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More-than-human perspectives become increasingly important with the growth of global challenges and the intervention of autonomous technologies. Research has elaborated on the rationale for more-than-human-centred design approaches but still needs more practical guidance to embody non-human perspectives in the design process. This paper addresses embodied co-creation practices that enable the involvement of human and non-human actors in the design process. The estrangement framework provides a lens for comparing three examples from the literature. The evaluation of these three different co-creation projects reveals considerations on how to alter the human way of designing to be more inclusive of non-human perspectives. In this process, relationships and agency between human and non-human co-creators dynamically change and unfold. Their entanglements impact the collaborative design process in different ways. Humans and non-humans' diverse perspectives and vulnerabilities become transparent and facilitate the negotiation of their individual values and needs. Embodied design practices can translate the theoretical considerations made in this paper into tangible design activities. The performing arts could provide a laboratory to experiment with such co-creation processes through artistic means—to understand better non-human perspectives and how humans and non-humans co-shape their relationships in and with the world.

KEYWORDS: more-than-human-centered design, posthumanism, relational design, human-AI relationships, performative design methods, technology entanglements

KEYWORDS: Methods & Methodologies

Introduction

More-than-human-centered design approaches gain increasing interest in design research and design-related human-computer interaction (HCI) (Giaccardi & Redström, 2020; Wakkary, 2021). The ambition is to understand and facilitate the inclusion of non-human perspectives into research and design. With the emerging interest in more-than-human approaches, efforts have become evident to develop concepts, methodologies, and practices that can frame this change of perspective (Coskun et al., 2022). A recently published framework promotes initial guidance on designing with non-humans (Ianniello et al., 2022). The authors argue that alienation is the starting point and draw their perspective on pragmatism, de-colonialism, and post-human feminism. Alienation can be achieved by suspending our self-image as a human being and reassessing all entities, regardless of their origin and existence. From a critical stance, the authors suggest withdrawing from the humanistic perspective and reassessing all entities equally to consider diverse perspectives in a balanced manner without putting a human-centred standpoint into the foreground. Although this concept of de-identification from the humanistic perspective is solid and comprehensible in theory, it is difficult to grasp in practice. How can human actors move away from their identity as humans in the design process? How can non-human perspectives be embodied in the design process?

To break down the theoretical construct of alienation (Ianniello et al., 2022) and to more specifically address the incorporation of embodied approaches in co-design studies between human and non-human actors, I draw on the concept of estrangement as described by Wilde et al. (2017). The authors provide a framework that builds on the idea of making strange and experiencing new awareness through accessing other perspectives in that process. This framework guides the thought experiment of this paper on co-design projects between human and non-human actors to be equally involved in the design and research process. By doing that, this paper aims to stimulate the discussion across the design research community on how embodied design methods could contribute, integrate, or adapt to the burgeoning more-than-human perspective in design-oriented HCI. It intends to provide methodological directions for the design and research of emerging technologies, focusing on human-technology relationships that are mediated in a responsible and meaningful way (Akata et al., 2020;

Verbeek, 2015). Initial questions tackle desirable futures and relationships of humans and technologies in the design process: How can human and non-human actors fruitfully co-design while acknowledging and carefully treating emerging vulnerabilities?

The initial analysis of three case studies (Ghajargar et al., 2022; Giaccardi et al., 2016; Jochum & Derks, 2019) forms the basis for understanding and discussing how non-humans are to be given a co-creation role and what challenges might occur. Central concerns relate to the division of agency in the design process and the importance of exchanging perspectives throughout co-designing. Both aspects influence how humans and non-humans shape and embody their relations with and through each other. Follow-up inquiries may be needed for weaving embodied design approaches successfully into an HCI program that entangles the social, political, or moral challenges that emerge with the growing presence and development of ubiquitous, intimate, and other AI-enabled technologies.

Background

I draw on a more-than-human perspective to "highlight the co-constitutive role of non-human aspects" (Homewood et al., 2021, p. 7) in completion to the existence of humans and for the active construction of our world. Such non-human aspects are, for instance, technology, materials, nature, space, or time. They are also called non-human actors (Frauenberger, 2019) or non-human agents (Ianniello et al., 2022). This understanding is rooted in posthumanism, where hierarchies between species, anthropocentric worldviews, and the hegemony of humans no longer exist (Ferrando, 2013). Within this point of view, non-human entities play a central role when we speculate about desirable futures of and relationships between humans and technology (Frauenberger, 2019) or between humans and nature (Ianniello et al., 2022)—or generally speaking, between human and non-human actors.

