Gardening Frictions in Creative AI: Emerging Art Practices and Their Design Implications

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Abstract

Feverish narratives of artistic AI-revolution obscure the fact that empirical documentation of the actual impacts of artificial intelligence on artistic practices is still sparse. This paper focuses on the *frictions* of working with AI artistically. Based on interviews with 20 AI-artists, we 1) demonstrate that frictions experienced with the technological elements of the work processes with AI are inseparably intertwined with the artists' socio-material realities and the inherent asymmetries of access, and 2) show how frictional ambivalence and unpredictability in artistic interactions with AI tools function both as restrictive and productive elements of the art-making processes, presenting opportunities to reframe the core notions of artistic agency, authorship, and the ontology of art. We discuss these findings in the context of HCI and critical data studies and provide three invitations for designing with and for frictions. Our empirical work contributes to a deeper understanding of the emerging community of AI-artists and invites new mindful perspectives for the design and development of Creative AI applications.

Introduction

> "It's like if I was growing images in a garden,
> ... sowing the seeds and nurturing and breeding them."
>
> *Interviewee P12, translated*

The ongoing gold rush around creative AI (artificial intelligence) is not only a technological transfiguration but also a potent media and marketing spectacle. In its shadows, a quieter development is taking place as practicing artists are exploring these new tools, growing and cultivating the range of creative expressions they can provide. Our current knowledge of this emerging community is limited. What does the practical, everyday reality look like for artists who engage with AI? How have the material and conceptual sensibilities of their art-making changed as a result of adopting AI technologies in their artistic processes, if at all? What kinds of frictions have they encountered in this process?

In this work, we employ the concept of "friction" (Tsing 2005; Ruckenstein 2023) for the study of "tensions and contradictions involved in processes of datafication" (Ruckenstein 2023, 8-9). Friction refers to the interactions between – on the one hand – the "sticky materiality" (Tsing 2005, 1) of artists' everyday encounters with Creative AI technologies, and – on the other hand – the culture and politics embodied in the Creative AI tools and their accompanying narratives. This perspective embraces not only the negative connotations of friction in the form of crashes and errors but also their potential to *empower* (Tsing 2005, p.6). This dual capacity has been well-recognized within HCI research (*e.g.* Cox et al. 2016, Benford et al. 2012, Pierce 2021).

The empirical study presented in this paper aligns with this wider interpretation of the concept, shedding light on both positive and negative consequences and practical implications of frictions experienced in interactions with Creative AI in the field of arts. Our research question is: *What kinds of frictions are artists encountering in their use of AI for art-making?*. Using semi-structured interview data from artists (N = 20), we examine frictions through an analysis of changes that the interviewees are reporting in their work as a result of their artistic engagements with AI, and the challenges they have faced in those processes.

Our results confirm that the techno-material nature of artistic engagements with AI cannot be isolated from the social processes. Frictions with technology are inextricably intertwined with personal competencies, interests, and resources of the artists and their collaborative networks, but the study of frictions also exposes the entanglements and asymmetries of power and privilege in the social and commercial infrastructures of art-making processes. Secondly, our analysis indicates that frictional ambivalence and unpredictability in artistic interactions with AI tools occur in the material interactions with the immediate environment in which they conduct their work, when artists face the wider circle of social encounters, and in introspection of the artistic identity. Frictions act on all of these levels both as restrictive and productive elements of the art-making processes, thus presenting opportunities for reframing the core notions of artistic agency, authorship, and the ontology of art. These empirical findings contribute to a deeper understanding of the Creative AI domain from an interdisciplinary perspective of HCI, Science and Technology Studies (STS), and critical data studies (Hepp, Jarke, and Kramp 2022), and highlight the urgency to adopt more deliberate and mindful design strategies for the development of computational creativity applications for artistic uses. For this purpose, we contribute three invitations for designing Creative AI technology with and for frictions: Resisting the separation between the user

and the tool, embracing the vernacular heterogeneity of the users, and attuning to constructive ambivalence of frictions.

The paper is structured as follows: First, we situate our analytical lens of frictions in the wider context of HCI and critical studies on algorithmic systems. We then describe previous empirical work conducted on artistic communities broadly defined as "AI-artists", and outline the method of our empirical inquiry. After discussing the results, we illustrate how the perspective of frictions invites alternative ways to approach the development of Creative AI applications.

