A CATEGORISATION FOR MORE-THAN-HUMAN REPRESENTATION IN DESIGN

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ABSTRACT
Despite the recent interest in utilising More-Than-Human Design (MTHD) in design research, education, and practice, its integration into design curricula remains limited. This is because MTHD requires design students to engage with multiple stakeholders during the design process, explore relationships among them, including those of humans and nonhumans, and represent these relations and more-than-human users. This paper addresses this challenge by introducing a categorisation for more-than-human (MTH) representation tools and providing recommendations for integrating the MTHD approach into design education and practice, particularly supporting decision-making in preparing MTH user representations.

Keywords: More-than-human, user representation, design education

1 INTRODUCTION
Increasing environmental degradation, manifested through intensifying heatwaves, droughts, and ecosystem loss, has underscored the inadequacy of human-centred thinking in addressing ecological challenges. In line with this, More-Than-Human Design (MTHD) [1], which recognises both human and nonhuman stakeholders (e.g., animals, plants, and objects) as active participants in design [2], has been recently introduced to the design community. This approach resonates with emerging more-than-human perspectives in Human-Computer Interaction (HCI) research, where scholars call for ontologies that embrace humans' entanglements with technologies and multiple species [3], and contests the notion of humans as the sole users of design, promoting a multi-species, interconnected design practice [4].
With the introduction of MTHD, navigating complex, multi-stakeholder environments, integrating diverse data sources from expert insights and observations to embodied experiences, and ecological monitoring have become critical. This complexity demands that design students develop skills not only in gathering and analysing data on nonhuman users but also in translating these insights into actionable user representations. Recent work in design education reflects a growing need to address ecological and multispecies concerns through MTH approaches. Projects like Stromatolive [5] use ecological soundscapes to foster empathy toward nonhuman beings, challenging anthropocentric visual dominance by engaging students in multi-sensory exploration and multispecies ethnography. Similarly, field-based design seminars [6] incorporate speculative and life-centred approaches that ask students to design *with* rather than *for* plants, engaging nonhuman agency as a core part of the educational process. These examples illustrate how MTHD pedagogy advances beyond theory into experiential practices that embrace sustainability, relationality, and critical representation.
User representation tools like personas, empathy maps, and journey maps have long been employed in human-centred design to transform user insights into actionable design formats, relying on verbal, cognitive, and behavioural data from interviews and observations. However, when applied to nonhumans, these tools encounter significant limitations, as they fail to accommodate non-verbal communication (e.g., many species rely on chemical or vibrational signals), species-specific perception of time, and ecological relationships [7]. To address these challenges, researchers adapted human-centred tools for MTH contexts, like animal personas and experience maps, to make nonhumans more visible in design. However, these tools oversimplify non-human experiences and can lead to anthropomorphism. Others developed new representation tools, such as Sensing Bodies [8] and Under the Shade [5], to explore sensory, performative, and data-driven approaches. Design educators and students who would like to integrate an MTHD approach into their work can utilise both tools. However, the literature lacks a resource to help them understand the type of tools and select the ones suitable for

their context. Plus, fragmented representation practices in MTHD hinder the integration of these methods into design curricula and practice. This paper introduces a categorisation for MTH representation tools, **reflective, analytical, and interpretive,** and assesses them according to three key dimensions: **transferability, depth of representation, and the designer's role in the representation process**. It also offers recommendations for tool selection, usage, and their integration into design education.

2 MORE-THAN-HUMAN USER REPRESENTATIONS

2.1 More-Than-Human Design in Educational Context

The influence of MTHD on design education can be seen in diverse lines of work, challenging the field's human-centred focus. Some of these focuses more on the philosophy of MTHD, criticising how conventional research methods reinforce human dominance and overlook nonhuman entanglements [9], advocating for listening to nonhuman voices [10], and highlighting the limitations of qualitative research that over-relies on human perspectives [11]. MTHD education seeks to address these issues by integrating nonhuman perspectives into learning. Beach and Fox [12] propose Value Sensitive Speculative Design to expand students' awareness of human-nonhuman entanglements. Hansen et al. [13] introduce a pedagogical framework for incorporating MTH values in design. Zamansky et al.'s [14] work engages students with animal stakeholders in technology development, fostering a broader understanding of nonhuman agency in design.