The term human, as I use it throughout this paper, refers to what is defined as "human being, a person; a member of the species Homo sapiens or other (extinct) species of the genus Homo" by the Oxford English Dictionary (retrieved online on September 1st, 2023). I thereby consider a diverse global community that could be a human actor, as referred to throughout this text. Of course, dominant groups of human actors differ from underrepresented and often marginalised human actors. It is essential to carefully

consider the diversity of human actors in the design process to prevent biases built up on dominant human perspectives of the world. In this paper, however, the diversity of humans is not the point under investigation. Instead, I am concerned with the conceptual understanding of how a diverse human population could engage in a less hegemonic manner with what is not human. I assume that non-humans are diverse, too. I am referring here mainly to technology as non-humans and have in mind that other entities, including living beings, could also be considered non-humans.

This paper further builds on the understanding and importance of the lived experience in the design process. According to the phenomenological foundation of this understanding (Merleau-Ponty, 2013), the body is central to the ability to perceive the world and to have sensations in interaction with the world. Research has shown that this understanding of embodied being-in-the-world holds for the design process and designerly thinking (Poulsen & Thøgersen, 2011). When designing interactive systems, our interactions with different types of technologies become embodied In the prototypes and applications we build (Dourish, 2004). Likewise, when different types of stakeholders are involved as co-designers in the design process, their needs and wishes can be incorporated into this process and in the designerly outcome —in other words, their perspectives are embodied.

The body and the need for more-than-human perspectives in design

Recent research is questioning what/who actually is the body (Homewood et al., 2021): When tracing the understanding of the body in HCI research, it can be seen as a performative and sensing individual or as a collection and intersection of information about multiple individuals. The authors further emphasise that there is more than one universal understanding. The body is not the human user. Instead, the body is a construct to be understood as an always unique entity with different meanings depending on the point of view through which it is perceived. The most recent understanding of this construct likewise relates to more-than-human bodies (Homewood et al., 2021). This results in the need to include the perspectives of non-humans in the design and speculation of desirable futures.

However, human-centeredness is very popular in designing interactive systems, and technology is typically understood as a thing to be designed or as a tool in the design

process. The recent public discourse around AI diverges from that, putting AI into the role of an entity that should act transparently, responsibly, and even morally (Laschke et al., 2023). Because of its capabilities and potential to work autonomously, researchers argue that we need to consider the non-human perspective of such intelligent non-humans thoroughly in the design process (Frauenberger, 2019; Giaccardi & Redström, 2020) to embrace their different perspectives on the world. Moreover, researchers are questioning if human-centeredness is part of or the cause of all the challenges humans face globally and thus suggest taking a more-than-human-centered path in design (Wakkary, 2021). The shift away from the current human-centred focus is, therefore, becoming likely to give rise to the next wave of HCI (Frauenberger, 2019) and design research. Non-human perspectives could inform the understanding of problem spaces from previously unappreciated directions. This paper contributes to these types of research approaches.

The power of embodied design practices

Our individual body is given to each of us. Therefore, some scholars argue we need to design in action by using our bodies as tools for first-hand experiences in the design process and teach the future generation of designers how to do this (Hummels et al., 2007). Body-centric and movement-based design methods have been explored and presented as essential to design. They facilitate empathy to understand users better and truly feel the problem space behind them. Such embodied design practices bring forth techniques, tools, and theories that enable researchers and designers to use their bodies to create and speculate on human-centred technologies, considering a human's first-person perspective and generating empathy for other humans.

By embodied design practices, I primarily refer to embodied design ideation methods and frameworks that serve as tools or strategies to enable “all of a person's senses to be leveraged in an emergent design space” (Wilde et al., 2017, p. 5159). This understanding can embrace a first-, second-, or third-person perspective of an engagement with the body (Svanæs & Barkhuus, 2020). Similarly, somatic approaches engage with “the subjective, first-person perception of one's own body” (Loke & Schiphorst, 2018, p. 55) that still can be tightly connected to second- or third-person perspectives (Höök et al., 2021). Central to all these approaches is that the (human) body is the starting point of the design process. Lots of strategies, frameworks, and

methods have been developed and explored to design with, through, and for the lived body, such as those presented in (Fdili Alaoui et al., 2015; Höök, 2018; Hummels et al., 2007; Márquez Segura et al., 2016; Núñez-Pacheco & Loke, 2018; Schleicher et al., 2010; Svanæs & Barkhuus, 2020; Tomico & Wilde, 2016; Turmo Vidal & Márquez Segura, 2018; Weijdom, 2022). Most of these methods work through/with movement, be our attention directed toward the inside of the body (e.g., perceiving one's heartbeat or breath) or towards the outside (e.g., activities performed by the whole body or groups).