Background

Studying frictions

The concept of "friction" was introduced by Anna Tsing (2005) for facilitating an ethnographic account of global interconnections. She defined it as "the awkward, unequal, unstable, and creative qualities of interconnection across difference" (Tsing 2005, p.4). In that very sense, the lens of frictions has been employed in ethnographic work by Ruckenstein (2023) to investigate how people at the same time pursue and criticize processes of datafication, for instance in the context of personal health apps. Edwards et al. (2011) have used the term "science friction" to describe the difficulties of disciplines that try to collaborate, and focus on avoiding these by proposing a more process-oriented perspective on the handling of metadata. With a similarly negative connotation, Rose (2016) has described crashes, glitches, and errors as types of frictions that contribute to the instability of digitally mediated cultural objects. In the present paper, we wish to maintain the wider perspective on frictions adopted by Ruckenstein (2023) that embraces their potential to empower users of technology.

This wider perspective on frictions is supported by a longer history of research in HCI. Without using the term explicitly, Egelman, Cranor, and Hong (2008) have used pop-up dialogues as a friction to introduce an extra step in processes that gives users time to think. Later on, Cox et al. (2016) applied the term "design frictions" as points of difficulty in interactions that incite moments of reflection and mindful interaction. Instead of a focus on reflection, Benford et al. (2012) aimed for entertainment, enlightenment, and sociality when introducing aspects of discomfort into interactions. More recently, Pierce (2021) offered a design-theoretical framing for such alternative designs, among other things by introducing a set of frictional tendencies that aim to diversify design and open up teleological ambiguity compared to conventional design. These examples of HCI research shall suffice to support the argument that an identification of frictions in the interactions between artists and Creative AI may be of great value to carve out a set of design implications for the technology at hand.

AI-art and AI-artists

In the context of this study, we adopt a broad definition of Creative Artificial intelligence (Creative AI) as encompassing *methods, tools, and services of content generation and analysis that are powered by Machine Learning (ML)* and applied for creative work. This focus is chosen on the basis that ML-approaches dominate the current landscape of Creative AI (Cetinic and She 2022). Correspondingly, there is currently no universally accepted definition of "AI-artist" (Browne 2022). Our informants are, hence, individuals who self-identify as practicing artists and use or have used AI-powered creative tools as one of the central elements in at least one artwork. This broad definition excludes artists who use in their works other computational or algorithmic methods that are *not* driven by AI-based models.

It is relevant to note that many of the artists interviewed would not necessarily label themselves as AI-artists. In fact, when asked to name the artistic domain in which they mainly practice, all but one of the interviewees chose other designations (see Table 1), and several interviewees spontaneously indicated discomfort towards defining their work specifically through the perspective of AI involvement . Consequently, in describing the interviewees' experiences, we refer to them as "AI-artists" and to their work as "AI-art" merely as a shorthand for indicating the shared elements between their otherwise divergent artistic practices.

Studies of making art with AI

There has been significant interest in theorizing the general nature of creativity in the context of AI, (*e.g.* Esling and Devis 2020, Bown 2021). Previous empirical work has furthermore explored the emerging re-definitions of creativity and co-creativity (Wingström, Hautala, and Lundman 2022; Nordström, Lundman, and Hautala 2023; Thelle and Wærstad 2023; Lopes et al. 2023), provided recommendations for designing software for creativity in the context of AI (Santo, Santos, and Inácio 2023) and calls for more critical and speculative approaches of designing for creativity (Epstein, Schroeder, and Newman 2022; Liu, Huang, and Holopainen 2023), and explored the intersection of ethical reasoning or responsible AI and creativity (Brown and Ventura 2022; Fraser, Kiritchenko, and Nejadgholi 2023).

Many of the early efforts in documenting the experiences of AI-artists focused on a small group of internationally renowned visual artists, most of whom had worked with AI tools for some years already and were often supported by a strong institutional network that provided the artists with financial and technical assistance (Ploin et al. 2022; Caramiaux and Fdili Alaoui 2022). This is not necessarily the case for the emerging community of artists who practice their craft with AI outside such resource-rich networks, and whose experiences are currently less explored. Other studies have focused on a particular artistic domain in a single country, such as UK-based composers (Kehagia and Moriaty 2023), Finnish game professionals (Vimpari et al. 2023), practitioners in the cross-areas of artistic and engineering research (Jourdan and Caramiaux 2023), or as a regrettably rare example of an inquiry conducted outside the Euro-Western context, Indian artists (Divakaran, Sridhar, and Srinivasan 2023). A handful of inquiries have focused on exploring the potential of critical AI art to advance discussions on specific themes such as surveillance (Stark and Crawford 2019) or public AI literacy (Hemment et al. 2023).

Participant	Artistic domain
P1	Media artist, researcher
P2	Contemporary / hybrid artist
P3	Choreographer, visual artist
P4	Visual and performance artist
P5	New media artists (2)
P6	Visual, conceptual artists (2)
P7	Contemporary artist
P8	Visual artist
P9	Artist, researcher, activist
P10	Media artist, director
P11	Computational and AI artist
P12	Visual artist
P13	Transdisciplinary multimedia artist
P14	Composer
P15	Composer
P16	Multimedia artist
P17	Composer, interdisciplinary artist
P18	Composer, music technologist

Table 1: Summary of the self-defined artistic domains of the anonymized interview participants.

