On Values, Technological Mediation, and the Artifacts they Create

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Abstract

This paper investigates values within the material and sonic cultures of New Interfaces for Musical Expression (NIME) research with a focus on the techno-cultural practices prevalent at the NIME conference and in related human-computer interaction (HCI) research. The NIME community, despite its cultural diversity, relies disproportionately on particular technologies, aesthetic priorities, and forms of musical practice, and these affect both the tangible artifacts of NIME research and the stories that are told about them by the authors. We conduct a situational analysis of 26 tangible digital musical instruments (DMIs) from the 2024 NIME conference proceedings alongside 20 artifact-related papers from the 2024 ACM Designing Interactive Systems (DIS) conference. Our analysis reveals five emergent values-oriented themes: Unconventionality, Community, Care, Intimacy, and Transformation. We probe areas of convergence and divergence within each theme and speculate on actionable steps toward the generation of differentiable, community-enabled and values-accurate design artifacts.

Keywords

Expression, Values, Diversity, Material culture, Techno-sonic mediation, Sonic monoculture

1 Introduction

Over the past 25 years, researchers and artists within the New Interfaces for Musical Expression (NIME) community have explored a considerable variety of new interactive technologies, performance practices, design methodologies and sociopolitical ideologies. The NIME community features considerable (though perhaps not yet sufficient) demographic and geographic diversity [4, 30, 78]. At the same time, part of what defines NIME as a community of practice [50] is a shared repertoire of often-used technologies and aesthetics.

Aesthetically, NIME draws significantly though not exclusively from post-Cage experimental practices which George Lewis describes as being "characterized by an absence of intention"[1] [46] and from the rationalist legacy of high modernism. Collectively, Born suggests these practices are defined "by a complex and overlapping set of assertions of difference" [7] from more "conventional" and "popular" music technologies and music-making practices[2] [45, 65]. Meanwhile, in contrast to Lewis's critique of certain experimental music practices as being "divorced from social or cultural implications" [46], a recent trend in NIME is the self-conscious integration of extra-musical personal, political or social values into tangible design artifacts.

A growing critical literature probes the sociocultural, economic and technical influences of NIME research and music technology more broadly [8, 30, 38, 50, 53, 55, 57]. But we are left with an observable disconnect between heterogeneous stated values in published papers and observable through-lines in design artifacts and sonic cultures which Snape and Born describe as "familiar and consolidated technical-and-aesthetic universes" [8]. The purpose of this paper is to capture a contemporary snapshot of this phenomenon, examining the stated values within recent NIME research papers and where those values might (or might not) have consistent material or aesthetic manifestations.

The primary method of this paper is *situational analysis* [14] applied to a selection of 26 papers from the NIME 2024 proceedings and 20 papers from the 2024 ACM Designing Interactive Systems conference (Section 4). Our analysis has two aims: (1) to shed light on the tensions between personal/narrative values, communities of practice, and the technologies that make interactive system design possible and (2) to offer a possible way forward via a values-attuned expansion of Gurevich's ecological notion of "new expressive cues" [26].

2 Related Work

Albert Borgmann described design as a discipline concerned with "world-making" rather than world description, explanation, or prediction [39] - a sentiment still understood, believed, and practiced within designerly communities today [76]. As such, the techno-social values inscribed within contemporary experimental musicking and DMI-making practices become sites of ethical importance worthy of critique and scrutiny. Assuming the inherently political nature of design artifacts [77], we introduce a few critical stances on the mediation of music making practices through communities of practice and technology.

2.1 The Sound of NIME

The historical inclination of some artists and institutions toward separating the experimental art music which emerged in the mid-20th century from other improvised and experimental musics of the time[3] [7], stemmed from a desire to contribute to the "great trajectory of western European art music composition" [73]. Such attempts at canonizing particular musical traditions raise uncomfortable questions of whose music is declared legitimate or not. While not the moral responsibility of individual NIME practitioners, it is important to consider the historical/political context that still influences contemporary NIME aesthetics.

[1] Lewis's "absence of intention" could refer to chance and determinism, for example, rather than self-expression and determination. Of course, by way of institutions like STEIM, NIME is also influenced by a free improvisation tradition of which Lewis himself is a leading voice. [64]

[2] Examples include a particular approach to musical time scheduling and the "reification of timbre" within the NIME community.

[3] Namely, the black American art form often referred to as jazz.

NIME '26, June 23–26, 2026, London, UK

A sonic culture defined by the destabilization of traditional musical practices (timbral virtuosity rather than instrumental facility; the ambivalence of intelligible performance practices and rejection of musical time, "constricting harmonies, forms, and rigid meters," [6]; the rise of indeterminism; etc.) creates quite the conundrum for a community interested in novel forms of musical expression: if the project of transforming music is successful, then surely what "musical expression" means should change as well [26].

While acknowledging the artistry and open-mindedness of *individual* NIME practitioners, NIME (collectively) runs the risk of technical and aesthetic groupthink, leading to a sort of sonic monoculture which evolves far more slowly than the apparent focus on "newness" might suggest. The characteristic of this monoculture is not a literal aural sameness, but a shared attunement to the world defined by a rejection of popular music and culture, the reliance on a narrow set of technological tools, and – potentially – the disregard of sociocultural concerns [7].

We will question the last of these points in this paper.

2.2 Techno-Social Mediation Critique

Understanding the fundamentally intertwined relationship between computation and DMIs, Tahiroglu et al. note that computation "shapes our relationship with DMIs and also transforms our musical norms, habits, language and intentions" [72], while Magnusson argues "the digital musical instrument ... is constituted by generic, prescriptive and normative sets of rules that affect or direct the musician at the high level of musical language" [49].