In this paper, the focus lies not on the precise distinction between embodied design methods and somatic approaches to design research. Instead, I focus on their common ground and overlaps to inspire discussions and ambitions on how such body-centred approaches and methods could fit or merge into the growing understanding across the design research and HCI community "to design meaningful relations, rather than optimizing user experiences" (Frauenberger, 2019, p. 22). Drawing on the benefits of embodied design practices, the research presented here aims to foster the understanding of how more-than-human bodies (Homewood et al., 2021) could take advantage of such approaches to fertilise the mutual process of speculating on desirable futures. Besides the demand for reconsidering current design practices (Giaccardi & Redström, 2020) or deploying more participatory approaches (Frauenberger, 2019), research has so far neglected to present more details on translating these considerations into practical design actions. This paper sheds more light on these gaps to make the first theoretical design guidelines (Ianniello et al., 2022) more tangible for practice.

A thought experiment

To better understand how we can embody non-human perspectives in the design process, I extract here how we can engage non-humans in the design process through embodied design practices. The estrangement framework (Wilde et al., 2017) provides a lens to analyse three selected case studies. Practically, the process of estrangement has four overlapping phases: 1) Disruption from the usual way of doing something, 2) destabilisation of underlying standards, 3) emergence of new ideas, and 4) embodiment of the altered experience in doing something. The authors further demonstrate the power of this framework by analysing several embodied design ideation methods that relate different materials and actions to the human body.

In the following, I depict tangible and immaterial qualities of co-creation processes between human and non-human agents from the stance of that framework. The evaluation of the selected cases is based on the strategy of close reading (Schur, 1998). I extracted the patterns, similarities, and differences between the cases from their distinct publications (Ghajargar et al., 2022; Giaccardi et al., 2016; Jochum & Derks, 2019).

Three cases of co-creation with non-humans

In the selected case studies, non-human actors are involved to an extent that attributes them to an autonomous role in the co-creation process. Something fundamentally different would have evolved without their contribution, or the creation process would not have been possible. No specific strategy has been used to select these cases. Instead, my choice was random, following the idea to take not only two studies as their insights might be diametrically opposed. At best, a third study could mediate between the two. Also, the studies should address different technologies and have different creative outputs. I first overview each study with a focus on their research objectives, the study design, the role of the included technologies, and the main results.

Thing ethnography (2016). The first study investigates how data and trajectories collected by non-human, everyday objects can reframe our perspective on a problem space (Giaccardi et al., 2016). An autonomous camera equipped with different kinds of sensors to trigger the shutter function—a so-called autographer—was attached to a cup, a kettle, and a fridge. Five households participated for two days in the data collection. The researchers analysed the resulting visual narrative in the form of timelines and movie clips. The first revealed insights into sequential and temporal structures and objects' trajectories; the latter gave insights into the same scenes from the point of view of the three different objects and provided information about their individual experiences. With their approach, the authors “attempt to promote a more holistic way of understanding relationships among people, objects and practices” (Giaccardi et al., 2016, p. 387). Indeed, the findings point to the impact of (non-)movement, filling or generating time, and the agency such non-human actors have to influence humans using them.

Tonight, we improvise (2019). The second study explores how a robot, as an equal partner in dance performances, can improvise in exchange with a human performer (Jochum & Derks, 2019). A robot wheelchair base was hacked for this purpose, including pre-programmed motion sequences allowing flexible responses to the human's position and movement. The human and non-human performers were each equipped with an off-the-shelf handheld Bluetooth controller and, together with two base stations, formed a $5m^2$ 3D trackable stage area. Video observations of several training sessions and public performances with three performers of different genres (physical theatre, modern dance, and breakdance) and interviews informed the analysis of the project. The authors found "evidence of embodied interaction and intersubjectivity that resulted in engaging and authentic performances" between the two partners (Jochum & Derks, 2019, p. 8). Each training session and performance resulted in unique outcomes and spontaneous interactions. Although there were frustrating moments for the humans involved (e.g., through technical malfunctions), the performers experienced their improvised relationship with the robot as inspiring, whether its behaviour was intentional or not.

A redhead walks into a bar (2022). The third study auto-ethnographically evaluates the co-writing process of a fictional story between a human and an AI-based natural language processing system that generates human-like text (called GPT-3) (Ghajargar et al., 2022). A literature version of the conversational user interface was used that only allows the human actor to give an initial textual prompt and select the literary style. The non-human actor then creates a part of the story with three possible progressions, of which the human actor chooses one. The non-human actor generates three continuations again, and so on, until the story is complete. At first, the authors studied co-writing when prompting the non-human agent with essential elements of fiction (character, setting, dialogue). Building on this, a second exploration used more advanced text prompts, such as metaphors or dialectics, by one of the authors trained in creative writing and literature. The researchers found that the non-human agent could autonomously introduce new elements (e.g., characters) to the plot or switch between storytelling modes. At the same time, however, it had difficulties making relevant semantic connections or misunderstood semantic concepts. Regarding their own experiences, authors engaged with their curiosity to learn about their co-writers

and explored new ways of creative writing. They “also observed that [they] built a relation of care with AI, similar to that with Tamagotchi” (Ghajargar et al., 2022, p. 239).