Finally, there has been an increasing interest in exploring the changing conditions of art-making and the artistic ecosystems in the age of AI technologies without explicit empirical grounding (*e.g.* Zylinska 2020, Srinivasan and Uchino 2021, Clancy 2022, Jiang et al. 2023, Baradaran 2024).

Our work contributes to this literature by providing insights from a mainly Nordic-based community of AI-artists and by expanding the analytical perspectives towards an area that has, to our knowledge, not been previously applied to Creative AI applications: the analytical lens of frictions.

Method

The data of this study derives from 18 semi-structured interviews conducted between April 2022 and April 2023 with a total of 20 artists who engage with AI in their work. In two of the interviews, two members of the same artist collective were present. The interviewees came from Finland (N=9), Sweden (N=7), Norway (N=2), Denmark (N=1), and the UK (N=1), and were found with targeted convenience and snowball sampling. The interviewees were between 27 and 65 years old at the time of the interview (median 39 years). Six of the interviewees self-identified preferred the female pronouns she/her, fourteen the male pronouns he/him, and none indicated preference for other options. The artistic domains of the anonymized participants are provided in Table 1.

Either of the first two authors conducted the interviews in Finnish or in English on Zoom (average ca. 60 min). The artists were first asked to specify their artistic domain and the genre of the works they create and then to describe in closer detail one of their artworks that uses AI in some form, as well as the process of creating it. This general contextualization was then followed by an interview protocol that covered topics such as artistic motivation, environmental sustainability, and ethics. Out of this complete set of data, the current study focuses on the responses to two questions: Q1: *"In which ways has working with AI changed your creative processes?"* and Q2: *"Did you encounter any technical, practical, or creative challenges in the process? What happened and how did you solve them?"*, supplemented with further prompts and questions on these topics, as provided in the interviews. The results of other parts of the interviews pertaining to themes not covered here have not yet been published.

The transcribed interview data was analyzed using a reflexive thematic analysis (TA) methodology (Braun and Clarke 2023) in the original language of the interview. The epistemological position of this process falls in the interpretative — rather than positivist or 'codebook' — paradigm, as described in (Braun and Clarke 2020). This position entails a commitment to the analysts' reflexive interpretation as an analytic resource rather than an invalidating limitation of the method (Braun and Clarke 2020).

Following the reflexive TA method, the first author familiarized herself with the whole interview data and then identified the parts that pertained to the two questions listed above. The first author then inductively coded these parts of the transcripts, gradually identifying salient features of the data on a high level of detail, and provided brief summative descriptions for the excerpts in which the code was found. These codes were subsequently clustered on the basis of similarity in semantic or thematic content, and such code clusters were iteratively developed into larger themes and sub-themes. The themes generated in this process were revised over several rounds of review by comparing the identified code clusters across all themes, by referring them back to the original interviews and the wider contexts of the individual utterances, and finally by ascertaining that the codes covered data from all interviews. Finally, the resulting themes and their labels were discussed and further refined and consolidated in collaboration between the first and the third author. The first author finally translated to English the quotes from the Finnish interviews that are cited here.

Results

Artists reported a wide range of changes and challenges in their practices with AI, from which we inducted indications of frictions. Such frictions were often situations where the normal flow of creative work was cut short, impended or slowed down in a way that forced the artist-user to shift attention to the technological and physical context of their art making and to take actions to solve a problem, strive to understand an error or a glitch, or to identify alternative ways to move forward with their process. We begin the presentation of the results with an overview of the (1) Scale and valence of transition as holistic evaluations pertaining to the artists' frictional experiences with AI in their work. We then proceed to describe (2) Frictions in material interactions with AI-technologies, (3) Social and procedural frictions, and (4) Frictions in role reconfigurations. These three latter themes pertain to different perspectives that artists adopted with respect to their art-making: focusing on the elements in the immediate environment in which they conduct their work (2), facing the wider circle of social encounters (3), and turning the gaze back to themselves as an introspection of their

artistic identities and the ontologies of artworks (4). In the following sections, we will discuss each of our four themes and their subthemes in more detail.

Theme 1: Scale and valence of transition

When inquired about the changes AI had brought to their artistic practices, most of the interviewees started by providing a holistic evaluation of the extent to which using AI had shifted the fundamentals of their artistic working practices. Three artists (P4, P11, P18) indicated that AI had invoked major positive reconfigurations in their artistic practices. P11 described how the use of AI tools had dramatically changed their focus on the conceptual embeddings of human perception and categorization, but also for P4 and P18, the AI-enabled opportunity to work in scale marked a certain paradigm shift:

> P18: "It has [had] like the most profound impact ever. I don't think I would be able to go back [to] not playing with these algorithms or not working with them."