Teaching MTH perspectives presents several challenges. Bekker et al. [15] identify representation as a key issue, as nonhuman stakeholders cannot advocate for themselves. They emphasise designers' ethical responsibility in choosing appropriate representation methods, such as consulting Indigenous knowledge or using environmental data. They also highlight challenges in justifying nonhuman inclusion, defining the designer's role when AI or animals contribute to the design, and establishing clear success criteria. According to Bekker et. al., technology often prioritises human needs, while design methodologies tend to reflect Western biases, underscoring the need for cultural sensitivity and alternative approaches.

2.2 User Representations in Human-Centered Design and More-Than-Human Design

User representation in HCD refers to tools and practices that communicate user needs, emotions, and behaviours to support empathy and guide design decisions [16]. Common tools include personas, empathy maps, journey maps, and experience maps. These tools help synthesise complex insights into actionable formats, yet they rely heavily on verbal, cognitive, and behavioural data, making them inherently anthropocentric and limited when applied to nonhuman users.

MTHD expands the notion of "user" to include nonhumans such as animals, plants, and ecosystems. This shift challenges anthropocentric design practices and demands new forms of representation that account for non-verbal communication, relational agency, and ecological interdependence. However, designers often struggle to empathise with nonhumans due to the tendency to interpret them through human-centric practices, while nonhumans lack the ability to articulate their needs and experiences. While some MTHD studies adapt HCD tools (e.g., animal and object personas, narratives, and experience maps), others propose novel tools like Sensing Bodies [8] or Under the Shade [5], which explore embodied, sensory, or data-driven approaches to conveying nonhuman perspectives.

As the literature evolves, new studies continue to introduce diverse representation examples, with some being newly developed and others adapted from human-centred practices. However, there is no guidance for designers and educators to choose appropriate tools for different design cases and how to use them. In this paper, we present a categorisation for representation tools using three key parameters.

3 CATEGORISING MORE-THAN-HUMAN REPRESENTATIONS

3.1 Three Parameters for MTH Representations

Preparing MTH representations requires consideration of several factors that influence how nonhuman perspectives are conveyed, understood, and utilised in the design process. Drawing from our prior experience with user representation tools in MTHD and building on recurring themes in the literature such as the notion of voice (i.e., who constructs the representation) [15], the various ways nonhumans participate in representation processes [17], and care and relationality [18], we identified three key parameters that shape the design and use of MTH representations.

The first parameter, **transferability**, is about a tool's ability to communicate nonhuman perspectives to diverse audiences. A transferable tool is accessible, clear, and engaging. Accessibility ensures ease of

use and comprehension without specialised knowledge. Clarity means the tool's outputs are well-structured and need little explanation. Engagement captures interest and encourages deeper interaction with the nonhuman stakeholder.

The second parameter, **depth of representation**, is about a tool's capacity to capture nonhuman complexity, foster empathy, and acknowledge agency. A tool with higher depth integrates multiple dimensions, portraying nonhumans as active participants. This depth challenges anthropocentric biases, encouraging emotional connections and deeper awareness in design, making MTH representations more meaningful and transformative.

The third parameter, **the designer's role in MTH representation**, depends on data collection and design approaches, influencing effort, expertise, and creativity. Data may come from various sources (e.g., desk research or firsthand fieldwork with nonhumans). Representation methods also vary—some adapt familiar tools like personas, while others require creative interpretation or hands-on artifact creation, demanding greater time, materials, and skills.

3.2 Categories of MTH Representations

We propose a categorisation of MTH representations based on how they vary across parameters. Each category represents a distinct configuration of these parameters, illustrating different approaches to how nonhuman perspectives are interpreted, constructed, and communicated in design.