Evaluation

The three introduced examples of co-designing with non-human actors are different in nature. They employ different types of technologies, which all obtain a certain degree of autonomy. The technology of the oldest example, the thing ethnography, builds on the interference of five sensors that indicate that something in the environment has changed (colour, light, motion, direction, temperature), so pictures are autonomously taken. The others build on AI. The improvisation project builds on machine learning algorithms, enabling the robot to adapt to its dance partners. The co-writing study uses deep learning to improve humanoid text production constantly.

The collaborations between human and non-human actors are very different in nature. Comparing the cases reveals that all non-human actors have a central role in creating the intended output. Without them, the result would be totally different or impossible to achieve. Human actors rely heavily on the contributions of non-human actors. Further, all human actors shape the creation process by interpreting and reacting to the actions of the non-human actors. Their influence varies in intensity, i.e., their degree of impact is different. For instance, in ethnography, the whole analysis processed by humans depends on the data material collected by the autographers. Here, non-human actors took the lead, and human actors could only act upon this. Similarly, for the co-writing example, the human actors rely entirely on the options the non-human actor provides. Still, the non-human actor requires an initial prompt from the human actor, without which the whole co-creation process would not commence. For the dance improvisation study, it seems a more balanced relationship, as both partners influence each other on a similar level. It is thus the most equal relationship found in the examples. We can observe a continuous back and forth between both partners, although this dynamic process held moments of surprise and frustration for the human actors.

Movement only plays a role in two of the three cases. The co-writing study fully counts on the intellectual capabilities of AI; physical movement is involved neither in the design phase nor in the outcome. In contrast, for the other two cases, movement is observed as being central: In the dance improvisation study, the co-creation process is fully built

on negotiating the relationship between the human and non-human performer through physically moving around in the space. For the thing ethnography study, (non-)movement is interpreted as the relation of the objects to their environment, next to other possible changes measured by the attached sensors.

Table 1 shows the analysis of the three examples regarding their inherent qualities of estrangement. We see that human ways of designing are disrupted, and thus, human perspectives on the world are destabilised. From that, non-human perspectives can emerge in the design process and are, therefore, *embodied* in the outcomes.

Instances of estrangement	**Thing ethnography (Giaccardi et al., 2016)**	**Tonight, we improvise (Jochum & Derks, 2019)**	**A redhead walks into a bar (Ghajargar et al., 2022)**
DISRUPT	the human perspective on everyday situations and familiar environments	the human way of partnering with (un)predictable dance partners	the output of human imagination through creative writing
DESTABILISE	the human understanding of the passiveness of everyday objects	the human perception of a mutual performative engagement with a partner	the human ability to express creatively is restricted
EMERGE	perspectives and trajectories of non-human actors become visible	constantly balancing the interconnections between human and non-human actors	surprising literary artefacts and cognitive differences of non-humans
EMBODY	non-human experiences of everyday scenarios and the impact of non-humans on human actors	unique relationships between human and non-human actors	creative potential and capacitive limitations of non-human actors

Table 1: Comparison of the three case studies using the framework of Wilde et al. (2017).

Disrupting human ways of designing. The human ways of creation were disrupted by the introduction of non-humans as collaborators. Human actors stop taking complete control of the process, situation, or space. Instead, the moments of disruption were enabled through human actors sharing control and impact on the process with non-human actors. This disruption could be achieved through completely giving control to the non-human actors (thing ethnography), in a dialogue (improvisation study), or through an initialising act by the human actor (co-writing study). The degree of sharing control, and thus the ability to influence the design outcome, varied depending on the technological and intellectual possibilities introduced. Sharing this power may have led to the most balanced design process, including fully balancing both perspectives. Being overweight on one side necessarily leads to less impact on the other side.

Destabilising human perspectives. In all three cases, the non-human interventions destabilised the human perspectives of/in the creative process. This destabilisation was caused by either fully autonomous actions of the non-human actors (thing ethnography), negotiations between human and non-human actors (improvisation study), or overweight in the control of the process on the non-human actor's side (co-writing study)—in every case through troubling the typical human way of seeing the world or accomplishing tasks. Hence, sharing control and agency in the design process destabilised the hegemonic (self-)perception of humans. At the same time, this destabilisation minimised the dependence of non-humans on human actors, enabling them to get active in the design process. Consequently, human comprehension, expression, and other abilities were changed or limited.

