are they responding? I realized that stage based performances are in the way of fully focusing on the (surrounding) space because of the predominant focus on the stage itself and the performer(s) on the stage. I became interested in the idea of creating environments and, as a consequence, a more active exploring audience. This doesn't mean that I think that listening is not active but I mean active in the sense that they are also taking action in space. Focusing on the space allows me to use and integrate specific aspects of the space in the composition/work. The

role of the audience changes in that they have to explore the space by taking actions and relating themselves to the work. The audience is in a dialogue with their environment and, up to a certain extend, building their own order of events.

This is not a situation where the space or the audience take over the role of composer. The composer is the one creating and structuring the environment. But do the audience members become performers because they have a more active role? In my opinion the audience members do become performers but not performers in the sense of musical performers. They become performers because they perform actions in the space. They don't necessarily perform in a conscious way and wouldn't call themselves performers. They become performers because the work invites and steers them. The audience members let themselves being steered and they interact with the work within all the openness and closedness there is.

When we have an active moving audience they not only relate themselves to the sound but also to the space. Also the space is steering the audience. We get the following triangle: The sound is in a dialogue with the space, the audience is in a dialogue with the space, the audience is in a dialogue with the sound. The space is structured by the sound and the sound is structured by the space. This means it becomes a responsibility of the composer to structure, not only the sound but also the space (or at least, to structure how to use the space).

An interactive work is often seen as a work that reacts to the actions of the audience. I think this is a misconception. I believe a good interactive work is so well structured that it makes the audience do things.

ADRIANA: Interestingly, this seems to point out a possible convergence between interfaces meant for author interaction and user interaction: the term "composing an instrument" is frequent in NIME literature. For example, [Magnusson 2010] describes 'composing an instrument' as defining and limiting the boundaries of a musical space to be traversed in performance. The term is also extended in [Murray-Browne et al. 2011], which proposes an approach to instrument creation as an art form in itself, where instrument, mapping and music are an integrated part of a greater composition.

ADRIANA TO MICK GRIERSON: You developed interfaces meant for individual use as well interfaces for audience interaction. Can you point out basic similarities and divergences in interaction design? E.g., do you create greater amount of constraints when the system is meant for audience interaction than when it is meant for a specific performer? Is the interface less complex?

MICK: I'll try to answer this question simply, but it's not a simple question. Also, I respect the question so want to answer as truthfully and completely as possible.

Audiences. First I'd like to make clear that I haven't ever created instruments for audience interaction. As a composer/performer/content

generator, I'm interested in one-way, non-inclusive experience generation, where I direct and create experiences for an audience in a space. As a musician and designer, I'm interested in creating interactive systems that allow people to play music together more easily, so we can all experience spontaneous music creation as a group. In the second scenario, we are all doing things to each other in a space, and nobody cares about the audience – the audience isn't relevant until you book a gig, and then we're all back to the first scenario. That's just how I see it.

I should add that the choice of title for my piece "Study for Film and Audience" was really meant as a joke about spectatorship and interactivity.

Complexity. I'm quite disinterested in having a long-term relationship with any instrument. I will more or less use anything. I get bored so easily that I need to constantly create new approaches for myself, and I'm happiest performing with something that I'm experiencing for the first time. I love playing other people's instruments, particularly when they are very badly made, or very simple, as they can be challenging and exciting. I learned this from an old friend. He could make a snapped-off piece of wood sound very compelling. So I don't think an interface or instrument has to be complex in order for it to be used to create interesting, meaningful, and complex expressive sound. You just have to understand what sound is, and be present in what you are doing. That's the skill of the musician in my view.

Furthermore, speaking as a musician who's reached a professional level of proficiency in a number of instruments, we spend a great deal of time practicing complex behaviour. This virtuosity has a tendency to infect musical and sonic style in a negative way. I can think of very few instances when this has resulted in music that expresses anything other than 'look how great I am'. This is a significant aesthetic problem that cuts across contemporary music and sound discourse just as it always has. Complex spaces of interaction and behaviour are great, but it is finite, specific interactions and behaviour that carry meaning. These don't require complexity at all.

Constraints. As a researcher and designer, I really care about creating tools for other people to use, as this seems like a harder and more interesting problem from my perspective than making instruments for myself. Most people have absolutely no interest in my approach to music and sound – they aren't going to be convinced by my friend and his broken stick, and I have no aesthetic interest in their approach to music making either. So there are all these kinds of expectations set up about sound, music, composition and meaning that although are totally worthless to me, I must accept are vitally important to others. These are examples of the constraints that I find myself working with, and I really enjoy understanding what it is that people want to do.

Other examples of constraints that I feel really matter include those made significant because of people's physical or mental abilities. I've created tools specifically for people to use just so I can play with those people, and make contact on a non-verbal, human level. They are definitely

not an audience member. In this situation, we are in the second scenario, communicating through sound, and modulating it as a means of discussing our experience together. This experience is much more expressive, meaningful and powerful in my estimation than the homogeneity of contemporary musical culture. I also wonder if it's more important than the notion of composition, or the notion of performance altogether.