In other cases (P6, P7, P8, P10, P16), the personal creative process proved to be highly independent of the specific technology and material chosen for the occasion. P6 remarked somewhat less enthusiastically that the use of AI changed "a lot" in their work practices, while also noting that this had mostly to do with the reorientation inherent in starting new projects in general, rather than specifically with the nature of AI models as artistic tools. Both P7 and P16 framed the change to AI-based work as merely an extension of the earlier working methods and routines:

> P7: "AI has not changed so much in terms of how I make things, because that's somehow separate from any type of technology."

Instead of significant adjustments, these artists seemed to observe an *expectation* of AI as a major agent of change for their practices. P1 and P10, in particular, distinguished with certain unease the narratives of the marketing-driven social panic that is typical of the cycles of technological innovation and the actual shifts in the reality of artistic practices, which were much less dramatic. The friction experienced between these competing narratives made artists aware and vigilant of the power structures inherent in the processes and infrastructures governing their artistry.

Theme 2: Frictions in material AI-interactions

Frictions with the technological aspects of the work included tensions around the hardware and other computational resources, the software and the algorithms, and the data. A closer study of these encounters illustrated that the experiences with a particular AI system are inseparable from the artist's personal expertise and resources, thus highlighting the critical importance of approaching Creative AI as a *socio*-technical system (Johnson 1994; Seaver 2017), or entanglements (Barad 2007) of the human and the machine.

Hardware and computational resources Five artists (P2, P5, P7, P13, P18) had experienced frictions related to access to suitable computer hardware. For instance, models with sufficient computing capacity were too expensive for personal purchase (P2), hardware provided by institutions such as the university was not necessarily powerful enough to run pre-trained AI-models (P5, P7), or the choice of suitable GPU was complicated in other ways (P13). P18 outlined how the chosen visual engine required manual intervention to be computable with the limited capacity of the personal laptop. Such frictions demonstrate the asymmetry of access to computational resources, especially between artists who have some affiliation or other connection with institutions, and those who have to modify their artistic project to fit the limitations of their personal computing equipment.

Software and algorithms Six artists (P1, P3, P5, P6, P10, P17) provided examples of various situations where the AI-related software had not functioned as expected . For P1, the reason was that her team had built the software from scratch, whereas for P6 the issue was caused by a software component that failed to fulfill its function in the expected way and had to be replaced. P3 listed a number of error situations and glitches, but described them as "small problems". P17 on the contrary went into great detail illustrating the diverse set of problems he had encountered with a sample RNN model, eventually leading to a decision to abandon that part of the project altogether to save time for other aspects of the work.

Two artists specifically mentioned the issue of model outdating. For P5, a business takeover caused the model they had used to suddenly no longer be available, which led to the artist losing the work already invested in it. To avoid such problems, P10 described a preemptive strategy of combining elements of AI and computer vision structures to keep the system overall resilient and flexible for updates and reuse options. The artist further recognized that in this manner, they had started to self-identify as software developers of a kind. These experiences exemplify how both the frictions and the technical solutions available are closely intertwined not only with the individual users themselves, but also with the socio-political and economic dynamics of the wider software markets.

Data Three interviewees (P5, P13, P17) specified data as a factor that unexpectedly complicated their creative processes. For instance, P13 outlined the issues related to acquiring sufficient quantity and quality (resolution and size) of image data for the artwork, the overall workload of preparing the data for a suitable format, and the impossibility of manually combing through the metadata of all the individual images used. P5 discovered that the language of the open-access poetry datasets intended for the project was both linguistically and culturally outdated, reflecting values that the artists did not want to include in their artwork. Hence, the simple choice of accessible data quickly turned into a complex deliberation of mitigating cultural and aesthetic biases. P13 and P17 also expressed concerns about various biases inherent in the data.

Human-machine entanglements The imprecise descriptions of the technical issues the artists ran into during their artistic processes point to another factor that is critical in understanding the experience of using AI in artistic work.

There was a wide variety in the level of technical expertise among the participating artists. Many relied at least in part on collaborators who could help them with technical problem-solving or accepted the limitations of what they were able to do and shaped their creative practices around those constraints.

> P14: "I'm not that literate in the sort of computer parts behind it. So I mean the training of the models are [sic] run on the Colab ... and that generally just works or it doesn't work at all. And there isn't that much space for my part to actually tweaking or configuring."