Emerging non-human perspectives. In the examples, the destabilisation of human perspectives made negotiations between the different entities or tangible moments of non-human perceptions possible. These moments of emergence included unknown perspectives of non-humans on the world (think ethnography), dynamic interconnections between non-humans and humans (improvisation study), or co-authoring qualities and limitations of non-humans (co-writing study). Hence, the reallocation of control and agency in the design process gave rise to non-human perspectives on the world. Concepts, artefacts, connections, and events could emerge and be built not only on human input. Instead, non-human perspectives and logic shaped the design process and its outcome. Also, unexpected feelings or new

impressions could occur, as the interaction between human and non-human actors created surprising moments (e.g., through miscommunication). In the design process, human and non-human actors ideally made what emerges for them transparent.

Embodying non-human perspectives. The shared design process inherited new ways of shaping the connections between humans and non-humans. Thereby, potentials and limits of human and non-human capabilities were embodied. The experiences on each side were altered through the collaboration, and each perspective could manifest itself in the outcome. All three examples incorporated varying aspects of their co-creation process. These aspects concerned individual experiences (unravelled by either or both sides), mutual relationships (shaped by human and non-human actors), and shared output (in the form of products or services). Ideally, the experiences and relationships were balanced in the co-creation process, with significant consideration of human needs and vulnerabilities.

Practical considerations for co-creation with non-humans

In practice, conducting and reflecting on design and research projects based on the four instances of the estrangement framework (Wilde et al., 2017) facilitates the engagement with non-human perspectives in diverse ways throughout the design process. Comparing three design cases through the lens of this framework showed similarities and differences. Based on this comparison, I extract three primary considerations for successful embodied co-creation practices with non-humans.

1) Facilitate relationships that are shaped dynamically by all co-creators. The disruption, destabilisation, and emergence of human and non-human perspectives embody the potential and limits of human and non-human capabilities in the design process. Through their collaboration, the experiences on both sides can continuously be altered so each perspective can manifest itself in the respective outcome. Enabling relationships that dynamically influence the design process can lead to innovative insights and outcomes.

2) Carefully consider the distribution of agency between co-creators. The more agency non-humans have in the process, the more their perspective can be taken into account. At the same time, handing over agency to non-humans impacts human agency. The degree of sharing control varies depending on the technological and intellectual

possibilities introduced to the design process. Sharing control equally may lead to the most balanced relationships. In every case, being overweight on one side necessarily leads to less influence from the other side. That means the agency distribution between human and non-human collaborators is a responsible task that requires thoughtful consideration to avoid unwanted effects.

3) Enable reciprocity for a mutual understanding. If we reallocate control and agency in the design process, we give rise to new non-human perspectives on the world. Concepts, artefacts, connections, or events built not only upon human input can emerge. Instead, non-human perspectives and logic co-shape the design process and its outcome. Also, unexpected feelings, new impressions, or vulnerabilities can occur for the human participant as the interaction between both entities can create surprising moments. Ideally, human and non-human actors make transparent what emerges for them through interacting with each other. Both sides should support the other's expressiveness and emerging perspectives, and the design process should facilitate their exchange and reciprocal interrelations.

Discussion

This preliminary study has shown that the appearance of the non-human collaborators in the three examples was very different, ranging from everyday objects over robots to graphical interfaces, including AI behind or not. If we understand these material shapes and immaterial forms as more-than-human bodies (Homewood et al., 2021), we can argue that these non-human bodies made a crucial contribution to each project's design process. The non-human bodies and their perspectives on the world were embodied in the design process. Incorporating the knowledge and activities of these non-humans in the design process further led to new outcomes that humans would not have achieved alone. Co-creation with non-humans was possible, and different non-human entities contributed valuable perspectives and ideas to the creative process. This understanding aligns with theoretical considerations about the agency technology has in shaping the world (Frauenberger, 2019) and the experiences humans make throughout this mediation (Verbeek, 2015). It further supports the request that humans collaborate more closely with nature (Ianniello et al., 2022) or artificial things (Giaccardi & Redström, 2020) to imagine the world's future while considering different needs and vulnerabilities carefully.

Although I pointed out in the background that movement is typically closely related to embodied design practices, physical movement did not play a role in every embodied co-creation process I investigated. Instead, embodiment was achieved through active engagement, which can happen physically, intellectually, or as a mix of both. Non-human entities can also bring in their valuable perspectives (e.g., for thing ethnography (Giaccardi et al., 2016)) and other intangible qualities (e.g., the ability to co-write a fictional story (Ghajargar et al., 2022)). Further investigation is needed to understand how such intangible qualities contribute to co-designing and how to make the 'tacit' knowledge of AI technologies transparent therein. Research should explore the communication, non-verbal exchange, and mutual understanding in the co-design process between human and non-human entities—e.g., to make transparent how they encourage or challenge each other in the design process, how they communicate their awareness, how both sides ensure mutual responsibility, and how they arrive at a co-authored design outcome.