In this way I would argue that the constraints I am faced with when working with trained musicians who have what they consider to be culturally valuable affordance requirements are much greater than those I am faced with when working with those from outside contemporary music culture, and who have never or could never otherwise experience making music with another human being. Conversely, the design considerations and technical effort required in the second case is far far greater, as those requirements are beyond my understanding, whereas the requirements of musicians are more or less obvious to me.

ADRIANA: There are very compelling points of discussion here. A study conducted in an hospital environment showed that physical movements change from *exploratory* to *performatory* when a person becomes skilled in the execution of a specified task: movements become fluent, with a "focus on timing" [Kilborn and Isaksson 2007]. Personally I take a long time to develop my instruments, and I stick to each one for years. But I certainly don't find one type of movements more important than the other. To me, creating instruments entails the discovery and development of particular techniques, which combine performatory and exploratory movements: whereas the performatory aspect of the music entails fluency and focus on timing, the exploratory aspect makes the musical thread unrepeatable and unique. This seems close to Andrew's and Atau's thinking about the role of unpredictability and signal volatility. I feel that it is my great familiarity with the instrument that enables me to create interesting musical meaning upon unexpected events that could feel "wrong" within the musical logics. And the audience also has an influence upon the sonic construction. My playing is very sensitive to this empathic link; each performance is a common voyage.

I feel that there are fundamental differences between author-oriented design and user-oriented design. These are not that easy to pin down. One possible indicator is the level of challenge in the interaction, and consequently, the amount of time/ investment one needs to play the instrument/ system. This is a simplistic way to put it, but it touches important political/ economical issues, as for example research funding criteria.

Many designers seek methodologies for musical instruments/ systems to adapt to different types of users, while keeping all of them engaged. For example, Francois Pachet developed what he called *musical mirroring effects*, where, by construction, the level of challenge represented by the behaviour of the system always corresponds to the level of the user [Pachet 2004]. Another example are the *personal instruments* developed by Tod Machover and the MIT Media Lab, which the authors describe as musical tools that enable everyone to participate directly in music-making regardless of background [Machover 2009].

Alternatively, one can defend that an instrument requires great investment in playing, and that developing a new instrument is also developing a new mu-

sical language. For Michel Waisvisz, changing the algorithms that constitute the sound engine meant learning a new instrument, involving the re-incorporation of the conceptual understanding of the engine's functionality into bodily memory [Waisvisz 1999]. Joanne Cannon and Stuart Favilla also stressed that creating a new instrument must be accompanied with developing new skills to play the instrument; one does not learn to play an acoustic instrument in weeks, and that should also not be expected with digital instruments [Cannon and Favilla 2012].

ADRIANA TO MICK: Returning to your previous answer Mick, you use the term "culturally valuable", which is a very broad term. It brings the question if there are essentially different ways of understanding the cultural function of music. When trained musicians play together, human interaction is certainly fundamental; yet playing together is satisfactory or not depending on the sonic result – the musical logics, bound not only to the individuals involved, but also to their particular skills, and to the whole music history. I think that Joel explained that in a very clear way. Would you say that the value of a sonic construction can also be considered independently from the musical logics itself, i.e., do you think it can derive from the human value of personal interaction alone? Would you draw a distinction between "sound organisation" and "music"?

> **MICK:** Ok that's a great question. Before I answer, I should address why and how I used the term culturally valuable. I'm saying that musicians tend to have very strong ideas about what is culturally valuable and what is not. I'm saying that this is a constraint that affects the design process, and that it's a problem. A problem I'm fine with by the way!
>
> Fundamentally, coming to your actual question, it's really clear to me that when anybody plays music with anybody else, the sonic result is as important regardless of their skill, or self-identification as musicians. My point is that certain kinds of skills do not necessarily affect the sonic result. In fact, I think it's arguable (and I have argued) that skill often makes things sound much worse. Sonic results, certainly from a compositional perspective, have nothing to do necessarily with skill beyond the skills required for sonic construction. Take concrete music, for example: it's the sound that is primary. Musical interaction is actually not that useful in the context of sonic construction – only the sound is. Finally, I would state that great sonic results can be generated by a person using/working within a system that is designed to produce a specific sonic outcome, and that this is a fascinating political resource, and one that might invite and encourage all people to consider the value of very different types of sonic experience, regardless of preconceived or prejudiced notions of cultural value.
>
> And more directly, I don't really think there is a meaningful difference between sound and music in general. I think there are many different types of sound and music, and they are all beautiful. Currently enjoying listening to the air conditioning hum in my office, while people move chairs above me. Awesome.

ADRIANA TO MIGUEL CARVALHAIS: You have been interested in how the audience perceives a performer's interaction with their system. Once you told me that sometimes, performer and system are perceived as whole, and other times not. What do you think leads to one or the other?

MIGUEL: When thinking about interactive systems for performance – either when designing them or when studying them in other contexts – I find it extremely important to consider how the audience may interpret the interactions at any given point throughout the performance. Although these systems are interactive, they are commonly not designed to be experienced as such by the audience, but rather they're experienced as performance tools to which the audience has no direct access. Therefore, the audience relates to them in a manner similar to what Golan Levin describes as "vicarious interaction" (more about this in Levin's own writings or in Katja Kwastek's excellent *Aesthetics of Interaction in Digital Art*).