Outside of NIME, Marrington suggests "the DAW is essentially a genre-specific medium in the sense that it foregrounds specific notions of creative practice associated with the aesthetics of electronic music" [51]. While Marrington interrogates the DAW as a site of sonic hegemony, many have had similar ideas regarding Max/MSP and Pure data [7, 8, 45]; Lepri and McPherson suggest "the identity of an instrument emerges from a process of recursive inscription from successive generations of musicians and technologists" [45].

Within NIME, Marquez-Borbon and Stapleton unpack the term *community* to suggest that "technological developments... inherit, intentionally or not, characteristics of the social, cultural or economic environment from which it emerges" [50], while Morreale et al. examine the inherently political nature of design and musical instruments [55]. Additionally, Pardue and Bin reflect on an "invisible" musical hegemony that is often overlooked, namely "the culture of technological development" [57].

One can question the moral and ethical implications of technological and community mediation of ideas, but that's just one part of the equation: that NIME is a scholarly meeting point with certain commitments toward novelty and research-orientation of musical expression should not be overlooked [30]. In support of diverse research practices in the NIME community, Gurevich asks the question: "what are the traditions and modalities of research that we wish to draw upon to advance the state of knowledge and art?" [24]

2.3 NIME's Epistemological and Cultural Accountability

NIME practitioners obviously engage with design artifacts, but what of the sonic output of DMIs? How does the sonic output of NIME contribute to the dissemination of knowledge? Is there any commitment toward making experimental music that sounds "good" – by whatever varied definition of "good" one might come up with [63]? Or is the primary objective of sound within the NIME community to serve as a vehicle for other forms of knowledge production?

As a community of creatives who straddle the line between design and research, there ought to be a clear stance on the subject such that "robust discourse on transdisciplinary understanding" [24] can flourish. Unfortunately, no such consensus exists. Consequently, the question of design researcher accountability is not only one of practicality (as the types of knowledge expected from science and design aren't necessarily compatible with one another), but of ethical and moral import; in alignment with Borgmann's view, knowledge produced through design practice not only contributes to human understanding of the world, but directly shapes what design researchers and practitioners "believe is technically feasible and *desirable*" [68].

One of NIME's inherited musical practice, post-1950s experimental music characterized by aleatoric and indeterminate elements, has a history of differencing itself from other musical practices (Section 2.1). Anthony Braxton remarks: the words "have been coined... to bypass the word improvisation and as such the influence of non-white sensibility" [11, 46]. Although NIME is temporally removed from many of the damaging implications of language used to describe contemporary and experimental musics of the mid-20th century, and although it takes influence from other traditions, NIME still suffers from a cultural bias disguised via exnomination: an aversion to and avoidance of naming. Further, exnomination not only provides a safety net for exclusion, but allows for the "avoidance of self-recognition and self-definition" [19, 46] - a privilege not offered to marginalized, gendered, or racialized communities.

A more personal motivating factor for the inquiry into the values of the community stem from the first author's dissatisfaction with the NIME community's poor track record of Afro-diasporic inclusion [2, Section 4]. While an examination of the desires of a research community won't make it any more or less inclusive in the present, it may offer insight toward a more inclusive future.

3 Methodology

In an effort to understand the sonic and material values of the NIME community and the influence of technological mediation, we apply Adele Clarke's situational analysis methodology [14] to a collection of published papers. Rather than focusing solely on NIME, we complement this effort with analyses of papers from the ACM Designing Interactive Systems (DIS) conference, which shares certain affinities with NIME: DIS papers frequently introduce new interactive systems; papers often take design- or arts-led methodologies; and they often feature attention toward sociocultural values. Furthermore, in a useful contrast to NIME, DIS lacks an obvious technical canon of hardware and software tools, allowing scrutiny of where NIME values might emerge in part from the technologies used [53].

Situational analysis (SA), a three-stage mapping process, was selected for its modernized approach to grounded theory [21]. Intended as a supplemental practice toward grounded theory generation [21], SA centers the social situation as the fundamental unit of analysis. Through a reflexive, qualitative mapping process (Section 3), SA aims to "elucidate the key elements, discourse, structures, and conditions of possibility that characterize the situation of inquiry" [14]. Although similar in scope to popular qualitative methodologies, namely reflexive thematic analysis

[10], we've opted to leverage SA's inclusion and emphasis of social worlds, discourse, feminist ideology, and nonhuman elements within the analysis process such that we can gain a deeper understanding of the overall situation of inquiry rather than simply "identifying, analysing and reporting patterns (themes) within data" [10].

The analysis began with the following criteria to determine which NIME papers would be of interest:

(1) Specifies the construction of a tangible DMI; not software or "tool" focused
(2) Should explicate a particular DMI, not a performance practice, philosophy, taxonomy, or composition
(3) Should not focus solely on challenges, strategies, or suggested practices of/for design or case studies

The criteria were applied to NIME's 2024 conference proceedings; our search revealed 26 paper/artifact pairs.

We performed a similar search on the DIS 2024 proceedings: We identified 20 paper/artifact pairs. In both cases, we chose a single-year snapshot of 2024 rather than a longitudinal search to capture the zeitgeist of discourse and design practices within these communities.