Regarding the role of movement in the design process, other research has made concrete attempts to co-design with materials and technologies through a more-than-human lens and published the first practical design methods (Gemeinboeck & Saunders, 2023). This work is based on a performative design approach that engages performers, materials, and technologies in the design process to enact human-robot interaction (Gemeinboeck, 2021). More such research is needed on how the theoretical considerations, as made through the thought experiment in this paper, unfold in practical design methods. Future research should demonstrate how different types of technologies, including AI, could be engaged in co-design projects. Thereby embodied design ideation methods (Wilde et al., 2017), body-storming (Schleicher et al., 2010), live-action role-play (Márquez Segura et al., 2019), and other types of user enactment (Odom et al. 2012) are a promising starting point to co-design with non-humans.

I suggest looking more into techniques borrowed from the performing arts, such as mirroring (Morgenroth, 1987), pretending (Gillett, 2012), or improvisation (Frost & Yarrow, 1990). If non-humans as co-designers are not present or cannot act autonomously—i.e., in highly speculative cases where the non-human counterpart does not yet exist in the anticipated form—such artistic techniques might be helpful to put humans into the role of non-humans. For example, human performers could be

assigned the role of a robot to interact artistically with other performers in human roles. The insights from the aforementioned thought experiment provide guidance on strategically embodying different perspectives into the design process.

While the estrangement framework (Wilde et al., 2017) initially addresses design works that engage human designers with new perspectives on the world through using materials in unusual ways and behaving unexpectedly when acting out new usage scenarios, I here propose that non-human agents become co-designers in this process. Of course, new perspectives on the world can also be achieved through engaging a diverse global community through other co-design activities. Participatory research has a long tradition of giving underrepresented human perspectives a voice and active role in the design process. For instance, recent research in child-centred AI advocates that children should obtain an innovator role throughout all design project phases (Mathiyazhagan & La Fors, 2023). Such approaches likewise foster diverse perspectives on the world, including new perspectives on technologies and reducing the biases of previously dominant human views. Future research is needed to understand better how insights gained through involving non-human agents in the design process may have parallels to participatory approaches accounting for underrepresented human perspectives. Future research should further investigate whether the engagement with non-human perspectives through embodied design practices, as explored in this paper using three technology projects as examples, also applies to non-human entities beyond technology (e.g., nature).

Finally, ethical concerns arise. Investigations are needed to understand how ethical values change or can be maintained when one side (the non-human actor) controls the co-creation process more than the other. Shared moral values are needed to treat existing and emerging human vulnerabilities respectfully and to avoid discrimination or any other form of harm. The research agenda for hybrid intelligence (= the human intellect is augmented with AI) (Akata et al., 2020) could inspire future research on co-design processes between humans and non-humans. This agenda outlines four main challenges that address the collaborative (How to create synergies?), adaptive (How to learn from each other?), responsible (How are ethical values integrated?), and explainable (How to share awareness and intentions?) aspects of the relationship between humans and non-humans. Practising embodied co-creation between both

sides can contribute to overcoming these challenges on two levels: First, through investigating embodied co-design practices between human and non-humans, their relationships can be studied as they unfold in the design process, e.g., through analysing how vulnerabilities or ethical values are considered and made transparent. Second, the practical outcome of such co-creation projects is speculation on desirable futures that ideally embody the perspectives and values of both sides. This co-creative entanglement of humans and non-humans contributes to a world that shapes the relationships of humans with their non-human environment respectfully and sustainably.

Conclusion

This paper investigated how a more-than-human perspective in HCI and design research could leverage the potential of embodied design practices. It contributes to a practical understanding of conducting co-creation activities with non-human actors and makes emerging challenges transparent. Comparing three case studies focusing on technology showed that redistributing agency and control between human and non-human actors throughout the design process is essential for the embodiment of either or both perspectives. Taking control of the design process or giving it up shapes the design outcome and the evolving relationships between human and non-human actors. The design process should facilitate dynamic relationships between human and non-human actors while carefully distributing agency amongst these co-creators and enabling interchange (reciprocity) between them. However, shared language and moral agreements are needed to mediate these dynamic and mutual relationships and shape them sustainably and meaningfully. Future research may shed light on how relationships are mediated throughout the design process and how emerging vulnerabilities are made transparent and responsibly treated while considering the diversity of human and non-human co-creators.