Other artists had a high level of AI literacy, which could explain why certain technical hiccups seemed "small" to them. Nevertheless, even a high level of expertise did not eliminate all the frictions involved. P8 and P12 described the balancing act of keeping up with the latest technological developments while experimenting with and configuring the tools to fit their individual creative processes and visions. Furthermore, P4 who had described the technical aspects of the model as "not that complicated" to understand, expressed some concern about how strategizing around the optimization of the technical process may happen at the cost of free creative exploration.

In these kinds of situations, the technical system and the artist operating it posed mutual limitations to each other. Lacking a sufficient understanding of the technical details of the problem source, or in an effort to bend the system to their own needs, the friction forced the artist to seek alternative ways to steer the system into the aesthetically desired directions or to reject options that were not within reach given their technical expertise.

Theme 3: Social and procedural frictions

A range of frictions that artists had faced were less directly related to the technological material, but rather to limitations of financial and time resources, and to collaborative challenges. Furthermore, working with AI called for efforts to navigate between different means of expression and control, and to balance aesthetics and communication.

Financial and time resources Three artists (P5, P13, P14) mentioned the financial cost of cloud computing as a frictional factor that affected their planning and implementation of artistic work processes. P14 felt that the new pricing model for Google CoLab had constrained his willingness to run exploratory iterations where it was not clear from the onset whether the end result would be artistically useful. P5 had similarly thought of each iteration in Microsoft Azure as bearing an extra cost on the project, and the sparse resources were one of the main reasons why they had chosen to refrain from "going all in" with AI methods in art, focusing on speculative and critical design approaches instead. P13 further reflected on the asymmetry of limitations that the access to resources brought upon different artists, a consideration closely shared with P3:

> P13: "It's normal[ly] institutional access because I can't buy my own. It's like thousands of euros. And so I'm always relying on institutional servers. And the more rich [sic] artists like Refik Anadol they have their own, like massive datacenters, GPUs and all that. So the cost of doing this work is also there. It's expensive art work."

Time was another important factor impacting the experiences of artistic work with AI tools. The same three artists (P5, P13, P14) noted that the technical implementation had become more strenuous:

> P5: "From the technical implementation, it's a longer process. And I guess you can also say that to predict the outcomes of different iterations is harder. Because the iterations take so long to be processed."

P14 similarly described how he weighted the necessary investment of time and the risk of getting non-productive output against further rounds of training that would have been needed to modify the output closer to the artistically desirable direction.

Interestingly, P4 expressed an opposing view on both of these resource aspects. According to him, the financial cost of using services was "quite low", and he saw the benefit of the AI tools specifically in the possibility of quickly rendering prototypes for ideation or for asking for feedback from a colleague. These incongruities illustrate the diversity of ways various resource frictions and access constraints affect artists with different technical capabilities, in different artistic domains, and with varying levels of support from resource-rich infrastructures around them.

Collaboration challenges Many of the artists interviewed were indeed not doing solitary work but collaborated with individuals and institutions in various ways. At times such collaborations complicated, rather than supported, the artistic processes. Six interviewees (P1, P3, P6, P7, P8, P10) described various frictions they had experienced in setting up the collaboration with institutions or corporate partners, or in finding initial funding for their project. P6 had faced several rounds of re-negotiating deadlines, technical resources, and budget for the project due to the corporate partner's staffing changes, rigid management structures, and shifting conceptions of which models would perform best for the intended artistic vision. P3 had initially endured an unplanned delay of six months in gaining a license to access GPT-3, but later actively sought technical support from a private company, and found the interaction with the engineering team inspiring and fun. P8 expressed frustration about how museum exhibition planning schedules of two to three years were fundamentally incompatible with the fast pace of change in the AI domain, prompting him to experiment with alternative publishing and exhibition venues instead. On a larger scale, P8 saw this as potentially leading to the traditional curatorial institutions being sidetracked from the main role as gatekeepers, and he found such a scenario anarchistic and interesting.

Navigating aesthetic border areas Several artists (P2, P5, P8, P12, P14, P15, P16) had either adjusted their working methods along with the increased availability of pretrained general models or transitioned the modalities or domains they primarily work with. P16, for instance, had moved from audio to visual work. P15 reported a relief in

the transition from having had to synthesize all the sound material from scratch to generating samples which he could then process further. P12 had previously trained general neural networks with his own visual data but had then transitioned to generalist networks. This marked an inspiring shift in his artistic focus, away from purely visual work to partially text-based but abstracted control parameters , and to a search for personally meaningful areas of aesthetic expression in the enormous visual and informational universes. P14 similarly considered the artistic process to grow organically from the gradual learning or "unlocking" of the otherwise abstract relations between gestures and the corresponding resonances in the latent space. For P16, incongruities between control modalities caused "seams" between outputs from various individual text-to-image models, which she then had to manually touch up and fix:

> P16: "I think one interesting puzzle was getting DALL-E to outpaint in a way that seems coherent with something generated in another model. . . . And I had to touch up seams as well because there's really, kind of no matter what you do, there ends up being seams between Midjourney and DALL-E."