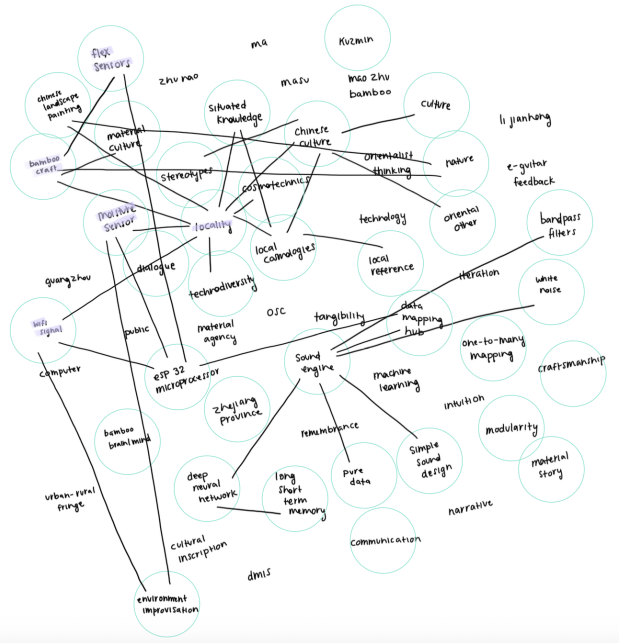

Figure 1: An example of an unorganized situational map for a NIME 2024 paper [42].

3.1 Data Analysis

Situational analysis, at its simplest, involves the following: identifying relevant materials for analysis; engaging in a reflexive gathering of relevant elements (human and nonhuman) within each data point; identifying relations/connections between elements (Figure 1); and identifying patterns of collective action and commitment.

The following section discusses the process in further detail.

open codes - zhu nao

① designing within specific cultural contexts **within-a-culture-memo**
② acknowledging the influence of localitiy + local cosmologies
③ articulating a symbolic and practical dimension of a material
④ contributing to chinese dmi discourse **ethnic-centric-design-memo**
⑤ conscientiously avoiding the "oriental other"
⑥ taking inspiration from a specific locality
⑦ allowing a local reference point to inspire design
⑧ embracing cosmotechnical philosophy
⑨ contributing to technodiversity **diverse-technology-memo**
⑩ leveraging cosmotechnical thought within techno-diverse-centric design
⑪ continuing to grow and encourage dialog surrounding chinese nimes
⑫ including local ways of knowing + being in the development of technical systems **local-knowledge-memo**
⑬ prioritizing rural rather than exemplary sites of cultural futurity **unconventional-prioritization-memo**
⑭ embracing cosmotechnic plurality within dmi design **plurality-memo**
⑮ explicating the experience of a particular site within a dmi
⑯ acknowledging material agency **affordance-leveraging-memo**
⑰ rejecting stereotypical "orientalism"
⑱ attending to locality, material affordances, and traditional dmi materiality
⑲ using locally-sourced material
⑳ leveraging one-to-many mappings **mappings-memo**
㉑ using machine learning to perform "memories" of environmental data **ml-memo**
㉒ enabling flexibility via multiple ml algorithms **flexibility-memo**
㉓ environmental improv and memory
㉔ bridging the gap between artisinal practices with conventional dmi design practices
㉕ engaging with traditional artisanal craftsmanship technique **skilled-practicioner-memo**
㉖ acknowledging the material's perspective
㉗ designing toward modularity, affordability, and replaceability (or the ability to repair cheaply, quickly, and sustainably) **modularity-memo**
㉘ engaging with crafting technique intrinsic to the material as a non-western approach to dmi design
㉙ acknowledging cultural and musical ideas inscribed in music instruments and materials **values-tracing-memo**
㉚ creating relational consistency via cosmotechnical thought
㉛ designing possible futures from the "bottom" up

Figure 2: An example of an organized situational map for a NIME 2024 paper [42].

3.2 Situational Maps

The analysis/mapping process takes course over three stages - situational mapping, positional mapping, and social worlds mapping. Situational maps serve as a proxy to record the relevant components within a designated "situation of concern." We designated a single situational map for each paper/artifact pair - i.e. instead of a single situational map that covers the entirety of the situation of inquiry, we compiled 46 situational maps to gather a more comprehensive view of tangible interactive system design practices, strategies, and values within the NIME and DIS communities. The following questions, posed by Clarke, guide the situational mapping process:

(1) Who and what are in the situation?
(2) Who and what matters?
(3) What elements "make a difference"?
(4) What nonhuman things matter - to whom/what?
(5) What ideas, concepts, discourses, symbols, sites of debate, etc. matter?

As we've considered each design artifact its own situation of inquiry (to feed into the greater situation), we've amassed a

large database of notes that would have proven very difficult to traverse without the aid of linked intermediary notes; our "analysis software" of choice became popular note-taking application Obsidian due to its ease-of-use and built-in note-linking feature.

Our primary goal throughout the situational mapping process is a thorough examination of each design artifact inclusive of 1) the motivational structuring, 2) the design process, and 3) the interaction details of each project respectively. Situational mapping occurs in two stages: 1) messy/unorganized (e.g. Figure 1) and 2) organized mapping (Figure 2). Unorganized situational maps include a collection of handwritten human and non-human actors - specified within the research document - that pertain to the three primary areas of interest and that contribute to the overall situation of interest. Relations amongst actants are drawn[4] to begin the process of isolating important thematic material. Upon completion of drawing relations within the messy situational maps, the maps are organized, annotated, and coded. The maps are structured into the following categories:

(1) Open Codes: Highly specified, process-based notes based upon the explicated actions of the designer-researcher.
(2) Interaction Details: Description of the "ideal" working / performance environment.
(3) Media: Images, video and audio recordings, etc.
(4) Quotes: Stand out quotes from the research document.
(5) References: References that seemed particularly pertinent to some aspect of the design process
(6) Material Bits: Non-human actants that contribute to the research product assemblage.