3.2.1 Reflective Representation Tools

Reflective representation tools engage audiences in interpreting nonhuman perspectives through sensory interaction and personal engagement. Instead of directly conveying data, these tools encourage exploration, fostering self-reflection, empathy, and deeper engagement. An example reflective representation tool is Sensing Bodies [8], an interactive installation using biosensors and LED displays to explore human-plant relationships. Participants interpret biodata responses rather than receiving direct insights, highlighting nonhuman entanglements in plantation economies.

Reflective tools often integrate direct observation and embodied experiences, which enhance the depth of representation by incorporating multiple aspects of nonhuman perspectives. In Sensing Bodies, the audience reflects on the complex entanglements of human-nonhuman relationships within plantation economies and the shared respiration process between human and plant bodies. Yet, as meaning emerges subjectively through interaction, and interpretations may vary depending on the audience and context, they become less transferable.

Reflective tools are often created as installations, requiring expertise or previous experience in hardware, electronics, and interactive systems to develop functional representations. The design process typically involves two stages of data collection: first, sensor-driven data collection to gather insights about nonhumans, and second, audience-driven data collection, where interactions with the representation itself generate additional insights. Since engaging with these tools is a sense-making activity, audience interactions contribute to the ongoing construction of meaning, making them dynamic representations of nonhuman perspectives.

3.2.2 Analytical Representation Tools

Analytical tools focus on clear and straightforward nonhuman representations, which help communicate key insights without requiring significant interpretive effort. They are often adapted from HCD approaches. For example, Animal Persona [19] allows designers to focus on otherwise inaccessible users and ensure that stakeholder perspectives are identified and represented effectively, making the data actionable for design decisions.

Because analytical tools convey information directly rather than fostering audience interpretation and typically focus on a single aspect of nonhuman representation, they lack depth and emotional engagement but excel in transferability, making insights accessible to diverse audiences. For instance, in Animal Persona, the focus is on behaviours, habitat, needs, etc., lacking the relational and temporal aspects. Their structured approach and usual reliance on secondary data sources, expert insights, and proxy accounts rather than direct interaction or fieldwork ensure that nonhuman perspectives can be easily integrated into design processes without requiring extensive expertise, resources, or specialised tools. However, they are prone to anthropomorphising and oversimplification.

3.2.3 Interpretive Representation Tools

Interpretive tools blend data with creativity, allowing designers to reimagine and express nonhuman perspectives in exploratory and artistic ways. They encourage alternative ways of representation by visual explorations of data. One example is Dear Nature [20], a tool that uses an exploratory data-drawing method that helps participants engage with human-nature relationships through place-based observations and personal sense-making.

Interpretive tools transform information into expressive formats, allowing for abstraction rather than structured data. Dear Nature, for example, uses hand-drawn data visualisation instead of digital representations, fostering reflection on human-nonhuman interactions. Thus, these tools often require expertise in design, storytelling, or artistic expression, making them less straightforward to implement. By incorporating relational and temporal aspects and qualitative, contextual, and emotional layers into the representation, interpretive tools provide a nuanced, personal understanding of nonhuman perspectives, challenging anthropocentric thinking. While less transferable than analytical tools, they excel in fostering empathy, imagination, and deeper engagement.

Table 1. Summary of Representation Tool Groups and Parameters

	Evaluation by Parameters		
MTH Representations	**Transferability**	**Depth of Representation**	**Designer's Role**
Reflective representations Engages audiences in sensory interaction and personal engagement, fostering self-reflection and deeper understanding.	Lower transferability due to subjective interpretation.	High depth, incorporating multiple aspects of nonhuman perspectives, fostering empathy.	Data-Driven & Interactive: Requires expertise in hardware, electronics, and interactive systems.
Analytical representations Provides clear, structured representations of nonhumans, efficiently communicating key insights with minimal interpretation.	High transferability as insights are clear and accessible to diverse audiences.	Lower depth, focusing on singular aspects such as behavior and needs.	Desk Research & Proxy-Based: Relies on structured frameworks and secondary data sources.
Interpretive representations Blends data with creativity, allowing exploratory and artistic representations of nonhuman perspectives.	Moderate transferability; depends on the clarity of abstract representations.	Medium-high depth, integrating multiple layers of information into a representation.	Creative & Transformative: Demands expertise in design, storytelling, or artistic expression.