References

1. Akata, Z., Balliet, D., de Rijke, M., Dignum, F., Dignum, V., Eiben, G., Fokkens, A., Grossi, D., Hindriks, K., Hoos, H., Hung, H., Jonker, C., Monz, C., Neerincx, M., Oliehoek, F., Prakken, H., Schlobach, S., van der Gaag, L., van Harmelen, F., … Welling, M. (2020). A Research Agenda for Hybrid Intelligence: Augmenting Human Intellect With Collaborative, Adaptive, Responsible, and Explainable Artificial Intelligence. *Computer*, *53*(8), 18–28. https://doi.org/10.1109/MC.2020.2996587
2. Coskun, A., Cila, N., Nicenboim, I., Frauenberger, C., Wakkary, R., Hassenzahl, M., Mancini, C., Giaccardi, E., & Forlano, L. (2022). More-than-human Concepts, Methodologies, and Practices in HCI. *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–5. https://doi.org/10.1145/3491101.3516503
3. Dourish, P. (2004). *Where the Action Is—The Foundations of Embodied Interaction*. MIT Press.
4. Fdili Alaoui, S., Schiphorst, T., Cuykendall, S., Carlson, K., Studd, K., & Bradley, K. (2015). Strategies for Embodied Design: The Value and Challenges of Observing Movement. *Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition*, 121–130. https://doi.org/10.1145/2757226.2757238
5. Ferrando, F. (2013). Posthumanism, Transhumanism, Antihumanism, Metahumanism, and New Materialisms: Differences and Relations. *Existenz*, *8*(2), 26–32.
6. Frauenberger, C. (2019). Entanglement HCI The Next Wave? *ACM Transactions on Computer-Human Interaction*, *27*(1), 2:1-2:27. https://doi.org/10.1145/3364998
7. Frost, A., & Yarrow, R. (1990). *Improvisation in Drama*. Red Globe Press. https://doi.org/10.1007/978-1-349-20948-4
8. Gemeinboeck, P. (2021). The Aesthetics of Encounter: A Relational-Performative Design Approach to Human-Robot Interaction. *Frontiers in Robotics and AI*, *7*. https://www.frontiersin.org/articles/10.3389/frobt.2020.577900
9. Gemeinboeck, P., & Saunders, R. (2023). Dancing with the Nonhuman: A Feminist, Embodied, Material Inquiry into the Making of Human-Robot Relationships. *Companion of the 2023 ACM/IEEE International Conference on Human-Robot Interaction*, 51–59. https://doi.org/10.1145/3568294.3580036

10. Ghajargar, M., Bardzell, J., & Lagerkvist, L. (2022). A Redhead Walks into a Bar: Experiences of Writing Fiction with Artificial Intelligence. *Proceedings of the 25th International Academic Mindtrek Conference*, 230–241. https://doi.org/10.1145/3569219.3569418
11. Giaccardi, E., Cila, N., Speed, C., & Caldwell, M. (2016). Thing Ethnography: Doing Design Research with Non-Humans. *Proceedings of the 2016 ACM Conference on Designing Interactive Systems*, 377–387. https://doi.org/10.1145/2901790.2901905
12. Giaccardi, E., & Redström, J. (2020). Technology and More-Than-Human Design. *Design Issues*, *36*(4), 33–44. https://doi.org/10.1162/desi_a_00612
13. Gillett, J. (2012). Experiencing or pretending—Are we getting to the core of Stanislavski's approach? *Stanislavski Studies*, *1*(1), 19.
14. Homewood, S., Hedemyr, M., Fagerberg Ranten, M., & Kozel, S. (2021). Tracing Conceptions of the Body in HCI: From User to More-Than-Human. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–12. https://doi.org/10.1145/3411764.3445656
15. Höök, K. (2018). *Designing with the Body: Somaesthetic Interaction Design*. MIT Press. https://mitpress.mit.edu/9780262038560/designing-with-the-body/
16. Höök, K., Benford, S., Tennent, P., Tsaknaki, V., Alfaras, M., Avila, J. M., Li, C., Marshall, J., Roquet, C. D., Sanches, P., Ståhl, A., Umair, M., Windlin, C., & Zhou, F. (2021). Unpacking Non-Dualistic Design: The Soma Design Case. *ACM Transactions on Computer-Human Interaction*, *28*(6), 40:1-40:36. https://doi.org/10.1145/3462448
17. Hummels, C., Overbeeke, K. C. J., & Klooster, S. (2007). Move to get moved: A search for methods, tools and knowledge to design for expressive and rich movement-based interaction. *Personal and Ubiquitous Computing*, *11*(8), 677–690. https://doi.org/10.1007/s00779-006-0135-y
18. Ianniello, A., Romani, A., & Casnati, F. (2022). Technology toward more-than-human symbiosis: Critical reflections from the design perspective. *Proceedings of the 25th International Academic Mindtrek Conference*, 158–166. https://doi.org/10.1145/3569219.3569379
19. Jochum, E., & Derks, J. (2019). Tonight We Improvise! Real-Time Tracking for Human-Robot Improvisational Dance. *Proceedings of the 6th International Conference on Movement and Computing*, 1–11. https://doi.org/10.1145/3347122.3347129