In any performance with interactive systems – and this includes both stage-performances as vicariously witnessing any other person directly interacting with a system – audience members will try to understand the affordances of the interactive system, will try to infer rules of causation or of transformation of the interactor's actions by the system, or to predict the system's actions and reactions throughout the performance. This of course happens in parallel with the more conventional aesthetic enjoyment of the work, but opens the door to two new levels of aesthetic enjoyment that we may identify as: 1) the aesthetics of interaction and, 2) the aesthetics of generative processes (particularly when the system is partially autonomous and not only responding linearly to the actions of the performer or interactor).

When witnessing a performance with an interactive system or instrument, or when interacting vicariously, one may perceive the aggregate of interactor + system (or interactors + systems) as a single entity, or one may read them individually, basing the interpretation of the human interactor on our own knowledge of physical mechanics and human psychology, and trying to predict possible responses and reactions from the system, thus developing a "theory of the system" that may help one to understand and predict the development of the performance.

I find this way of reading performances of the utmost importance for the enjoyment of this aesthetics of interaction. From this it follows that both the composer, the designer of the interactive system, and the performers, must be very aware of the necessity to give ongoing clues or affordances of the system's mechanics to the audience, so that it becomes possible for them to construct meaning from the observation of the performative act with the interactive system.

ADRIANA TO MIGUEL: Sensing causation is not necessarily the same than understanding the actual base cause-effect relationships. You use the term "clues", which raises the question: do you enjoy it more when you feel that you understand/ predict the cause-effect relationships, or, do

you like to be confounded, perhaps to the extent of quitting that logic understanding, and focus on the experience itself?

> **MIGUEL:** Sometimes the clues may lead to a logic understanding of the process, to a complete knowledge of how the system reacts to the interactor's input and, conversely, of how this reacts to the system. Sometimes they may simply lead to the identification of a number of cause-effect relationships that may barely allow one to understand that whatever is happening is not arbitrary, that there is a meaningful exchange going on even if we don't quite get it. In either case, this doesn't mean that all the details of the process are understood, but just that the audience is able to predict relationships and thus be surprised whenever either system or interactor deviate from the predicted outcomes. Both an understanding and accurate prediction of events as confusion may have their place in a performance, and they may both lead to its enjoyment.

ADRIANA: I can only agree with the importance of providing "cues", so that one gets a sense of causation – as a researcher, instrument designer, performer, or audience. However, personally I do not like to focus for too long on the mechanics of the instrument, and even less, to fully predict its mechanics. I suppose that is an aspect of subjective, aesthetic experience. But it may not be restricted to me as an individual. This actually motivated a study about perceiving causation without understanding the base cause-effect relationships [Sa et al. 2014].

ADRIANA TO ALEX MCLEAN: You do live coding, like Thor, and live coders project the computer screen so that audience members can see the code. Is there a political meaning to it?

> **ALEX:** Without projecting screens, people can't see any of the activity behind the performance. That's fine in a lot of cases, sometimes activity is a distraction, and code doubly so. However if you're on stage, and people are sitting in rows watching you, it's just a bit ridiculous that they can't see what you're actually up to.
>
> But yes, I think there are political reasons for projecting. Not too long ago the fashionable movement for creative coding was 'generative art', a fairly utopian movement looking for computational creativity in quite simple processes, sometimes mistaking arbitrary random selection for infinite, qualitative variety. Generative artists have endless discussions about authorship – if you program a computer to make art, is the author the programmer, or the computer? In my view this whole question of authorship is an intellectual cul-de-sac; humans have always thought through their tools, and followed lines through their materials. Thankfully live coding makes this question redundant, no-one can deny the human influence in such a performance.
>
> I think this reassertion of the humanity of computer language is political. At a time when there is much to fear from opaque software that governs our relationships and lives in general, making the authorship of code visible gives us a chance to reimagine code as social and communal. I don't think I'll ever meet a linguist who agrees, but my hunch is

that we are stepping towards making programming language more like natural language.

ADRIANA TO ALEX: You perform in clubs, and people may not understand programming language; anyway you like people to dance to your beats, rather than pay attention. To which extent is their understanding of your code important for you?

ALEX: Understanding code is not important to me, in fact in Slub we have sometimes purposefully obscured our code to make it more difficult to read, while still showing some of the activity of the edits. When I watch live coding performances, I don't read the code. Indeed even as a live coder I don't have top-down understanding of what my code is doing, I am just working with the code as a material, while listening to the output of the process it describes. I don't think the code holds any answers for me, it's just a step in a wider feedback loop. I changed my mind a bit about this though when a Deaf audience member let me know he got more from the music by reading the code, and was annoyed by the strobe that stopped him from being able to read it. So it's not important to me, but it seems to be crucial to some listeners, and inconsequential to others.

ADRIANA: Thank you all for your precious contributions to this discussion. Each topic can unfold in many directions. The fact is, with digital instruments physical action will always be mediated through code. The general purpose of this conference is to expose and discuss the principles governing interaction – that is the reason for the hyphen in INTER-FACE.

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