After structuring, the open codes, interaction details, and material bits are annotated and linked.

3.3 Social Arena Maps

The categories that are deduced from the open codes, interaction details, and material bits are placed into social arena maps (which consist of the ideas, values, and strategies of the community that are enacted and stabilized over time).

Each social arena map includes the following categories: open codes - motivations/desires of the authors regarding their respective interactive systems; interaction details - technical specification of the system as well as tools and materials used during the making process; media - audio/video shared by authors (if applicable); themes - thematic alignment amongst all artifacts; and material bits - shared material configurations between musical and non-musical interactive systems.

During the social arena phase of analysis, linked notes served as proxies for emergent theme generation. Linked notes include a shared topic of interest (i.e. the use of a particular software or motivating factor) alongside the specific implementation of the shared interest for each constitutive design artifact (Figure 3). Theme generation (i.e. the reduction of similar, albeit distinctive, linked notes into defined emergent themes) occurred via the clustering of similarly-linked notes.

3.4 Positional Maps

Positional mapping occurred in a multi-stage process. Initial positional mapping took place during the situational mapping phase of analysis, but continued throughout the mapping process as new connections were discovered. Although the primary goal of situational mapping is to identify actants within the situation

[4]Relations are drawn in the style of a typical mind map with individual actants circled and connected via hand-drawn nodes.

Figure 3: Linked note detailing DMIs that used Max/MSP or Pure data as a design material.

of inquiry, a direct focus was also placed on the positionality i.e. values-orientation of authors.

4 Results

Although a plethora of unique motivations were identified throughout the analysis process, we encountered many shared values within the NIME and DIS communities. The most common emergent values[5] are as follows:

- Unconventionality
- Community
- Care
- Intimacy
- Transformation

4.1 Unconventionality

The value of unconventionality (Table 1) can mean anything from seeking inspiration from outside fields, disciplines, and interests to critiquing and challenging the normative aspects of humanity. Further, some approaches include complete reconfigurations of interaction practices that have become commonplace (not only within artifact-driven research communities but within everyday life as well).

Unconventional approaches to design, interaction, musical expression, and performance seek to break free from "traditional," "conventional," and/or "typical" modes of design (methods, materials, and evaluation), music making (performance, interaction, and enjoyment), and interaction paradigms [1, 5, 17, 22, 31, 32, 37, 43, 44, 48, 59, 67, 75]; incorporate non-paradigmatic interactions into domain-specific interactive systems [9, 23, 79]; advocate for individuals who belong to historically oppressed, underrepresented, or marginalized groups [29, 33]; and any one or combination

[5]We use "emergent" here to denote we're intentionally leaving out more conventional community strategies and cliches such as the use of microcontrollers/sensors, Max/MSP and Pure Data, modularity, etc.

Subtheme	Artifact	Code
Alternatives	Vocalcords [1]	Seeking inspiration from non-musical phenomena (cat's cradle)
	Stitch [9]	Textile design as musical process
	Sonic Wings [59]	Rejecting control via randomness and companionship
	Pain Creature [48]	Relinquishing control via somatic awareness of chronic pain
	Mechanical Techno Project [17]	Encouraging errors, instability, and unpredictability
	Gestolumina [32]	Alternative ways to engage with sound and music for the Deaf
	MagneTip [23]	Musical expression via unusual interaction techniques (Drawing)
	Icy Interfaces [44]	Prioritizing ephemerality over standard stable/reliable interactions
	Groovetransformer [28]	Abstracting away traditional methods of composition and control
	Sophtar [75]	Enabling interactions beyond conventional organ consoles
	Entering the 3d Printer [22]	Reconfiguring designer, machine, material, and environmental relationships
	Undertable [31]	Disrupting existing connections with (and relationships mediated by) tables
	How to Train Your Drone [43]	Rejecting normative assumptions about artifact knowledge requirements
	Retrospective Autoethnography [5]	Resisting the traditional representationalist take on data in HCI
	Designing for Interdependence [70]	Challening the status quo to foster more-than-human relationships
	Plant-Driven Actuators [34]	An alternative to immediacy
Subversion	Rheostat Rotary Rack [33]	Challenging gender norms and roles
	Lorentz Lap Brass [67]	Embracing a non-traditional approach to evaluation
	Resistive Threads [29]	Energizing textile metaphors and matters as sites of social change

Table 1: Theme 1: Unconventionality. Artifacts, subthemes and codes within this category.

of the motivations above via intermediary artifacts (specifically, musical instruments that control other instruments .

Unconventional approaches have been further clustered into the following subgroups: alternatives, subversion, intermediary and misuse.

Alternative approaches tend to be non-disruptive in that they're not meant to destabilize normative conventions, but seek to identify and perhaps prioritize other ways of knowing and doing.

Subversion is much more intentionally disruptive in nature, usually incorporating an overt, non-normative political position that defines some facet of the interactive system.

What is most peculiar about "unconventional" approaches within the context of our analysis is that this particular value (the desire to make an artifact, making process, or form of interaction that is outside of the norm) was the most populous of all emergent values that were identified. What's more, the subvalues attended to within unconventionality (rejecting control, somatic awareness of chronic pain, encouraging error and instability, challenging gender norms, to name a few) are completely unrelated to one another. Naturally, we're left asking the question: if the majority of researches are (self-identifying) as engaging in alternative ways of being and doing, then what, exactly, does unconventionality mean?

4.2 Community

The commitment to community (Table 2) (in creation, cultivation, and prioritization) contributes to a socially situated understanding of the world.