Similar, but more conceptual border work took place when artists pursued an aesthetic sweet spot for communicating their process with both technical-academic audiences and artist communities (P11), deciding between visual and textual representations and interaction modes (P6 and P7), and finding the level of socially acceptable realism in the representation of a digital twin persona (P10). Hence, frictions encountered when shifting between different modalities often caused the artists to do additional manual and conceptual work, but in some cases, also gave rise to new inspiring ways for artists to approach their artistic material.

Theme 4: Frictions in role reconfigurations

Many artists reflected on the changes in their artistic role when making art with AI. These considerations were related to shifts in the conceptions of agency and authorship.

Shifting agencies In six interviews (P3, P4, P12, P13, P15, P17), artists contemplated the changes in the types of artistic agencies the AI processes afforded them. These changes led to various reframing of the self-assigned work descriptions by the artists. For instance, P4 called himself "a curator", whereas P15 described having transferred to the role of a "producer", driving and managing the creative process from the sidelines:

> P15: "I've become less concerned with me being involved in everything. . . . It's like you have these little minions working for you. . . . You are still in charge of the whole, but you leave the individual parts up to other things. "

Both P3 and P13 characterized their current working mode as "archiving". P12, as quoted at the beginning of the article, preferred the metaphor of "gardening", likening the acts of nurturing algorithmic raw materials to those performed in the seeding and growing of living plants. This reconfiguration of agency paralleled with the artists adopting some new working practices. P10 pointed out that AI follows a logic of its own, which is separate from traditional image editing, and involving it in the artistic process necessitated building the whole project with a different approach. P17 emphasized the inspirational aspect of relocating some control to the AI system in exchange for "response and resistance", which could even lead to the re-definition of "creativity as a relational phenomenon":

> P17: "I think working with AI can have a bit of the same that it forces you out [sic] into putting yourself in your place, you know, like you have to reduce your ego. You have to give space, you have to be accepting of whatever is coming and not trying to be a specific thing, but be more shaped by the natural flow of the process."

As a consequence of relocating control, P9 accepted glitches in the outcomes, while P7 specifically optimized their creative process for "promoting surprise", and P16 sought particular types of output errors as part of the intended aesthetics of the artworks. P2 and P14 conversely indicated unease with the loss of "craft" (P2) and with the necessary distancing from strict pre-defined expectations (P14):

> P14: "It's a very different approach from the sort of conscious compositional sound design. . . . I have to really not care. I can't have this, 'yeah it should have like this sonic equality, we should have this musical structure or you should have this timbral texture' or anything. It's like, this is what I got, this is what I have to work [with]."

In these situations, frictions around the questions of agency could prove to be either productive and inspirational, frustrating and limiting, or both simultaneously. The experience depended on artists' own expectations and to what extent their personal creative processes could mold around the shifts and transitions that the adoption of AI tools seemed to require.

Authorship redefined Shifts in the artists' role furthermore evoked a series of questions about the location of authorship in the creative process. For instance, P13 described how the endlessly iterative nature of the process marked a shift in how he views the ontological nature of his artwork. In this new context, he abandoned earlier notions of "closure" in favor of open-endedness and an infinity of options. P3 further reflected on the cascading effects of this on the notions of authorship over artistic ideas and expressions:

> P3: "I think it has, you know, just broadened my horizon in regards to how to think about art and artwork . . . [W]hen are you inspired by something? When is something a part of your work? "

P4 concurred, describing the difficulty of deciding how the level of artistic involvement and the relation to the previous content should correlate with the ownership assigned to the output, for example when using tools such as outpainting provided in DALL-E:

> P4: "Coming from graphic design, one of the things we often speak about is remix culture and collage. So I view it as working with collages and as inspiration. So to me, the things that I generate, they can't be the end result. They have to fit into a larger picture, a bigger installation with lots of other pieces, or a performance. . . . That's something that I reflect on, like where do I draw the line for when it's mine enough or when it's original enough, according to me."

As a response to the lack of definite answers to these dilemmas, the interviewee (P4) emphasized his artistic responsibility to bring deliberate and interesting conceptual complexity to the artwork. Such ambivalence furthermore points towards the artist either observing or anticipating shifts in societal norms surrounding professional artistic processes and the ontology of AI artworks.

Discussion

In the following, we will first reflect further on our interview results from the perspective of friction and then, based on our findings, provide design recommendations for working with friction in Creative AI development.