4 RECOMMENDATIONS FOR DESIGN EDUCATORS

This paper presents a categorisation of MTH representations in design (See Table 1 for the summary). In concluding this paper, we provide recommendations on selecting appropriate MTH representation tools for different contexts. Our work could help educators better equip students to navigate the complexities of MTHD, ensuring a meaningful representation of nonhuman stakeholders in design.

4.1 Prioritise High-Engagement Tools Early in the Process

Reflective tools encourage direct interaction with nonhumans, fostering a deeper, more nuanced understanding of their perspectives. Since they involve more engagement and reflection on nonhumans, they create richer, more immersive insights that can shape the entire design process. Hence, tools that require significant designer engagement would be better introduced at the beginning of the design process. For example, conducting fieldwork, sensory observations, or interactive installations early on helps designers form a meaningful connection with nonhuman stakeholders before moving into more structured design phases. By engaging with these tools, design students may benefit from a self-reflective, experiential learning process that encourages them to question their assumptions, challenge anthropocentric thinking, and develop a more empathetic approach to MTHD. This early-stage

engagement may provide a strong foundation for subsequent design decisions, helping to keep nonhumans central throughout the process.

4.2 Use Reflective or Interpretive Tools in Group Settings

When working in teams, reflective and interpretive tools can facilitate diverse perspectives by encouraging subjective discussions and multiple interpretations. By inviting different modes of interpretation, these tools may expand the scope of understanding, making room for perspectives that might otherwise be overlooked in a structured, data-driven approach. Group settings enhance their effectiveness by fostering collaborative meaning-making, where team members can compare insights, challenge assumptions, and build on each other's reflections. This process may encourage deeper engagement, as individuals are exposed to alternative viewpoints. Plus, the subjectivity of reflective and interpretive tools may help surface emotions, values, and ethical considerations, making discussions more empathetic and personally meaningful.

4.3 Utilise Analytical Tools When Time and Resources Are Limited

When time and resources are limited, analytical tools provide a structured and familiar way to integrate nonhuman perspectives. They streamline information into clear, actionable insights, reducing the need for extensive interpretation or creative processing. This may be especially useful in settings where key findings must be communicated quickly and effectively to diverse stakeholders. Although tools that encourage reflection and personal engagement are recommended for deeper understanding, time, resources, or expertise may not always be available. In these cases, analytical tools may offer a practical alternative, as they are easily usable, widely accessible, and adaptable to different contexts. Their structured nature allows them to integrate smoothly into the design process without requiring specialised knowledge or extensive training. Additionally, analytical tools often build on familiar frameworks adapted from HCD, making them more intuitive for designers. Their accessibility may help nonhuman perspectives still be represented meaningfully, even in constrained situations. While they may lack the depth and engagement of other tools, they are an effective choice for integrating nonhuman considerations within limited timeframes.

5 CONCLUSIONS

MTHD introduces new challenges and opportunities in design education, particularly in representing nonhuman stakeholders within the design process, requiring new methods to integrate their perspectives. This paper introduces a categorisation for MTH representation tools, grouping them as reflective, analytical, and interpretive using three key parameters: transferability, depth of representation, and the designer's role. Reflective tools foster personal engagement and sensory interaction, encouraging deep reflection on nonhuman perspectives but requiring expertise and effort. Analytical tools provide structured, easily transferable insights but often simplify nonhuman experiences and risk anthropomorphism. Interpretive tools balance creativity and data-driven approaches, offering nuanced representations but requiring artistic or storytelling expertise. Furthermore, we offer three key recommendations. First, designers may prioritise high-engagement tools early in the design process, as immersive interactions with nonhumans foster a deeper understanding that informs later decisions. Second, group settings can benefit from reflective or interpretive tools, as they facilitate diverse discussions and broaden perspectives on nonhuman representation. Lastly, when working within time and resource constraints, analytical tools offer a practical and structured approach to incorporating nonhuman perspectives. The categorisation and these recommendations aim to support educators and students in making informed decisions about MTH representation tools, ensuring that MTH perspectives are meaningfully integrated into the design process.

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