This theme divides into two approaches to community which we label *ethno-socio-cultural* and *relational*. Ethno-socio-cultural approaches to community value cultural specificity and prioritization [29, 42, 74] and inclusion [32, 47, 52, 79]. Similarly to unconventionality, ethno-socio-cultural approaches seek novelty in the design choices that are either not prioritized or are antithetical to traditional forms of making and performing within HCI communities. However, where unconventionality is usually ethnicity-agnostic, ethno-socio-cultural community leans into ethnic and social difference.

Relationality concerns itself with community facilitation and cultivation [15, 35, 37, 59, 61, 62]. Relational artifacts facilitate situated sense-making through personal relationships and interactions with artifacts and histories [62]; promote mutual understanding between sighted and unsighted individuals through shared musical performance/experience [15]; and deepen community bonds via playful traveling interactions [37].

Musically, community-based approaches to design range from "non-dialogic" practices that reject "habitual understandings" of traditional musicking performance paradigms [42], to engagement with more conventional musical material such as vocal technique and phrasing [36].

Perhaps the most sonically distinctive of all the DMIs analyzed reside within the community category; specifically, DMIs commited to specific ethnic communities. The Bishop Boombox [52], Agbaixo and Botoes Falantes [74], and Transhuman Ansambl [36] in their commitment to preserving and/or prioritizing ethnic diversity, created space within the NIME community for alternative sonic realities.

4.3 Care

Care (Table 3) suggests both an internal and empathetic turn within NIME/DIS. Self care refers individual wellness, while empathetic care refers to sustainability and care for others.

Self care includes themes of meditation [9, 33], empowerment [48] and acceptance [20].

Sustainability primarily focuses on geographically local materials [74] and material reuse [27, 41, 79] while care for others encourages using technological processes to create spaces and technologies of healing for both humans and non-humans alike [12, 29, 35, 58].

There isn't any prevailing musical output or contradictory messaging within the care category, however, in revisiting the messy situational maps to learn more about discourse within artifact-oriented design communities, a rather counterintuitive discovery was revealed: in many cases, the motivational values and ideologies that prompt DMI design are as equally important, if not more so, than musical values, musical output, or the DMIs

Subtheme	Artifact	Code
Ethno-socio-cultural	Zhu Nao [42]	Taking inspiration from a specific locality
	Within a Musical Culture [74]	Resonance within a specific musical community
	Resistive Threads [29]	Self-reflection and community care via fabric
Novices	Bareemins [79]	A commitment to accessibility and inclusivity
	Malletwand [47]	Designing intuitive DMIs
Disablity	Gestolumina [32]	Music enjoyment for the DHH
	Bishop Boombox [52]	Prioritizing the disabled user
Relational	Sonic Wings [59]	Companionship between human performer and electronics
	Musicane [15]	Promoting mutual understanding through shared experience
	Red Redacted Theatre [62]	Facilitating unpredictable relationships
	Interactive Knitting Machine [37]	Deepening relationship with community members
	Domestic Grief Practices [61]	Placing grief experiences in relation with one another
	Designing for Interdependence [35]	Emergent relationships via multispecies cohabitation

Table 2: Theme 2: Community-oriented Approaches. Artifacts, subthemes and codes within this category.

Subtheme	Artifact	Code
Self Care	Stitch [9]	Self care via relaxation/meditation
	Rheostat Rotary Rack [33]	Creating a meditative space through slow performance
	Pain Creature [48]	Self care and empowerment
Sustainability	Within a Musical Culture [74]	Geographically local material culture and sustainability
	Two Experimental Instruments [41]	Material reuse
	Bareemins [79]	Designing for sustainability and the environment
	Threads of Traceability [27]	bridging the gap between sustainability and consumer engagement
Care for Others	Snugglebot [58]	Supporting human wellness via simple technology
	Resistive Threads [29]	Healing through technology
	Algae Alight [12]	Prompting care and relationsohips with more-than-human agents
	Designing for Interdependence [35]	Mobilizing care for the local ecosystem

Table 3: Theme 3: Care-oriented Approaches. Artifacts, subthemes and codes within this category.

themselves[6] - or, at the very least, the way design researchers write about their artifacts suggests equal importance of musical and extra-musical values (Figure 4).

In the same way the DIS community imagines new ways of interacting with the world through varied motivational ideologies and values (the prioritization of ecological care and understanding [12, 35], community healing and material reuse [27, 29], and the support of human wellness via simple technology [58] to name a few), the NIME community offers interactive system designers a plethora of possible interaction paradigms for musical instruments.

What hasn't been quite as thorough within the community, is an exploration of how these values can extend throughout the musicking process. This isn't necessarily a critique, but rather an acknowledgement of the difficulty of designing interactive systems that make musical sound.

4.4 Intimacy

Intimacy (Table 4) insinuates a desire for connection and suggests a desire for deeper, meaningful interactions with others (humans and non-humans alike).

Within the context of our analysis, intimacy is the only category to contain more DIS artifacts than NIME DMIs. Within the NIME community, intimacy is achieved through the creation of intimate spaces via sound spatialization [36]; an increased "understanding of intimate menstrual fluids" [69]; and the combination of audio and haptic feedback to replicate acoustic intimacy [23]. Within the DIS community, there is a similar breadth of approaches to intimacy including the prioritization of human touch/closeness [31]; intimate interaction via the absence of screens [29]; and intimate relationships between people, objects and/or places [40, 43, 70].

Of particular interest to this research project is a manufactured relationship between human and non-human agents that, although not intentionally performance-oriented, creates a compelling performance-practice-like interaction and values-attunement (Section 6.2) that is in alignment with an ecological approach to musical expression that may lead to interesting avenues of musical exploration.