Harvesting frictions in artistic AI

The analysis of frictions in artistic practices with and around AI exposed a wide diversity of experiences closely intertwined not only with the material affordances of the AI-tools but also with resources, obstacles, and restrictions specific to the individual circumstances of art-making. For example, the artists with strong technical, financial, and institutional support could afford to explore and experiment with the AI-tools more freely than their resource-poorer colleagues who had to plan and adjust their creative processes around the computational limitations. In extreme cases, such accumulating frictions led the interviewees to reconsider whether they would choose to continue engaging with AI artistically in the future at all. Studying frictions in individual art-making processes hence exposes structural vulnerabilities and how asymmetries in access lead to widely different realities of how AI tools can, or fail to, serve the users artistically. Interviewees' frictional encounters with institutional and commercial gatekeepers further illustrate how the entanglements of power and privilege determine the nature of interactions that artists have with AI technologies on many levels, from the individual to the societal.

Other frictions transformed from mere nuisances or restrictions to seeds of creative potential, as frictional ambivalence and unpredictability played a constructive role in many artists' interactions with AI tools. For instance, some interviewees were specifically drawn to certain models because of the glitches they produced (see similar observations in, *e.g.* Ploin et al. 2022, Wallace et al. 2023). For others, navigating between different modalities of expression (audio – visual – text) opened up new aesthetic spaces for artists to explore, or impelled them to develop new "languages" in order to communicate with the models in ways that were supportive of their personal artistic vision. Frictions with social narratives and aesthetic norms around AI guided the artists to negotiate and reconfigure their roles in emerging and shifting aesthetic spaces. Artists embraced new identities as curators, space explorers, producers, and gardeners. They found inspiration in the new aesthetic opportunities and in the liberation from certain arduous work processes but also experienced challenges to their artistic agency and authorship. Such transformations and ambiguities led to critical introspection on the new ontologies of artwork in the era of AI and, consequently, those of an artist.

Design implications for working with frictions in Creative AI

The choices made in the design and development of AI-driven creativity tools affect the concrete purposes these tools may serve and the value they provide for actual users and stakeholder communities in a variety of real-world contexts. Massive social and ecological footprints of the AI supply chains (Crawford 2021) and the current stream of lawsuits brought against text-to-image models (Saveri and Butterick 2023) are just two powerful examples of what is at stake. These observations call for the adoption of deliberate and mindful strategies for the design and development AI across different application areas.

If the development of AI tools for creativity aims at widening or *democratizing* the access to creative endeavors for wider user populations, future research should continue to pay close attention to the practical realities artists face in their adoption and use of AI. To this end, the power of the friction metaphor lies in the perspective that it opens not only toward the negative and destructive (obstacles, errors) but also toward the positive and constructive (sparks of creativity found in the resistance and grit). In the following, we provide three invitations for design reconfigurations that arise from adopting the lens of frictions in the development and design of Creative AI applications. Rather than a comprehensive list of recommendations, these three aspects are intended as inspirations for further analysis and reflection, contributing to the related work in the Computational Creativity (*e.g.* Santo, Santos, and Inácio 2023) and HCI (*e.g.* Benford et al. 2012, Pierce 2021).

Resisting separating the user from the tool Frictional interactions of the artists with AI powerfully illustrated the need to resist viewing the user and the technology as separate and independent entities and instead embrace the notion that in the flow of the artistic processes, they are, in fact, fundamentally inseparable. In particular, the affordances (Norman 2002; Gibson 1977) provided by the AI technology for the interviewees could only be realized if material, financial, temporal, and expertise resources available to them at the time allowed them to do so.

Such notions of cultural embeddedness are, of course, nothing radically new from the perspectives of STS and the fourth wave of HCI in which contextual and in-situ studies are well-established (Bødker 2015; Ashby et al. 2019). In STS studies of art technologies, for instance, Seaver (2017) calls for abandoning the view of algorithms as distinct technical objects existing *in* culture, in favor of studying algorithms *as* culture, embracing them as "unstable objects, culturally enacted by the practices people use to engage with them" (Seaver 2017, p.5, echoing the notions of other critical scholars such as Haraway 1988, Barad 2007). Similarly, the analytical lens of friction distances itself from individual and isolated analysis of either the tools or the users, inviting the focus to be directed instead towards the amalgam of them both. It is in the encounters and interconnections of the users and the tools in which the friction emerges; "where the rubber meets the road" as Tsing (2005, p.6) phrases it. Such valuable perspectives are lost when the tools of com-

putational creativity are developed and evaluated in isolation from the messy real-life contexts of use.