20. Laschke, M., Bucher, A., Coulton, P., Hassenzahl, M., Kuijer, L., Lallemand, C., Lockton, D., Ludden, G., & Deterding, S. (2023). Moral Agents for Sustainable Transitions: Ethics, Politics, Design. *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–6. https://doi.org/10.1145/3544549.3573814
21. Loke, L., & Schiphorst, T. (2018). The somatic turn in human-computer interaction. *Interactions*, *25*(5), 54–5863. https://doi.org/10.1145/3236675
22. Márquez Segura, E., Spiel, K., Johansson, K., Back, J., Toups, Z. O., Hammer, J., Waern, A., Tanenbaum, T. J., & Isbister, K. (2019). Larping (Live Action Role Playing) as an Embodied Design Research Method. *Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion*, 389–392. https://doi.org/10.1145/3301019.3320002
23. Márquez Segura, E., Turmo Vidal, L., & Rostami, A. (2016). Bodystorming for movement-based interaction design. *Human Technology*, *12*(2), Article 2. https://doi.org/10.17011/ht/urn.201611174655
24. Mathiyazhagan, S., & La Fors, K. (2023). Children's right to participation in AI: Exploring transnational co-creative approaches to foster child-inclusive AI policy and practice. *Information Polity*, *28*(1), 141–153. https://doi.org/10.3233/IP-229014
25. Merleau-Ponty, M. (2013). *Phenomenology of perception*. Routledge.
26. Morgenroth, J. (1987). *Dance Improvisations*. University of Pittsburgh Pre.
27. Núñez-Pacheco, C., & Loke, L. (2018). Towards a technique for articulating aesthetic experiences in design using Focusing and the Felt Sense. *The Design Journal*, *21*(4), 583–603. https://doi.org/10.1080/14606925.2018.1467680
28. Odom, W., Zimmerman, J., Davidoff, S., Forlizzi, J., Dey, A. K., & Lee, M. K. (2012). A fieldwork of the future with user enactments. *Proceedings of the Designing Interactive Systems Conference, DIS '12*, 338–347. https://doi.org/10.1145/2317956.2318008
29. Poulsen, S. B., & Thøgersen, U. (2011). Embodied design thinking: A phenomenological perspective. *CoDesign*, *7*(1), 29–44. https://doi.org/10.1080/15710882.2011.563313
30. Schleicher, D., Jones, P., & Kachur, O. (2010). Bodystorming as embodied designing. *Interactions*, *17*(6), 47–51. https://doi.org/10.1145/1865245.1865256
31. Schur, D. (1998). *An introduction to close reading*. https://media.gradebuddy.com/documents/2651162/2e637c34-5bca-4e19-af0a-ed3c86596017.pdf

32. Svanæs, D., & Barkhuus, L. (2020). The Designer's Body as Resource in Design: Exploring Combinations of Point-of-view and Tense. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–13. https://doi.org/10.1145/3313831.3376430
33. Tomico, O., & Wilde, D. (2016). Soft, embodied, situated & connected: Enriching interactions with soft wearables. *MUX: The Journal of Mobile User Experience*, *5*(1), 3. https://doi.org/10.1186/s13678-016-0006-z
34. Turmo Vidal, L., & Márquez Segura, E. (2018). Documenting the Elusive and Ephemeral in Embodied Design Ideation Activities. *Multimodal Technologies and Interaction*, *2*(3), Article 3. https://doi.org/10.3390/mti2030035
35. Verbeek, P.-P. (2015). Beyond interaction: A short introduction to mediation theory. *Interactions*, *22*(3), 26–31. https://doi.org/10.1145/2751314
36. Wakkary, R. (2021). *Things we could design: For more than human-centered worlds*. MIT Press.
37. Weijdom, J. (2022). Performative prototyping in collaborative mixed reality environments: An embodied design method for ideation and development in virtual reality. *Sixteenth International Conference on Tangible, Embedded, and Embodied Interaction*, 1–13. https://doi.org/10.1145/3490149.3501316
38. Wilde, D., Vallgårda, A., & Tomico, O. (2017). Embodied Design Ideation Methods: Analysing the Power of Estrangement. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 5158–5170. https://doi.org/10.1145/3025453.3025873

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