How to Train Your Drone utilizes the umwelt, the "mutual inaccessibility" of the different experiential realities of living organisms [43], as a design metaphor for a new kind of interaction between humans and drones. Inspired by two unlikely sources, jellyfish and child development, La Delpha et al. sought to develop technological umwelts dependent upon human shaping that ultimately led to unique and individualized human/drone relationships.

The results of How To Train You Drone suggest a profound implication; although the drones and human could never truly "know" one another, somatic sensitization can allow humans to sense not only how the drone sensorially participates in our world, but how our behavior, in turn, impacts the drone's; as the participants within the study learned to shape their drone's

[6]Extramusical values weren't particular to Care, but were recognized as prominent factors of DMI design when reviewing this data cluster.

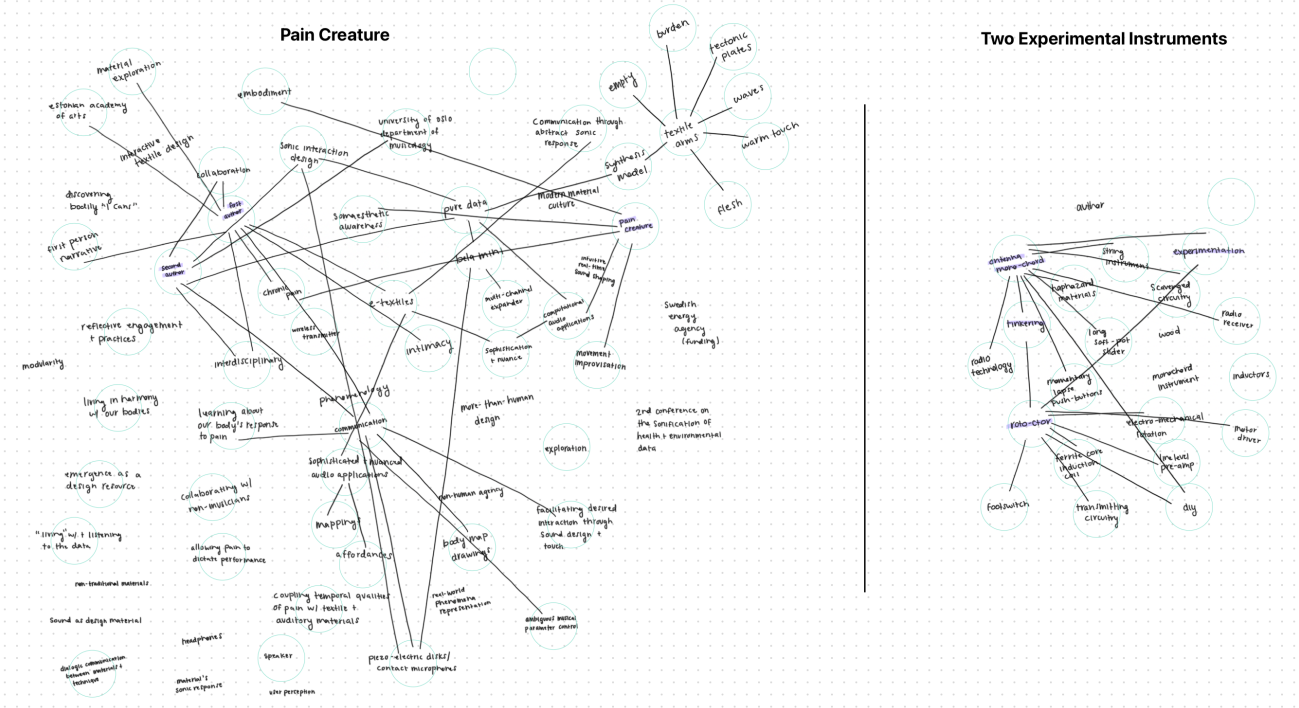

Figure 4: Two messy situational maps within the Care category. Much of *Pain Creature's* interest lies not only in the instrument itself, but within the relationality between the co-designers as well as the first author's struggle with chronic pain. Conversely, *Two Experimental Instruments* focuses squarely on the design and technical specification of the DMIs.

respective umwelts, they gained an intimate understanding of what and how the drones sensed.

In reading How to Train Your Drone as an "expressive" artifact, one way expression manifests is in the understanding of the idiosyncrasies of one's drone and the behavior changes required to grow the drone's experiential area. With an influx of extra-musical values within the NIME community, there's a wide range of "expressive" potential waiting to be explored.

4.5 Transformation

Transformation (Table 5) includes the following subcategories: augmentation, expansion, and metaphorical transformation.

Expansion refers both to an empowered user whereby more creative control is offered within a usually restrictive interaction [28]. Augmentation concerns itself not only with enhanced "traditional" instruments [54] but also refers to ecological improvement in order to facilitate a more "meaningfully accessible" world [52]. Lastly, metaphorical transformation seeks to crystallize the intangible whether it be the singing voice [1], sound in general [17, 18], or a political/discursive process [29, 33].

Examples of expansive and augmentative DMIs (respectively) include Groove transformer, which offers users creative control to redefine and reroute decoupled musical output and the Hyperney, which capitalizes on the "unused potential" of the ney (i.e. finger holes that aren't used when fingering different pitches) in order to generate "new expressive dimensions" [54].

Metaphorically transformative systems ultimately transform that which is usually invisible into that which can be seen, and in some cases felt. Approaches to metaphorical transformation include a stringed instrument designed to create a manipulable tangible manifestation of the singing voice [1], the manipulable embodiment of granular synthesis via tangible granules [18], and an e-textile wearable that transforms silenced voices into literal social movements [29].