Resisting generalizations about users A consequence of the deep interconnectedness of the user and the tool is that frictions can only be identified and understood in the rich context of the users' subjective experience of their material and social realities. For example, as discussed in previous sections, artists' different socio-economic contexts and their level of technical expertise deeply influence their experience of the AI art tools. Conversely, collapsing users under rigid categorizations such as basic demographics or too simplistic personas at the onset of a study may conceal or obscure some of the pivotal frictions that emerge in real-world interactions. For example, Cabrero, Winschiers-Theophilus, and Abdelnour-Nocera (2016) have critiqued the use of personas as a way of othering people through representation, and similarly urge for fine-grained contextual inquiries.

The perspective of frictions furthermore urges developers to embrace the users' culturally situated understandings of the AI systems, as incomplete, skewed, or erroneous as they may be (Seaver 2017; Ruckenstein 2023). Instead of establishing hierarchies of correct and proper knowledge as opposed to the magical thinking of the technically less literate users, this entails approaching the vernacular descriptions with curiosity and welcoming them as alternate readings that are no less real to the users themselves. Such a shift of perspective may help open new ways of identifying pain points and limitations in the system, or establish more accessible and intuitive modalities of interaction that speak not only to the domain experts but to diverse types of users. Even if some elements of the individual users' idiosyncratic experiences with AI tools are perhaps bound to remain out of sight for the developers and designers of such technologies, it is nevertheless productive to stay critical of collating user experiences into pre-defined categories at the expense of observing users' real lived experiences and the meaningful differences between them.

Attuning to the frictions without assuming they all must be "fixed" Developers and designers of the AI applications can choose to act upon some of the frictions that artists experienced. For instance, artists' adversities related to the available hardware capacity and consequent time constraints, which may seem like personal resource deficits, can be influenced by the model design and development. For instance, the minimum system requirements could be steered by the design of the model architecture in ways that make it accessible with a wide(r) range of computational resources and expertise levels. Similarly, model maintenance, comprehensive documentation, and sufficient efforts in providing open communication channels can alleviate some problems artists encounter and mitigate the frictions experienced.

At the same time, it is important to pay attention to the productive anarchy that frictions can provide. The limited agency to control pre-trained models seemed to pose a potential risk of influencing and shifting the nature of artistic work in ways that were not entirely desirable for the artists, thus creating negative frictions. In other contexts, however, relinquishing control over the AI system that *resists* being tamed and embracing the more detached role of a "gardener" was a positive experience that the artists actively sought. Similarly, the ontological changes in what the artists regarded as a completed artwork – or the notion that such a goal could be abandoned altogether – could be both a distressing and an enriching experience for the artists.

Openness and sensitivity to such ambivalence strongly resonate with Haraway's (2016) famous invitation to "stay with the trouble". This change of perspective encourages the developers to approach the artists' experiences of frustration with curiosity, and to resist the initial urge to interpret all such frictions as bugs that need to be urgently fixed. The act of balancing between these contradictory impulses can, however, be delicate. It is ultimately only the artists themselves that can distinguish between constructive and destructive frictions, and communicate this difference. This calls for developers and designers to stay involved with a diverse ground of users in order to incorporate a variety of perspectives for addressing the constructive potential of ambiguity.

Limitations and future research

A particular challenge in studying emerging art forms is the dynamic nature of the topic of study. Our interviews provide insights into the threads and tendencies visible in AI-artistry in synchrony with its early development and unfolding, rather than in retrospect, but for this reason it may be premature to label the identified frictions as factors that will remain exclusively specific to AI-art projects. Secondly, while we identified frictions in changes and challenges that the artists reported in their engagements with AI, there may be other frictional moments in the artistic process that could be uncovered with a different focus question or an approach different from an interview study. Finally, we wish to critically remark that, along with many prior empirical studies, the current work is based on the Euro-Western context of AI-artistry. More work is needed to diversify the research focus towards the cultures and sub-cultures of the Global South and to include a wide range of social identities.

Conclusions

This study contributes to a deeper understanding of the use of Creative AI applications in artistic contexts from an interdisciplinary perspective of HCI, STS and critical data studies. We call for the adoption of more deliberate and mindful design strategies for their development, and provide three invitations to attune to frictions in such work. Resisting the separation between the user and the tool, embracing the heterogeneity and vernacular experiences of the users, and committing to tolerate and sustain constructive ambivalence are some possibilities for the development and design of Creative AI to approach frictions not as a weed to be removed and prevented, but as a creative resource worthy of nurture and care.

Author Contributions

Kaila and Jääskeläinen conducted the interviews in parallel. The thematic analysis was conducted by Kaila and then collaboratively developed by Kaila and Holzapfel. Kaila was

in charge of writing and structuring the manuscript, but all authors contributed to the writing.

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