While transformation has been approached in quite a few different ways, rather than equally varied approaches to musical expressivity, six of the seven DMIs rely on user control as the primary expressive medium. And while control paradigms within the NIME community are challenged (even within the context of our analysis [17, 48, 59]), it is still the prevailing mechanism that authors describe as providing expression.

We look to the single DIS entry, Resistive Threads, for alternative ways of engaging with transformation. In order to speak out against the "racial expulsion, exclusion, incarceration, and resistance among Black residents in the San Francisco Bay Area" [29] Halperin et al. partnered with the Anti-Eviction Mapping Project (AEMP) to reconfigure a printed zine into an electronic wearable interface. The interactive jacket allows for the triggering of audio samples, music, poetry, and oral histories via touch through speakers sewn onto the shoulders of the jacket.

The media embedded into the microcontroller and sewn into the jacket transform the garment into an organizing instrument with a "liveness" and energy that only embodiment can provide. Resistive threads, through the embodied documentation of the lived experiences of every day people, the leveraging of shared space, and the inherent affordances of wearable technology, transforms that which we very easily take for granted (items of clothing) into meaningful, albeit ephemeral, experiences of solidarity, healing, and resistance.

Similarly to How to Train Your Drone, we read Resistive Threads as an expressive artifact. Considering the inherent expressivity of the jacket (it is a heavily stylized garment after

Subtheme	Artifact	Code
Experiential	Transhuman Ansambl [36]	Creating an intimate space via sound spatialization
	Period Instrument [69]	Increasing curiosity and undersanding of intimate menstrual fluids
	Magnetip [48]	Combining audio and haptic feedback to replicate acoustic intimacy
	Undertable [31]	Facilitating honest and intimate interaction
	Resistive Threads [29]	Intimacy via screenless interaction
	Retrospective Autoethnography [5]	Seeking a personalized, intuitive, intimate understandings of design processes
	How to Train your Drone [43]	Creating unique and intimate human-drone couplings
	Passive Co-Presence [70]	Inspiring feelings of intimacy and relatedness

Table 4: Theme 4: Intimacy. Artifacts, subthemes and codes within this category.

Subtheme	Artifact	Code
Augmentation	Hyper-Ney [54]	Augmentation via untapped potential
	Bishop Boombox [52]	Leveraging ecological augmentation for meaningful interaction
Expansion	Groovetransformer [28]	Allowing users to redefine and reroute decoupled musical output
Metaphorical Transformation	Vocalcords [1]	Making the intangible tangible via tactile feedback
	Tangible Granular Device [18]	Linking tactile sensation and sound via physicality
	Rheostat Rotary Rack [33]	Making invisible, unpaid, gendered domestic labor visible
	Mechanical Techno Project [17]	Making changes to sound visible/intelligible
	Resistive Threads [29]	Transformation via embodied movement

Table 5: Theme 5: Transformation. Artifacts, subthemes and codes within this category.

all), transformation from garment to vehicle for social justice only occurs once the garment is worn and experienced anew by individuals both within and outside its community of origin. [7]

4.6 Making Musical Sense

This section, based upon audio examples and narrative descriptions of musical expression within the corpus of papers analyzed, seeks to learn more about how musicality was approached within the small snapshot of the community captured within our analysis. Links to performances have been supplied.

Although the term "expression" has been debated and contested within the community [16, 26], 16 of the 26 DMIs analyzed mentioned expression as either an integral component of the artifact or as a concept that the artifact's creation has expanded in some way. "Expression," according to the analyzed artifacts, falls under the following categories :

- Fine Control
- Gestural control
- Exploratory creativity

Fine control allows the user fine-grained control (if desired) of a sound or parameter - similar to a traditional musical instrument. Gestural control necessitates bodily motion in order to trigger or alter a sound, but doesn't guarantee the user "intimate" control of the sound. Contrastingly, exploratory creativity isn't concerned with control, rather, it creates space for user-defined expression.

Although the following term isn't necessarily associated with expression in the traditional sense, it certainly plays a large role in the NIME community: mapping. 11 of the DMIs analyzed include a mapping strategy that converts environmental, audio, or user-generated signals into sound that a performer can manipulate according to their aesthetic preference(s).

DMIs programmed with fine-controlled expression allow the performer moments of "traditional" musical expression (intelligible changes in pitch, rhythm, form, etc.)[8] [9]. As stated in Section 5.2, artifacts designed for community resonance tend to value more traditional music-making practices [10] [11] [12].

Gesturally controlled and exploratory creative instruments, both intimately connected to mapped instruments as many musical parameters are mapped for gestural control and exploration, are much more nuanced and difficult to distinguish between sonically. Visually, gesturally controlled expression can be determined via large or small movements the user makes in order to express or modify sound whereas exploratory creativity doesn't rely on specific intelligible gestures for expression, but creates space for expression via "time and constraints" [69][13]; "the amalgamation of artistic sensibilities with technological simplicity" [79][14]; and "harnessing deep generative models for musical expression" [28][15].

Lastly, there are a handful of instruments that follow conventional approach to musicking within NIME via mappings and user control, but either make no mention of expression [16] [17] [18] [19]

[7] Although this is somewhat of an aside, single-use DMIs and ideas don't have the temporal nor cultural capital to make meaningful change within the community (which makes the reuse of community-approved ideologies and technologies understandable). Creating space for the reuse of previously constructed DMIs by community and non-community members alike may offer alternative perspectives that will otherwise remain out of reach.

[8] Sophtar: https://youtu.be/N8uK5HPQ5lM?si=l9dBKJi8r4hgw1sB&t=869

[9] MagneTip: https://pod.univ-lille.fr/video/36913-magnetip-reintroducing-a-physical-interaction-loop-for-3d-musical-drawing-in-extended-reality/

[10] Agbaixo: https://www.youtube.com/watch?v=UNRNkNTN5Kc

[11] Botões Falantes: https://www.youtube.com/watch?v=oIFhlwC83dc

[12] Transhuman Ansambl: https://youtu.be/uDO21ZtDK2ssi=072_XGYTEl5sMqKS&t=43

[13] Period Instrument: https://www.youtube.com/watch?v=vOGdXnA11Is

[14] Bareemins: https://vimeo.com/772308349?fl=pl&fe=vl

[15] Groovetransformer: https://groovetransformer.github.io/assets/video/Jam%203%20-%20Pt1%20-%20compressed_compressed.mp4

[16] Zhunao: https://vimeo.com/913265461?fl=pl&fe=sh

[17] Stitch: https://www.youtube.com/watch?v=iZujUEqWma0

[18] Antenna Monochord: https://vimeo.com/869636687

[19] Rotoctor: https://vimeo.com/944200066?fl=pl&fe=sh#t=2m

or outright reject traditional notions of precision and clarity in favor of "wonky machines" [17] [20].

5 Discussion

The results of our situational analysis reveal the eclectic and diverse ideological values and interests of DIS and NIME designer-authors. Perhaps even more revealing, many (not all) of the motivating factors that make up the values orientation of our analysis have nothing to do with musical expression (which isn't necessarily cause for alarm; after all, now that the all of the rules have been broken [66], what's next?).

While the NIME community does an excellent job of designing new musical interfaces, the DIS community excels at creating space for interactive experiences - the difference being intentional interactive systems facilitated via freedom from historicized making practices that dictate contemporary possibilities. That isn't to say that the act of making isn't a political process - there are many ways of making that have been made invisible by academic making communities that, in recent years, have reemerged within HCI and NIME discourse as sites of nuance and novelty [3, 13, 56, 60, 71].

Three of the the five extramusical commitments discovered in our analysis - community, care, and intimacy - suggest a desire, at least in part by some members of the community, to break free from forms of musical expression that prioritize novelty and exnomination (Section 2.3). The bottleneck occurs, however, when we consider the irreducible, oftentimes circular, constellation of influences (socio-cultural, discursive, political and economic - to name a few) that dictate aesthetically-oriented academic communities of practice.

As stated previously, the extramusical commitments within the NIME community are numerous and, oftentimes, encompass the motivational framing of DMI creation: the motivational framework/narrative dictates the making of an object that, physically speaking, serves as a visual and physical manifestation of the narrative values - or at the very least of the intrinsic values of the designer(s) while the sonic output of the DMI (hopefully) further contributes to the narrative values via sound design/formal structure/rhythmic, harmonic, or melodic arrangement, etc. The scenario aforementiond, however, isn't necessarily what we've encountered during our analysis. What we find, more often, are incredibly interesting narrative accounts of personal values that are superficially linked to the aesthetic and sonic qualities of the cultural object (DMI).

Though material alignment with values is relatively straightforward, musically, values-alignment isn't as apparent. One would assume that the diverse extra-musical commitments and values embedded into DMIs would lead to just as diverse sonic output, however, the techno-sonic culture NIME overwhelmingly supports is that of mid 20th century Euro-American ideals regarding legitimate creative musicking practices. To be clear, that doesn't mean the community isn't resisting hegemonic musical practices, we're just acknowledging that there's still work to be done.

Gurevich offers insight into how the NIME community might break free from conventional modes of music making via an ecological model of expression [26] and constraint [25]. Perhaps, rather than completely foregoing the use of popular music-making tools or styles within the community, design researchers can modify their relationships with and expectations of them.

[20] Mechanical Techno: https://youtu.be/wl1ZrEza7uY?si=rFtXaXs7wBO0UPEx&t=300

In his ecological model, Gurevich listed the following alternatives to traditional musical expression:

- Machine imitative expression
- Expression via mappings
- New expressive cues
- Questioning expression as the goal

The introduction of non-musical values into the community make "new expressive cues" quite appealing. Rather than relying on oversimplified notions of expressive machines and mappings, or re-inscriptions of traditional and experimental music-making paradigms – or letting go of the concept of expression altogether – developing new expressive cues can set the stage for a new approach to musicality within the NIME community while making space for more diverse stylistic practices. By thinking more deeply and intentionally about extra-musical values and values-attunement within DMI design, the NIME community has an opportunity to redefine, on its own terms, what it means to be *musically* expressive.

As evidenced by non-musical interactive systems (Sections 5.4 and 5.5) there's much to be explored in the name of performative approaches to extra-musical values such that new expressive performance practices can develop.

We encourage NIME designers to continue examining and questioning NIME's prevailing discourse. With a continued commitment toward unpacking the values of NIME, new forms of expression and interactivity - whether grounded in musical or extra-musical values - not bound to the techno-sonic mediations of NIME's past can, over time, become normalized and stabilized manifestations of NIME's expressive possibilities.

6 Ethical Standards

As a critical survey of published literature, this paper does not involve research with human participants and hence no institutional ethics review was required. In reviewing these papers, we do not claim to speak on behalf of any of the authors, but leave readers to judge for themselves whether they agree with our analyses.

Acknowledgments

Our research is supported by a UKRI Frontier Research (Consolidator) Grant (EP/X023478/1, "RUDIMENTS") and the Royal Academy of Engineering under the Research Chairs and Senior Research Fellowships scheme. There are no identified conflicts of interest.

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